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CamScanner

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Aims and Objectives

Aims

- To disseminate research findings in a respective field
- To encourage scholarly communication
- To foster academic excellence

Objectives

- To advance knowledge and understanding, promote collaboration and innovation in a respective field
- To facilitate the exchange of ideas, promote critical thinking, build a strong research community, and increase the visibility and impact of research
- To promote high-quality research, encourage innovation, support academic career development, and improve the quality of education

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မြန်မာ့မျက်ပွင့်ဆောင်းပါးများမှ ဆရာဇေယျ၏အတွေးနှင့်အရေး

စန္ဒာလွင်[1]

စာတမ်းအကျဉ်း

ဤစာတမ်းသည် မြန်မာ့မျက်ပွင့်ဆောင်းပါးများမှ ဆရာဇေယျ၏ အတွေးနှင့်အရေးကို ဖော်ထုတ်တင်ပြထားသော စာတမ်းတစ်စောင်ဖြစ်ပါသည်။ မြန်မာစာပေနယ်ပယ်ရှိ စကားပြေကဏ္ဍမှ ဆရာဇေယျ၏ ဆောင်းပါးများကို အလေ့လာခံအဖြစ် ရွေးချယ်ထားပါသည်။ မြန်မာ့မျက်ပွင့်ဆောင်းပါးများကို "ရွာဓလေ့၊ လူဓလေ့" "စာဓလေ့"ဟူ၍ ကဏ္ဍခွဲကာ ဖော်ပြထားသည့်အနက် ရွာဓလေ့မှ 'ကန်စွန်းနွယ်'၊ 'ကောက်ရိုးနွယ်'၊ လူဓလေ့မှ 'ပုဂ္ဂိုလ်ထူးပုဂ္ဂိုလ်မွန်'၊ 'ဤငါးဦး' ဆောင်းပါးများကို ဤစာတမ်းတွင် လေ့လာတင်ပြထားသည်။ ဆရာ၏ဆောင်းပါးများသည် မြန်မာ့စိတ်ဓာတ်၊ မြန်မာ့အားမာန် ထက်မြက်ရင့်သန်လာစေရန် လှုံ့ဆော်ပေးနိုင်စွမ်းရှိသည်။ ထိုသို့ဘဝအားမာန် အသိအမြင်များ ရရှိခံစားနိုင်အောင် ဖန်တီးရေးသားခဲ့သော ဆရာဇေယျ၏ အတွေးနှင့်အရေးအသားစွမ်းရည်ကို ဖော်ထုတ်တင်ပြလိုသော ရည်ရွယ်ချက်ဖြင့် ဤစာတမ်းကို ရေးသားပြုစုခြင်း ဖြစ်ပါသည်။ ထိုသို့ လေ့လာရာတွင် စာတမ်းငယ်စာပေစာတမ်းလာ ရသစာတမ်း၏ သွင်ပြင်လက္ခဏာများကို နည်းနာအဖြစ် အသုံးပြု၍ လေ့လာထားပါသည်။ နောင်မျိုးဆက်သစ် လူငယ်များ စိတ်ဓာတ်ခွန်အား၊ ဘဝခွန်အားများရရှိကာ အားမာန်အပြည့်ဖြင့် ကြိုးစားလိုစိတ်များ၊ နိုင်ငံကိုချစ်သည့် ဓာတိမာန် စိတ်ဓာတ်များ ထက်မြက်ရင့်သန် လာစေနိုင်ပါသည်။

သော့ချက်စကားလုံးများ - မြန်မာ့မျက်ပွင့်၊ ဆောင်းပါး၊ ရွာဓလေ့၊ လူဓလေ့၊ အားမာန်။

နိဒါန်း

ဤစာတမ်းသည် မြန်မာ့မျက်ပွင့်ဆောင်းပါးများကိုရေးသားခဲ့သည့် ဆရာဇေယျ၏ အတွေး၊ စိတ်ကူးနှင့် ဖန်တီးတင်ပြမှု အရေးအသားကို စိစစ်လေ့လာဖော်ထုတ်ထားသော စာတမ်းဖြစ်ပါသည်။ မြန်မာ့မျက်ပွင့် ဆောင်းပါးများအနက် ရွာဓလေ့တွင်ပါဝင်သော "ကန်စွန်းနွယ်"၊ "ကောက်ရိုးနွယ်"၊ လူဓလေ့တွင်ပါဝင်သော "ပုဂ္ဂိုလ်ထူး ပုဂ္ဂိုလ်မွန်"၊ "ဤငါးဦး" ဆောင်းပါးများကို အလေ့လာခံအဖြစ် ရွေးချယ်ကာ လေ့လာတင်ပြထားပါသည်။ ထိုဆောင်းပါးများတွင် ထင်ဟပ်ပေါ်လွင်နေသော မြန်မာ့စိတ်ဓာတ်၊ မြန်မာ့အားမာန် ထက်မြက်ရင့်သန်လာစေရန် လှုံ့ဆော်ပေးနိုင်စွမ်းရှိသည့် ဆရာဇေယျ၏ အတွေးနှင့်အရေးကိုပေါ်လွင်အောင် ဖော်ထုတ်တင်ပြလိုသောရည်ရွယ်ချက်ဖြင့် ဤစာတမ်းကို ရေးသားခဲ့ခြင်းဖြစ်သည်။

ဆရာဇေယျသည် ကျေးရွာ၏ ပကတိအလှ၊ ကျေးရွာ၏သဘာဝကို နှစ်သက်သည်။ ကျေးရွာသားတို့၏ အချစ်၊ ကျေးရွာသားတို့၏ အပျော်အရွှင်၊ ကျေးရွာသားတို့၏ ကြံ့ခိုင်မှု၊ ကျေးရွာသားတို့၏ နေထိုင်စားသောက်မှုကို အံ့သြ၍မဆုံးဖြစ်ခဲ့သည်။ ထို့ကြောင့် ရွာဓလေ့ကို ရှုထောင့်အမျိုးမျိုးမှ စာဖွဲ့ခဲ့သည်။ တစ်ဖန်တစ်မျိုးသားလုံး လေးစားဂုဏ်ယူလောက်၊ အားကျအတုယူလောက်အောင် အဖက်ဖက်မှ ထင်ပေါ်ကျော်ကြားခဲ့သော ပုဂ္ဂိုလ်များအကြောင်းကို စာတစ်စောင်တစ်ဖွဲ့အနေဖြင့် ဖြစ်ထွန်းစေလိုသည်။ ထို့ကြောင့် ပုဂ္ဂိုလ်ထူး များအကြောင်းကို လူဓလေ့ကဏ္ဍတွင် လေးစားအားကျ အတုယူဖွယ် စာဖွဲ့ခဲ့ပေသည်။ ဆရာဇေယျ ရေးဖွဲ့ခဲ့သော ဆောင်းပါးများသည် မြန်မာ့စိတ်ဓာတ်၊ မြန်မာ့အားမာန် ထက်မြက် ရင့်သန် လာစေရန် လှုံ့ဆော်ပေး နိုင်စွမ်းရှိပါသည်။

ဤဆောင်းပါးများကို လေ့လာခြင်းဖြင့် ဆောင်းပါးဟူသည်အဘယ်နည်း။ မြန်မာ့မျက်ပွင့်ဟု အဘယ်ကြောင့် အမည်ပေးခဲ့သနည်း။ မည်သည့်အကြောင်းကို မည်သို့ရေးသား တင်ပြထားသနည်း။ စာဖတ်သူကို မည်သည့်အကျိုးကျေးဇူးများပေးသနည်း။ မည်သည့်သုတ ရသများ ရရှိခံစား ရပါသနည်း အစရှိသော သုတေသနမေးခွန်းများကို ဖော်ထုတ်နိုင်မည်ဖြစ်သည်။ ထို့ပြင် တိုင်းပြည်

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[1] စန္ဒာလွင်၊ ဒေါက်တာ၊ ပါမောက္ခ၊ ဌာနမှူး၊ မြန်မာစာဌာန၊ မြစ်ကြီးနားတက္ကသိုလ်

နှင့် လူမျိုး၏တာဝန်ကို ပခုံးပြောင်း၍ ဆက်လက်တာဝန်ယူသွားကြမည့် မျိုးဆက်သစ်လူငယ်များအတွက် ဘဝခွန်အား၊ စိတ်ဓာတ် ခွန်အားများ ရှင်သန်ထက်မြက် လာစေနိုင်ပါသည်။

ဆရာဇေယျ၏အတ္ထုပ္ပတ္တိအကျဉ်း

အမည်ရင်းမှာ ဦးယောဖြစ်သည်။ ၁၉၀၀ ပြည့်နှစ် ဇူလိုင်လတွင် သာယာဝတီခရိုင် ဇီးကုန်းမြို့၌ အဖ သစ်တောဝန်ထောက်ဦးခလယ်နှင့် အမိ ဒေါ်ရွှေကြိုးတို့မှ ဖွားမြင်သော တစ်ဦးတည်းသောသားဖြစ်သည်။ ငယ်မည် မောင်ယောရှုဖြစ်သည်။ ငယ်စဉ်က ဇီးကုန်းမြို့ အမေရိကန်သာသနာပြုကျောင်း၊ သာယာဝတီမြို့ ကရင်အထက်တန်းကျောင်းနှင့် ပြည်မြို့ အစိုးရအထက်တန်းကျောင်းတို့တွင် ပညာသင်ကြားခဲ့သည်။ ၁၉၂၀ ပြည့်နှစ် တွင် ၁၀ တန်းကို ဂုဏ်ထူးသုံးဘာသာဖြင့် အောင်မြင်ခဲ့သည်။

၁၀တန်းအောင်ပြီးနောက် ရန်ကုန်မြို့ ဒဂုန်မဂ္ဂဇင်း၌ ဝင်ရောက်လုပ်ကိုင်ခဲ့သည်။ ထိုအချိန်မှစ၍ ဇေယျ အမည်ခံယူကာ ဝတ္ထုများစတင်ရေးသားခဲ့သည်။ မြတ်လေးရွှေဓားဗိုလ်ဝတ္ထုသည် ပထမဆုံးလက်ရာဖြစ်သည်။ ဇေယျသတင်းစာကို တည်ထောင်ထုတ်ဝေခဲ့သည်။ လန်ဒန်အက် မဂ္ဂဇင်း၊ ဗြိတိသျှ ဘားမားမဂ္ဂဇင်း၊ ရူဝံမဂ္ဂဇင်း၊ ရူဝံဂျာနယ်တို့တွင် အယ်ဒီတာအဖြစ်ဆောင်ရွက်ခဲ့သည်။ ရုပ်ရှင် ဇာတ်ညွှန်းများကိုလည်း ရေးသားခဲ့သည်။ ဝတ္ထုတိုပေါင်း ၅၀၀ ခန့်နှင့် ဆောင်းပါးပေါင်း ၂၀၀ ကျော်ကို ရေးသားခဲ့သည်။

(ဒဂုန်ရွှေမျှား၊၁၉၇၂၊ ၉၅)

စစ်ပြီးခေတ်တွင် ပြန်ကြားရေးဝန်ကြီးဌာနတွင် အမှုထမ်းခဲ့ပြီး ညွှန်ကြားရေးဝန်ရာထူးဖြင့် အငြိမ်းစား ယူခဲ့သည်။ သမိုင်းကော်မရှင်ယဉ်ကျေးမှုကောင်စီ၊ မြန်မာစာပေပြုစုရေးနှင့် ဘာသာပြန်ကော်မရှင်၊ စာပေဗိမာန်ဆု ရွေးချယ်ရေးအဖွဲ့တို့တွင် ပါဝင်ဆောင်ရွက်ခဲ့သည်။ မြန်မာနိုင်ငံစာရေးဆရာအသင်း ဥက္ကဋ္ဌအဖြစ်လည်း ဆောင်ရွက်ခဲ့သည်။

ဆရာဇေယျသည် သခင်ကိုယ်တော်မှိုင်း၏သမီးကြီး ဒေါ်မြရိနှင့် အိမ်ထောင်ပြုခဲ့သည်။ ၁၉၅၀ ခုနှစ်တွင် နိုင်ငံတော်အစိုးရကပေးသော ဝဏ္ဏကျော်ထင်ဘွဲ့ကိုလည်းကောင်း၊ ၁၉၅၅ ခုနှစ်တွင် သီရိပျံချီဘွဲ့ကို လည်းကောင်း ရရှိခဲ့သည်။ ၁၉၆၁ ခုနှစ်တွင် မြန်မာ့မျက်ပွင့်(ရွာဓလေ့၊ လူ့ဓလေ့)စာအုပ်ဖြင့် စာပေဗိမာန် စာပဒေသာဆုကို ရရှိခဲ့သည်။ (ဇေယျ၊ ၂၀၀၀၊ စာ ၆)

စာပေလေ့လာဆန်းစစ်ချက်

ဤစာတမ်းကိုပြုစုရန်အတွက် ဆရာဇေယျ၏ဆောင်းပါးများဖြစ်သော မြန်မာ့မျက်ပွင့်(ရွာဓလေ့၊ လူ့ဓလေ့)၊ မြန်မာ့မျက်ပွင့်(စာဓလေ့)၊ စာသဘင်၊ ဗမာ့အရေးနှင့်အနုပညာအသွေး၊ ဇေယျ၏စာ၊ ဇေယျစာတမ်း၊ မြန်မာစာ မြန်မာ့စိတ် မြန်မာ့မာန်၊ စာတိုပေစ၊ စာတွေ့ငါတွေ့၊ မှတ်တမ်းဝင်ဗမာ့ အရေးအခင်းများ၊ ဇေယျစာစုများ(၁)(၂)ဟူ၍ စုစည်းထုတ်ဝေခဲ့သော စာအုပ်များကို တွေ့ရှိရသည်။ ယင်းတို့အနက် မြန်မာ့မျက်ပွင့်ဆောင်းပါးများကို ရွေးချယ်ခဲ့ပါသည်။

မြန်မာ့မျက်ပွင့်ဆောင်းပါးများသည် ၁၉၄၅ မှ ၁၉၅၇ ခုနှစ်အတွင်း စာပဒေသာ၊ ရွှေမဝ၊ မြဝတီ မဂ္ဂဇင်းများ၌ ရေးသားခဲ့သော ဆောင်းပါးများကို စုပေါင်းပုံနှိပ်ထားခြင်း ဖြစ်သည်။ ရွာဓလေ့တွင်(၁၃)ပုဒ်၊ လူ့ဓလေ့တွင်(၁၉)ပုဒ်၊ စာဓလေ့တွင်(၃၅)ပုဒ်ပါရှိသည်။ ၁၉၆၁ ခုနှစ်တွင် မြန်မာ့မျက်ပွင့် (ရွာဓလေ့၊ လူ့ဓလေ့) စာအုပ် ထွက်ခဲ့၍ ၁၉၆၂ ခုနှစ်တွင် မြန်မာ့မျက်ပွင့်(စာဓလေ့) စာအုပ်ထွက်ရှိခဲ့သည်။

ဆရာဇေယျသည် ကျေးလက်တောရွာကို ချစ်မြတ်နိုးသည်။ တောသူတောင်သားတို့၏ ရိုးသား ပွင့်လင်းသောစရိုက်ကို နှစ်ခြိုက်သည်။ သာယာလှပသည့် တောတောင်ရေမြေသဘာဝအလှ

ရှုခင်းတို့ကို နှစ်သက်သည်။ တောသူတောင်သားတို့၏ လုံလ၊ ဝိရိယ၊ ဇွဲ၊ အားမာန်နှင့် လုပ်ငန်းဆောင်တာတို့ကို အလေးဂရု ပြုခဲ့သူဖြစ်သည်။ ကျေးလက်တောရွာလေးများ၏ ချစ်စရာသဘာဝ အလှအပနှင့် ကျေးတောသူလေး၏ အားမာန်ကို ရွာဓလေ့ဆောင်းပါးများတွင် တွေ့နိုင်ပါသည်။

ဆရာဇေယျသည် ကျေးလက်ကိုသာ စိတ်ဝင်စားသည်မဟုတ်။ တစ်မျိုးသားလုံး အတုယူစရာ ဂုဏ်ယူစရာပုဂ္ဂိုလ်ထူးများအကြောင်းကိုလည်း စိတ်အားတက်ကြွဖွယ် ဖော်ထုတ်တင်ပြခဲ့သည်။ လူ့ဓလေ့တွင် အင်ရုံဝန်ကြီး၊ မင်းခေါင်နော်ရထာ၊ ယောမင်းကြီးနှင့် ရှိတ်စပီးယား၊ ဦးရွှေဇံအောင်၊ ဦးလတ်နှင့် မှော်ပီဆရာသိန်းကြီး၊ ဦးရွှေကြူး၊ ဆရာရော စသော ပုဂ္ဂိုလ်ထူးများအကြောင်းကို ဆောင်းပါး (၁၉)ပုဒ်ဖြင့် ဖော်ပြထားသည်။

ဆရာဇေယျသည် ကျေးလက်ကိုချစ်၍ ပုဂ္ဂိုလ်ထူးများကိုလေးစားသည့်အပြင် မြန်မာ့စာပေနှင့် ယဉ်ကျေးမှုအနုပညာကိုလည်း မြတ်နိုးလေးစားသူဖြစ်သည်။ နိုင်ငံ့အကျိုး၊ စာပေယဉ်ကျေးမှုအကျိုး ဆောင်ရွက်သူများကိုလည်း ကြည်ညိုလေသည်။ စာဓလေ့တွင် စာပေရေးရာနှင့် ဆက်နွယ်သော ဆောင်းပါး (၃၅)ပုဒ်ကို ဖော်ပြထားသည်။ မြန်မာ့မျက်ပွင့်ဟု အမည်ပေးရခြင်းနှင့် ပတ်သက်၍

> "မြန်မာစကား၌ ချစ်မငြီး၊ ရှုမငြီး မျက်စိအောက်က အပျောက်မခံနိုင်လောက်အောင် ချစ်မြတ်နိုးအပ်သော အရာများကို မျက်ရှု၊ မျက်နှစ်၊ မျက်ပွင့်ဟု ခေါ်ဆိုကြ၏။ ဤစာအုပ်တွင်ပါရှိသော အကြောင်းအရာများကား မြန်မာတို့ချစ်အပ်သော "မြန်မာ့မျက်ပွင့်" များဖြစ်၏"(ဇေယျ၊ ၁၉၆၁၊ အမှာစာ)

ဟုဆိုထားပေသည်။ ထို့ကြောင့် မြန်မာ့မျက်ပွင့်ဆောင်းပါးများသည် စာဖတ်သူ မြန်မာတစ်မျိုးသားလုံး အတွက် ချစ်ခင်အပ်၊ လေးစားအပ်၊ မြတ်နိုးအပ်၊ အတုယူအပ်သော အချက်များနှင့် ပြည့်စုံမှုရှိ မရှိ၊ စာရေးသူက သုတရသ ပေးစွမ်းနိုင်မှုရှိ မရှိ၊ စိတ်ဝင်စားအောင် ဖန်တီးတင်ပြနိုင်မှုရှိ မရှိ လေ့လာဆန်းစစ်ရန် လိုအပ် ပါသည်။

နည်းနာ

ဤစာတမ်းကို လေ့လာတင်ပြရာတွင် ပညာရပ်ဆိုင်ရာနည်းနာကို အသုံးပြုထားပါသည်။ ဆရာဇေယျ၏ ဆောင်းပါးများသည် ဆောင်းပါးဟုအမည်တပ်ထားသော်လည်း ဆောင်းပါးမည်ကာမတ္တမဟုတ်။ စာဖတ်သူကို သုတ၊ ရသပေးစွမ်းနိုင်သည်။ ဘဝအသိအမြင်လည်းရသည်။ နှစ်သက်မှု ရသလည်း ခံစားရသည်။ အက်ဆေး၊ စာတမ်းငယ်၊ ရသစာတမ်း အရေးအသားမျိုးဖြစ်သည်။ ထို့ကြောင့် မောင်ခင်မင် (ဓနုဖြူ)၏ စာတမ်းငယ်စာပေ စာတမ်းတွင် ဖော်ပြထားသော ရသစာတမ်း၏သွင်ပြင်လက္ခဏာများ ဖြစ်သည့်

(၁) စာရေးသူ၏ကိုယ်ရည်ကိုယ်သွေးပေါ်နေခြင်း
(၂) အကြောင်းအရာထက် အတွေးအမြင်ခံစားမှုတို့ကို အားပြုခြင်း
(၃) စာဖတ်သူကိုဆွဲဆောင်နိုင်သော စကားပြေအရေးအဖွဲ့မျိုးဖြစ်ခြင်း
(၄) တိုတိုကျဉ်းကျဉ်းရေးဖွဲ့သော အရေးအဖွဲ့မျိုးဖြစ်ခြင်း
(၅) စာဖတ်သူကိုနှစ်သက်မှုရသပေးခြင်း (ခင်မင်၊ ၁၉၈၇၊ စာ ၃၉)

ဟူသည့် လက္ခဏာ(၅)ရပ်ဖြင့် ဆောင်းပါးများကို ချိန်ထိုးလေ့လာမည်ဖြစ်ပါသည်။ ဆရာဇေယျ၏ ဆောင်းပါးများသည် ထိုသွင်ပြင်လက္ခဏာများနှင့် ကိုက်ညီနေသည်။ မိမိ၏အတွေးအမြင်များကို မိမိ၏ ကိုယ်တွေ့အဖြစ်အပျက်များဖြင့် စာဖတ်သူနှစ်သက်အောင် တိုတိုကျဉ်းကျဉ်းနှင့် ထိထိမိမိ ဆွဲဆောင်ရေးသားထားသည်ကို တွေ့ရပါသည်။

CamScanner

လေ့လာတွေ့ရှိချက်

မြန်မာ့မျက်ပွင့်ဆောင်းပါးများအနက် ရွာဓလေ့တွင် ပါဝင်သော "ကန့်စွန်းနွယ်"၊ "ကောက်ရိုးနွယ်"၊ လူ့ဓလေ့တွင်ပါဝင်သော "ပုဂ္ဂိုလ်ထူး ပုဂ္ဂိုလ်မွန်"၊ "ဤငါးဦး"ဆောင်းပါးများမှ ဆရာဇေယျ၏ အတွေးနှင့် အရေးစွမ်းရည်ကို လေ့လာတွေ့ရှိနိုင်ပါသည်။

ကန့်စွန်းနွယ်

ကန့်စွန်းနွယ်ဆောင်းပါးသည် ရွာဓလေ့တွင်ပါဝင်သော ဆောင်းပါးတစ်ပုဒ်ဖြစ်သည်။ အမျိုးသားရေး၊ မျိုးချစ်စိတ်နှင့် ပတ်သက်လာလျှင် ကျေးရွာသည်သာ အခြေအမြစ်ဖြစ်ကြောင်း သိစေလိုသော ရည်ရွယ်ချက်ဖြင့် ရေးသားခဲ့ခြင်းဖြစ်သည်။ ဆောင်းပါး၏ရည်ရွယ်ချက် ပေါ်လွင်လာစေရန်၊ မြန်မာတို့အား ကျေးရွာချစ်စိတ် ဖြစ်ပေါ်လာစေရန် လှုံ့ဆော်စည်းရုံးကာ ရေးသားထားသည်။

မြို့ကြီးပြကြီးများသည် မည်မျှကြီးမားခဲ့ထည်စေကာမူ စီးပွားရေး၊ ပညာရေးတို့အတွက် ခေတ္တ နေထိုင်ရာအရပ်များသာဖြစ်ကြောင်း၊ ကျေးရွာသည်သာ အခြေအမြစ်ဖြစ်ကြောင်းကို

> "အမျိုးသားရေးနှင့် ပတ်သက်၍သော်လည်းကောင်း၊ မျိုးချစ်စိတ်ဓာတ်နှင့် ပတ်သက်၍ သော်လည်းကောင်း မြို့ကြီးများ၌ ထက်ထက်သန်သန် မြဲမြဲမြံမြံ ပေါ်ပေါက်ခွင့်မရ။ ကျေးလက်တောရွာ များ၌သာလျှင် ထက်ထက်သန်သန်နှင့် အခြေအမြစ်စွဲလေ့ရှိ လေသည်" (ဇေယျ၊ ၁၉၆၁၊ အမှာစာ)

ဟု ဖော်ပြထားပေသည်။ ထို့ကြောင့် အမျိုးသားရေး၊ မျိုးချစ်စိတ်နှင့်ပတ်သက်လာလျှင် ကျေးလက်တောရွာ၌သာ ထက်ထက်သန်သန်ပေါ်ပေါက်ခွင့်ရကြောင်း စာဖတ်သူများအား သိမြင်လာစေသည်။

ကျေးရွာ၏အရေးပါပုံကို သိရှိလာစေရန် အင်္ဂလန်ပြည်နှင့် သာဓကဆောင်ပြခဲ့သည်။ အင်္ဂလန် ပြည်သည် မြို့ကြီးပြကြီးအလွန်ပေါသော်လည်း ကျေးရွာများကို စိတ်ဝင်စားဂရုစိုက်သည်။ ရွာတိုင်းတွင် ကျေးရွာအကြောင်း မှတ်သားထားသော ကျေးရွာသမိုင်း တစ်ခုစီရှိကြသည်။ ထိုသို့ ကျေးရွာသမိုင်း ပြုစု ကြခြင်းနှင့် ပတ်သက်၍ ဆရာဇေယျက

> "ဤသို့လေးလေးစားစား မှတ်သားထားကြခြင်းအားဖြင့် ရွာသားကလေးများမှာ သိတတ်စ အရွယ်မှစ၍ မိမိတို့ကျေးရွာကလေးအကြောင်းကို ကောင်းကောင်းသိရှိ ကြ၍ ဂုဏ်ယူကြ လေသည်။ မိမိတို့ရွာကလေးကို စွဲလမ်းကြသည်။ စိတ်တွင်း၌ အခြေအမြစ်စိုက်ကြသည်။ ရွာကိုချစ်သောစိတ်သည် အမျိုးကိုချစ်သောစိတ်သို့ ကူးပြောင်းလာလေသည်။"(ဇေယျ၊စာ-၃)

ဟု သူ့အမြင်ကို ဆန်းစစ်တင်ပြခဲ့သည်။ အင်္ဂလန်ပြည်သည် ကျေးရွာချစ်စိတ်ကို အခြေခံတည်ပြီး ဖြစ်ပေါ် လာသော မျိုးချစ်စိတ်ဓာတ် ထက်သန်ခိုင်မာမှုကြောင့် သေးငယ်သော ကျွန်းနိုင်ငံလေး ဖြစ်သော်လည်း ကမ္ဘာတစ်ဝက်ဖုံးသည့် အင်ပါယာပိုင်ရှင် ဖြစ်လာခဲ့ခြင်းဖြစ်သည်။ ကမ္ဘာစစ်ဒဏ်ကို အလူးအလဲခံရ သော်လည်း မယိမ်းမယိုင် မားမားမတ်မတ် ရပ်တည်နေထိုင်ခဲ့ခြင်း ဖြစ်ပေသည်။

ထို့ကြောင့် ဆရာဇေယျသည် ရွာတိုင်းရွာတိုင်း၌ ကျေးရွာသမိုင်းရှိသင့်ကြောင်း၊ ထိုသို့သော ကျေးရွာသမိုင်းကြောင်းကို ကျောင်းသားအရွယ်ကလေးများအား သင်ကြားပေးပြီး ကျေးရွာချစ်စိတ် ဖြစ်ပေါ်လာအောင် စည်းရုံးသင့်ကြောင်း၊ ကျေးရွာအလှအပလေးများကို မြင်တတ်၊ ကြည့်တတ် စေရန် လေ့ကျင့်ပေးသင့်ကြောင်း သူ့အမြင်ကို လမ်းညွှန်တင်ပြခဲ့သည်။ ဆက်၍ မြို့ကြီးပြကြီးများနှင့် ကျေးရွာ၏ အနှစ်သာရ ကွာခြားလှပုံကို "လယ်တောမှ လတ်လတ်ဆတ်ဆတ် ဖမ်းယူလာခဲ့သော ငါးဆီပြန်ချက် ကလေး၏ အရသာနှင့် ဆာဒင်းငါး၏အရသာ ခြားပေသည်" (စာ-၇) ဟု မြင်ယောင်

လာအောင် ဥပမာပေးရေးသား ဖော်ပြခဲ့သည်။ မြို့ကြီးပြကြီးများကိုသာ အထင်ကြီးနေကြသူ များအတွက် ကျေးရွာကလေး၏ ဂုဏ်ကို မြင်ယောင်လာအောင် ရေးဖွဲ့ပြနိုင် သည်။ ထို့ပြင်

> "နှင်းဆီခြံသည် ကောင်းပါ၏။ လှပါ၏။ သို့သော် လူတို့က စိုက်နိုင် ပျိုးနိုင် ရေလောင်းနိုင် ပြုစုနိုင်မှ ပေက်သည်။ လူက ပြုစုမပေးနိုင်သည်နှင့် ပျောက်ကွယ် ကုန်၏။ လယ်ကန်သင်း ရေစပ်မှ ကန်စွန်းနွယ်ကလေးကား မည်သူမျှမပြုရဘဲ သေ သည် ပျောက်သည် မရှိ။ အမြဲ ထာဝရ ရွှင်လန်းပေါက်ရောက်လျက်ရှိ၏။" (စာ-၈)

ဟုဖော်ပြကာ နှင်းဆီနှင့် ကန်စွန်းနွယ်၏ အလှတရားနှစ်ခုကို နှိုင်းယှဉ်တင်ပြထားသည်။ ကျေးရွာ၏ သဘာဝ၊ ကန်စွန်းနွယ်၏အလှကို ပိုပြီးမြင်ယောင်လာစေရန် တင်ပြနိုင်စွမ်းရှိပေသည်။

ဤသို့ ကျေးရွာချစ်စိတ်ဖြစ်အောင် စည်းရုံးတင်ပြထားခြင်းကြောင့် စာဖတ်သူများသည် တောရွာ ဟူသည် ခြောက်ကပ်ကပ်နိုင်လှသည်။ ပျင်းစရာကောင်းသည်ဟူသော အတွေးများ ပြောင်းလဲသွားစေသည်။ တောသား၊ ရွာသားဖြစ်ရခြင်းအပေါ် ဂုဏ်ယူလာကြစေသည်။ ဆောင်းပါး၏ အဆုံးတွင် "ကျွန်ုပ်တို့၏ ကျေးရွာကလေးများဘက်သို့ မျက်နှာမူကြပါဦးစို့" (စာ-၈)ဟူ၍ စာဖတ်သူ အား တိုက်ရိုက်ပင် တိုက်တွန်း နှိုးဆော် လိုက်ပါသည်။

ဆရာဇေယျ၏ဆောင်းပါးသည် စာဖတ်သူများအတွက် မိမိရပ်ရွာနှင့် ပတ်ဝန်းကျင်အပေါ် အမှတ်တမဲ့ဖြစ်နေရာမှ သတိပြု စိတ်ဝင်စားလာစေသည်။ စိတ်ဝင်စားရာမှတစ်ဆင့် ရပ်ရွာအပေါ် ချစ်သည့်စိတ်များ ဖြစ်ပေါ်လာစေသည်။ ထိုမှတစ်ဆင့် မိမိနယ်၊ မိမိနိုင်ငံကို ချစ်သည်အထိ ကျယ်ပြန့် လာစေနိုင်ပါသည်။ ဆရာဇေယျသည် မြန်မာတစ်မျိုးသားလုံးအား ကျေးရွာချစ်စိတ်မှသည် နိုင်ငံချစ်စိတ် ဖြစ်ပေါ်လာစေရန် ဆောင်းပါးဖြင့် နှိုးဆော်ပေးနိုင်ခဲ့သည်။

ကောက်ရိုးနွယ်

ကောက်ရိုးနွယ်ဆောင်းပါးသည် ကျေးလက်မိန်းကလေးတစ်ဦး၏ အားမာန်ကို ဂုဏ်ပြုလိုသည့် ရည်ရွယ်ချက် ဖြင့်ရေးဖွဲ့ထားခြင်းဖြစ်သည်။ ဆရာဇေယျ အာရုံ ကျက်စားရာသည် ကျေးလက်ဒေသ ဝန်းကျင်ဖြစ်သည်။ ကျေးရွာသားတို့၏ အချစ်၊ အပျော်အရွှင်၊ ကြံ့ခိုင်မှု၊ နေထိုင်စားသောက်မှုတို့ကို ပြောချင်မြဲ။ စာဖွဲ့၍ မကုန်နိုင်ပေ။ ယခုဆောင်းပါးတွင်လည်း မည်သူမျှ ဂရုမပြုမိ၊ စိတ်မဝင်စားမိ၊ စာမဖွဲ့မိကြသော ကောက်ရိုးနွယ်လေးနှင့် ကျေးလက်မိန်းကလေးတစ်ဦး ၏ အကြောင်းကို စာဖွဲ့ခဲ့ပေသည်။

ပထမဦးစွာ ကျေးလက်တောရွာ လယ်ကွင်းပြင်ရှိ ရိုးပြတ်ကလေးများကြား၌ ပေါက်ရရာ သော ကောက်ရိုးနွယ်ကလေးကို မျက်စိထဲမြင်ယောင်လာစေရန် စာဖွဲ့ပြသည်။

> "ရိုးပြတ်များကို လိမ်၍ ပတ်ကြားအက်များကို ကျော်လျက် ပေါက်သွားသော ကောက်ရိုးနွယ်ကလေးကို မြင်၏။ အတော်သန်ပုံရ၏။ အရင်းဘက်တွင် အရွက်များ ရင့်လျက် လက်ခွကြားမှ အပွင့်ကလေးတစ်ပွင့် ထွက်နေ၏။ လက်သန်းဖျားလောက် ရှိ၏။ အနားဖြူ၍ အလယ်တွင် ခရမ်းရောင်လိုလိုရှိ၏။ အနွယ်ကလေးလည်း ရိုးရိုး ဖြစ်၏။ အရွက်လည်း ရိုးရိုးဖြစ်၏။ အပွင့်လည်းရိုးရိုးဖြစ်၏။ မြေကြီးကို တွား၍ ပေါက်ရ၏။ ပတ်ကြားအက်များအကြားတွင် ပျော်ရ၏။ သူများတကာ အပင်တွေ ဝေဝေဆာဆာပေါက်၍ လယ်ကွက်ခြောက်မှ ပေါက်ရ၏။ တော်တော်ရိုး၏။ တော်တော် အောက်တန်းကျ၏။" (စာ-၁၁)

ဟု ကောက်ရိုးနွယ်လေး၏ အောက်ကျ၊ နောက်ကျ၊ နိမ့်ကျသောဘဝကို ဖွဲ့ပြ၏။ သို့သော် ကောက်ရိုးနွယ်လေး၏ စိတ်ဓာတ်မှာမူ မပျော့ညံ့ပါ။ အလျှော့ပေးပုံမရပါ။ စိတ်ပျက်နေပုံမရပါ။ ခေါင်းကလေးမော်ကာ ဟိတ်ဟန်ထုတ်နေသည်ဟု ကောက်ရိုးနွယ်လေး၏ အားမာန်ကို

"အနွယ်ကလေးမှာ အားလျော့ပုံမရ၊ အညွန့်ကလေးတစ်ညွန့်သည် တစ်ထွာကျော် ကျော် မျှရှိသော ရိုးပြတ်ကလေးကိုလိမ်တက်၍ ခေါင်းကလေးမော်ကာ ဟိတ်ဟန် ထုတ်နေပုံရ၏။" (စာ-၁၁)

ဟု ဝါကျတိုများဖြင့် ကောက်ရိုးနွယ်၏သရုပ်ကို ဖော်ထုတ်ပြ၏။ ကောက်ရိုးနွယ်လေးကို သက်ရှိသဖွယ် တင်စားကာ ခေါင်းကလေးမော်နေ၊ ဟိတ်ဟန်ထုတ်နေသည်ဟု ဖော်ပြခဲ့သည်။

ထို့နောက် စပါးများရိတ်သိမ်းပြီး၍ လယ်ကွက်ထဲတွင် ကျန်နေသော ကောက်သင်းများကို လိုက်လံ ကောက်ယူနေသော မိန်းကလေးတစ်ဦးကို ဆက်လက်ရေးဖွဲ့ပြန်ပါသည်။

"အသက် ၁၆ နှစ်လောက် သာသာရှိ၏။ ထမီကလေး ဒူးလောက်ထိ ဝတ်ထား၏။ ဆံထုံး နောက်တွဲကလေး ထုံးထား၏။ ခြောက်တောက်တောက်၊ ဆီနှင့်ဝေးပုံရ၏။ အင်္ကျီကလေး မှာလည်း လက်မောင်းစုတ်နေ၏။" (စာ-၁၂)

ဟု မိန်းကလေး၏ နိမ့်ကျသောဘဝ၊ အသွင်အပြင်နှင့် သူ၏လုပ်ရပ်ကို မြင်ယောင်လာအောင် ကရုဏာ သက်ဖွယ်ရေးဖွဲ့ပြသည်။ မိန်းကလေးနှင့် ကောက်ရိုးနွယ်ကလေးတို့သည် ဘဝတူများ ဖြစ်ကြသည်။ သို့သော် သူတို့သည် ဘဝ၏ ညှဉ်းပန်းနှိပ်စက်မှု၊ လောကဓံ၏ ထုထောင်းမှုဒဏ်ကို ကြံ့ကြံ့ခံနိုင်သူများ ဖြစ်သည်ဟု ဆရာဇေယျမြင်မိသည်။ ထို့ကြောင့်လည်း ကောက်ရိုးနွယ်နှင့် မိန်းကလေးတို့၏ လောကဓံကို ရင်ဆိုင်ရဲသည့် အားမာန်နှင့်သတ္တိကို

"ကောက်ရိုးနွယ်ကလေး ရိုးသလို ရိုး၏။ ကောက်ရိုးနွယ်ကလေး အောက်ကျသလို အောက်ကျ၏။ ကောက်ရိုးနွယ်ကလေးသည် တစ်ပါးအပင်များပေါက်ပြီး လယ်ကွက်ခြောက်မှ ပေါက်ရသကဲ့သို့ ကလေးမကလေးသည်လည်း သူတစ်ပါး လက်ဦးစား၊ သူတစ်ပါး လက်ဦးယူပြီး အကြွင်းအကျန်ကလေးများကို လိုက်၍ ကောက်ရသူဖြစ်၏။ သို့သော် ကောက်ရိုးနွယ်ကလေး သန်သလို ထိုမိန်းကလေး လည်း သန်၏။ ကောက်ရိုးနွယ်ကလေး ခေါင်းထောင်သလို မိန်းကလေး၏ ခေါင်းကလေးသည် ထောင်လျက်ရှိ၏။ ထိုကောက်ရိုး နွယ်နှင့် ထိုမိန်းကလေးတို့ ကား ဘဝ၏ ညှဉ်းပန်းခြင်းကို ခံနိုင်သူများဖြစ်၏။ ဘဝ၏ ဖိစီးခြင်းကို ရုန်းကန်နိုင်သူ ဖြစ်၏။" (စာ-၁၂)

ဟု မြင်ယောင်လာအောင် ဝါကျတိုများဖြင့် ရှင်းရှင်းလင်းလင်းရေးဖွဲ့ပြထားသည်။ ဆရာဇေယျသည် ကောက်ရိုးနွယ်နှင့် မိန်းကလေး တို့၏ အားမာန်ကို မြှင့်တင်ပေးခဲ့သည်။

စာဆိုတော်ကြီးငယ်တို့ ဖွဲ့ဆိုသီကျူးခြင်းမရှိခဲ့ကြသည့် ကောက်ရိုးနွယ်နှင့် မိန်းကလေးတို့ သည် ငှင်းတို့ကို မည်သူက ချီးကျူးကျူး မကျူးကျူး အလေးမမူ၊ ဂရုမပြု၊ အားမငယ် ဝမ်းမနည်းပေ။ သူတို့၏ အလုပ်ကို သူတို့ ပုံမှန်ဆက်လုပ်နေကြသည်။ သူတို့၏ အားမာန်နှင့် စိတ်ဓာတ်သည် ချီးကျူးဖွယ်ပင် ဖြစ်သည်။ ထို့ကြောင့်လည်း ဆောင်းပါး၏နိဂုံးတွင် စာရေးသူက

ငှင်းတို့ကား ပျော်ပတိမ်မြုပ်ခြင်းမရှိ လယ်ကန်သင်းဘေး ပတ်ကြားအက် အကြားတွင် "ပျော်ပျော်ပါးပါးကြီး တည်၍ သွားကြမည် ဖြစ်သတည်း။" (စာ-၁၄)

ဟူ၍ ဂုဏ်ယူဖော်ပြခဲ့ပေသည်။

ဤဆောင်းပါးတွင် ကျေးလက်တောရွာများမှ လူတို့သတိမမူ၊ ဂရုမပြုမိသည့် ကောက်ရိုးနွယ် လေးကိုဖော်ပြ၍ ကျေးရွာကိုသတိပြုမိအောင်၊ ကျေးရွာကို ချစ်ခင်တွယ်တာလာအောင် စည်းရုံး ဖော်ဆောင်သွားသည်။ ထို့ကြောင့် မိမိရပ်ရွာကို ချစ်မြတ်နိုးသောစိတ်များ ဖြစ်ပေါ်လာစေသည်။ ထိုပြင် ကောက်ရိုးနွယ်လေးနှင့် မိန်းကလေးတို့၏ ဘဝကို အညှဉ်မခံ၊ အရှုံးမပေး၊ ဦးခေါင်းကလေး

မော်ကာ အရာရာကို ရင်ဆိုင်နိုင်စွမ်း၊ လောကဓံကို ခံနိုင်စွမ်း၊ ဘဝကို ရုန်းကန် နိုင်စွမ်းရှိကြသည့် စိတ်ဓာတ်နှင့် အားမာန်ကို ဖော်ပြထား၍ ဂုဏ်ယူ လေးစား အားကျစိတ်များ ဖြစ်ပေါ်လာစေသည်။ စာရေးသူ၏ အရေးအဖွဲ့ စွမ်းရည်ကြောင့် အားမာန်လည်းပါ၊ ရသလည်း မြောက်သော နှစ်သက်ဖွယ် ဆောင်းပါးကောင်း တစ်ပုဒ်အဖြစ် တည်ရှိနေပါသည်။

ပုဂ္ဂိုလ်ထူးပုဂ္ဂိုလ်မွန်

ပုဂ္ဂိုလ်ထူးပုဂ္ဂိုလ်မွန်ဆောင်းပါးသည် မြန်မာ့မျက်ပွင့် လူဓလေ့တွင် ပါဝင်သော ဆောင်းပါးတစ်ပုဒ် ဖြစ်သည်။ ဤဆောင်းပါးတွင် လက်ရုံးရည်၊ နှလုံးရည်ဖြင့် နိုင်ငံတာဝန်ထမ်းရွက်ခဲ့ကြသော ပုဂ္ဂိုလ်ကြီးများ၏ ကြိုးပမ်းဆောင်ရွက်ချက်များကို မှတ်သားအားကျ အတုယူစေလိုသော ရည်ရွယ်ချက်ဖြင့် ရေးသားခဲ့သည်။

ဆောင်းပါးတွင် စာရေးသူက ဆင်မြူရယ်ဆမိုင်းခေါ် ဆရာကြီးတစ်ဦးရေးသားထားသော “ကိုယ့်ထူးကိုယ်ချွန်ပုဂ္ဂိုလ်များအကြောင်း” စာအုပ်ကို ဖတ်ရှုမှတ်သားခဲ့ပုံ၊ ထိုစာအုပ်တွင် အင်္ဂလန်၊ အမေရိကန်စသည့် ဥရောပနိုင်ငံများရှိ ပုဂ္ဂိုလ်ထူးကြီးများသည် ဆင်းရဲသော်လည်း ထူးချွန်ကျော်စော ခဲ့ကြပုံတို့ကို ဖော်ပြထားသည်။ ဥစ္စာအင်အားရှိမှသာမဟုတ် စွမ်းအင်သတ္တိ၊ လုံ့လဝီရိယရှိလျှင် တိုးတက်အောင်မြင်နိုင်ကြောင်း ပုဂ္ဂိုလ်ထူးကြီးများ၏ လုပ်ဆောင်ချက်များဖြင့် သာဓကပြ၍ သိမ်ငယ် စိတ်များပပျောက်စေပြီး အတုယူအားကျစိတ်များ ဖြစ်ပေါ်လာစေရန် ရေးသားထားသည့် စာအုပ် ဖြစ်သည်။ ဤသို့တိုင်းတစ်ပါး ရာဇဝင်မှ ပုဂ္ဂိုလ်ထူးကြီးများအကြောင်း ဖတ်ရှုရခြင်းသည်ပင် စိတ်အား တက်ကြွမှု ဖြစ်ရပုံကို ဖော်ပြသည်။

မိမိရာဇဝင်သမိုင်းမှ မိမိတို့လူမျိုးအကြောင်း ရေးသားထားချက်များကို ဖတ်ရလျှင် ပို၍ပင် နိုးကြား တက်ကြွစိတ်များ ဖြစ်ပေါ်လာနိုင်သည်ကို ဆရာဇေယျတွေးမိပေသည်။ ထိုသို့သော သူ့အတွေးကို

> “တစ်ပါးလူမျိုးမှ ပုဂ္ဂိုလ်ထူးတို့ကပင် ကျွန်တော်တို့အား ထိုမျှ စိတ်အားတက်ကြွ လာအောင် နှိုးဆော်ပေးနိုင်ပါမူ ကျွန်တော်တို့အမျိုး၊ ကျွန်တော်တို့ဆွေသားမျိုးသား ရာဇဝင်မှ ပုဂ္ဂိုလ်ထူး ကြီးများ၏ အကြောင်းအရာများကမူကား ကျွန်တော်တို့ စိတ်ဓာတ်ကို အတိုင်းမသိ ထကြွစေ နိုင်လိမ့်မည်။” (စာ- ၁၆၁)

ဟု အသိပေးဖော်ပြကာ မြန်မာတစ်မျိုးသားလုံး စိတ်ဓာတ်တက်ကြွလိုလျှင် ဘုရင့်နောင်၊ တပင်ရွှေထီး၊ အလောင်းမင်းတရား၊ ရာဇသင်္ကြန်၊ မဟာဗန္ဓုလ စသည့်မြန်မာ့သမိုင်းမှ ပုဂ္ဂိုလ်ထူး ကြီးများကို သတိရပြီး ထိုပုဂ္ဂိုလ်ထူးကြီးများကိုစံထားကာ အတုယူဆောင်ရွက်သင့်ကြောင်း ဖော်ပြထားသည်။ စာဖတ်သူများ စိတ်ဓာတ်တက်ကြွလာစေရန် နှိုးဆော်တင်ပြထားသည်။

ဆက်လက်၍ တိုင်းတစ်ပါးမှ ပုဂ္ဂိုလ်ထူးများအကြောင်းကဲ့သို့ မြန်မာ့ရာဇဝင်မှ ပုဂ္ဂိုလ်များ အကြောင်း စာတစ်စောင်ပေတစ်ဖွဲ့ ရေးသားထားမှုများကို လိုက်လံရှာဖွေခဲ့ကြောင်း၊ ယင်းမှ “အထွဋ်ပွတ္တိထူး” ဟူသော စာအုပ်ကို အမှတ်မထင်တွေ့ရှိခဲ့ကြောင်း စာရေးသူက သူ့ကိုယ်တွေ့ အဖြစ်ကို တင်ပြထားသည်။ ထိုစာအုပ်တွင် ဗညားကျန်းတော၊ စကားတောင်စား၊ မိုးညှင်းမင်းတရား၊ ညောင်ရမ်းမင်းတရား၊ ငါးဆူ ဒါယကာ၊ ဟံသာဝတီဆင်ဖြူများရှင် စသည့် ထူးခြားထင်ရှားသော ပုဂ္ဂိုလ် ၁၁ ဦးတို့၏ အကြောင်းအရာများ ပါရှိလေသည်။ သို့ဖြစ်၍ ဆရာဇေယျက

> “ဤသို့သော အကြောင်းအရာများကို ဖတ်ရှုရသောအခါ ကျွန်တော်တို့မှာ အထူးပင် အားတက်လျက် ငါတို့အမျိုး၊ ငါတို့ရာဇဝင်သမိုင်းများတွင်လည်း ဤသို့ ထူးထူး ခြားခြား မှတ်သားအားကျဖွယ်ရာကောင်းသော ဝိသေသပုဂ္ဂိုလ်ကြီးများ ရှိပါတကား ဟု အားရ ဝမ်းမြောက် ဖြစ်မိလေသည်။” (စာ-၁၆၉)

ဟူ၍ ထိုစာအုပ်မျိုးဖတ်ရ၍ အားရဝမ်းသာဖြစ်မိကြောင်း၊ အားတက်မိကြောင်း မိမိ၏အတွေ့အကြုံ နှင့် ခံစားချက်ကို ပေါ်လွင်အောင် ဖော်ပြထားသည်။

ထို့နောက် မကြာမီပင် အမျိုးသားပညာဝန် ဦးဖိုးကျား၏ မြန်မာ့ဂုဏ်ရည်ရာဇဝင်ဖတ်စာ စာအုပ် ပေါ်ပေါက်လာကြောင်း၊ ထိုကျမ်းသည် အတ္ထုပ္ပတ္တိထူးထက် ပိုမိုစုံလင်ခြင်း၊ ခေတ်သုံးစကား များကိုသာ သုံး၍ ရေးသားထားခြင်း၊ အမျိုးသားစိတ်ပြင်းထန်နေသော ဝံသာနုခေတ်တွင် ပေါ်ထွက်ခဲ့ ခြင်းတို့ကြောင့် ပိုမိုလူသိများ၍ ထင်ရှားခဲ့သည်။ ယင်းစာအုပ်တွင် ပုဂံခေတ်မှ ကုန်းဘောင်ခေတ် အထိ ခေတ်အဆက်ဆက် လက်ရုံးရည်၊ နှလုံးရည်၊ ပညာရည်ပြည့်ဝ ထူးချွန်ခဲ့ကြသည့် ပုဂ္ဂိုလ်ကြီးများ၏ ဂုဏ်ရည်ကို ပေါ်လွင်အောင် ဖော်ပြထားသည့်အတွက် မြန်မာတစ်မျိုးသားလုံး အားကျ အတုယူဖွယ်ပင်ဖြစ်သည်။

ဆရာဇေယျသည် ထိုသို့သောစာအုပ်မျိုး၊ ထို့ထက်ကောင်းမွန်သောကျမ်းမျိုး ပေါ်ထွက်စေ လိုသည်။ ပညာရှင်များက ပြုစုရေးသား ထုတ်ဝေကြစေလိုသည်။ ထိုစာအုပ်မျိုးကို မြန်မာတစ်မျိုး သားလုံး လက်ထဲသို့ ရောက်ရှိစေလို၊ ဖတ်ရှု၍ အားကျကြစေလိုသည်။ ထိုသို့ ပေးပို့နိုင်လျှင် ယောင်တိယောင်ကန်း ဖြစ်နေသူများ လမ်းမှန်သို့ ရောက်အောင်ပို့ဆောင်နိုင်မည်ဖြစ်ကြောင်း တွေးမိ သည်။ ထိုသို့ သူ့အတွေး သူ့ဆန္ဒကို ဆောင်းပါးနိဂုံးတွင်

> "ဤသို့သောကျမ်းများကို ကျကျနနရေးသားပြုစု၍ ကျွန်တော်တို့ အမျိုးသားများ၏ လက်သို့ ထည့်ပေးနိုင်ပါမူကား ကျွန်တော်တို့အနက် ယောင်တိယောင်ကန်း လမ်းမှန် မတွေ့၊ တောင်မျှော်မြောက်မျှော် ဖြစ်နေကြရှာသော မျှော်တော်ယောင်စိတ်များ ပပျောက် သွားကြမည် ဖြစ်ပေသည်။" (စာ-၁၇၀)

ဟူ၍ လမ်းညွှန်အကြံပြုသွားပေသည်။ မြန်မာတစ်မျိုးသားလုံး အားကျဂုဏ်ယူစေရေး၊ တိုးတက် စေရေးအတွက် ဆောင်းပါးကိုရေးသားခဲ့သော ဆရာဇေယျ၏ အတွေးနှင့်အရေးကို တွေ့နိုင်ပါသည်။

ဤဆောင်းပါးသည် မြန်မာတစ်မျိုးသားလုံး မြန်မာ့ရာဇဝင်ကို သိရှိကြစေရန်၊ မြန်မာ့ရာဇဝင် မှ ပုဂ္ဂိုလ်ထူးကြီးများအကြောင်းကို အတုယူအားကျစိတ်၊ ဂုဏ်ယူစိတ်များ ဖြစ်ပေါ်လာစေရန်၊ ထိုကဲ့သို့ ထူးချွန်ထက်မြက်သူများ ဖြစ်ပေါ်လာစေရန် ကြိုးစားသင့်ကြောင်း လမ်းညွှန်အသိပေးထား သည်။ ပုဂ္ဂိုလ်ထူး ပုဂ္ဂိုလ်မွန်ဆောင်းပါးသည် သုတရသကို ပေးစွမ်းနိုင်သော မြန်မာ့ဇာတိမာန်ကို သိမ်မွေ့စွာ နှိုးဆွဆော်သြ ရေးသားထားသော ဆောင်းပါးကောင်းတစ်ပုဒ် ဖြစ်ပေသည်။

ဤငါးဦး

ဤငါးဦးဆောင်းပါးသည် မြန်မာ့မျက်ပွင့် လူဓလေ့မှ ဆောင်းပါးတစ်ပုဒ်ဖြစ်သည်။ ကုန်းဘောင်ခေတ် နိဂုံးသားတို့ ကြီးပွားတိုးတက်ရေးအတွက် ဦးစီးဦးဆောင်ပြုခဲ့ကြသော ပုဂ္ဂိုလ်ငါးဦး၏ဂုဏ်ရည်ကို ဖော်ထုတ်တင်ပြကာ အားကျအတုယူစေလိုသည့် ရည်ရွယ်ချက်ဖြင့် ရေးခဲ့ပေသည်။ ထိုပုဂ္ဂိုလ်ကြီးများ စွမ်းဆောင်ခဲ့သော လက်ရုံးရည်၊ နှလုံးရည်၊ ပညာရည်တို့ကို ဂုဏ်ယူလေးစားဖွယ် သိရှိမှတ်သားရသည်။

"မကွရာမင်းသားကြီး"သည် အမရပူရမြို့တည် ပဒုံမင်းတရားကြီးလက်ထက်မှစ၍ တိုင်းရေး ပြည်မှု အစုစုတွင် ပါဝင်ထမ်းရွက်ခဲ့သူဖြစ်သည်။ ဘကြီးတော်ဘုရားလက်ထက် အင်္ဂလိပ်-မြန်မာစစ်ပွဲအပြီး၌ အနောက်နိုင်ငံသားတို့နှင့်ယှဉ်လျှင် ခေတ်နောက်ကျနေသော မြန်မာနိုင်ငံသား တို့ တိုးတက်ကြီးပွားရေးအတွက် အနောက်နိုင်ငံများ၌ တိုးတက်နေသော ခေတ်သစ်ပညာများကို ရှာမှီးခြင်း၊ အနောက်နိုင်ငံသား အက်ဒဝပ်လိန်း၏ အကူအညီဖြင့် "ရိုးစင်စိုင်ကလိဖိုးဒီးယား" စွယ်စုံကျမ်းမှ ကောင်းနိုးရာရာအခန်းများကို မြန်မာဘာသာသို့ ပြန်ဆိုရေးသားခြင်း၊ အင်္ဂလိပ်-

မြန်မာအဘိဓာန် ပြုစုထုတ်ဝေခြင်းတို့သည် မက္ခရာမင်းသား၏ စွမ်းဆောင်မှုဂုဏ်ရည်များပင် ဖြစ်သည်။

"မြဝတီမင်းကြီးဦးစ" သည် စစ်ရေးတွင်ကျမ်းကျင်သူဖြစ်သည်။ ပန်းဝါတိုက်ပွဲတွင် အနိုင်ရခဲ့၍ မေဂျာဂျင်နရယ်မောင်စ ဟု ထင်ရှားခဲ့သူဖြစ်သည်။ နေပြည်တော် စစ်ကောင်စီအဖွဲ့ဝင် ဝန်ကြီးအဖြစ် တာဝန်ယူ ထမ်းရွက်ရသည်။ ပထမ အင်္ဂလိပ်-မြန်မာစစ်ပွဲအပြီး၌ အနောက်နိုင်ငံသား လူအမျိုးမျိုးနှင့် ဆက်ဆံ၍ ခေတ်သစ်ပညာရှာမှီးခဲ့သည်။ နှလုံးရည်ဘက်တွင်လည်း ထူးချွန်သူ ဖြစ်ရာ မြဝတီမင်းကြီး ဦးစနှင့် မြန်မာ့ဂီတ ခွဲခြားမရ ဖြစ်ခဲ့ရသည်။

"ကနောင်မင်းသားကြီး"သည် မင်းတုန်းမင်း၏ညီတော် အိမ်ရှေ့မင်းဖြစ်သည်။ မြန်မာတို့ စစ်ရှုံးရခြင်းသည် သတ္တိနည်းပါးခြင်း၊ စစ်ရေးနားမလည်ခြင်းကြောင့်မဟုတ်ဘဲ လက်နက် အသုံးအဆောင်များ မကောင်း၍ဟု ဆင်ခြင်မိသည်။ အနောက်နိုင်ငံများသို့ လက်နက်အတတ်၊ စက်ကိရိယာအတတ်စသော ခေတ်ပညာများ သင်ကြားရန် လူငယ်များစေလွှတ်ခဲ့သည်။ အနောက် နိုင်ငံမှ သံဖိုကြီးများ မှာယူကာ စစ်ကိုင်းဘက်တွင် သံချက်စက်ရုံနှင့် အလုပ်ရုံများ တည်ထောင် ပေးခဲ့သူဖြစ်သည်။

"ယောမင်းကြီးဦးဘိုးလှိုင်"မှာ ကနောင်မင်းသား၏ နိုင်ငံတော်ခေတ်မီရေး စီမံကိန်းတွင် ပါဝင်ခဲ့သူ ဖြစ်သည်။ အင်္ဂလိပ်-မြန်မာ ဒုတိယစစ်ပွဲအပြီးတွင် မြန်မာလူမျိုးတို့၏ ခေတ်ဟောင်း၊ အကြံအစည်ဟောင်းများကို ပယ်ဖျက်၍ ခေတ်သစ်အကြံသစ်များ သွတ်သွင်းစေရန် ကာယာနုပဿနာကျမ်း၊ ဝိမုတ္တိရသကျမ်း၊ အလင်္ကာနိဿယသစ်ကျမ်း၊ ပြင်သစ်ကင်မစတြီကျမ်း၊ ရာဇဓမ္မသင်္ဂဟကျမ်းတို့ကို ရေးသားပြုစုခဲ့သူ ဖြစ်သည်။

"ကင်းဝန်မင်းကြီးဦးကောင်း"သည် မင်းတုန်းမင်းကြီး၏ ပြည်ထောင်ဘက် ရဲဘော် အမတ်ကြီး ဖြစ်သည်။ အနောက်ဥရောပတိုက်၊ အင်္ဂလိပ်၊ ပြင်သစ်၊ အီတလီပြည်များသို့ မြန်မာ့သံတော်ကြီးအဖြစ် သွားရောက်ကာ မြန်မာ့ဂုဏ်သတင်းကို မြှင့်တင်၍ မိတ်ဆွေကောင်း ရှာဖွေခဲ့သူ ဖြစ်သည်။ ထိုအကြောင်းကို လန်ဒန်သွားမှတ်တမ်း၊ ပြင်သစ်သွားမှတ်တမ်းဟူ၍ ရေးသား ပြုစုခဲ့သည်။ အင်္ဂလိပ်အစိုးရ တရားပိုင်မင်းကြီး မစ္စတာဘားဂျက်စ်၏ တောင်းပန်တိုက်တွန်းချက် အရ ရှေးဓမ္မသတ် ၃၆ စောင်ကို စုပေါင်း၍ မြန်မာလူမျိုးတို့၏ အိမ်မှုခန်းဓမ္မသတ်နှင့် အမွေမှုခန်း ဓမ္မသတ်ဟူ၍ ဓမ္မသတ်ကြီးနှစ်စောင်ကို ရေးသား စီရင်ခဲ့သူဖြစ်သည်။

ဤသို့ ကုန်ဘောင်ခေတ် မြန်မာ့ဂုဏ်ဆောင် ပုဂ္ဂိုလ်ကြီးများသည် မြန်မာအမျိုးသားတို့ တိုးတက် ကြီးပွားရေးအတွက် စာပေ၊ ယဉ်ကျေးမှု၊ အုပ်ချုပ်ရေး အဘက်ဘက်မှ ကြိုးပမ်း အားထုတ်ခဲ့ကြသည်။ ယင်းအတွက် ဆရာဇေယျက ဂုဏ်ယူခဲ့သည်။ ဤမျှနှင့်အားမရ၊ ကမ္ဘာက သိအောင်ပင် ကြိုးစားလိုသည့် စေတနာကို တွေ့ရသည်။ အနောက်ဥရောပမှ ပုဂ္ဂိုလ်ကြီးများ၏ စွမ်းဆောင်ချက် ကမ္ဘာကျော်သကဲ့သို့ မြန်မာ့ ပုဂ္ဂိုလ်ကြီးများကိုလည်း ကမ္ဘာကျော်စေချင်သည်။ သို့သော် မြန်မာဘာသာဖြင့်ပင် ရေးသားပြုစု ထားသော ကျမ်းတစ်စောင် ပေတစ်ဖွဲ့ကိုပင် ရှာဖွေ မတွေ့ရ၍ စိတ်ပျက်အားလျော့မိလေသည်။ ထိုအကြောင်းကို

> "ကျွန်ုပ်တို့ မြန်မာနိုင်ငံ၌မူကား ကျွန်ုပ်တို့ဂုဏ်ယူထိုက်သော ပုဂ္ဂိုလ်ကြီးများ၏ အတ္ထုပ္ပတ္တိ များကို ကမ္ဘာသို့ ပြန့်နှံ့စေဖို့ထားဘိ၊ မြန်မာဘာသာဖြင့်ပင် စူးစူးစမ်းစမ်း ဟုတ်ဟုတ်ခြားခြား စာစောင်ဟူ၍ ယခုတိုင် တစ်စောင်တစ်လေမျှ မရှိသေးချေ။" (စာ-၁၉၄)

ဟု ဆရာဇေယျက ဖော်ထုတ်တင်ပြခဲ့သည်။

မြန်မာ့ရာဇဝင်မှ ပုဂ္ဂိုလ်ကြီးများသည် နိုင်ငံဂုဏ်ကိုဆောင်ခဲ့ကြသည်။ မြန်မာအမျိုးသားတို့ တိုးတက် ကြီးပွားရေးအတွက် ဆောင်ရွက်ခဲ့ကြသည်။ လေးစားချီးကျူးဂုဏ်ယူဖွယ် ပုဂ္ဂိုလ်ကြီးများ ဖြစ်ကြသည်။ ထိုပုဂ္ဂိုလ်ကြီးတို့၏ ဂုဏ်ရည်ကို ဖော်ထုတ်ပြရင်း မြန်မာ တစ်မျိုးသားလုံး လေးစား အားကျ အတုယူစေချင်၊ ဂုဏ်ယူဝင့်ကြွားစေချင်သော စေတနာဖြင့် ဤဆောင်းပါးကို ရေးသားခဲ့ခြင်း ဖြစ်ပေသည်။ ထိုပုဂ္ဂိုလ်ကြီး များကို မြန်မာသာမက ကမ္ဘာကသိအောင် ကြိုးစားစေချင်သည်။ ထို့ကြောင့်

> "ယခု လွတ်လပ်သောနိုင်ငံတော်၊ လွတ်လပ်သောအမျိုးသားအဖြစ်သို့ ရောက်ရှိနေပြီ ဖြစ်သော အချိန်၌ကား နောက်ခံကားမရှိသော အညတရလူမျိုးကဲ့သို့သောအခြေနှင့် မလျော် တော့ပြီ၊ ကမ္ဘာကလေးစားအောင် အမျိုးဂုဏ်ကို ထုတ်ဖော်ပြသရချေ တော့မည်။" (စာ-၁၉၅)

ဟု အကြံပြုကာ ဆောင်းပါးကို အဆုံးသတ်ထားပေသည်။

ဤဆောင်းပါးတွင် မြန်မာ့ဂုဏ်ဆောင်ပုဂ္ဂိုလ်ကြီးများကို ဂုဏ်ပြုမှတ်တမ်းတင်ခဲ့သည်။ အတုယူ လေးစားစိတ်၊ အားကျဂုဏ်ယူစိတ်များ ဖြစ်လာအောင် စည်းရုံးရေးဖွဲ့သွားနိုင်သည်။ မြန်မာကို ကမ္ဘာက သိအောင် ကြိုးစားစေလိုသော၊ အမျိုးဂုဏ်ကို ဖော်ဆောင်စေလိုသောစိတ်များ ဖြစ်ပေါ်လာအောင် ရေးဖွဲ့ ထားနိုင်သည်။ မြန်မာ့စိတ်ဓာတ် မြန်မာ့ဂုဏ်ရည်ကိုမြှင့်တင်ပေးလိုသော ဆရာဇေယျ၏ စေတနာကို မြန်မာ့မျက်ပွင့်ဆောင်းပါးများတွင် အထင်အရှားတွေ့နိုင်ပါသည်။

သုံးသပ်ချက်

ဆရာဇေယျ၏ ရွာဓလေ့ဆောင်းပါးများသည် ကျေးရွာများဘက်သို့ ခြေဦးလှည့်ကာ မြန်မာ့ဘဝ၊ မြန်မာ့အလှ၊ မြန်မာ့သဘာဝတို့ကို ရှာဖွေဖော်ထုတ်ပြခဲ့သည်။ ကျေးရွာချစ်စိတ်ဖြစ်လာအောင် စည်းရုံးလှုံ့ဆော်ခဲ့သည်။ ကျေးရွာချစ်စိတ်မှသည် အမျိုးကိုချစ်သောစိတ်၊ နိုင်ငံကိုချစ်သော စိတ်အထိ ဖြစ်ပေါ်လာစေနိုင်သည်။

လူ့ဓလေ့ဆောင်းပါးများတွင် မြန်မာ့ရာဇဝင်တွင် ထူးခြားသော ပုဂ္ဂိုလ်ကြီးများ၏ ဂုဏ်ကို ဖော်ထုတ် တင်ပြ ရေးဖွဲ့ထားသည်။ စာဆိုတော်ကြီးများကလည်း ထိုသို့သောပုဂ္ဂိုလ်ကြီးများကို ရှာဖွေဖော်ထုတ် တင်ပြရေးဖွဲ့ကြရန်၊ မြန်မာကိုကမ္ဘာကသိအောင် ကြိုးစားကြရန် တိုက်တွန်း နှိုးဆော်ထားသည်။ သို့မှသာ ထိုပုဂ္ဂိုလ်ကြီးများသည် မြုပ်နေရာမှ ရဲရဲတောက် ပေါ်ထွက်လာကြ ပေလိမ့်မည်။ ငါတို့အမျိုး ငါတို့စာပေတွင် ဂုဏ်ယူ မှတ်သားလောက်သော ပုဂ္ဂိုလ်ထူးများ ရှိပါပေတကားဟု အမျိုးမာန်၊ ဇာတိမာန် စိတ်များ တက်ကြွ လာစေနိုင်ပါသည်။

ဆရာဇေယျသည် မိမိ၏အတွေးအမြင်များကို မိမိ၏ ကိုယ်တွေ့ အဖြစ်အပျက်များ၊ ခံစားမှုများ၊ စေတနာရည်ရွယ်ချက်များဖြင့် ပေါင်းစပ်ပြီး စာဖတ်သူ နှစ်သက်မှုရသခံစားရအောင် တိုတိုကျဉ်းကျဉ်းနှင့် ထိထိမိမိဆွဲဆောင် ရေးသားထားသည်။ ရသစာတမ်း၏ သွင်ပြင်လက္ခဏာရပ် များနှင့် ကိုက်ညီနေသည်ကို တွေ့ရသည်။ စာဖတ်သူများ သုတလည်းရ၊ ရသနှစ်သက်မှုလည်း ခံစားရစေသည်။ ထိုဆောင်းပါးများသည် မြန်မာ့စိတ်ဓာတ်၊ မြန်မာ့အားမာန် ထက်မြက်ရင့်သန်လာ စေရန် လှုံ့ဆော်ပေးနိုင်စွမ်း ရှိသည်ဟုသုံးသပ်မိ ပါသည်။

နိဂုံး

ဆရာဇေယျ၏မြန်မာ့မျက်ပွင့်ဆောင်းပါးများသည် လူငယ်များအား ဘဝအားမာန် ပေးသည်သာမက မျိုးချစ်စိတ်၊ ဇာတိမာန်စိတ်ဖြစ်ပေါ်လာစေရန် သိမ်မွေ့လှပစွာ ဆွဲဆောင်စည်းရုံး ဖော်ထုတ်တင်ပြ သွားနိုင် ပေသည်။ ရွာဓလေ့၊ လူ့ဓလေ့ဆောင်းပါးများတွင် မြန်မာ့စိတ်ဓာတ်

အားမာန်တို့ကို လေ့လာနိုင်သကဲ့သို့ စာဓလေ့ဆောင်းပါးများတွင်လည်း မြန်မာ့စာပေ၊ မြန်မာ့ယဉ်ကျေးမှုဓလေ့တို့ကို ဆက်လက်လေ့လာ သုတေသနပြုနိုင်ပါသည်။

ကျမ်းကိုးစာရင်း

ခင်မင်၊ မောင်(ဓနုဖြူ)နှင့်အများ။ (၁၉၈၇)။ "စာတမ်းငယ်ဟူသည်"၊ *စာတမ်းငယ်စာပေစာတမ်းများ၊ ပ တွဲ*။ရန်ကုန်၊ စာပေဗိမာန်။

ဇေယျ။ (၁၉၆၁) ။ *မြန်မာ့မျက်ပွင့် (ရွာဓလေ့၊ လူ့ဓလေ့)*။ ရန်ကုန်၊ ထိန်ဝင်းစာပေ။

ဇေယျ။ (၂၀၀၀) ။ *ဇေယျစာစုများ(၁၂)*။ရန်ကုန်၊ ပန်းရွှေပြည်စာအုပ်တိုက်။

တိုက်စိုးနှင့်မင်းယုဝေ။(၁၉၈၀)။"မြန်မာ့မျက်ပွင့်"၊ *မြန်မာစာမိတ်ဖွဲ့(တ ကြိမ်)*။ရန်ကုန်၊ စံပယ်ဦးစာပေ။

ဒဂုန်ရွှေမျှား။(၁၉၇၂)။ *မြန်မာနိုင်ငံစာပေဆုများ*။ ရန်ကုန်၊ စာပေဗိမာန်။

မြန်မာစာအဖွဲ့။(၁၉၄၉)။ *မြန်မာအဘိဓာန်အကျဉ်းချုပ်၊ အတွဲ(၂)*။ ရန်ကုန်၊ မြန်မာစာအဖွဲ့။

မြစ်ကြီးနားမြို့သုံးဒေသိယစကားများ

နန်းနန္ဒာသက်[1]

စာတမ်းအကျဉ်း

ဤစာတမ်းသည် မြစ်ကြီးနားမြို့အတွင်း၌ အသုံးပြုနေသည့် နေ့စဉ်သုံး အပြော ဘာသာစကားကို လေ့လာထားသော စာတမ်းဖြစ်သည်။ ကချင်ပြည်နယ်၏မြို့တော်ဖြစ်သော မြစ်ကြီးနားမြို့တွင် ကချင် မျိုးနွယ်စုများ၊ ရှမ်းမျိုးနွယ်စုများ၊ ဗမာလူမျိုးစုများနှင့် အခြားတိုင်းရင်းသားတို့သည် ချစ်ခင်ရင်နှီးစွာ စုပေါင်းနေထိုင်လာခဲ့ကြပါသည်။ နေ့စဉ်တစ်ဦးနှင့်တစ်ဦး စံမြန်မာဘာသာစကားဖြင့် ပြောဆို ဆက်သွယ်ခဲ့ကြပါသည်။ ထိုသို့ ပြောဆိုနေကြသော စကားများသည် စံမြန်မာဘာသာစကားနှင့် ကွဲလွဲနေသည်ကို တွေ့ရှိရသည်။ ဤစာတမ်းတွင် ပါဝင်သည့်စကားများသည် မြစ်ကြီးနားမြို့အတွင်း၌ ကွင်းဆင်းမေးမြန်းခြင်းနည်းလမ်းဖြင့် ကောက်ယူထားသော အလေ့လာခံ ဒေသိယစကားလုံးများ ဖြစ်ပါသည်။ ဤစာတမ်းကို ဒေါက်တာအောင်မြင့်ဦး၏ ဘာသာစကားသုတေသနစာအုပ်မှ နည်းနာများကို အခြေခံ၍ လေ့လာတင်ပြထားပါသည်။ ဤစာတမ်းကို လေ့လာခြင်းဖြင့် ဒေသိယစကားများ၏ တန်ဖိုးကို သိရှိစေရန်နှင့် ဘာသာစကား လေ့လာလိုသူများအတွက် အကျိုးကျေးဇူး ရရှိစေရန် မျှော်မှန်းပါသည်။

သော့ချက်စကားလုံးများ - ဒေသိယစကား၊ စံမြန်မာစကား၊ မြစ်ကြီးနားမြို့သုံးဒေသိယစကား။

နိဒါန်း

ဘာသာစကားသည် လူမှုဘဝဖွံ့ဖြိုးတိုးတက်ရေးတွင် အရေးပါသည်။ ဘာသာစကားတွင် အပြော ဘာသာစကားနှင့် အရေးဘာသာစကားဟူ၍ နှစ်မျိုးရှိသည်။ ကမ္ဘာပေါ်တွင်အရေးဘာသာစကားမရှိသော လူမျိုးသာရှိပါသည်။ အပြောဘာသာစကားမရှိသော လူမျိုးမရှိပေ။ မြန်မာနိုင်ငံတွင်လည်း ဘာသာစကား မတူညီကြသော တိုင်းရင်းသားမျိုးစုံတို့သည် အတူယှဉ်တွဲနေထိုင်လာခဲ့ကြသည်မှာ ရှေးပဝေသဏီ ကတည်းကပင်ဖြစ်သည်။ လူမှုကိစ္စအကြောင်း အရပ်ရပ်ကြောင့် ဆက်သွယ်ပြောဆိုဆက်ဆံ လာခဲ့ကြသောအခါ စံစကားကိုသာ ရုံးသုံး ကျောင်းသုံးအဖြစ် ပြောဆိုလာခဲ့ကြသည်။ ထိုစံဘာသာစကားမှ ကွဲထွက် လသော စကားကို ဒေသိယဘာသာစကား ဟုခေါ်သည်။ ဒေသိယစကားလေ့လာမှုသည် ဘာသာစကားလေ့လာမှု၏ အရေးပါသော ကဏ္ဍကြီးတစ်ရပ်ဖြစ်ပါသည်။ မြန်မာဘာသာစကားတွင် ဒေသိယစကားပေါင်း မြောက်များစွာ ရှိပါသည်။ ဒေသိယစကားအမျိုးမျိုးတွင် စံဘာသာစကားနှင့် ကွဲပြားမှုနည်းသည့် ဒေသိ

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[1] နန်းနန္ဒာသက်၊ ဒေါက်တာ၊ ပါမောက္ခ၊ မြန်မာစာဌာန၊ မန္တလေးတက္ကသိုလ်။

ယ စကားများ ရှိသကဲ့သို့ ကွဲပြားသောဒေသိယစကားများလည်းရှိပါသည်။ ယခုစာတမ်းတွင် စံမြန်မာစကားနှင့် ကွဲပြားမှုအနည်းငယ်ရှိသော မြစ်ကြီးနားမြို့သုံး ဒေသိယစကားများကို အလေ့လာခံအဖြစ်ရွေးချယ် လေ့လာ တင်ပြထားပါသည်။

ကချင်ပြည်နယ်၏ မြို့တော်ဖြစ်သော မြစ်ကြီးနားမြို့ပေါ်တွင် ရှေးပဝေသဏီ ကတည်းက အတူတူနေထိုင်လာခဲ့ကြသော ကချင်၊ ရှမ်း၊ ဗမာအစရှိသော လူမျိုးတို့သည် မိမိတို့မျိုးနွယ် အချင်းချင်း တွေ့ကြသည့်အခါ ကိုယ်ပိုင်ဘာသာစကားကိုသာ ပြောဆိုကြသည်။ သို့သော် မျိုးနွယ် မတူသောသူအချင်းချင်း တွေ့ကြသောအခါ နိုင်ငံရေး၊ စီးပွားရေး၊ လူမှုရေးကိစ္စများကြောင့် တစ်ဦးနှင့်တစ်ဦးပြောဆိုဆက်သွယ်ကြသောအခါ ကိုယ်ပိုင်ဘာသာ စကားထက် ကြားခံဘာသာ စကားအဖြစ် မြန်မာဘာသာစကားကိုသာ ပြောဆိုကြသည်။ ပြောဆိုကြသော ဘာသာစကားသည် စံမြန်မာဘာသာစကားနှင့် အသွင်ကွဲကာပြောဆို နေကြသည့် မြန်မာဘာသာစကားဖြစ်နေသည်ကို တွေ့ရှိရပါသည်။ ထိုသို့အသွင်ကွဲနေသော ဒေသိယဘာသာ စကားသည် စံမြန်မာဘာသာစကားနှင့် အများကြီးကွဲပြားနေခြင်းမဟုတ်ပေ၊ အနည်းငယ်သာ ကွဲပြားစွာ ပြောဆိုနေကြခြင်း ဖြစ်သည်။ ထိုမြန်မာဘာသာစကားကို မြစ်ကြီးနားမြို့သုံး ဒေသိယစကားအဖြစ် လေ့လာတင်ပြသွားမည် ဖြစ်ပါသည်။

ဒေသိယစကားဟူသည်

ဒေသိယစကားဟူသည် ဘာသာစကားတစ်ခုမှကွဲပြားသွားသော ဘာသာစကား၏အသွင်ကွဲ ဖြစ်သည်။ ပင်မဘာသာစကားတစ်ခုသည် အချိန်ကာလအလျောက်ကွဲပြားနိုင်ရုံမက သုံးစွဲသူဒေသ အလိုက် သော်လည်းကောင်း၊ အသက်အရွယ်အလိုက်သော်လည်းကောင်း၊ လူမှုအခြေအနေအလိုက် သော်လည်းကောင်း၊ လုပ်ငန်းဆောင်တာအလိုက်သော်လည်းကောင်း ပုံစံအမျိုးမျိုး ကွဲပြားသွားနိုင် သည်။ ထိုသို့ ဘာသာစကား တစ်ခုမှ ကွဲပြားသွားသော အသွင်ကွဲ စကားများကိုဒေသိယစကားများ အဖြစ် သတ်မှတ်သည်။

ဘာသာစကားတစ်ခု၏ ဒေသိယစကားတို့တွင် တစ်ခုနှင့်တစ်ခု အသံထွက်အားဖြင့် လည်းကောင်း၊ ဝေါဟာရအားဖြင့်လည်းကောင်း၊ သဒ္ဒါအားဖြင့်လည်းကောင်း ကွဲပြားနိုင်သည်။ ဒေသိယအသွင်ကွဲစကား အမျိုးမျိုးထဲမှ တစ်ခုကို စံအဖြစ်ထားပြီး စံဘာသာစကားအဖြစ် ပြောဆိုကြသည်။ စံဘာသာစကားကို ပြောဆိုရာတွင် လေယူလေသိမ်း ကွဲပြားနေလျှင် ဒေသိယလေသံဟု သတ်မှတ်နိုင်သည်။

ဒေသိယစကားတို့ကို အဓိကအားဖြင့် အမျိုးအစား(၃)မျိုးခွဲခြားနိုင်သည်။

(၁) ကာလဒေသိယ

(၂) ဒေသဒေသိယ

(၃) လူမှုဒေသိယ တို့ဖြစ်ပါသည်။

ဘာသာစကားသည် ပြောင်းလဲတတ်သော သဘောရှိသည့်အလျောက် အချိန်ကာလ ပြောင်းလဲ လာသည်နှင့်အမျှ အသုံးပြုသည့်ဘာသာစကားလည်း ပြောင်းလဲလာမည်ဖြစ်သည်။ အချိန်ကာလ၊ ခေတ် ၊ သမိုင်းကြောင်းအရ ကွဲပြားသွားသော ဘာသာစကား၏အသွင်ကွဲကို ကာလဒေသိယဟုခေါ်သည်။

အချိန်ကာလတစ်ခုတည်းအတွင်းမှာပင် နေရာဒေသကွာခြားမှုကြောင့် ပြောင်းလဲ ကွဲပြားသွားသော ဘာသာစကားတစ်ခု၏ အသွင်ကွဲကို ဒေသဒေသိယဟုခေါ်သည်။ ဒေသ ဒေသိယ

စကားများ ဖြစ်ပေါ်လာရခြင်းသည် ဒေသဆိုင်ရာအလှမ်းကွာမှုနှင့် အတားအဆီးများကြောင့် ဖြစ်သည်။

ဘာသာစကားတစ်မျိုးတည်းဖြစ်စေကာမူပြောသူ၏လူမှုဆိုင်ရာ အကြောင်းရင်းခံများဖြစ်သော အသက်အရွယ် ၊ လိင် ၊ ပညာအရည်အချင်း ၊ အလုပ်အကိုင် ၊ နေအိမ် ၊ ပတ်ဝန်းကျင်၊ လူမျိုးနွယ်စု ၊ ယဉ်ကျေးမှုနောက်ခံ ၊ ဘာသာရေးတို့ကြောင့်လည်း အသွင်ကွဲ စကားများဖြစ်ပေါ်လာသည်။ ထိုသို့ လူမှု အကြောင်းရင်းခံများကြောင့် ဖြစ်ပေါ်လာသော ဘာသာစကားအသွင်ကွဲကို လူမှုဒေသိယဟုခေါ်သည်။ လူမှုဒေသိယစကားတွင် လူမှုဆိုင်ရာ သွင်ပြင် လက္ခဏာများ ထင်ဟပ်နေသည်။

နေရာဒေသလိုက်၍ ကွဲပြားသောဒေသိယစကားများမှာ လူမှုဆက်ဆံရေးနယ်ပယ်တွင် ကျယ်ပြန့်စွာ နေရာယူထားနိုင်သည်ကို တွေ့မြင်သုံးသပ်နိုင်ပါသည်။ လူမှုအဖွဲ့အစည်းနှင့် ဘာသာစကားဒွန်တွဲနေကြောင်းကို ဒေသိယစကားလေ့လာခြင်းဖြင့် ပိုမိုသိရှိလာစေပါသည်။

ထို့ကြောင့် ဒေသိယစကားဟူသည် စံဘာသာစကားတစ်မျိုးတည်းကိုပင် နေရာဒေသပထဝီဝင် အနေအထားကြောင့်လည်းကောင်း၊ လူနေမှုအဆင့်အတန်းကွဲပြားမှုကြောင့်လည်း ကွဲပြားသွားရသော စံဘာသာစကား၏ အသွင်ကွဲကို ဒေသိယစကားဟုခေါ်သည်။

စံမြန်မာဘာသာစကား

ဘာသာစကားတစ်ခုကို အသုံးပြုသည့်လူ့အဖွဲ့အစည်းတစ်ရပ်သည် ဘာသာစကားအသွင်ကွဲအမျိုးမျိုးအနက် အသွင်ကွဲတစ်မျိုးကို စံအဖြစ်သတ်မှတ်အသုံးပြုပါသည်။ မြန်မာဘာသာ စကားတွင်လည်း အသွင်ကွဲအမျိုးမျိုး ရှိသည့်အနက် အသွင်ကွဲတစ်မျိုးကို စံအဖြစ်သတ်မှတ် အသုံးပြုကြသည်။ အခြားဒေသိယစကားများကို လေ့လာရာတွင် စံမြန်မာစကားနှင့်နှိုင်းယှဉ် လေ့ရှိပြီး ဒေသိယစကားနှင့် စံမြန်မာစကားတို့၏ ကွဲပြားမှု အနည်းအများကို တိုင်းတာ ဖော်ထုတ်လေ့ရှိပါသည်။

စံဘာသာစကား၏ သွင်ပြင်လက္ခဏာများမှာ - တရားဝင်အသိအမှတ်ပြု အဘိဓာန်များတွင် စာလုံးပေါင်းသတ်ပုံနှင့် စံဝေါဟာရများဖော်ပြခံရခြင်း၊ တရားဝင်အသိအမှတ်ပြုခံရသည့် သဒ္ဒါရှိခြင်း၊ စံအသံထွက်ဖြစ်ခြင်း (စာတတ်ပေတတ် ပုဂ္ဂိုလ်များ၏မှန်ကန်ပီသစွာ ပြောဆိုသည့် အသံမျိုးကိုဆိုလိုသည်။)

မြန်မာဘာသာစကားတွင်လည်း ထိုသွင်ပြင်လက္ခဏာများနှင့်ကိုက်ညီသည့် အသွင်ကွဲတစ်မျိုးကို စံအဖြစ်သတ်မှတ်အသုံးပြုခြင်း ဖြစ်သည်။ထိုစံမြန်မာစကားကိုပင် ကျောင်းသုံး၊ ရုံးသုံးဘာသာစကားအဖြစ် တရားဝင်သတ်မှတ်ပြဋ္ဌာန်းထားပါသည်။ စံဘာသာစကားသည် ရန်ကုန်၊ မန္တလေးစသည့် မြို့ကြီးပြကြီးတွင် အသုံးပြုသည့် မြို့တော်သုံး ဘာသာစကားအပေါ် အခြေခံကြောင်း မှတ်ယူနိုင်သည်။

စံမြန်မာစကားသည် ဒေသနှင့် လူမှုဆိုင်ရာကွဲပြားမှုများကို ပြသမှုမရှိသည့် ပုံစံဖြစ်သည်။ စံမြန်မာစကားသည် ကွဲပြားသည့်အသွင်ကွဲစကားများမှ တူညီမှုပုံသဏ္ဌာန်ရှိသည့် ဘာသာစကားဖြစ်သည်။

မြစ်ကြီးနားမြို့သုံးဒေသိယစကားများ

ဤစာတမ်းတွင် မြစ်ကြီးနားမြို့သုံး ဒေသိယစကားလုံးများကို -

(၁) အသီးအနှံဆိုင်ရာ ဒေသိယစကားလုံးများ၊

(၂) အစားအသောက်ဆိုင်ရာ ဒေသိယစကားလုံးများ၊

(၃) သဘာဝနှင့် အသုံးအဆောင်ဆိုင်ရာ ဒေသိယစကားလုံးများဟူ၍ ခွဲခြားတင်ပြသွားမည် ဖြစ်သည်။

CamScanner

(၁) အသီးအနှံဆိုင်ရာ ဒေသိယစကားလုံးများ

စံဘာသာစကားတွင် "ခူး" ဟူသောအသုံးကို မြစ်ကြီးနားမြို့တွင် "ကောက်" ဟု ပြောဆိုသုံးစွဲပါသည်။ မြန်မာအဘိဓာန်တွင်-

ကောက် / န / စပါး

ကောက် / နဝ / မဖြောင့်သော။ ကွေးသော။ လိမ်သော။

ကောက် / ကြို / ကျနေသောအရာကို ကုန်းယူသည် ဟုဖွင့်ဆိုထားပါသည်။

ခူး / ကြို / အသီးအပွင့်၊ အရွက်အညွှန့် စသည်တို့ကို ဆိတ်ဖြတ်ဆွတ်ယူသည်။ ထမင်းကို အိုးမှကော်ယူသည် ဟုဖွင့်ဆိုထားပါသည်။

ကချင်ပြည်နယ်အတွင်းနေထိုင်ကြသော တိုင်းရင်းသားမျိုးနွယ်စုတို့သည် လယ်ယာမြေလုပ်ငန်းများ ဖြင့်လည်းကောင်း၊ ဥယျာဉ်ခြံမြေ စိုက်ပျိုးခြင်းလုပ်ငန်းများဖြင့်လည်းကောင်း၊ တိရစ္ဆာန်မွေးမြူရေး လုပ်ငန်းလုပ်ကိုင်၍လည်းကောင်း စီးပွားရှာဖွေလုပ်ကိုင်ကြသူများ ဖြစ်ကြပါသည်။

ထိုသူတို့ စိုက်ပျိုးထားသော စားပင်၊ သီးပင်၊ ပန်းပင်များမှထွက်ရှိလာသော အရွက်၊ အသီး၊ အပွင့် များကို " ခူး " သည်ကို " ခူးဆွတ် " သည်ဟု မပြောဘဲ "ကောက်" သည်ဟု စံမြန်မာဘာသာစကားမှ အသွင်ကွဲကာ ပြောဆိုကြသည်ကို တွေ့ရပါသည်။ ဗျည်းပြောင်းလဲမှု၊ အသံပြောင်းလဲမှုပါ မတူညီသည့် ဒေသိယစကားလုံးဖြစ်သည်ကို တွေ့ရသည်။

ကချင်မျိုးနွယ်တို့၏ စပါးပေါ်ချိန်တွင် ပြုလုပ်သောပွဲတော်ကို " ကောက်သစ်စားပွဲ " ဟုခေါ်ဆိုသည်။ ပထဆုံးထွက်ပေါ်လာသော ဆန်စပါးနှင့်သီးနှံများကို " ကောက် " ယူ၍ ပွဲတော်အဖြစ် အောင်ပွဲခံကြသည့် ဓလေ့ရိုးရာလည်းရှိကြောင်း လေ့လာတွေ့ရှိရပါသည်။

ထို့ပြင် မြန်မာဘာသာစကားမှ အသွင်ကွဲအသုံးပြုပြောဆိုနေကြသော မြစ်ကြီးနားသုံး အသီးအနှံ ဆိုင်ရာ ဒေသိယစကားလုံးများမှာ-

စံဘာသာစကား	မြစ်ကြီးနားမြို့သုံးဒေသိယစကား
ကြက်သဟင်းရွက်	ဟင်းချိုရွက်
ဟင်းကြားရွက်	တောင်အိုရွက်
လိုက်ချီးသီး	တရုတ်ဆီးသီး
နှင်းသီး	သမင်မျက်လုံး
ဥရွက်(ဒရင်ကောက်ရွက်)	တင်ကောက်ရွက်
ကျဲကောသီး	ရှောက်ပန်းသီး
ဘီစပ်ပင်	ဂျာမဏီပင် အစရှိသည့်

မြစ်ကြီးနားမြို့သုံးစံမြန်မာဘာသာစကားမှ အသွင်ကွဲထွက်ပြီး နေ့စဉ်သုံးအပြောဘာသာ စကားအဖြစ် အသုံးပြုပြောဆိုနေကြသည်ကို လေ့လာတွေ့ရှိရပါသည်။

(၂) အစားအသောက်ဆိုင်ရာ ဒေသိယစကားလုံးများ ကချင်ပြည်နယ်၏ မြို့တော်ဖြစ်သော မြစ်ကြီးနားမြို့သည် တောင်တန်းများပတ်လည်ဝန်းရံကာစီးထားသောမြို့ဖြစ်ပြီး၊ ဧရာဝတီမြစ်ကြီး သည်လည်း မြို့၏ဘေးမှ ဖြတ်၍ စီးဆင်းသွားသောမြို့တော်ကြီးဖြစ်သည်။ ရာသီဥတုအနေဖြင့် နွေရာသီ၊ မိုးရာသီနှင့် ဆောင်းရာသီဟု သုံးမျိုးရှိသော်လည်း အပူခြောက်လ၊ အအေးခြောက်လ ခံစားရသော ထူးခြားသည့်မြို့ဒေသလည်းဖြစ်သည်။ တွေ့ကြုံရသည့် အပူခြောက်လတွင်

ပူအိုက်သောဓာတ်ကို ခံစားကြရပါသည်။ ထိုပူလွန်းသော အချိန်ကာလရောက်လျှင် ဒေသခံတိုင်းရင်းသားတို့သည် "ဒိန်ချဉ်" ကိုမြတ်နိုးစွာ သောက်သုံး ကြပါသည်။

မြစ်ကြီးနားမြို့၏ ပတ်ဝန်းကျင်တွင် နွားမွေးမြူရေးလုပ်ငန်းကို စီးပွားရေးတစ်ရပ်အဖြစ် လုပ်ကိုင်ကြသည်ကိုတွေ့ရပါသည်။ နွာနို့နှင့် နို့ထွက်ပစ္စည်းများ ပေါများသည်ကိုလည်း တွေ့ရပါသည်။ စံမြန်မာ ဘာသာစကားတွင် " ဒိန်ချဉ် " ဟူသောအသုံးကို မြစ်ကြီးနားမြို့ပေါ်တွင် " နို့ချဉ် "ဟု ပြောဆိုသုံးစွဲပါသည်။ " ဒိန် "ဟူသော စကားလုံး နှင့် " နို့ "ဟူသော စကားလုံးတို့ သည် ဗျည်းအသုံးနှင့် အသံထွက်ပါ ပြောင်းလဲသွားသည်ကို တွေ့ရပါသည်။ မြို့ပေါ်ရှိ အအေးဆိုင်များတွင် " ဤဆိုင်တွင် " နို့ချဉ် " ရသည် " ဟုသာ ရေးသားဖော်ပြထားသည်ကို တွေ့ရှိရပါသည်။ အချဉ်ပေါက်သွားသော " နို့ " ၊ " နို့ချဉ် "ဟု တိုက်ရိုက်အသုံးပြုထားခြင်းဖြစ်သည်။ မြန်မာအဘိဓာန်တွင် -

နို့ချဉ် / နို့ကျင် / န / - ဒိန်ချဉ်ဟု ဖွင့်ဆိုထားသည်ကိုတွေ့ရပါသည်။

ထို့ပြင် ကချင်ပြည်နယ် ၊ မြစ်ကြီးနားမြို့ပတ်ဝန်းကျင်တွင် နွားမွေးမြူရေးလုပ်ငန်းနှင့် ထွက်ကုန် ပစ္စည်းများကိုပါ လုပ်ကိုင်ကြကြောင်း လေ့လာတွေ့ရှိရပါသည်။

ထို့အတူ အစားအသောက်ဆိုင်ရာ မြစ်ကြီးနားသုံး ဒေသိယစကားလုံးများမှာ -

စံဘာသာစကား	မြစ်ကြီးနားသုံးဒေသိယစကား
ရေနွေးကြမ်း	အခါးရည်
ကြာဇံချက်စား	ကြာဇံချက်သောက်
မုန့်ဟင်းခါးစား	မုန့်ဟင်းခါးသောက်
ကော်ဖီမုန့်	ကော်ဖီကြမ်း
ဆီပူ	ဆနွင်းတူး

စာကလေးခွေကြော်(စာကလေးချီးခွေ) ကုလားပဲခွေကြော် အစရှိသည့် မြစ်ကြီးနားမြို့သုံး ဒေသိယ စကားလုံးများသည် စံမြန်မာဘာသာစကားမှ ကွဲထွက်နေပြီး နေ့စဉ်သုံး အပြောစကားများ အဖြစ် သုံးစွဲပြောဆိုနေကြသည်ကို လေ့လာတွေ့ရှိရပါသည်။

(၃) သဘာဝနှင့် လူ့အသုံးအဆောင်ဆိုင်ရာ ဒေသိယစကားများ

မြစ်ကြီးနားမြို့အပါအဝင် ကချင်ပြည်နယ်သည် မိုးများသော အရပ်ဒေသဖြစ်သည်။ မိုးရာသီတွင် မိုများရွာတွန်းပြီး ဆောင်းရာသီ ၊ နွေရာသီတို့တွင်လည်း အချိန်အခါမဟုတ် မိုးများ ရွာတွန်းတတ်ပါသည်။ ထို့ကြောင့်လည်း

" တစ်နှစ်လုံးလေတစ်နှစ်လုံး နေပူသည်ကရွာလှသည်
၁၂လရာသီအချိန်အခါမရွေး မိုးသဲပေးနေ " ပြည်နယ်ကိုယ်စားပြု ချစ်စရာတေးသီချင်း လေးဖြင့် မိုးရွာသွန်းမှုအကြောင်းကို တင်စားဖွဲ့ဆိုထားခြင်း ဖြစ်သည်။ ဆောင်းရာသီအတွင်းမှာ မိုးများရုတ်တရက် ရွာသွန်းလာသောအခါ

"အကျီတွေနေပူလို့လှမ်းလာပါတယ်ဆိုမှ
အခုအချိန်အခါမဟုတ် မိုးကျလာတော့
ပြန်စိုကုန်ပါပြီ"

ဟု ဒေသခံဆရာမတစ်ဦး၏ ပြောစကားကိုကြားလိုက်သောအခါ စံဘာသာမြန်မာစကားတွင် " မိုးရွာ "သည်ဟူသော အသုံးကို မြစ်ကြီးနားမြို့တွင် " မိုးကျ "သည်ဟုပြောဆိုသုံးစွဲပါသည်။

မြန်မာအဘိဓာန်တွင်-

" ကျ / ကြိ / အမြင့်မှအနိမ့်သို့၊ အမြတ်မှအယုတ်သို့၊

အများမှအနည်းသို့ သက်ဆင်းဆိုက်ရောက်သည်။

ရွာ /နှ / ၁- လူအများစုပေါင်းနေထိုင်ရာကျေးလက်အိမ်စု။

၂- လူနှတ်၊ ငြဟ္မာနေထိုင်ရာဘုံ။

၃-ကောင်းကင်မှမိုးစက်မိုးပေါက်များကျလာသည်။"

ဟုဖွင့်ဆိုထားပါသည်။ စံမြန်မာဘာသာစကား အသုံးဖြစ်သော "ရွာ " ဟူသောအသုံးကို မြစ်ကြီးနားမြို့ပေါ်တွင် " ကျ "ဟု ပြောဆို သုံးစွဲခြင်းဖြစ်သည်။ ဗျည်းအသုံးနှင့်အသံထွက်ပါ ပြောင်းလဲသွားသည်ကို တွေ့ရသည်။ မြစ်ကြီးနားမြို့သုံး ဒေသိယစကားလုံးဖြစ်သော "မိုးကျ" မှ "ကျ" ဟူသော စကားသည် စံမြန်မာဘာသာ စကားမှ အသွင်ကွဲပြီးအသုံးပြုကြပြီး " အမြင့်မှ အနိမ့်သို့"ကျဆင်း လာသည်ကို တိုက်ရိုက်အသုံးပြုသုံးစွဲ ထားသည်ကို လေ့လာတွေ့ရှိရပါ သည်။

ထို့အပြင် စံမြန်မာဘာသာစကားတွင် အသုံးပြုသော " လေတိုက်သည် "ဟူသော စကားအသုံးကို မြစ်ကြီးနားမြို့တွင် " လေလာသည် "ဟု အသွင်ကွဲကာ ပြောဆိုသုံးစွဲသည်ကို တွေ့ရှိရပါသည်။ အရှေ့ စကားလုံးတွင် ပါသည့် "တိုက်"နှင့် အနောက်စကားတွင်ပါသော "လာ" စကားလုံးတို့သည် ဗျည်းအသုံးနှင့် အသံထွက်ပါ ပြောင်းလဲအသုံးပြုထားသည်ကို တွေ့ရှိရပါ သည်။ဒေသခံတို့၏အပြောစကားတွင်-

" လေလာနေပြီ လှမ်းထားတဲ့
ငြုပ်သီးခြောက်တွေလွင့်ကုန်မယ်
မြန်မြန်သိမ်းကြတော့" ဟု အသုံးအရသိရှိခဲ့ရပါသည်။

မြန်မာအဘိဓာန်တွင်-

" တိုက် / ကြိ / - အရှိန်အဟုန်ဖြင့် ထိခတ်သည်။တိုက်ခိုက်သည်။

-လေတိုးဝှေ့ရွေ့ရှားသည်။

လာ / ကြိ / တစ်ပါးသောအရပ်မှ မိမိနေရာသို့ဦးတည်ရွေ့လျားသည်။

မိုးရွာလာပြီ။" ဟုဖွင့်ဆိုထားပါသည်။ တိုက် နှင့် လာ ဟူသော အသုံး စကားလုံးသည် အဘိဓာန်အနက်အဖွင့်အရတူညီမှုရှိသော်လည်း အသုံးပြုမှုကွဲသည်ကို တွေ့ရှိရပါ သည်။

စံမြန်မာဘာသာစကား "မြေလှန်"လိုက်သည်ဟူသောအသုံးကို မြစ်ကြီးနားမြို့တွင် "ဖြို" လိုက်သည် ဟု ပြောဆိုသုံးစွဲကြပါသည်။ "လှန်" နှင့် "ဖြို" ဟူသောစကားလုံးနှစ်လုံးသည် ဗျည်းအသုံးရော အသံထွက်ပါ ပြောင်းလဲကာ အသွင်ကွဲအသုံးပြုပြောဆိုသည်ကို တွေ့ရသည်။

" စိုက်ထားသည့် နံနံပင်ခင်း
ရင့်သွားလို့ ပန်းတွေတောင်ပွင့်ကုန်ပြီ
ဒါကြောင့် အသစ်ပြန်စိုက်မလို့
မြေကြီးကို ' ဖြို ' ချလိုက်ပြီဗျ "

ဟူသော မြန်မာဒေသိယစကားသုံးကို တွေ့ရှိရပါသည်။ မြန်မာအဘိဓာန်တွင်-

" လှန် / ကြိ / - အတွင်းနှင့်အပြင်၊ အထက်နှင့်အောက်ပြောင်းလဲစေသည်။

လန်အောင်လုပ်သည်။

-ဖုံးထားသောအရာကိုလှုပ်သည်။

ဖြို / ကြိ / - အထုအထည်ကို ကွဲပျက်ကွာကျအောင်ပြုသည်။ ပြိုကွဲအောင်

လုပ်သည်။" ဟုအဘိဓာန်ဖွင့်ဆိုချက်တွင် အနက်ဖွင့်ဆိုမှုရှိသော်လည်း အသုံးပြုမှုကွဲပြားနေသည်ကို တွေ့ရပါသည်။

နိုက်ပျိုးရေးလုပ်ငန်းကို အဓိကထားလုပ်ဆောင်ကြသောကချင်ပြည်နယ်တွင် နိုက်ပျိုးကြသော မုန်ညင်း၊ ခရမ်းသီး၊ ခရမ်းချဉ်သီး၊ ငြုပ်ပင်၊ နံနံပင်၊ ရွေပဲရွက်၊ ချဉ်ပေါင်ရွက် အစရှိသည့် နိုက်ပျိုးရေး လုပ်ဆောင်ကြသော တိုင်းရင်းသားတို့သည် မိမိတို့နိုက်ပျိုးထားသော အပင်များနေရာတွင် အခြားသီးနှံ အသစ်နိုက်ပျိုးရန်အတွက် မြေကြီးကိုအထက်အောက် လှန်လိုက်ခြင်းကို ဖြုလိုက်သည်ဟု အထူအထည် ကွဲကာကျအောင် ပြုလုပ်ခြင်းကို တိုက်ရိုက် သုံးစွဲပြောဆိုခြင်း ဖြစ်ကြောင်း လေ့လာတွေ့ရှိရပါသည်။

စံမြန်မာဘာသာစကားတွင် " မီးပျက် " သွားပြီဟူသောအသုံးကို မြစ်ကြီးနားဖြို့တွင် "မီးသေ" သွားပြီဟု ပြောဆိုသုံးစွဲကြပါသည်။ " ပျက် " ဟူသောစကားလုံးနှင့် " သေ " ဟူသော စကားလုံးနှစ်လုံးသည် ဗျည်းအသုံးရောအသံထွက်ပါ မတူညီသည်ကိုတွေ့ရသည်။

" စာသင်ခန်းတွင် စာသင်နေတုန်း
မီးပျက်သွားသဖြင့် မှောင်ကျသွားသည်"
ဒေသခံကျောင်းသူတွေက
"ဟာ...မီးသေသွားပြီဘာမှမမြင်ရတော့ဘူး"
ဟုပြောသံကို ကြားလိုက်ရသည်။

" မီးသေ " ဟူသောဒေသိယစကားသုံးကို တွေ့ရှိရပါသည်။ မြန်မာအဘိဓာန်တွင်-

" ပျက် / ကြဲ / ချွတ်ယွင်းသည်။ ယွင်းယိုသည်။
သေ / ကြဲ / အသက်ကုန်ဆုံးသည် "ဟု အဘိဓာန်အနက်ဖွင့်ဆိုချက်တွင် "မီးပျက်" ဟူသောအဓိပ္ပါယ်သည် မကြာမီပြန်လာနိုင်သေးသည့် သဘောပါဝင်သည်။ မြစ်ကြီးနားဖြို့ သုံးဒေသိယစကား "မီးသေ"သည် လုံးဝသေဆုံးရပ်နားသွားသည့်သဘောအဖြစ် စံစကားလုံးနှင့် ကွဲကာအသုံးပြုသော စကားလုံးအသစ် မီးသေခြင်းသည် အလင်းရောင်ရှိနေခြင်းမှ လုံးဝ ပျောက်ကွယ်ခြင်းဘက်သို့ ဦးတည်ပြောဆိုခြင်း ဖြစ်နိုင်ပါသည်။

ထို့အတူ သဘာဝနှင့်လူ့အသုံးဆောင်ဆိုင်ရာ စကားလုံးများမှာ-

စံဘာသာစကား	မြစ်ကြီးနားသုံးဒေသိယစကား
မီးပျက်	မီးသေ
လက်နှိုးစုတ်	ပူကယ်
ထပ်လောင်း	ထပ်ထည့်
လူကြုံထည့်	ပါးလိုက်မယ်
ယူလာခဲ့	သယ်လာခဲ့
ဆရာဝန်ပြ	ဆရာဝန်ကြည့်
အလကားကျွေး	ပေးစားမယ်
အပေါ့သွား	အိမ်အောက်ဆင်း
နုတ်၊ မြေလှန်	ဖြို
ခြေအိတ်ဝတ်	ခြေအိတ်စွတ်
တွယ်ချိတ်	အပ်ချိတ်
ကြွေပန်းကန်ပြား	တိုက်ပန်းကန်ပြား

CamScanner

အစရှိသည့် စံမြန်မာဘာသာစကားမှ ကွဲထွက်နေသော မြစ်ကြီးနားသုံးဒေသိယစကားလုံးများကို လေ့လာ တွေ့ရှိရပါသည်။

သုံးသပ်ချက်

ဒေသိယစကားသည် ဘာသာစကားတစ်ခုမှ ကွဲပြားသွားသော အသွင်ကွဲဘာသာစကား ဖြစ်သည်။ ပင်မ မြန်မာဘာသာစကားမှ အသွင်ကွဲထွက်လာသော မြစ်ကြီးနားမြို့အတွင်း အသုံးပြုသော ဒေသိယစကား တို့သည် အသံထွက်အားဖြင့်လည်းကောင်း ၊ ဝေါဟာရအားဖြင့် လည်းကောင်း ၊ သဒ္ဒါအားဖြင့်လည်းကောင်း ကွဲပြားသွားသည်ကို - စံမြန်မာဘာသာစကား၌ အသုံးပြုသော စကားလုံးဖြစ်သည့် အင်းကြားရွာက်ကို တောင်အိုရွာက်၊ လိုက်ချီးသီးကို တရုတ်ဆီးသီး ၊ ရေနွေးကြမ်းကို အခါးရည် ၊ လူကြုံထည့်ပေးသည်ကို ပါးလိုက်သည် ၊ မြေလှန်သည်ကို ဖြိုသည် ၊ မီးပျက်သည်ကို မီးသေသည် ၊ ဆန္ဒင်းတူးသည်ကို ဆန္ဒင်းမီးလောင် သွားသည် ၊ စာကလေးခွေကြော်ကို ကုလားပဲခွေကြော် ၊ ကြာဇံချက်စားသည်ကို ကြာဇံချက် သောက်သည် ၊ ထပ်ထည့်ကေးသည်ကို ထပ်လောင်းသည်ဟု အသုံးပြုပြောဆိုနေကြကို လေ့လာတွေ့ရှိရပါသည်။

ဘာသာစကား၏ အသွင်ကွဲများဖြစ်သော ဒေသိယစကားတို့သည် ဘာသာစကား တစ်ခု၏ သဘော လက္ခဏာများကိုဖော်ပြပေးရုံမက ဘာသာစကားပြောဆိုအသုံးပြုသည့် အချိန်ကာလ နေရာဒေသ၊ ပတ်ဝန်းကျင် အနေအထား၊ ဓလေ့ထုံးစံ၊ အယူအဆ၊ လူမှုဘဝ ဓလေ့စရိုက်တို့ကိုပါ ထင်ဟပ်ဖော်ပြလျက်ရှိသည်။ မြစ်ကြီးနားမြို့သုံး ဒေသိယစကားများသည် ပတ်ဝန်းကျင် အနေအထားနှင့် လူမှုဘဝ ဓလေ့စရိုက်များကို တိုက်ရိုက်ဖော်ပြနေသော အဓိပ္ပာယ်ရှိသည် စံမြန်မာဘာသာစကားတွင် အသုံးပြုသည့် "ဆွတ်ခူးသည်ကို ကောက်သည် ၊ ကြက်သဟင်းရွက်ကို ဟင်းချိုရွက်၊ ဥရွက်ကို တင်ကောက်ရွက် ၊ ဒိန်ချဉ်ကို နို့ချဉ် ၊ ရေနွေးကြမ်းကို အခါးရည် ၊ ကော်ဖီမှုန့်ကို ကော်ဖီကြမ်း၊ မိုးရွာသည်ကို မိုးကျသည် ၊ လေတိုက်သည်ကို လေလာသည် ၊ ဆရာဝန်ပြသည်ကို ဆရာဝန်ကြည့်သည် ၊ လက်နှိုးစုတ်ကို ပူကယ်နှင့် အလကားကျွေးသည်ကို ပေးစားမယ်" အစရှိသည့် စကားလုံးများဖြင့် ပြောဆို အသုံးပြုနေကြသည်ကို လေ့လာတွေ့ရှိရပါသည်။

စံမြန်မာဘာသာစကားတွင် နေရာဒေသအလိုက်ကွဲပြားသော ဒေသိယစကားတို့တွင် အချို့ဒေသိယ စကားများသည် စံဘာသာစကားနှင့် ကွဲပြားမှုနည်း၍ အချို့ဒေသိယစကား တို့သည်ကွဲပြားမှုများသည်ကို တွေ့ရသည်။ မြစ်ကြီးနားမြို့ပေါ်တွင် နေထိုင်ကြသောတိုင်းရင်းသားမျိုးနွယ်တို့သည် စီးပွားရေး၊ လူမှုရေး၊ နိုင်ငံရေးကိစ္စများကြောင့် တစ်ဦးနှင့်တစ်ဦး ဆက်သွယ်ပြောဆိုကြသော မြန်မာဘာသာစကားသည် စံဘာသာ စကားမှ ကွဲပြားမှုနည်းသော ဒေသိယစကား အမျိုးအစားတွင် ပါဝင်နေသည်ကို လေ့လာတွေ့ရှိရပါသည်။

မြန်မာဒေသိယစကားများရှိမြစ်ကြီးနားမြို့သုံးဒေသိယစကားကိုလေ့လာဆန်းစစ်ဖော်ထုတ်ခြင်းဖြင့် မြန်မာဒေသိယစကားများကို သိရှိနားလည်ခြင်းနှင့် မြန်မာဘာသာစကား၏ သဘော သဘာဝကို လေ့လာ လိုသူများအတွက် အထောက်အကူပြုနိုင်မည်ဖြစ်ကြောင်းတွေ့ရှိ ရပါသည်။

နိဂုံး

ဤစာတမ်းသည် မြစ်ကြီးနားမြို့တွင်နေထိုင်ကြသော တိုင်းရင်းသားမျိုးနွယ်တို့၏ နေ့စဉ်ပြောဆိုဆက်သွယ် အသုံးပြုနေကြသော ဒေသိယစကားများကြောင့် စံမြန်မာဘာသာ အတွင်းသို့ ဝေါဟာရအသစ်များ ပေါ်ပေါက်လာကာ လူမှုကိစ္စအဝဝတို့အတွက် နားလည် သဘောပေါက်နိုင်ပြီး၊

ပြည်-နတ်ဆောင် ဒိုးဆားရေလုပ်ငန်းမှ အသုံးပြု အငုံကြီး ဒေသအပြင်ဘက်ရောင်းချရေးကို ဒီဇာရေးဆွဲခြင်း

နိဒါန်း

စာဆို၏ အတ္ထုပ္ပတ္တိအကျဉ်း

ဟံသာဝတီဆင်ဖြူများရှင်က နဝဒေးဘွဲ့ချီးမြှင့်ခံရသော ပြည်-နဝဒေးသည် တောင်ငူခေတ်တွင် ထင်ရှားကျော်ကြားခဲ့သောစာဆိုကြီးဖြစ်သည်။ မင်းပေးနဝဒေးဘွဲ့ကို ပထမဆုံးရရှိခဲ့သော ကြောင့် ပထမနဝဒေးကြီးဟု စာပေသမိုင်းတွင် အသိမှတ်ပြုကြသည်။ ပိဒ်စုံရတုအစုံ (၄၀၈)ခန့် စပ်ဆိုခဲ့ခြင်း၊ ရတုဆရာ၏ပုဂံဝရ့ေသွား လမ်းပြဆရာကြီးဖြစ်ခြင်းတို့ကြောင့် ရတုနဝဒေးဟုလည်း ကျော်ကြားသည်။ သက္ကရာဇ် (၈၆၀)ခန့်တွင် ပြည်မြို့၌ ဖွားမြင်ခဲ့သော နဝဒေးကြီးသည် သက္ကရာဇ် (၈၉၄)ခုနှစ် ပြည်မြို့ကို မင်းပြသော ဘုရင်နရပတိ ယောက်ဖတော် မင်းဘစောဏ်အထိန်းတော်သား ဖြစ်သည်။ မင်းဘစောကို ပွတ်လယ်ရွာတွင် ပြည်ဘုရင် နရပတိကွပ်မျက်၍ နမယ်တော်နရပတိ မယ်ကို စလင်းစည်သူကျော်ထင်သို့ ပေးသည်။ ထိုအခါ နမတော် ဘုရားနှင့်အတူ စလင်းသို့ လိုက်ပါသွားရသည်။ စလင်းတွင် မင်းလက်ျာဘွဲ့ရရှိခဲ့သည်။ စလင်းမြို့ပျက်၍ စစ်ကိုင်းရှိ စည်သူကျော်ထင် မင်းပြုသောအခါ စစ်ကိုင်းသို့လိုက်ပါရသည်။ မင်းလက်ျာအား ထောင်သင်းကို ကြီးမှူးစေသည်။ ထောင်သင်းမှူးဘွဲ့အမည်ရသည်။ သက္ကရာဇ် (၉၁၃)တွင် စစ်ကိုင်းစည်သူကျော်ထင်သည် နရပတိ စည်သူဟူသော အမည်ဖြင့် အင်းဝရွှေနန်းကို သိမ်းမြန်းစိုးစံသည်။ သက္ကရာဇ် (၉၁၆)တွင် ဆင်ဖြူများရှင် (ဘုရင့်နောင်) လုပ်ကြံတော်မူ၍ အင်းဝပျက်လျှင် ပြည်ဘုရင် သတိုးရာဇာ (ဘုရင့်နောင်၏ ညီတော်)က ဆင်ဖြူများရှင်ထံ လျှောက်ထားတောင်းယူ၍ ထောင်သင်းမှူးကို ပြည်သို့ခေါ်သွားသည်။ သက္ကရာဇ် (၉၂၈)ခုနှစ်တွင် ဟံသာဝတီ ဆင်ဖြူများရှင် မင်းတရားကြီးသည် ဟံသာဝတီနေပြည်တော်ကြီးကို မြို့အင်္ဂါခုနှစ်ပါးနှင့်အညီ ပြန်လည်တည်ထောင်တော်မူသည်။ တာဝန်း (၃၄၀၀)ရှိသော ဟံသာဝတီ နေပြည်တော်သစ်ကြီးသည် နန်းမအဆောင်တို့ဖြင့် တင့်တယ်လှပနေသည်။ စာဆိုထောင်သင်းမှူးသည် ဟံသာဝတီသို့ ရောက်ခိုက်ဖြစ်၍ ဟံသာဝတီမင်းနေပြည်တော်ကြီး၏ ရှုမငြီးဖွယ် ခမ်းနားကြီးကျယ်ပုံကို "ရာဇဋ္ဌာနီ ပြည်ကြီးဝိ၍ တုသိတာမှ ဘုံလျှင်ကျသို့"ဟု အစချီကာ ပိဒ်စုံရတုရေးဖွဲ့ပြီး ဆင်ဖြူများရှင်ထံ ဆက်သွင်းလေသည်။ မင်တရားကြီးလည်း အားရနှစ်သက်ကာ နဝဒေးဘွဲ့ကို ချီးမြှင့်တော်မူခဲ့သည်။ ထိုအခါမှစ၍ ပြည်-နဝဒေးကြီးဟု နီးဝေးကျော်ကြားခဲ့သည်။ ထိုအကြောင်းတို့ကို ရည်၍ "စစ်ကိုင်းထောင်သင်း၊ စလင်းလက်ျာ၊ ပြည်မှာနဝဒေး"ဟု မြန်မာစာပေသမိုင်းတွင် အမည်မွေး ထင်ရှား ခဲ့သည်။ အသက် (၁၀)နှစ်အရွယ်ကပင် ကဗျာ၊လင်္ကာတို့ကို လိုက်စား ရေးစပ် ခဲ့သော စာဆိုနဝဒေးသည် ပျို့၊ ကဗျာ၊ လင်္ကာ၊ ဧချင်း၊ ရတုစပ်ဆိုရာ၌ ဉာဏ်ပညာ ထက်မြက်သူ ဖြစ်သည်။ စာဆိုရေးသား ပြုစုခဲ့သည့် အခြားစာများမှာ သက္ကရာဇ် (၉၀၄)တွင် သုဓနကုမာရဇာတ် (မြန်မာပြန်)၊ သက္ကရာဇ် (၉၁၃)တွင် မင်းတရားမယ်တော်ချောင်း၊ သက္ကရာဇ် (၉၄၁)တွင် ရာဇဗျူဟာပျို့နှင့် မနော်ဟရီပျို့ တို့ဖြစ်သည်။ စာဆို နဝဒေးကြီးသည် အသက်(၉၀)ကျော်တွင်ပြည်မြို့၌ အနိစ္စရောက်ခဲ့ပါသည်။

ရတုကဗျာ၏ သဘောသဘာဝ

ရတုဟူသော ဝေါဟာရနှင့်ပတ်သက်၍ "ကဝိဘာရတီကျမ်း"တွင် -

> "ရတုသည် သက္ကတ စကားပျက်မျှသာဖြစ်သည်။ ဝသန္တ စသောဥတုကို ဟောသည်။ ရွှေကမိုးဘွဲ့၊ ဆောင်းဘွဲ့ကိုသာ ရတုဟူ၍ ခေါ်ဝေါ်ခဲ့ကြရာမှ နောင်အလားတူ လေးလုံးစပ် လင်္ကာ၊ တောလား၊ ဘုန်းတော်ဘွဲ့၊ ကျေးစေဘွဲ့၊ မယ်ဘွဲ့၊ မောင်ဘွဲ့ စသည်တို့ကိုလည်း ရတုဟူ၍ ခေါ်ဝေါ်လာခြင်းဖြစ်သည်"

ဟုလည်းကောင်း၊

မြန်မာအဘိဓာန်တွင်

"ရတု၊ ယဒု၊ နု-လေးလုံးတစ်ပိုဒ်ရေးဖွဲ့သော ကဗျာတစ်မျိုး (သာဓကတု)"

ဟု ဖွင့်ဆိုထားပါသည်။

မြန်မာစာပေသမိုင်း၌ -

"တစ်ပိုဒ်တည်းဖွဲ့စပ်လျှင် စကပိုဒ်၊ နှစ်ပိုဒ်ဖွဲ့စပ်လျှင် အဖြည့်ပိုဒ်၊ သုံးပိုဒ်ဖွဲ့စပ်လျှင် ပိုဒ်စုံဟု ခေါ်ဆိုသည်။ သုံးပိုဒ်ထက် ပိုမို၍ မဖွဲ့နွဲ့ကြချေ။ တစ်ပိုဒ် တစ်ပိုဒ်တွင်လည်း ပဒ အရေအတွက်အားဖြင့် (၁၀၈) ပဒထက်ပိုမို၍ မဖွဲ့နွဲ့ကြချေ။ အဖွားချများတွင်လည်း ခိုင်ညွှန့်ခက်ဖြာ (၇)လုံး၊ မထီဆံကျင် (၉)လုံး၊ အာသာဝတီ ဝတ်ဆံ (၁၁)လုံး၊ မထီဦးပြည့် (၁၅)လုံး၊ ဓော်တစ်ခိုင်လုံး (၁၉)လုံး စသည်ဖြင့် အဖွားစာလုံး အရေအတွက် သီးသန့် ထားလျှက်ရှိပါသည်"

ကာရန်ယူရာတွင် သက်စေ့နှက်သုံးချက်ညီ ၊ဘီလူးရယ်ဦးတိုက် စသည်ဖြင့် လက်ဘစ်နည်း (၆)မျိုးအတိုင်း ဖွဲ့ဆိုလေ့ရှိကြသည်။ ရတုအချတွင် အနည်းဆုံးအကွရာ (၇)လုံးမှ အများဆုံး (၃၅)လုံး အထိ ချနည်းပေါင်း (၂၈)မျိုးရှိပါသည်။ ရတုချိနည်းနှင့်ပတ်သက်၍လည်း ပညာရှင် အသီးသီးတို့က "ကဗျာစွယ်စုံကျမ်း"တွင် (၂၅)မျိုး၊"ကဝိဘာရတီကျမ်း"တွင်(၂၈)မျိုး၊ "ကဗျာသာရတ္ထသင်္ဂြိုလ်"တွင် (၄၁)မျိုး၊ "ကဝိလက္ခဏာသုံးကျမ်း" တွင် (၆၀)မျိုးရှိသည်ဟု ဖွင့်ဆိုထားပါသည်။ ရတုကဗျာများကို ဘုရားတိုင်၊ မိုးတော၊ မိုးတိုင်၊ စစ်ချီ၊ ကျူးစေ၊ သစ္စာတိုင်၊ မောင်ဘွဲ့၊ မယ်ဘွဲ့စသည်ဖြင့် အကြောင်းအရာလိုက် ခွဲခြားထားပါသည်။ ထို့ကြောင့် အကြောင်းအရာပိုင်းတွင် လွတ်လပ်စွာ ဖွဲ့ဆိုနိုင်သော်လည်း အဖွဲ့အနွဲ့ပုံသဏ္ဌာန်ပိုင်းတွင် သတ်မှတ်ထားသော ရတုဖွဲ့နည်းစည်းကမ်းများနှင့်အညီ ဖွဲ့ဆိုရခြင်းသည်ပင် ရတုကဗျာ၏ သဘောသဘာဝ ဖြစ်သည်ဟု ဆိုနိုင်ပါသည်။

ပြည်-နဝဒေး၏မိုးတောရတုများမှ အချစ်၊ အလွမ်း ၊ ခံစားချက်များ လေ့လာချက်

လောကကြီးတွင် ပုထုဇဉ်မှန်သမျှ ချစ်ခြင်းမေတ္တာနှင့် မကင်းနိုင်ကြသည်မှာ ဓမ္မတာပင် ဖြစ်ပါသည်။ အချစ်နှင့်မကင်းသော လူသားတိုင်း အလွမ်းနှင့်လည်း မိတ်ဆွေဖြစ်ကြရပါသည်။ စာဆိုနဝဒေးသည် ပုထုဇဉ်လူသားတစ်ဦးဖြစ်၍ အချစ်နှင့်မကင်းနိုင်ရကား စစ်မြေပြင်စခန်းမှ နေ၍ နေပြည်တော်၌ ကျန်ရစ်သော ချစ်သူဇနီးမယားအတွက် ရတက်ပွေခဲ့ရလေသည်။ လွမ်းဆွတ်တမ်းတခဲ့ရလေသည်။ ထိုအခါ စိတ်သာမှုရစေရန် ရတုကဗျာများရေးဖွဲ့ခြင်းဖြင့် ဖြေသိမ့်ခဲ့ဟန်တူပါသည်။ သို့ဖြစ်၍ စာဆိုနဝဒေး၏ မိုးတောရတုများတွင် အချစ်၊ အလွမ်း သောကရောက်ခဲ့ရပုံ အဖုံဖုံတို့ကို တွေ့ခဲ့ရခြင်းဖြစ်ပါသည်။ နဝဒေး၏ မိုးတောရတုများသည် မိုးရာသီသဘာဝကိုနောက်ခံထား၍ မောင်မယ်တို့၏ အချစ်၊ အလွမ်း ခံစားချက်များကို ရေးဖွဲ့ထားပေသည်။ ချစ်ခြင်း၏နောက်ကွယ်တွင် ကွေကွင်းရခြင်း သဘောရှိလာသည်။ ကွေကွင်း ရလျှင်လည်း လွမ်းရပြန်ပါသည်။ အလွမ်းများများပြားလာပါက ခံစားကာ ညှိုးလျော့ရပြန်သည်။ ထိုအခါ အချစ်၊ အလွမ်း ခံစားချက်တို့သည် ကွင်းဆက်သဖွယ် ယှက်နွယ်ကြမြဲသာ ဖြစ်လာကြရသည်ကို တွေ့ရှိပေသည်။

အချစ်ဖွဲ့

စာဆိုနဝဒေးသည် အချစ်ဖွဲ့များကို ရေးဖွဲ့ရာ၌ "ရတုညောင်ရေ-ချီ" မိုးတောရတုတွင် နွေရာသီအခါ သမယ ကဆုန်လပြည့်နေ့ ညနေခင်း ပြည်ရွှေဆံတော်ဘုရားတွင် ပြည်ရွာအဝှမ်း ညောင်ရေသွန်းရန် ရောက်ရှိလာကြပါသည်။ နံ့သာရေအပြည့်နှင့် ပန်းပေါင်းစုံ ထည့်ထားသော မြူတာအိုးများ ခေါင်းတွင်ရွက်၍ လုံမပျိုလေးများသည် ညောင်ရေသွန်းလောင်းခြင်း ဘုရားရှိခိုး ပူဇော်ခြင်းများ ပြုလုပ်ကြပါသည်။ ထိုအချိန်တွင် စာဆိုသည် ချစ်သူမယ်လေးကို စတင် တွေ့ရှိရကြောင်းကို -

"ရတုညောင်ရေ၊ ခါလိုက်နွေဝယ်
ညနေချမ်းခါ၊ သင်းမြူတာနှင့်

နံ့သာဖြူးပြည့် ၊ ပန်းစုံထည့်မှ
ပတ်လှည့်လက်ယာ ၊ မြတ်စိန္နာဝယ်”

ဟူ၍ ရေးဖွဲ့ထားသည်ကို တွေ့ရှိရပေသည်။ မိန်းကလေးမှာ နတ်သမီးလေးအသွင်နှင့် နုနယ်နွဲ့နှောင်းသောအထွေးဆုံး၊ အငယ်ဆုံးဖြစ်သော ရှင်နှောင်းလေးဖြစ်ကြောင်းကို “သွန်းမြူးစွေထန်-ချီ” ရတုတွင် -

“နုနယ်နွဲ့နှောင်း ၊ ပြင်ကောင်းနတ်ဟန်
ထွေးနှောင်းစွန်ကြောင့်”

ဟုလည်းကောင်း၊

“မည်းလေစွလေ-ချီ” ရတုတွင် -

“အလှငြိမ့်လေး၊နှောင်းဆုံးမွေးသည်”

ဟူ၍လည်းကောင်း ရေးဖွဲ့ထားသည်ကို တွေ့ရှိရပေသည်။

ချစ်သူမိန်းကလေးသည်ရံရွှေဘော်သုံးပါးအလယ်တွင်ဆံကေသာလက်သင်ဆံထုံးကလေးထုံးကာစရွှေစင်ကဲ့သို့သော အသားအရေရှိပြီး လှသည့်နေရာတွင် အလှအားလုံး၏ အထွတ်အထိပ်ထားရလောက်သော မယ်လေးဖြစ်ကြောင်းကို “သွန်းမြူးစွေထန်-ချီ” ရတုတွင် -

“သုံးဘော်ရွှေလယ် ၊ ရွက်သွယ်ကေသာ
ထုံးကာစစ ၊ ရွ ရွ လက်သင်
ရွှေစင်အသား ၊ လှထွတ်ထား”

ဟူ၍ ဖွဲ့ဆိုထားကြောင်း တွေ့ရှိရပါသည်။

ချစ်သူမိန်းကလေးနှင့် မိမိတွေ့ဆုံရသည်မှာ ရှေးကြမ္မာဘုန်းကံကြောင့်သာ တွေ့ဆုံရခြင်း၊ ဘုန်းကံခြင်း ကြုံကြိုက်၍သာ ချစ်ခွင့်ရကြောင်းကို စာဆိုက “မွန်းယိမ်းကလျင်-ချီ” ရတုတွင် -

“နှောင်နှင့်မယ်သာ ၊ ကြမ္မာဘက်တစ်
ဘုန်းကြောင့်ဖြစ်ရှင့် ၊ တင်ပြစ်မရှိ
မျက်စိအာရုံ ၊ ကြိုင်နှံ့ထုံသည်
ကြုံကြသည်လည်း ၊ ရှေးကောင်းကျိုး”

ဟူ၍ မောင်နှင့်မယ်တို့ ကြုံတွေ့ရပုံကို ရေးဖွဲ့ပြခဲ့ပါသည်။

လေးလေးနက်နက်နှင့် ရွှေတိုင်ကြီးစိုက်ထားသကဲ့သို့ ချစ်သူမိန်းကလေးထံ၌ အသက် ကိုပင် အပ်နှံထားရလောက်အောင် ချစ်ရကြောင်းကို စာဆိုက “တနေကသည်-ချီ” ရတုတွင် -

“လေးနက်မှတ်ပိုက် ၊ ရွှေတိုင်စိုက်သို့”
မယ်နှိုက်အသက် ၊ စိတ်ပျက်မဲ့တွေ
ကြိုးလှည့်ပေလည်း”

ဟု မိမိ၏ အချစ်ကို တင်စားကာရေးဖွဲ့ခဲ့ပါသည်။

စာဆို၏ အချစ်ခံစားချက်အဖွဲ့သည် ချစ်သူမိန်းကလေးအပေါ် မည်မျှတန်ဖိုးထားကြောင်း၊ အလေးအနက်ထားကြောင်း သိသာသည်ကား အမှန်ပင်ဖြစ်ကြောင်း လေ့လာသုံးသပ်မိပါသည်။

အလွမ်းဖွဲ့

ဤသို့ ချစ်သူရှင်နှောင်းလေးသည် အလွန်လှပ၍ စာဆိုသည် အသက်ပေးရလောက်အောင် ချစ်ရကြောင်းတို့ကို ဖွဲ့ဆိုပြီးနောက် မောင်နှင့်မယ်တို့ အပြန်အလှန်လွမ်းရပုံတို့ကိုလည်း ထည့်သွင်းဖွဲ့ဆိုခဲ့ပါသည်။ ထိုသို့ ဖွဲ့ဆိုရာတွင် စစ်သည်မောင်သည် တာဝန်နှင့် စစ်ချီထွက်သွားရာ တောတောင်

ဝန်းကျင် ရေပြင်ပါမကျန် သာယာကြည်နူးမှုများကို မြင်တွေ့နေရသော်လည်း အလွမ်း၏ ပူလောင်မှု ကြောင့် စိတ်မကြည်နူးနိုင်ဘဲ အိပ်စက်၍လည်းမပျော် နေတိုင်၍လည်းမရ ဖြစ်နေပုံကို "ကြိုရှာဖီဈေး-ချီ" ရတုတွင် -

"ဆိပ်စကမ်းနား ၊ စုပြုံးမြိုင်ကြည်း
သားမျိုးပည်းရှင့် ၊ စက်လည်းမပျော်
နေသော်မတတ် ၊ ပျောင်းညွတ်တိမ်းမူး"

ဟူ၍ စစ်သည်တော်တစ်ဦး၏ သောကအလွမ်းကို ရေးဖွဲ့ထားသည်ကို တွေ့ရှိရပေသည်။ သဘာဝ အတိုင်းဖူးပွင့်နေကြသော ပန်းကလေးများနှင့် ဖိုမတူစုံဆွဲ၍ ဖန်တီဖန်တွတ်နှင့် ချစ်စကား တွတ်ထိုးကာ ပျော်ပါးလျှက်ရှိနေကြသည့် ငှက်မောင်နှံမြင်ကွင်းကို တွေ့ရသောအခါ စာဆိုက "ကြိုရှာဖီဈေး-ချီ"ရတုတွင် -

"ဖိုမစုံညီ ၊ ဖန်တီဖန်တွတ်
ဆွတ်လွတ်ရက်ယူ ၊ မြင်တိမ္မကား
သည်းဦးကြွေလှူ"

ဟု စပ်ဆိုထားရာ ဖော်ကွာဝေးသူအဖို့ အသည်းနှလုံးကြွေပြတ်လုမတတ် ပူဆွေးကာ လွမ်းနေရ ကြောင်းကိုလည်း လေ့လာတွေ့ရှိရပေသည်။ ငှက်မောင်နှံတို့၏ တူစုပျော်ရွှင်ကြပုံကို မြင်ရပြီး မိမိတို့၏ စစ်သည်တော် ဘဝမလွတ်လပ်မှုကို အားမလိုအားမရဖြစ်ကာ လွတ်လပ်သော ငှက်ကလေး များသာ ဖြစ်လိုက်ပါက ယခုချက်ချင်းပင်ချစ်သူထံပျံသန်း၍ သွားရောက်ချင်လှသည်ဟု "မည်းလေစွလေ-ချီ" ရတုတွင်

"သဘောငှက်တူ ၊ ပျံတက်မူကား
တွေးယူမစွ ၊ ရောက်ချင်လှ၏"

ဟူ၍ စပ်ဆိုထားရာ စာဆို၏ အလွမ်းစိတ်ကို ကိုယ်ချင်းစာကာ သနားစိတ်ဖြစ်ပေါ်လာရပါတော့ သည်။ ချစ်သူမောင် စစ်ချီသွားရာမှ ပြန်ရောက်လာရမည့်အချိန်တွင် ပြန်မရောက်လာသည့်အတွက် မယ်၏ စိတ်နှလုံးဝယ် စစ်မြေပြင်၌ ကြန့်ကြာလွန်းလှသည်ဟု အောက်မေ့နေရှာပေသည်။ နှုတ်ဖျားမှ ထုတ်ဖော် မပြောသော်လည်း စိတ်အတွင်းက အောက်မေ့နေရှာမည့် ချစ်သူမယ်လေး၏အဖြစ်ကို တွေးတောမိပုံအား စာဆိုက "တစိတ်စိတ်လျှင်-ချီ" ရတုတွင် -

"နှုတ်မျှဖြည်ပွက် ၊ မမြွက်သစ်းပဲ
နှလုံးထဲက ၊ သူရဲသက်ဝေ
ကြင်ဆွေမျိုးရှင့် ၊ ကြာလေ၏ဟု"

ဖွဲ့ဆိုထားရာ ချစ်သူမောင်ကိုတမ်းတ၍လွမ်းဆွေးမှုကြောင့် မယ်လေး ဝမ်းနည်းနေရပုံကို လေ့လာ တွေ့ရှိနိုင် ပေသည်။

မောင့်ကိုလွမ်းရသည်ကတချက် လွမ်းရလွန်းလို့ ရှက်ရသည်ကတကြောင်း ဖြစ်နေသည့် အပြင် မယ်လေးမှာ အိပ်စက်လဲလျောင်း၍ မနေနိုင်အောင် ဖြစ်နေရပုံကို "မွန်းချက်ပရောင်-ချီ" ရတုတွင် -

ညွတ်ခွေဝမ်းနည်း ၊ မယ်ချည်းဘော်ကွာ
စက်ဘုံသာဝယ် ၊ ဗျာပါညှိုးသန်း
လွမ်းသည်တချက် ၊ ရှက်သည်တကြောင်း
လျောင်းလည်းမသာ"

ဟူ၍လည်းကောင်း၊

"တစိတ်စိတ်လျှင်-ချီ" ရတုတွင် -

"မွေ့ရာခွင်ဝယ် ၊ မရွှင်ယောင်နွမ်း
နေကြောင့်သမ်းသည် ၊ ရေချမ်းကာဝေး
ပန်းကြာမွေးသို့ ၊ ငြိမ့်လေးစလ
ဆင်းမြမြသည် ၊ ပျောင်းပျစက်ရာခွေလိမ့်မည်"

ဟူ၍လည်းကောင်း ဖွဲ့ဆိုခဲ့ပါသည်။

ချစ်သူကို လွမ်းစိတ်ကြောင့် မွေ့ရာထက်ဝယ် ပျော်ရွှင်ခြင်းမရှိ နေရောင်နှင့်ထိတွေ့သော ကြာပမာ၊ ရေဝေးသော ကြာပမာ၊ ချစ်သူမယ်ကလေးသည် နွမ်းခွေနေလိမ့်မည်။ မောင့်ကို တမ်းတကာ လွမ်းနေရာမည့် ချစ်သူမယ်ကလေး၏ ပုံသဏ္ဌာန်ကိုမြင်ယောင်ကာ ရေးဖွဲ့ထားသည် ကိုလည်း လေ့လာတွေ့ရှိရပါသည်။

ခံစားချက်

စာဆိုနဝဒေး၏ မိုးတောရတုများသည် မိုးရာသီကိုအခြေခံ၍ ဖြစ်ပေါ်လာသော စစ်သည်တော် တို့၏ ခံစားချက်များကို ရေးဖွဲ့ပြရာတွင် ချစ်သူမိန်းကလေးအား ရည်မှန်းလျက် ချစ်သူမောင်မှာ အလွမ်းစိတ်များ ဆိုက်ရောက်နေဆဲတွင် တိမ်တောင်တိမ်တိုက်တို့သည် ယှက်ဆိုင်းပြီး မိုးသံများ တခြိမ်းခြိမ်းမည်ဟည်းကာ အိုင်ထွန်းအောင်ပင် ရွာလေတော့သည်။ ထိုသို့ ပြင်းပြင်းထန်ထန်ရွာချ လိုက်သောမိုးသည် ချစ်ရသူ မိန်းကလေးနှင့်ကင်းကွာ၍ အထီးကျန်ဖြစ်နေရသော စာဆို၏ဘဝကို "ထစ်ရင့်ဖြိုးဝှန်-ချီ" ရတုတွင် -

"သည်းဖျားဝှန်လှိုက် ၊ လွမ်းစဉ်ကြိုက်တွင်
တိမ်တိုက်ထက်ဆိုင် ၊ ကြူးကာအိုင်လျှင်
သံပြိုင်သံပြို ၊ လူလျှင်သီသို့
မိုးချိသန်လျက် ၊ ဆင်းသက်ဘနန်း
လှည့်ဝန်းအာကာ ၊ ရင့်သံဝါနှင့်
ဗျာပါစိမ့်မည် ဆင်ဘိသည်"

ဟူ၍ ဖွဲ့ဆိုထားသည်ကိုလည်း တွေ့ရပါသည်။

"စက်ဝန်းရံခွေ-ချီ" ရတုတွင်လည်း စာဆိုက -

မိုးမှာကိုပင်း ၊ အချမ်းသွင်းကာ
နှင်းနှင့်တည် ၊ ရာသီမင့်
ဆွတ်ပျံဝန်းကျင် ၊ ဝေရီဆင်သည်
ကိုယ်တွင်ချမ်းလှတော့သည်သာ"

ဟူ၍ ရေးဖွဲ့ထားရာ အချမ်းဓာတ်ကြောင့် အလွမ်းပိုလာရသော စစ်သည်မောင်၏ခံစားချက်ကိုလည်း မြင်ယောင်လာစေပါသည်။

"သွန်းမြူးစွေထန်-ချီ" ရတုတွင်လည်း -

ခွေစာဆောင်းပါး ၊ လက်ရွေသားနှင့်
သနားဘွယ်သာ ၊ ဖွေရှာစီစစ်
ပေးသည့်ဖြစ်ကို ၊ ဖြေလစ်ကြည့်သော်
မပျော်ရွှင်ခဲ့ ၊ မြွက်ဖော်သံသာ
မျိုးစံရာသည် ၊မှာဘိသည်လည်းမပြန်ရက်"

ဟူ၍ ရေးဖွဲ့တားရာ စစ်သည်စာဆိုတော်သည် စစ်ချီသွားနေချိန် ချစ်သူမယ်လေးနှင့် ခွဲခွာနေရ၍ လွမ်းဆွတ်သတိရနေစဉ် ချစ်သူမယ်လေး၏ဆာကို ဖောက်ဖတ်လိုက်ရ၍ မပျော်ရွှင်နိုင်ဘဲဖြစ်ရကာ တာဝန်ကြောင့်ချစ်သူထံအပြန်ခက်နေသည့် ခံစားချက်ကိုလည်း တွေ့မြင်နိုင်ပေသည်။ မယ်လေးသည်လည်း ဝမ်းနည်းပူဆွေးကာ အလွမ်းရက်များကို ရေတွက်နေလိမ့်မည် ဖြစ်ကြောင်းကို "တစိတ်စိတ်လျှင်-ချီ" ရတုတွင်

"သည်သူငါမှာ ၊ ကြိမ်တတီလှာဟု
ရံခါမမေ ၊ လွမ်းသရွေ့ကို
မှတ်နေရက်ကြာ နေလိမ့်မည်"

ဟူ၍လည်းကောင်း၊ တိုကဲ့သို့ အလွမ်းရက်များကို ရေတွက်နေမည့် ချစ်သူမယ်လေးသည် အတိန်းတော်များက ပြေရာပြေကြောင်း ဖျောင်ဖြေသော်လည်း မပျော်ရွှင်ဘဲ ခံစားနေရကြောင်းကို "မည်းလေစွလေ-ချီ" ရတုတွင် -

"ထိန်းယာရွေဘော် ၊ ပျော်ကြောင်းဖျော်လည်း
မပျော်ညှိုးငယ် ၊ ရွှေများလယ်တွင်
ပြုံးရယ်မဲ့တွေ ၊ နေလေအံ့လော"

ဟုရေးဖွဲ့တားရာ ချစ်သူမယ်လေး ခံစားရမည့်အဖြစ်ကို စာဆိုသည် အဝေးတစ်နေရာမှ မြင်ယောင်ပြီး ဖွဲ့ဆိုခဲ့ခြင်းဖြစ်သည်ကိုလည်း လေ့လာတွေ့ရှိရပါသည်။ ဤသို့အားဖြင့် စာဆိုသည် ဝေးကွာနေကြသော ချစ်သူမောင်မယ်တို့၏ ခံစားချက်များကို မြင်ယောင်လာအောင်ရေးဖွဲ့နိုင်စွမ်း ရှိကြောင်း လေ့လာသုံးသပ်မိ ရပါတော့သည်။

သုံးသပ်ချက်

ဤသို့အားဖြင့် စာဆိုနဝဒေး၏ ဝိုးတောရတုများတွင် တွေ့ရသော မောင်၊ မယ်တို့၏ အချစ်၊ အလွမ်း၊ ခံစားချက်များသည် ဝိုးရွှာခြင်းကို အခြေခံ၍ ရေးဖွဲ့တားသည်ဟု ယေဘုယျအားဖြင့် ဆိုနိုင်ပါသည်။ တိုသို့ ရေးဖွဲ့ရာတွင်လည်း စစ်မြေပြင်ရောက် စစ်သည်စာဆိုတစ်ဦးနှင့် နေပြည်တော်တွင် ကျန်ရစ်သော ချစ်သူမိန်းကလေးတို့၏ အချစ်၊ အလွမ်း သောကရောက်ရပုံတို့ကို ပရိယာယ် အသွယ်သွယ်ဖြင့် ရေးဖွဲ့တင်ပြခဲ့သည်ကို တွေ့ရှိရပါသည်။ စာဆိုနဝဒေးသည် ချစ်သူမိန်းကလေးနှင့် စတင်တွေ့ဆုံသောအချိန်၊ နေရာနှင့် အသက်အရွယ်တို့ကိုလည်း အသေးစိတ်ဖွဲ့ဆိုထားသည်ကို တွေ့ရှိရပြီး ချစ်သူမိန်းကလေးအား တွေ့ကြုံချစ်ကြိုက်ခွင့်ရခြင်းသည် ရှေးကြမ္မာကောင်းကျိုး ကြောင့်သာဖြစ်ရပြီး ဗိမိအသက်ကိုပင် အဝံနံထားရလောက်အောင် လေးလေးနက်နက်နှင့် ရှေတိုင်ကြီး စိုက်တူထားသကဲ့သို့ တန်ဖိုးထား ချစ်မြတ်နိုး ရကြောင်းကို အချစ်ဖွဲ့များတွင် တွေ့ရှိရပြီး အလွမ်းဖွဲ့များတွင်လည်း ဗိမိတစ်ဦးတည်း လွမ်းရသည်သာမက ချစ်သူမယ်လေးကလည်း ဗိမိကဲ့သို့ လွမ်းနေရာမည်ဟူသော စာနာခံစားချက်များဖြင့် အတွေးနယ်ချဲ့ကာ ချစ်သူမယ်လေး၏ လွမ်းနေရမည့်ဟန်များကို ဖန်တီးကာ ရေးဖွဲ့တားနိုင်သည်သာမက ဝိုးတောရတုများဖြစ်သည့် အားလျော်စွာ ဝိုးရာသီသဘာဝကို နောက်ခံထား၍ အလွမ်းကို ရှပ်လုံးကြွေအောင် ဖွဲ့ဆိုထားနိုင် ကြောင်းကိုလည်း လေ့လာတွေ့ရှိရပါသည်။ ချစ်သူမိန်းကလေး၏ အချစ်ကို ရရှိပြီးသော်လည်း ခွဲခွာနေရ၍ ခံစားနေရသော ခံစားချက်များ၊ လွမ်းဆွတ်သတိရနေစဉ် ရာသီဥတုကြောင့် ရင်တွင်းဒဏ် ဖြစ်ပေါ်လာသော ခံစားချက်များ၊ တာဝန်ကြောင့် ချစ်သူထံ အပြန်ခက်နေသည့်ခံစားချက်များ စသည်ဖြင့် အချစ်၊ အလွမ်း ခံစားချက်များကို စုံလင်စွာတည့်သွင်း ရေးဖွဲ့တားနိုင်ကြောင်း လေ့လာသုံးသပ်မိပါသည်။

နိဂုံး

တောင်ငူခေတ်စာဆို ပြည်-နဝဒေး၏ အချစ်၊ အလွမ်း၊ ခံစားချက်တို့အပေါ် အခြေခံ၍ ဖြစ်တည်လာသော မိုးတောရတုများသည် စာဆို၏ အတွေးစိတ်ကူး ခံစားချက် အရေးအဖွဲ့ စွမ်းရည်တို့ကို လေးစားဖွယ် တွေ့မြင် ရပေသည်။ ရတုစာပေခေတ်ကြီးကို ဦးဆောင်ဦးရွက်ပြုသူ နဝဒေးကြီး၏ ကြိုးပမ်းမှုများမှာ ယနေ့တိုင် ဂန္ဓဝင်စာပေလောကကို အကျိုးပြုလျှက်ရှိသည်ဟု ဆိုချင်ပါသည်။ သုတေသီများအနေဖြင့် ပြည်-နဝဒေး၏ ရတုများမှ ဘုရားတိုင်၊ စစ်ချီ၊ မယ်ဘွဲ့၊ မောင်ဘွဲ့၊ မြို့ဘွဲ့၊ ရေလား၊ တောလား၊ ဥဒေါင်းဖို,မ အမေးအဖြေ၊ ဝမ်းဘဲဖို,မအမေးအဖြေ၊ ပန်းဘွဲ့၊ အဖြည့်ခံရတုများကိုလည်း ဆက်လက်သုတေသနပြုနိုင်ပါသည်။

ကျမ်းကိုးစာရင်း

ကျော်ရင် ၊ ဦး ။ ပုပ္ပါး ။ (၁၉၄၁) ။ *ကဝိဘာရတိကျမ်း* (ပထမတွဲ) ။ မန္တလေး ၊သုခဝတီပုံနှိပ်တိုက် ။

ထွန်းရွှေဦး။ ဓမ္မစရိယ ။ (၁၉၆၇) ။ *ကဗျာစွယ်စုံကျမ်းကြီး* ။ ရန်ကုန် ၊ အောင်မိတ်ဆက်ပုံနှိပ်တိုက် ။

နဝဒေး ၊ ပြည် ။ (၁၉၆၆) ။ *နဝဒေးရတုပေါင်းချုပ်*(စတုတ္ထအကြိမ်) ။ရန်ကုန်၊ဟံသာဝတီပုံနှိပ်တိုက် ။

ဖေမောင်တင် ၊ ဦး ။ (၁၉၈၇) ။ *မြန်မာစာပေသမိုင်း*(ပထမအကြိမ်) ။ ရန်ကုန် ၊ ခေတ္တရာပုံနှိပ်တိုက် ။

မြန်မာစာအဖွဲ့ ။ (၂၀၀၈) ။ *မြန်မာအဘိဓာန်* (၃-ကြိမ်) ။ ရန်ကုန် ၊ တက္ကသိုလ်များပုံနှိပ်တိုက် ။

လွမ်း ၊ ဆရာ ။ (၁၉၅၅) ။ *ကဗျာသာရတ္ထသင်္ဂြိလ်* ။ ရန်ကုန် ၊ ရန်အောင်မင်္ဂလာပုံနှိပ်တိုက် ။

သြ ၊ ဦး ။ (၁၉၆၀) ။ *ကဝိလက္ခဏာသုံးကျမ်းတွဲ* ။ ရန်ကုန် ၊ မြဓော်ပုံနှိပ်တိုက် ။

Characterization of the Selected Short Stories by O.Henry

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Abstract

This research studies the characterization of the selected short stories by O.Henry. The three selected short stories are *"A Service of Love"*, *"After Twenty Years"* and *"The Last Leaf"*. This research aims to analyze the characters in the selected short stories. The objectives of this study are to describe each character's major traits and qualities, to identify the characters whether they are dynamic or static, and to explore the humanity of the characters in the selected short stories. The selected short stories are analyzed by using "Five methods of characterization" by Warner (2015). The findings of this research reveal the dynamic character of the story and the humanity of the characters in the story. It is hoped that this research will help the learners of English literature to comprehend how to analyze the characters in their literary works to some extent.

Key Words: characteristics, statics, dynamics, explore, humanity

Introduction

The present research studies the characters in the selected short stories written by O.Henry. The three selected short stories are *"A Service of Love"*, *"After Twenty Years"* and *"The Last Leaf"*. The characters of the short story are mostly interesting to the readers. Without characters, there would be no plot and hence, no story. The primary attraction lies in the characters for most readers. O.Henry's selected short stories are analyzed by using "Five methods of Characterization" by the instructor Connie Warner (2015). This research deals with the aim of the story and how to analyze the characters in the story. The author's biography, literary works, and synopses of the selected short stories are presented. Then, the research methodology used in this research is mentioned. The findings found in the study are discussed in the next section.

This research aims to analyze the characters in the selected short stories by O.Henry from the point of view of characterization. The objectives of this research are as follows:

(i) to describe the major traits and qualities of each character;

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(ii) to identify the characters in terms of whether they are dynamic or static; and
(iii) to explore the humanity of the characters in the three selected short stories by O.Henry.

Literature Review

The author's biography and his literary works

O.Henry was a well-known American writer in world literature history. His original name was William Sydney Porter. O.Henry is his pen name. 'O' stands for Oliver. He was born on September 11, 1862, in Greensboro, North Carolina, America. His parents were Algernon Sidney Porter, a physician, and Mary Jane Virginia Swaim Porter. When O'Henry was three, his mother passed away after giving birth to her third child, and they moved into the home of his paternal grandmother. In 1879, he started working in his uncle's drug store in Greensboro. He showed his natural artistic talents at the drug store by sketching the townsfolk. In 1882, he moved to Taxes.

There, he met his wife and he had two children. In 1884, he began writing as a sideline and wrote many of his early stories. He was known for his wit, story-telling, and musical talents. He played both the guitar and mandolin. In 1895, O.Henry and his family moved to Houston, where he started writing for the post. He gathered ideas for his column by loitering in hotel lobbies and observing and talking to people there. This was a technique he used throughout his writing career. In 1902, after the death of his wife, O.Henry moved to New York. He chose to move to New York to be near his publishers. His most fertile writing period started in 1902. He wrote 381 short stories. He wrote a story a week for over a year for the *New York World Sunday Magazine*. His wit, characterization, and plot twists were adored by his readers.

O.Henry is one of the world's three most famous short story writers. He is equal status with Chekhov and Maupassant. His stories are full of colourful characters most of whom are derived from the people he met in his daily life. O.Henry's trademark is the surprise ending that each of his stories contains. The twist ending and the humanity of the characters can be found in O.Henry short stories. O.Henry shows sympathy for the poor social underdogs, upgrades human virtues as well as exposes human defeats. O.Henry's short stories give the sense of surprising endings and tearful smiles. Some critics call him "the founder of American stories."

In 1907, he went to his native state North Carolina. He met again his childhood sweetheart and remarried her. In 1908, O.Henry became a heavy drinker and his health deteriorated which did not support his writing. In 1909, his wife left him. On June 5, 1910, he breathed his last breath because of cirrhosis of the liver. He was buried in the Riverside Cemetery in Asheville, North Carolina.

Synopses of the selected short stories

The synopses of the selected short stories are presented as follows.

A synopsis of the short story *A Service of Love*

In this story, Joe and Delia meet in an atelier and they fall in love. They both came from small cities. Both are artists and love art. Joe is a painting artist and Delia is a pianist. They get married and set up a home in a small flat. They continue their studies; however, they often lack money. Each does not want their partner to drop out of the University because of financial difficulties. Both of them lied to one another to try to make a living. The two lovers have to sacrifice their desire with the aim of more important and better to gratify the people they loved. This story is about Love and Sacrifice between Husband and Wife. This story proves that "When someone loves, no service seems too hard.

A Synopsis of the Short Story *After Twenty Years*

In this story, there are two main characters, Jimmy and Bob. They had been brought up in New York like two brothers. Twenty years ago, that night, they had dined together and parted with each other at 10:00 pm. At that time, Jimmy was twenty and Bob was eighteen.

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They agreed to meet again exactly twenty years from that date and time, no matter what their conditions might be or from what distance they might have to come. After twenty years, the two friends arrive at their appointed place on time. The reunion of the two childhood friends is very emotional. At the end of the story, Jimmy is a police officer and Bob is a wanted criminal. Jimmy must arrest the wanted criminal, Bob. This story reveals the difficult situation between the loyalty of friendship and loyalty to the nation.

A Synopsis of the Short Story *the Last Leaf*

This story is about the three artists in Greenwich Village, a section of New York City, during a pneumonia epidemic. Sue and Johnsy are very close friends and they have come to New York to make their living. And another artist is Mr. Behrman who considered himself a protector of the two young artists. He saves the life of a young neighbouring artist, Johnsy whom he was very fond of. He gives her the will to live. This story is based on humanity and love and gives the moral lesson that even if we have to face bad things, we should always help our beloved ones. This story also tries to empower a person to fight against death.

Research Methodology

This research studies the characters in the selected short stories written by O.Henry. The characters in the stories are analyzed using "Five Methods of Characterization" by instructor Connie Warner (2015). These five methods of characterization are:

1. Physical description
2. Action
3. Inner thoughts
4. Reactions
5. Speech

These methods can be called the acronym, PAIRS.

1. Physical description

The character's Physical appearance is described. For example, characters might be described as tall, thin, fat, pretty, etc. We might be told the colour of hair or something about the clothing of the character. How the character dresses might reveal something about the character. Does the character wear old, dirty clothing or stylish, expensive clothing?

2. Action

The attitude and behaviour of the character include the action. What the character does tells us a lot about him/ her, as well as how the character behaves and his or her attitude. Is the character a good person or a bad person? Is the character helpful to others or selfish?

3. Inner thoughts

What the character thinks reveals things about the character. The readers discover things about their personalities and feelings, which sometimes help the readers to understand the character's actions.

4. Reactions

Effect on others or what the other characters say and feel about his character. The readers learn about the relationships among the characters. How does the character make the other characters feel? Do they feel scared, happy, or confused? This helps the readers have a better understanding of all the characters.

5. Speech

What the character says provides a great deal of insight for the readers. The character might speak in a shy, quiet manner or nervous manner. The character might speak intelligently or in a rude manner.

Findings and Discussion

The present research analyzes the characters in the three selected short stories by O. Henry. In this research, five methods of characterization proposed by instructor Connie Warner (2015) were used. Most authors typically reveal the personality traits of their

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characters through characterization. In the selected short stories, O. Henry can allow the reader to explore the characterization of the main characters. Overall, O. Henry's short stories have not only the twisted ending, but also the reversal reflected from the twist ending of his character's humanity.

Analysis of Characters

Delia Caruthers *(A Service of Love)*

In the story, Delia wants to be a famous pianist. She is from South America and her family raises the money and sends her New York to learn and excel in her talent. She is studying under Herr Rosenstock, very famous pianist. She wants to be sought after by orchestras where she can be performed like a diva. She meets Joe Larrabee at an atelier and falls in love quickly. She marries Joe even though she knows that he is a struggling artist. Although she is a young lass of twenty, she is a loving, loyal, and caring wife. She supports her husband's dreams. Everything goes well until they run out of money. When they face the financial problem, she willingly takes another Job at the Laundry Shop. She never complains even though she has to work to make ends meet and help her husband education to get a Master's Degree. She always thinks of a way to try and support her husband's art.

One day, she told Joe that she has got a job related to the art of music which was to give music lessons to the daughter of a wealthy general. Her husband disagrees at first, but she manages to convince him. However, one night, Delia comes back home with a burned hand and she makes up a story about her pupil spilling something hot on her hand. Joe does not accept her explanation and asks her to tell the truth about her job. She admits that she got a job ironing shirt at a laundry and she was burned when another girl set an iron down on her hand. Finally, they found out that they were both working at the same laundry shop.

Among the five methods of characterization by Warner (2015), action and speech reveal that she is a good person and she has a helpful character. She can make her husband happy and satisfied. According to her speech, she can be imagined that she speaks intelligently and she has a quiet manner.

"I have a pupil. And, oh, the loveliest people. General — General A.B. Pinkney's daughter "

According to this speech, she has to use white lies in order to fulfill her husband's ambition and shoulder their financial load.

"Joe, dear, you are silly. You must keep on with your studies. It is not as if I had quit my music and gone to work at something else. While I teach, I learn. I am always with my music."

Because of this utterance, she wants to sacrifice her ambition so that her husband gets ahead in his studies. She prefers her husband's ambition and she feels very pleased to be able to help the person she loves so much.

"I couldn't get any pupils, and I couldn't bear to have you give up your lessons, and I got a place ironing shirt in that big Twenty-fourth Street laundry."

Finally, she confessed that she did not get any pupils and that she had to tell a white lie with good intentions for her husband. She has a fighting spirit and she is never afraid to work hard. Because of love, she is willing to do things that she does not really wants to do. So, the story ends with her speech—

"When one loves, no service seems too hard."

The story starts with the premise that "When one loves one's Art, no service seems too hard." However, at the end of the story, she proves that the premise is wrong because she has to do everything with love, not art. It can be concluded that she has a dynamic character in the story and her actions reveal the humanity of her character.

Joe Larrabee *(A Service of Love)*

In the story, Joe is an excellent painter. He can draw some pictorials at six years old. His first painting was framed at the drug store. At twenty years old, he left for New York to study art. He is from Central America. He met Delia at an art gallery where most art lovers

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like to hang out. They fall in love and get married. He supports his wife's dream and also continues his studies under a famous Magister. His dream is to paint pictures that old, rich gentlemen would love to buy. Their lives seem fine until they run out of their money. At that time, he decides to sacrifice his artistic ambition and drop out of his education. However, his wife insists on continuing his education. Finally, he accepts his wife's wish and he gets a Master Degree. He felt guilty himself and he also lied to his wife about his job. He works secretly as a machine operator in the same laundry shop where Delia is working.

According to the use of five methods of characterization, his actions show that he is a good husband. He is not afraid of working hard to achieve his goals. His reactions to his wife describe that he has a heart of gold. His wife's life and success are more important to him and he would like to delight to fulfill his beloved ones. Because of his speech, it can be decided that he speaks and acts intelligently and he has a dynamic character.

"And Tinkle permitted me to hang two of them in his window. I may sell one if the right kind of a moneyed idiot sees them."

In this speech, the readers can know his dream. He hopes someone will buy his sketches that are hung in Tinkle's window. He tells his goal to his wife. He is an ambitious artist.

"Sold that watercolor of the obelisk to a man from Peoria."

Joe announced overwhelmingly this speech to his wife. When they face with straitened circumstances, he also secretly works at a laundry shop. When his wife takes her wage to their home, he makes surprise her by telling her that he has sold a sketch to a rich man from Peoria. Joe and Delia lie about their real jobs to each other. They never want to hurt their beloved person's feelings.

"I sent up this cotton waste and oil from the engine room this afternoon for a girl upstairs who had her hand burned with a smoothing iron. I've been firing the engine in that laundry for the last two weeks."

According to this speech, the readers find out how they lie about their true jobs and how they protect each other dreams. Delia returned home with her right hand wrapped up in bandages and that day, Joe heard there was a hand accident at an ironing shop. Therefore, he can guess the real situation and asks his wife to tell the truth. And Joe admits that he has been actually firing the engine in that laundry for the last two weeks.

"My purchaser from Peoria and Gen. Pinkey are both creations of the same art—"

In this speech, Joe admits that he has never sold any of his art. Both of them lied to one another but with good intentions. Each of them has their artistic goals, however, they sacrifice their ambitions for the more delightful goal of the person they love so much. What kind of difficulties they meet, their love is never ending and they can break through their struggles with their love. Finally, they are happy because they are honest with each other.

Joe's character reveals that he is a workaholic and a very admirable person. He is not afraid to work hard to achieve his goals. He is a dutiful husband to his wife. According to the five methods of characterization by Warner (2015), his action, reaction, and speech are pointed out that he is a good helpful person and he has a dynamic character. He can be remarked that he is a man of great humanity. This story *"A Service of Love"* is a great example of how love drives two people to sacrifice their ambitions for the pleasure of each other. The moral is that when someone loves, no service seems too difficult.

Bob *(After Twenty Years)*

In the story *"After Twenty Years"*, Bob, alias "Silky Bob" is described as a rich man. According to the following sentences, the readers know his physical appearance.

"The light showed a pale, square-jawed face with keen eyes, and a little white scar near his right eyebrow. His scarf pin was a large diamond, oddly set".

"The waiting man pulled out a handsome watch, the lids of it set with small diamonds."

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Because of the physical description, Bob's character is described as a rich person. In this short story, Bob is the viewpoint character and he does a lot of talking about himself. As a consequence of his speech, he is understood that be in a sentimental mood. He expects to meet his childhood friend and talk about their old times.

"I'm just waiting for a friend. It's an appointment made twenty years ago."

"He and I were raised here in New York, just like two brothers, together. I was eighteen and Jimmy was twenty."

Bob is waiting for his childhood friend, whom he had agreed to meet with at that place, twenty years ago that day. They had been raised in New York like brothers. Bob is two years younger than Jimmy. So, he is 38 years old in this story. He decided to head west to make fortune. The two childhood friends had agreed to meet again in the appointed spot after twenty years, no matter what their conditions might be or from what distance they might have to come.

"He'll never forget. I came a thousand miles to stand in this door tonight, and it's worth it if my old partner turns up."

According to this speech, Bob is confident that his old friend will meet him that night if he is alive whatever circumstances he may have. Bob believes that Jimmy is forever the truest, staunchest old friend in the world. Bob is a wanted criminal and has been dodging the police for many years. Despite his flaws and criminal background, he has redeeming qualities. He is a loyal friend to Jimmy. Although he runs more risk of keeping the appointment, he goes on to meet his old friend. Bob fails to recognize Jimmy because it is a fact that a uniform tends to obscure the wearer's identity. Bob thought that the man he met is just a patrolman because of his uniform, especially a military uniform. He believes that his friend would be there on time if he is still alive on earth. Therefore, he waited for his friend for another half an hour at that place. After about twenty minutes he waited, a tall man in a long overcoat hurried across from the opposite side of the street. He suspected that man, and finally, he realized that the man who meets him is not Jimmy.

"You've changed lots, Jimmy. I never thought you were so tall by two or three inches."

This speech shows his remembrance of his friend's physical appearance. And then, when he saw clearly a tall man's face with the brilliant electric lights of a drug store, he confirmed that the tall man is not his friend.

"You're not Jimmy Wells, twenty years in a long time, but not long enough to change a man's nose from a Roman to a pug."

Therefore, he exactly knows that Jimmy has a Roman or long, straight nose. Although he is a wanted criminal, he is punctual in keeping his meeting with Jimmy. Bob's characters demonstrate the friendship, loyalty, and trust between the two childhood friends. He has a dynamic character. The readers know his character according to the speech that he told the police officer whom he did not recognize at first his childhood friend, Jimmy Wells. Bob has become a wanted criminal, so in that way, he is bad. On the other hand, he remains good enough of a person to remember his old friend fondly and wants to keep their meeting. He is regarded as a man of great humanity.

Jimmy Wells *(After Twenty Years)*

Jimmy is a policeman in the short story *"After Twenty Years"*. Since he is two years elder than Bob, he is forty years. Her characters are described by his action, reaction, and speech of Bob. At the beginning of the story, Jimmy is known that the picture of a nonchalant, confident, and reliable patrolman.

"The policeman on the beat moved up the avenue impressively."

"... the officer with his stalwart form and slight swagger, made a fine picture of a guardian of the peace."

According to these statements, Jimmy portrays a fine impression of a police officer. He dutifully performs his job. Jimmy is tough and sturdy in his looks. He is an honest

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policeman and has maintained his loyalty to his job. He went to the appointed place to meet his friend without fail. Therefore, he is a great friend. Jimmy's characters are mostly learned about through Bob's descriptions. When Bob tells the police officer about Jimmy, he describes him as follows

"... Jimmy Wells, my best chum, and the finest chap in the world."

"You couldn't have dragged Jimmy out of New York: he thought it was the only place on earth."

"He was a kind of Plodder, though, good fellow as he was."

Therefore, Jimmy is Bob's best friend and the finest person in the world. He had been brought up in New York and he loves his city too much. He never leaves his city and serves as a police officer in his land. Jimmy is a true friend because he did not absent to come the appointed place on time. He describes in the note:

"I was at the appointed place on time."

Jimmy indicates that he is an observant police officer when he writes a note to his friend.

"When you struck the match to light your cigar, I saw it was the face of the man wanted in Chicago."

Therefore, the original policeman to arrest the wanted criminal is Jimmy. However, he did not have the heart to arrest his childhood friend. He shows his deep affection for his friend in the note.

"Somehow I couldn't do it myself, so I went around and got a plain clothes man to do the job."

His action portrays that he is a noble friend. Although he knows his friend is a wanted criminal, he could not arrest his childhood friend. Jimmy is truly the major character because the story turns on what he does in the story. He had to decide a difficult decision between two painful situations. On the one side, he wants to continue his way and let Bob escape from the law. If he did so, he would feel guilty that he did not accomplish his sworn duty as a police officer. On the other side, he has to arrest Bob or cause him to be arrested. If he did that, he would feel guilty that he is a faithless friend of his old chum. Therefore, in the story, he is determined that he is in a lose-lose situation. Jimmy had to make a decision to arrest a wanted criminal. He is more loyal to the country than his friend. He has got well training at the police academy. He had been taught that as a police officer, he could not be performed by personal feelings. He has to maintain the law and the pe ethics. Finally, he made his mind up to send another person to arrest his old chum, a wanted criminal. Therefore, his character shows that he is a moral, law-abiding person. According to the five methods of characterization by Warner (2015), his action, reaction, and inner thoughts reveal that he is a dynamic character in the story. He explores the humanity of the character.

Sue *(The Last Leaf)*

In this story, Sue is a young artist who comes from Maine. She had recently come to Greenwich Village to make her living. She met Johnsy and lived together in a flat. Although they have known each other for only about six months, she takes care of Johnsy spiritually and morally when Johnsy got pneumonia. Much of Sue's character is known through her relationship with her roommate, Johnsy. She is deeply devoted to Johnsy. She knew her friend's illness from the doctor that Johnsy had about one chance in ten to live. When she heard the bad news about her friend, she went into her room and cried. Later, trying not to show her sadness, she went into Johnsy's room, whistling. She tries to hide her sorrowful feeling of concern for Johnsy's illness. She looks after and encourages her beloved friend until she recovers from her illness.

The use of five methods of characterization, action, reaction, and speech describes that she is an optimistic one. When the doctor comes and sees Johnsy, she tells him firmly that Johnsy is not depressed because of her love affair and she also tells that Johnsy had always

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wanted to paint a picture of the Bay of Naples. She knows in detail about her friend's life and artistic ambitions. To Sue's speech,

"What connections have those old leaves with your getting well?"

"Please don't be silly! The doctor told me this morning that your chances of getting well soon were excellent."

She thinks of the situation from the positive side and she provides mental strength to Johnsy to break through her illness. She is a symbol of optimism in the story. According to the following speech of Sue, she is a loving and caring friend.

"Now try to take some of your soup and let me get back to work so that I can make money to buy you some good port wine."

Sue always takes care of Johnsy and she also supports them financially during her illness. She earns her living by drawing illustrations for magazines. As she cannot hire a regular model, she asks for Behrman as a model. She wants to create her friend's happiness as much as she can. She is an all-weather friend.

"I'd rather stay here with you. Besides, I don't want you to keep looking at those silly leaves."

Because of this speech, she would like to stay with Johnsy in the same room and she encourages her to get well soon. She tries to dissuade Johnsy from looking at the ivy leaves. She wishes for Johnsy to live and she also informs Mr. Behrman about Johnsy's growing hopelessness.

"Think of me if you won't think of yourself. What shall I do?"

When Johnsy was talking about her death, Sue told this speech. Although she has known Johnsy for only about six months, she is deeply devoted to Johnsy. She tries to disguise her sorrowful feeling and she creates herself like a mature person to face any difficult situation for Johnsy. Her speech demonstrates the ties of friendship. She toils to help her sick friend. She never gives up on restoring Johnsy's will to live. She offers her loving efforts to help Johnsy regain her health. As the saying goes "A friend in need is a friend indeed", Sue is a genuine friend to Johnsy. She is an image of friendship and sacrifice, the two most virtues of life. After Johnsy recovers, Sue informs that the last leaf is not a real one but a painting on the wall of the opposite building that was made by Mr. Behrman, himself. Because of the use of five methods of characterization, her action, reactions, and speech describe that she is a dynamic character. She reveals the humanity of the character.

Johnsy *(The Last Leaf)*

Johnsy is a young artist from California. She is another main character in the story. She lives with Sue in a studio apartment in Greenwich Village. She has a dream to visit Italy to paint the Bay of Naples. She falls seriously ill with pneumonia and becomes convinced that she will die when the last leaf falls from the vine. The leaves fall day by day, however, the last leaf stays hanging on for several days. When Johnsy saw the last leaf on the wall, her will she live returned. Her life was saved because of the painted leaf.

Her speeches reveal her character a lot. According to her speech to Sue,

"Leaves. The leaves of that vine. When the last leaf of that vine falls, I must go too."

Johnsy has the superstitious belief that she will die when the last leaf falls. She is a bit of a pessimist and she could not think of anything except dying. Her roommate, Sue, constantly tries to support her when she talks about dying. As Sue wants to watch out for her beloved friend, she draws near Johnsy's bed. However, Johnsy is a bit of a selfish person and she never understands her friend's kindness and sorrowful feeling. Therefore, she said coldly to Sue,

"Can't you draw in your room?"

"I want to turn to lose my hold on everything, and go sailing down, just like one of those poor, tired leaves."

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Johnsy thinks the ivy leaf stands for her life. She used to love that old vine leaf so much. She has stopped fighting her illness and the pneumonia is slowly making her weaker day by day. She has decided that when the last leaf falls off the tree, she will fall along with it.

And then, the next speech of Johnsy shows that she has to make a conscious effort to live longer.

"I've been a bad girl, Sudie, something has made that last leaf stay there to show me how wicked I was. It is a sin to want to die."

After the violent storm and the heavy rain, one leaf is still hanging on the vine. When Johnsy sees the leaf remains in the vine tree, she feels hopeful enough to get well soon. The last leaf is a symbol of hope for Johnsy. When she sees the leaf on the tree, she will live and return, and her life is saved. Johnsy understands that her wish of dying is a sin. She also knows about old Mr. Behrman who had climbed up and painted a green leaf on the wall. That painting leaf has restored her hope and refreshed her desire. Finally, she realizes that her attitude has been unacceptable and she recovers from her illness and then, her intent in her painting receives. In this story, Johnsy is the one who learns a lesson and changes significantly. Her action, inner thoughts, and speech point out that she is a dynamic character in the story. She displays the humanity of the character.

Old Mr. Behrman *(The Last Leaf)*

Old Mr. Behrman is a painter. He lives on the first floor beneath the two young artists, Sue, and Johnsy. He is more than sixty years old. He is a failure in art. He always has the ambition of drawing an impressive work, however, he has never started to paint it. For four decades, he has painted nothing except commercial art or advertising work. He earns a little money by posing as a model for young artists who could not pay the price for regular models. He is an alcoholic and whenever he is drunk, he always talks about the great masterpiece he is going to paint. He is a fierce, intense little man who considered himself a protector of Sue and Johnsy whom he is very fond of. He is informed by Sue that Johnsy has a strange idea concerning the last leaf of the vine tree. He also knows that Sue feared that her friend would die when the last leaf fell. Hearing of that despair, Old Behrman becomes angry and shouted.

"Are there people in the world who are foolish enough to die simply because leaves fall from an old vine?"

"I have never heard of such a thing. Why do you permit such silly ideas to come into her mind? Oh, that poor little Miss Johnsy."

According to his speech, he is a short-tempered person. He did not accept Johnsy's strange idea that she will die when the last leaf of the vine falls. He thinks the leaves on the vine could have nothing to do with Johnsy's health. When he knows Johnsy's foolish idea, he scolds Sue because she permitted the frightening idea to come into Johnsy's mind. In this story, Behrman's character is significantly revealed by his action. His final act shows his devoted spirit to the two young artists. Mr. Behrman who always wants to paint a great masterpiece spends his latest time painting a realistic-looking leaf on the wall outside the window of Johnsy's bedroom. Behrman painted his ultimate masterpiece and saved the life of Johnsy. He is fond of Johnsy and he does not want her to die with the last leaf. Therefore, he offers his loving effort to help Johnsy regain her health. He sacrifices his life for Johnsy.

Mr. Behrman is a genuine friend with a pure soul and a golden heart. H can paint his supreme masterpiece to give Johnsy the will to live without expecting anything in return. The night the last leaf fell, he went into the icy night, climbed a ladder, and, painted a leaf on the wall. He worked all night in the air and snow. The next morning, Johnsy saw the leaf on the wall. She regained her will to live. Behrman's leaf saved the life of Johnsy. However, he caught pneumonia and he bathed his last in the hospital. He was for sick only two days. Mr. Behrman tricks her beloved neighbor by painting a leaf on the wall. He fulfilled the scriptural words:

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"Greater love hath no man than this, that a man lay down his life for his friends."

Mr. Behrman is an enormous asset to his society. Although he is a drunkard person, he has a pure soul to sacrifice his own life. He proves that outward appearances cannot determine one person's attitude. He undergoes significant change throughout the course of the story. His action and inner thought reveal that he is a dynamic character. His action demonstrates that he is quite human. He confirms the humanity of the character.

Conclusion

This research has attempted to analyze the characters in the selected short stories by O.Henry. These Selected short stories are based on humanity, love, and friendship. All the selected short stories have a surprise ending and the conclusions are very heart-touching because of the actions of the characters. O.Henry's characters reflect ordinary people's lives. In this study, the characters are analyzed using "Five methods of characterization" by Warner (2015). It is found that the humanity of the characters is vividly presented in the short stories. Because of the unexpected actions of the characters, O.Henry's short stories still capture the hearts of readers from generation to generation. In this research, all the seven characters reveal their humanity of the characters. In the story, *"A Service of Live"*, Delia is a loyal caring wife, and sacrifices her artistic ambition for her husband. And Joe is a dutiful husband and he always watches out for his wife's feeling and facial expression. In the story, *"After Twenty Years"*, Bob is a loyal friend for his childhood friend. Jimmy encounters the lose-lose situation between the loyalty of friendship and the loyalty of military service. In the short story, *"The Last Leaf"*, Sue is an adorable lass and a deeply devoted friend. Johnsy is superstitious and she gives up her hope. However, she overcomes her strange belief. Old Mr. Behrman sacrificed his own life. He has an amazing quality of helping others without the consideration of himself. His action illustrates the ode to the humanity. All the characters point out that the root of human society is the field of the humanity. The characters in O.Henry's short stories give the message to the readers in order to cultivate virtuous behavior such as kindness, self-sacrifice for love and friendship, and helping others without asking for rewards. It is hoped that this research will help learners of English how to analyze the characters of the short story.

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Perceptions of University Educators on Teacher Leadership in Universities

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Abstract

Teacher leadership is the attitude of teachers who constantly strive to improve their knowledge and skills continuously. The objectives of the research were to explore the perceptions of university educators on teacher leadership in universities and to find out how they can support university development programs. The quantitative research method was used, and the data were collected through the questionnaire survey. According to the findings, most teachers have the personal skills of teacher leaders, and they can support university development programs. As university development does not depend on administrators only, this paper may help administrators motivate teacher leaders in implementing university development programs.

Keywords: teacher leaders, teacher leadership, university development program

Introduction

We have seen that there are teachers with a vision that extends their classroom roles. They have the desire to give more to their university besides teaching and their normal responsibilities as teachers. They often find innovative ways to exercise their leadership skills. Teachers are often recognized for their leadership skills as effective instructors in their classrooms and at their universities. These teachers who are recognized as leaders are individuals who know their subject matter, curriculum, and classroom management. In addition, these individuals serve as role models for their peers in terms of professional qualities and behaviors. In addition, they demonstrate excellent instructional skills, have a clearly defined education philosophy, and believe in what it takes to be an effective teacher. Generally, teacher leaders are experienced teachers with good teaching skills. According to their colleagues, the leaders of the elementary university are professionals who accept work and responsibility and also support other teachers (Bryk & Gomez, 2010). Besides, they take part in mentoring, collaborating, and decision-making with others to create policies and improve the university's efficiency.

Boston Public Schools (BPS) is famous for teacher leadership, with teachers influencing curriculum, teaching and learning processes, professional development, and policy in their schools, the district, and beyond. In 2019, the Boston Public Schools (BPS) and Boston Teachers' Union (BTU) organized the Teacher Leadership Working Group (TLWG) which comprised teacher leaders, school administrators, and central office leaders. The group was intended for creating a teacher leadership strategy. After consulting literature from research and practice, as well as from their interviews and surveys, they created the definition of teacher leadership. According to BPS, teacher leadership is the formal and informal ways teachers leverage their varied expertise, diverse voices, and professional agency to promote innovation and collaboration that strengthens the capacity of BPS colleagues, school leadership, and the central office staff to impact adult learning and student outcomes. For teacher leaders, there are two fundamental roles: informal and formal. Formal teacher leaders act as instructional coaches or department chairs. On the contrary, informal teacher leaders emerge naturally from the ranks of teachers. They take the initiative of taking part in the university development programs instead of being selected. They have no author in a certain position, and their influence originates from the respect they get from commanding their colleagues through practice and expertise (Bryk & Gomez, 2010). Whether selected or not, effective teacher leaders possess significant skills, dispositions, and values.

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Involvement of Teachers Leaders

Teacher leaders' involvements take place across the university, within their teacher leader's team and department, or beyond the university (Muijs & Harris, 2006). Leading change within a team or department needs considerable interpersonal act or skill. At this level, leadership can take various forms with the aim of creating a university's better performance. The role of teacher leadership is related to the areas like schedules, student programs, grading policies, and educational reform.

Research Methodology

The present study is directed toward exploring the perceptions of university educators on teacher leadership in universities and finding out how they can support university development programs. A quantitative method was used. The instrument used in this study was a questionnaire. The questionnaire consisted of items to explore the perceptions of university educators on teacher leadership in universities. The questionnaire was distributed to teachers at selected universities. Before distributing the questionnaire, it was piloted by two teachers.

Table 1: ***Distribution of participants according to gender and teaching experiences (n=111)***

SN	Gender		Teaching experiences (Years)		Total
	Male	Female	1-15	16-30	
1	21 (%)	90 (%)	43 (%)	68 (%)	111 (100%)

Results

The importance of teacher leadership

Table 2: ***Participants' views on the importance of teacher leadership (n=111)***

SN	Theme	Responses					Calculation		Decision
		Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	M	SD	
1	To have effective university programs, teacher leaders need to get involved in policy-making as administrators cannot fully take part in the university improvement programs.	0%	0%	15%	35%	50%	4.35	0.73	Considered with extreme importance
2	A teacher leader group can be able to supply various professional knowledge required in university to improve policies.	0%	0%	11%	38%	51%	4.40	0.68	Considered with extreme importance
3	Involving the teacher leaders in university improvement programs is seen as appropriate as it offers more knowledge and expertise.	1%	13%	26%	33%	27%	3.72	1.03	Considered with high importance
Average		0%	4%	17%	35%	43%	4.16	0.88	Considered with high importance

NOTE

1.00-1.80=Not considered at all
1.81-2.60=Considered with low importance
2.61-3.40=Considered with moderate importance
3.41-4.20=Considered with high importance
4.21-5.00=Considered with extreme importance.

According to the results, most participants agree that involving the teacher leaders in university improvement programs is seen as appropriate as it offers more knowledge and expertise. Most administrators probably have specific instructional expertise areas. An

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administrator who was once a science teacher may be proficient in a science research-based instructional practice. He may not know well about the arts. On the contrary, individual teachers have their specific knowledge areas. Therefore, following these factors, it is clear that the university's improvement cannot depend on the administrators only (Farris-Berg & Edward, 2012).

Skills, Qualities, Dispositions, and Values Offered by Teacher Leaders

Table 3: *Skills and qualities offered by teacher leaders (n=111)*

SN	Skills and qualities	Responses					Calculation		Decision
		Not at all	Slightly	Moderately	Very	Extremely	M	SD	
1	I call other colleagues to action along with energizing them aiming for a successful implementation of the policy in learning and teaching	17%	25%	27%	20%	11%	2.83	1.24	Average
2	I involve mobilizing people's commitment to placing their energy into action	22%	26%	23%	19%	10%	2.69	1.28	Average
3	I involve individual commitment and collective mobilization	15%	20%	30%	25%	10%	2.95	1.20	Average
4	I have the ability of leaders to collaborate with my colleagues and others	6%	9%	17%	33%	35%	3.82	1.18	Above Average
5	I enlist colleagues who will support their policy vision, create consensus amongst the diverse educators' group and convince other people of their proposal and feasibility plan for the policy	31%	30%	21%	11%	7%	2.33	1.22	Below Average
6	I gain respect for my instructional skills.	11%	19%	24%	31%	15%	3.20	1.22	Average
7	I understand the information and evidence along with recognizing the need for focusing on the policy aspects that will result in significant gains for the students	23%	21%	20%	15%	21%	2.90	1.45	Average
Average		18%	21%	23%	22%	16%	2.96	1.33	Average

NOTE:
1.00-1.80=Very Poor
1.81-2.60=Below Average
2.61-3.40=Average
3.41-4.20=Above Average
4.21-5.00=Excellent

Table 4: Dispositions and values that make some individuals ideally appropriate for teacher leadership (n=111)

SN	Dispositions and values	Responses					Calculation		Decision
		Not at all	Slightly	Moderately	Very	Extremely	M	SD	
1	I am respectful and open-minded toward other people's views on the issue at hand.	6%	28%	27%	22%	17%	3.16	1.18	Average ability
2	I show enthusiasm and optimism, decisiveness, and confidence in others	5%	14%	30%	31%	20%	3.47	1.11	Slightly higher than average ability
3	I do not continue without checking a significant program I am following.	15%	19%	20%	22%	24%	3.21	1.39	Average ability
4	I am willing and flexible to consider a diverse approach if the first effort does not succeed	9%	18%	21%	22%	30%	3.46	1.32	Slightly higher than average ability
Average		9%	20%	25%	24%	23%	3.33	1.26	Average ability

NOTE:
1.00-1.80=Much lower than average ability
1.81-2.60=Slightly lower than average ability
2.61-3.40=Average ability
3.41-4.20=Slightly higher than average ability
4.21-5.00=Much higher than average ability.

Teacher leaders' characters are similar to good teachers' characters: expertise, flexibility, persuasiveness, confidence, and open-mindedness. According to the results, most of the participants believe that they have the ability of leaders to collaborate with their

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colleagues and others. This is one interesting thing to be noted. Regarding dispositions and values, it is found that half of the participants are respectful and open-minded toward other people's views, and they follow a systematic way of organizing their work.

Involvement of Teacher Leaders in three Key Areas

Table 5: ***Involvement of teacher leaders in three key areas (n=111)***

SN	Theme		Responses					Calculation		Decision
			Never	Seldom	Sometimes	Often	Always	M	SD	
1	Within the team or department	I coordinate the policy program by inviting other colleagues to examine the reasons for the need for the new policy to improve student performance.	30%	27%	26%	10%	7%	2.37	1.21	Slightly
		I organize the closest colleagues' efforts to enhance the university's policy program to benefit the students.	20%	25%	27%	22%	6%	2.69	1.19	Moderately
		Average	**25%**	**26%**	**27%**	**16%**	**7%**	**2.53**	**1.21**	**Slightly**
2	Across the University	I take part in exploring alternate grading approaches by studying the students' reactions toward the assignments they give them in class.	15%	18%	24%	23%	20%	3.15	1.34	Moderately
		I form systematic discussions with the students and make recommendations to the rest of the faculty towards a different grading system that can include student self-assessment and formative assessment.	18%	20%	22%	30%	10%	2.94	1.27	Moderately
		Average	**17%**	**19%**	**23%**	**27%**	**15%**	**3.05**	**1.31**	**Moderately**
3	Beyond the University	I make presentations at national or state conferences, speak at university board meetings or serve on the state standards board as the teacher's voice in the community to communicate the planned policy.	35%	33%	21%	6%	5%	2.13	1.11	Slightly
		I do more than teach and influence a larger education environment based on the university policies in their community and also the state.	37%	31%	20%	6%	6%	2.13	1.15	Slightly
		Average	**36%**	**32%**	**21%**	**6%**	**6%**	**2.13**	**1.13**	**Slightly**

NOTE:
1.00-1.80=Not at all
1.81-2.60=Slightly
2.61-3.40=Moderately
3.41-4.20=Very
4.21-5.00=Extremely.

According to the results, although most of the participants believe that they have the ability of leaders to collaborate with their colleagues and others, they cannot fully take part in conducting their department or university's better development. As perceptions affect

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behavior, university administrators need to introduce the idea of teacher leadership to teachers, and motivate and honor teacher leaders for university development. School administrators need to create a culture that will honor teachers that can take leadership roles and step outside the traditional roles (City, Richard, Fiarman & Teitel, 2009).

Conclusion

Teacher leaders play a vital role in creating a high-performing university and educational reform. University administrators tend to have a lot of duties and responsibilities. Teacher leaders are the only ones that may help to create programs that will improve university performance. To encourage teacher leadership, administrators must value and respect the role and work of teacher leaders; embrace change, and allow data-driven, research-based risk-taking; provide affirmation for teachers' leadership tasks; promote and facilitate collaboration; provide technical support for teacher leaders; empower teachers in their leadership tasks; involve faculty in decision making. Regarding teacher leadership, professor David Frost's non-positional teacher leadership and his international teacher leadership project are popular. Quality education entails issues such as appropriate skills development, gender equality, and the provision of relevant school infrastructure, equipment, educational materials, and resources. For quality education, teachers need to possess non-positional teacher leadership skills and empower each other through mutual inspiration, moral support, and knowledge sharing.

Acknowledgements

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Gender Representation in Grade 2 EFL Textbook in Myanmar

Kyaw Sein[1], Manoe Kumar[2] and Khin Khin Aye[3]

Abstract

In recent years, there has been an enormous increase in the number of researches done on gender representation in EFL textbooks. This paper investigates the representation of gender in Grade 2 EFL Textbook published in April, 2018 by the Ministry of Education, Myanmar. The aim of this study is gender representation in Grade 2 EFL Textbook in Myanmar. The textbook is analyzed based on the theory of Connell (1987). The methods chosen for this study were content analysis and the calculation of the relative frequency of occurrence of male and female character, their firstness and nouns and pronouns that represent the genders. The Grade 2 EFL Textbook is selected as material in this study intentionally due to its newness in Education Reform in Myanmar. The result reveals that the selected textbook depicts more female characters than male in overall representation. The book reflects the most up-to-date and current situation of our society that women are getting much more attention and they are equally respected and recognized as men in our society. It is learned that women are equally important as men in every aspect in our society. Therefore, the Grade 2 EFL textbook is the up-to-date prescribed textbook aimed at young learners to make them know the basic social behavior like gender equality. Further studies can examine other aspects of gender representation and cover wider range of EFL Textbooks used in primary, secondary and high school levels in Myanmar.

Keywords: Gender Representation, Grade 2 EFL Text book, Myanmar

Introduction

Gender is one of the most interesting and popular topics in this 21st century. It is said that gender is a social cultural phenomenon that divides people into various categories such as male and female with having associated dress, roles, stereotypes, etc.

The growth of multilingualism in Myanmar represents the unraveling of a key component of modern identity. Today, English is the first choice of foreign language education in most countries of the world. In Myanmar, English is categorized as a "core subject", meaning that every pupil must be educated in English and must demonstrate a certain standard to be able to get marks and degree in order to be qualified for higher education. This situation makes English an essential part of Myanmar education system.

When comparing teaching language with building a house, the text represents as material. It can be dangerous to use bad materials for building because there is always the chance that the house might collapse. The same thing or logic can be applied to English textbook. Therefore, teaching materials presented in textbooks are one of the mostly influential "gender agents". Gender representation in teaching materials reflects the attitude of a particular society towards gender that is subconsciously acquired by learners and may cause long term drawbacks on their performances and social behavior.

The atmosphere and way of thinking in the classroom is often a reflection of what goes on in the world outside. Therefore, it is important to bring issues of gender biases to the surface in the classroom. Textbooks are often a major part of the English language classroom as a foreign language (EFL) and are supposed to reflect the most common and prevailing features of gender representation in a society.

Therefore, it is found interesting and instructive to study gender representation in textbooks as they tend to influence the learners' way of thinking about society and gender through the means of language learning. This study focuses on how genders; male and female are represented in the current Grade-2 EFL Textbook in Myanmar in the male proportion to female on several aspects of imbalance such as visibility, firstness, and nouns and pronouns according to the theory of Connell (1987).

Quantitative approach is used for the analysis of the words under the investigation. The content analysis method is employed in this study. Grade 2 EFL Textbook published by

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the Ministry of Education of Myanmar is subjected to analysis. This textbook is chosen intentionally because it is a new recent syllabus publication in April, 2018 and therefore, it can provide an up-to-date data with regard to gender representation.

A large number of studies have been done about gender in language and textbooks are often a major part of the English language classroom and are supposed to aid the learners' learning.

This study aims at examining the representation of gender and gender roles in an EFL textbook. Specifically, it examines whether there is balance in the representation of gender in the Grade-2 EFL Textbook published in April, 2018 by the Ministry of Education of Myanmar which serves as the EFL syllabus in the primary public schools in Myanmar. And, to analyze Grade-2 EFL Textbook, the theory of Connell (1987) is applied in this study. The analysis of the textbook with regard to gender representation in EFL textbook is one of the newest and widely examined issues. And, it is believed that the result of this study will contribute to the development of gender-awareness of the teaching process participants and reflect the development of society towards equality between men and women. To achieve the aim of this research, the following objectives are set to be observed:

- To discover the occurrence of male and female characters in texts.
- To find out the way of gender representation in firstness.
- To illustrate the distinctive imbalance through the comparison on the ratio of nouns and pronouns that represent male and female.

Literature Review

In this section, a brief theoretical background of Connell (1987) on gender representation is demonstrated first with the support of relevant examples. And, the information of the textbook selected to be analyzed in this study is mentioned next.

Theoretical Background

According to Connell (1987), Gender is the socially constructed difference between men and women. There are different ideals of men and women: bodily difference and social effects are often linked through the idea of character dichotomy. It has been said that there are two gender roles; a male and female. The term "Gender" is provided on several aspects of imbalance in English textbooks and they are

1. Visibility
2. Firstness
3. Nouns and Pronouns.

Visibility

Visibility refers to the relative numbers of male characters and female characters appearing in textbooks and is perhaps the easiest aspect of gender balance to examine.

E.g. Mr. Paul, Mr. Smith and Ms. Jessica are the lecturers at Chulalongkorn University. In this sentence, it is found that males are outnumbering female by a ratio of 3 to 1. (Porreca, 1984)

Firstness

Firstness refers to the linguistic feature in the case of mentioning two genders together one gender is often said first.

E.g. Rahul and Megan are students of Bangalore University.
In this sentence, male "Rahul" is mentioned first and is followed by female "Megan". (Eckert and Ginet, 2004)

Nouns and Pronouns

Nouns and pronouns used to describe men and women can also yield evidence of gender imbalance.

E.g. The boy is a manager at Western Bank. He has his mother with him and he respects her so much. The noun "the boy" and pronoun "he" represents male and the noun "mother" represents female. (Porecca, 1984)

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The Textbook

Textbooks of foreign languages provide two aspects: systematic knowledge and schematic knowledge. Systematic knowledge is made up of the properties of language, i.e syntax and semantics. Schematic knowledge is acquired knowledge about the social environment of the target language. In other words, learners not only get acquainted with the target language but currently learn aspects of the cultural environment and the way the language learners view the world. Therefore, the English Textbook analyzed in this study is Grade-2 EFL Textbook in Myanmar published in April, 2018 by the Ministry of Education, Myanmar. This book serves as a syllabus for Grade-2 students in primary schools, Myanmar. This book comprises eight units; each having six lessons as sub-divisions. The skills of English Language; Listening Skill, Speaking Skill, Reading Skill and Writing Skill are all included and it really serves as a course material for the curriculum. Each unit in this book is structured in the same way, beginning with the listening and speaking sections and then followed by reading and writing sections which provide the students the sound method of learning a foreign language. A glossary at the back of the book provides clarification of vocabulary items and expressions which may be new to the learners. In this study, each of the eight units of Grade 2 EFL Textbook are examined for the representation of men and women according to their visibility, firstness and nouns and pronouns.

Research Methodology

The English language textbook analyzed in this study is Grade-2 EFL Textbook published in April, 2018 by the Ministry of Education, Myanmar. The textbook has been especially written for Grade-2 primary school students. The textbook is selected purposively due to its newness. Our country, Myanmar is having Basic Education Reform in recent years, publishing new books for certain classes. And, Grade 2 EFL Textbook is the up-to-date syllabus assigned to teach students in Myanmar and it is believed that it reflects the most current cultural perspectives in the scope of gender representation. The EFL is chosen for content and visual analyses. A systematic recording and tabulation are made of the characters and mentions of men and women in the written texts. This study has been carried out with the steps followed by the theory of Connell (1987). The textbook was selected and examined in depth to get the data required for the sound analysis. After being observed, the textbook is analyzed into different divisions, such as visual male and female characters, their firstness, and nouns and pronouns which represent the genders. To analyze the visibility, only proper nouns representing specific persons are collected and tabulated. In nouns and pronouns section, only nouns representing male and female, regardless of the names are considered and only subject pronouns of the gender words are analyzed.

Data Collection

The following table shows the frequency of words supposed to represent male and female on the various categories; visibility, firstness and nouns and pronouns according to the theory of Connell (1987).

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Table 1: Genders Used in the Texts of Grade-2 EFL Textbook

No of unit	Page No.	Sentences	Gender	No of gender	Visibility		Firstness		Nouns and Pronouns	
					Male	Female	Male	Female	Male	Female
1.	1.	Hello, I'm Daw Malar.	Daw Malar	✓		✓				
	2.	Hello, I'm Zaw Zaw.	Zaw Zaw	✓	✓					
	3.	He's Zaw Zaw.	Zaw Zaw	✓	✓					
	4.	Hello, I'm Nyi Nyi.	Nyi Nyi	✓	✓					
	5.	Hello, I'm Thidar.	Thidar	✓		✓				
	6.	She's Thidar.	She	✓						✓
			Thidar	✓		✓				
	7.	Hello, I'm Su Su.	Su Su	✓		✓				
	8.	Hello, I'm Aye Aye.	Aye Aye	✓		✓				
	9.	She's Aye Aye.	Aye Aye	✓		✓				
	10.	Hello, I'm Thandar. What's your name?	Thandar	✓		✓				
	11.	Hello, I'm Bo Bo.	Bo Bo	✓	✓					
	12.	He's Bo Bo.	Bo Bo	✓	✓					
	13.	This is Kyi Kyi. She's great.	Kyi Kyi	✓		✓				
			She	✓						✓
	14	I'm Kyi Kyi.	Kyi Kyi	✓		✓				
1	15.	This is Tun Tun. He's happy.	Tun Tun	✓	✓					
			He	✓					✓	
	16.	I'm Tun Tun.	Tun Tun	✓	✓					
	17.	This is Nyi Nyi. He's hungry.	Nyi Nyi	✓	✓					
			He	✓					✓	
2	18.	He has short hair.	He	✓					✓	
	19.	She has long hair.	She	✓						✓
	20.	She has brown eyes.	She	✓						✓
	21.	He has dark eyes.	He	✓					✓	
	22.	She has short hair.	She	✓						✓
	23.	He has short hair.	He	✓					✓	
3	24.	She has short hair.	She	✓						✓
	25.	His name is Aung Htet. He has short hair.	Aung Htet	✓	✓					
			He	✓					✓	

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	26.	Her name is Nandar. She has long hair.	Nandar	✓		✓				
			She	✓						✓
6	27.	Hello, I'm San San. I have three friends.	San San	✓		✓				
	28.	They are Ni Ni, Toe Toe and Moe Moe.	Ni Ni,	✓		✓		✓		
			Toe Toe	✓	v					
			Moe Moe	✓		✓				
	29.	This is Ni Ni.	Ni Ni	✓		✓				
6	30.	She's wearing a pink scarf and a white blouse.	She	✓						✓
	31.	She is wearing a blue skirt and green sandals.	She	✓						✓
	32.	This is Toe Toe.	Toe Toe	✓	✓					
	33.	He's wearing a black cap and a yellow T-shirt.	He	✓					✓	
	34.	He is wearing yellow socks and brown shoes.	He	✓					✓	
	35.	This is Moe Moe.	Moe Moe	✓						✓
	36.	She is wearing a yellow raincoat and a red T-shirt.	She	✓						✓
	37.	She's wearing brown trousers and red boots.	She	✓						✓
Total				45	11	14	-	1	8	12

Table 1 above reveals the total usage of gender words in the Grade-2 EFL Textbook. The total gender words are 45 and it shows the frequency of gender words that represent male and female on the various categories; visibility, firstness and nouns and pronouns according to the theory of Connell (1987). In the category, is it seen that 11 words for male characters and 14 words for female characters are used in the total of 25 words. In firstness section, female is supposed to be superior 100% because there is only one pair of two female proper names and one male proper name in the same sentence. And, 8 words for male and 12 words for female are resulted in the nouns and pronouns category.

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Data Analysis

Table 2: Gender Words Used in Terms of Percentage

No.	Category	Both Genders	Male		Female	
			Appearing	Percentage (%)	Appearing	Percentage (%)
1.	Visibility	25	11	44	14	56
2.	Firstness	1	-	0	1	100
3.	Nouns and Pronouns	20	8	40	12	60

As can be seen by the results tabulated in Table 2 above, there is a significant gender imbalance in overall gender ratio on the categories; visibility, firstness and nouns and pronouns. In visibility, it is revealed that 11 (44%) of male characters and 14 (56%) of the female characters are used in the Grade-2 EFL Textbook. In firstness section, because there is only one pair of two female proper names and one male proper name in the same sentence, female is supposed to be 100% superior. The quantitative number 8 (40%) out of 20 (100%) are used and 12 (60%) out of 20 (100%) are applied in the chosen textbook.

Data Interpretation

The following figure shows gender representation in Grade-2 EFL Textbook in Myanmar.

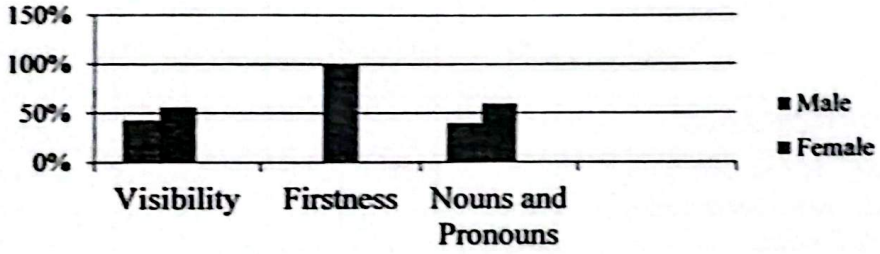


Figure 1 Overall Gender Ratio used in the Textbook.

This bar graph shows the overall percentage of gender representation on three categories: visibility, firstness and nouns and pronouns used in Grade-2 EFL Textbook in Myanmar.

Findings and Discussion

This study aimed at investigating the gender representation in Grade-2 EFL Textbook used in Myanmar by the use of the theory of Connell (1987) has resulted the following findings. Overall, it is found that women are frequently portrayed in all three categories; visibility, firstness and nouns and pronouns. In the area of visibility, there is a significant gender imbalance in Grade-2 EFL Textbook in terms of the number of male and female characters featured. The difference in proportion is vivid: 44% of the characters are male and 56 % of the characters are female. Therefore, it is clear that there are a full of 14% more female characters than male characters. In firstness section, because there is only one pair of two female proper names and one male proper name in the same sentence, female is supposed to be 100% superior. In the nouns and pronouns domain, there is a distinct difference in proportion: only 40% of the words represent male while 60% of the words are supposed to represent female, revealing that females had a higher prominence in terms of frequency. The impression given by these results is that women are also getting attention in the textbook in these days of our society and the detail description of gender appearance can help the learners understand gender equality and the gender representation.

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The result of this study has contributed a better impact on womanhood. Traditionally, Myanmar has always been a patriarchal society where women are dominated and controlled by male members of our society as revealed in many books and by history. But, the result of this study has given a new contribution that Myanmar, as a country striving towards a developed nation, gender equality is highly considered. This result really reflects the current situation of our society in Myanmar that women are given much more opportunities than in past. It is presumed that women of today's are given platform to foray into the fields that they want to and forge ahead; be it entrepreneurship, be at the Armed Forces and to voice their choices and opinions to make them independent today.

As it is already mentioned earlier that textbooks play one of the most important roles in the EFL classroom, EFL textbooks are the core material for the courses that have a great impact on students' behavior outside the classroom, and it present the present cultural and social background of the society. This study on the Grade-2 EFL Textbook has demonstrated that women are getting much more attention and they are in the eyes of our society. This study also reflects the current habit and concept of our people that we, Myanmar have the habit of uplifting those who are down-shored because females have been underrepresented and trivialized in relation to males for years. Therefore, this study on gender representation has confirmed that females are more visible than males in texts in the Grade-2 EFL Textbook by applying the theory of Connell (1987). This research has been done only on visibility of proper names that represent males and females on texts, their firstness and nouns and subject pronouns only on Grade-2 EFL Textbook. It is suggested that oceans of researches can be done by this theory about gender representation on visual images and illustrations that represent gender in various EFL Textbooks of primary, secondary and high school levels used in Myanmar.

Conclusion

This research reveals the gender representation in Grade-2 EFL Textbook used in Myanmar. The theory of Connell (1987) is applied in this research. The main purpose of this study was to access how male and female are represented in the selected textbook used in Myanmar Primary Schools. Therefore, a quantitative content analysis was carried out on three categories; visibility, firstness and nouns and pronouns. In firstness section, 44% of male characters and 56% of female characters are found to be used. In firstness, female character dominants 100% because only one sentence of proper names pair is found in the textbook. And, in nouns and pronouns section, it is found that 40% of the gender words represent male and 60% of the words represent female. The study made in this field of gender representation in Grade-2 EFL Textbook revealed that the proportion of female is higher than the proportion of male in overall representation. This textbook really reflects the current situation of our society that women are much more welcome in our society. They are given equal opportunity for what they are capable of which was rarely seen in previous years. The result carried out on the selected textbook showed that children are supposed to learn social behavior like gender awareness and gender equality at young ages. This study has demonstrated that Grade-2 EFL Textbook is supposed to give the learners new thoughts and new perspective on gender equality; showing women are equally important as men and they need to be respected and uplifted.

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First of all, a thankful word that stands diminished before the grace of Dr. Aung Win, rector of Myitkyina University, and Dr. Aye Aye Thant and Dr. Zin Mar Latt, pro-rectors of Myitkyina University for giving us the opportunity to conduct this research paper. And, we would like to express our most sincere thanks and humble gratitude to Dr. Yaung Chi Oo, Professor and Head of English Department, University of Myitkyina for his guidance, suggestions and encouragement. In addition, we would like to acknowledge our colleagues from the Department of English, University of Myitkyina for their support and motivation.

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Spatial Distribution of Fire Stations in Myitkyina

Aye Aye Moe[1], Thida Aye[2], War War Win[3], Naing Naing Htay[4]

Abstract

This research attempts to analyze the spatial distribution of fire stations in Myitkyina. The aim of this research is to evaluate whether the number of fire station is sufficient for the protection of the outbreaks of fire or not in the wards of Myitkyina. The spatial distribution of fire stations is analyzed by using Multiple Ring Buffers with the aid of a Geographic Information System (GIS). It is found that the housing types and human carelessness are important for fire prevention in the study area. In Myitkyina, Sitapru, Lekone, and Tatkone Wards are danger zones for fire risks because of the large number of houses, unsystematic road system, and inflammable materials. To avoid fire outbreaks, systematic utilization of land is essential in Myitkyina.

Keywords: fire station, outbreak, danger

Introduction

Myitkyina lies in the northern portion of Myanmar Naing Ngan. In Myitkyina the physical factors concerning high temperature and precipitation can cause. The social factors such as population and human's carelessness can cause fire. Fire outbreak has occurred in the pre-monsoon and post-monsoon period. The months of March, May and October are the most hazardous. This paper is a piece of research on the danger of fire to analyze the spatial distribution of fire stations and to evaluate their efficacy regarding the number of houses and residents.

Aim and Objectives

The aim of this research is to evaluate whether the number of fire stations are sufficient for the protection of the outbreaks of fire or not enough for wards. The objectives of this research are:

- to present the spatial distribution of buildings in the study area;
- to describe the spatial distribution of fire stations in the study area;
- to explore the availability of water within the study area; and
- to analyze the relationship between fire stations and buildings in the study area.

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Data Collection and Methodology

In this research, the necessary data and materials are collected by field survey. The secondary data and the necessary maps are collected from the official concern. To examine the spatial distribution of fire stations Multi Ring Buffer method, statistical methods and graphical methods are used. Geographical interpretations of the results have been done with the help of the maps.

The Study Area

Myitkyina is the capital city of Kachin State in Myanmar. It is located between North Latitudes 25° 20' 9"and 25° 27' 25" and East Longitudes 97° 23' 49" and 97° 25' 34". It is composed of 28 wards with an area of 25,900 acres or 40.47 square miles, spreading on the west bank of the Ayeyarwady (Figure 1 and 2). The Ayeyarwady bounds the town in the east and the south. On the west of Myitkyina, Namkoi creek flows through the western part in a north-south direction. The hottest month was April with 104°F and the coldest month was January with 48.84°F. The annual rainfall has 94.93 inches. According to Koppen's classification, Myitkyina has a generally humid subtropical climate (Cwa).

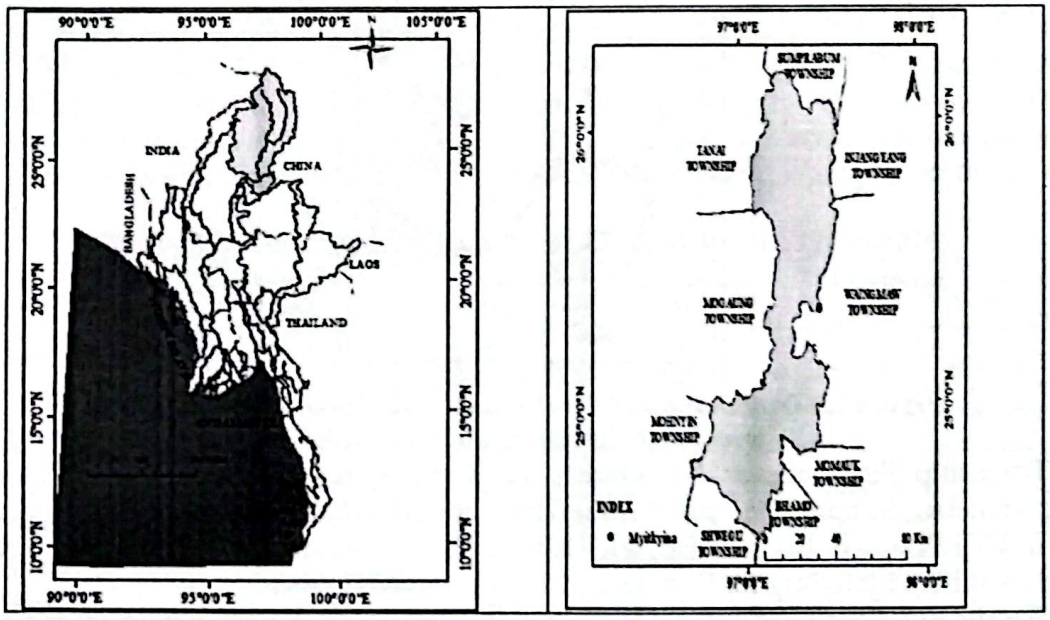


Figure (1) Location of Myitkyina
Source: UTM Map No.2597_07.

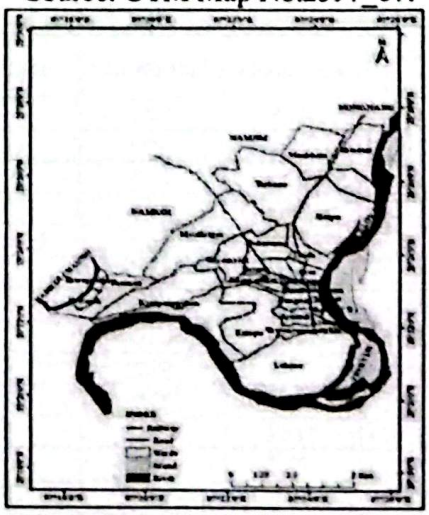


Figure (2) Wards of Myitkyina
Source: UTM Map No.2597_07.

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According to 2019 data, total population of Myitkyina is 190,870 persons and the largest population is found in Rampu Ward with 18,846 people and the smallest population is found in Shweait Ward with 1,209 people. Tatkone is the largest ward with 4.42 square miles of area whereas Minyat Ward is the smallest ward with 0.07 square miles.

Distribution of Fire Stations in Myitkyina

A natural disaster of fire outbreaks can cause losses of human lives, and property. The danger of fire breaking out is not predictable and for that reason, prevention of losses can be done effectively. In order to solve the problem of fire hazard, the Township Fire Department was established. Moreover, there is one fire station in Myoma Ward and 1 each reserve fire station in Sitapru, Rampu, Kyungpintha and Myothitkyi Wards (Figure 3).

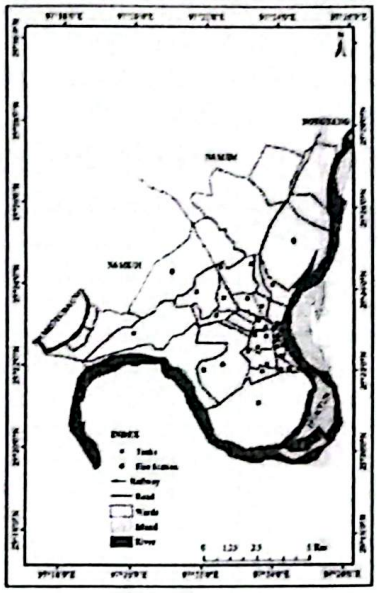


Figure (3) Distribution of Fire Stations and Tanks in Myitkyina
Source: Fire Brigade Department, Myitkyina.

Township Fire Brigade Department has 8 extinguishing vehicles, and 3 water-carrying vehicles. Sitapru, Rampu, Kyungpintha, and Myothitkyi have water-carry vehicles each. The Man Power of the Fire Brigade Department is composed of permanent firemen and reserved members including 50 firemen and 1504 reserved firemen.

For the availability of water for fire extinguishing vehicles, there is one tug, two fire boats, two overhead tanks and 27 tanks in Myitkyina (Table 1).

Table (1) Distribution of Extinguishing Tug and Tanks in Myitkyina

No	Wards	Area (Sq.m)	Buildings	Household	Tug	Tanks	Fire Stations	No. of Car
1	Ayer	0.49	415	727		1		
2	Kachinsu	0.16	229	259				
3	Shansu (N)	0.10	196	201		2		
4	Shansu (S)	0.11	130	144		1		
5	Myoma	0.10	139	163	1	4	1	11
6	Minyat	0.07	87	115		2		
7	Myothit	0.09	321	316		2		
8	Thida	0.38	310	619		1		
9	Dukataung	0.55	920	952		2		
10	Shwenyaungpin	0.32	1328	720		1		
11	Khemarthiri	0.33	1142	1345		1		
12	Yuzana	0.31	722	756		1		
13	Myemyint	0.25	801	787		1		
14	Yangyiaung	0.24	631	713		1		
15	Kyungpintha	0.25	730	715		1	1	1

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16	Ayesedi	0.20	679	688		2		
17	Aungnan	0.23	754	1176		3		
18	Sitapru	2.46	1949	1913			1	1
19	Myothitkyi	2.44	2347	2164			1	1
20	Rampu	2.34	4045	4192		1	1	1
21	Lekone	3.93	2930	3157		1		
22	Mankhein	3.84	1450	1532				
23	Tatkone	7.42	3655	3787				
24	Shwesat	2.52	1102	1215				
25	Kyetpaungchan	3.07	485	569		1		
26	Panmati	7.09	1656	1732				
27	Shweaik	0.58	238	350				
28	Shwepyitha	0.68	302	197				
	Total	40.47	29693	31204	1	29	5	15

Source: Immigration and National Department and Fire Brigade Department, Myitkyina.

According to 2015 data, there were 14 fire outbreaks with a total loss of about 32,389,000 kyats worth in Myitkyina. The number of fires and the losses vary with the type of fire outbreaks and localities. During 2015, the largest loss of property by fire was in Aungnan Ward with 5,770,000 kyats worth of property which was followed by the loss of 2,151,500 kyats worth in Lekone Ward. The smallest property loss by fire was recorded in Yangyiaung Ward with only 1,500 kyats worth. During 2015, the spatial variation of fire outbreaks was 3 in Lekone Ward, 2 each in Rampu and Panmati Wards, 1 each in Shansu (S), Yangyiaung, Ayesedi, Aungnan, Sitapru, Mankhein and Tatkone Wards respectively. (Table 2)

Table (2) Distribution of Fire Outbreaks in Myitkyina (2015-2019)

No	Wards	Fire Outbreak 2015	Fire Outbreak 2016	Fire Outbreak 2017	Fire Outbreak 2018	Fire Outbreak 2019
1	Ayer		1	1		2
2	Kachinsu		1			
3	Shansu (N)					
4	Shansu (S)	1	1			1
5	Myoma			1		
6	Minyat					1
7	Myothit		1	1	8	
8	Thida		1	1	1	
9	Dukataung					
10	Shwenyaungpin					
11	Khemarthiri		1	2		
12	Yuzana		3	1	2	
13	Myemyint			1	4	
14	Yangyiaung	1				
15	Kyungpintha		1		1	
16	Ayesedi	1			1	2
17	Aungnan	1	2	2	2	2
18	Sitapru	1		3	2	5
19	Myothitkyi		1	1		
20	Rampu	2	3	4	1	2
21	Lekone	3	2	5	2	2
22	Mankhein	1	1		1	
23	Tatkone	1	3	3	7	6

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24	Shwesat		1	1		1
25	Kyetpaungchan					2
26	Panmati	2		2	3	
27	Shweaik					
28	Shwepyitha					
	Total	14	23	29	35	26

Source: Fire Brigade Department, Myitkyina.

According to 2016 data, there were 23 fire outbreaks with a total loss of about 16,376,000 kyats worth in Myitkyina. During 2016, the largest loss of property by fire was in Rampu Ward with 4,855,000 kyats of property which was followed by the loss of 2,300,000 kyats worth of property in Tatkone Ward. The smallest property loss by fire was recorded in Kyungpintha Ward with only 3,000 kyats worth. During 2016, the spatial variation of fire outbreaks was 3 each in Yuzana, Rampu, and Tatkone Wards, 2 each in Aungnan and Lekone Wards, 1 each in Ayer, Kachinsu, Shansu (S), Myothit, Thida, Khemarthiri, Kyungpintha, Myothitkyi, Mankhein, and Shwesat Wards respectively.

According to 2017 data, there were total, of 29 fire outbreaks with a total loss of about 50,836,000 kyats of property in Myitkyina. During 2017, the largest loss of property by fire was in Lekone Ward with 10,365,000 kyats worth which was followed by the loss of 9,900,000 kyats worth in Rampu Ward. The smallest property loss by fire was recorded in Myoma Ward with only 15,000 kyats worth. During 2017, the spatial variation of fire outbreaks were 5 in Lekone Ward, 4 in Rampu Ward, 3 each in Sitapru and Tatkone Wards, 2 each in Khemarthiri, Aungnan, and Panmati Wards, 1 each in Ayer, Myoma, Myothit, Thida, Yuzana, Myemyint, Myothitkyi, and Shwesat Wards respectively.

According to 2018 data, there were a total 35 of fire outbreaks with a total loss of about 42,570,000 kyats worth in Myitkyina. During 2018, the largest loss of property by fire was in Lekone Ward with 9,235,000 kyats worth which was followed by the loss of 4,780,000 kyats worth of property in Yuzana Ward. The smallest property loss by fire was recorded in Myemyint and Myothit Wards with 50,000 kyats worth. During 2018, the spatial variation of fire outbreaks was 8 in Myothit Ward, 7 in Tatkone Ward, 4 in Myemyint Ward, 3 in Panmati Ward, 2 each in Yuzana, Aungnan, Sitapru, and Lekone Wards, 1 each in Thida, Kyungpintha, Ayesedi, Rampu, and Mankhein Wards respectively.

According to 2019 data, there were 26 fire outbreaks with a total loss of about 42,133,000 kyats worth of property in Myitkyina. The number of fires and the losses vary with the type of fire outbreaks and localities. During 2019, the largest loss of property by fire was in Lekone Ward with 12,100,000 kyats worth which was followed by the loss of 8,745,000 kyats worth of property in Aungnan Ward. The smallest property loss by fire was recorded in Shansu (S) Ward with only 5,000 kyats worth. During 2019, the spatial variation of fire outbreaks was 6 in Tatkone Ward, 5 in Sitapru Ward, 2 each in Ayer, Ayesedi, Aungnan, Rampu, Lekone, and Kyetpaungchan Wards, 1each in Shansu (S), Minyat and Shwesat Wards respectively. The causes of the fire were found to be the carelessness of people, electric shortcomings and forest fires. That is why the prevention of fire outbreaks plays an important role for the people in the study area. As fire can cause the loss of public and private property, and the lives of the people, it is necessary to prevent the occurrence of fire.

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Spatial Analysis of Fire Stations and Fire Outbreaks

The Township Fire Brigade Department and field data show that Myitkyina suffered 24 fire outbreaks every year between 2015 and 2019 (Table 3). According to table 3 and figure 4, the average fire outbreak is found to have maximum occurrence in the months of March, May and October. According to 2015-2019 data, the average maximum loss of property was in February, March and May in Myitkyina (Figure 4).

Table (3) Fire Outbreaks occurred in Myitkyina (2015-2019)

Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2015	2	1	4	2			1	1		3		0	14
2016	1	1	5	2	4			3		4	3	1	24
2017	2	1	4	3	6	3	2		2	1	2	2	28
2018	2	3	4	3	3	2	1	3	2	3	1	1	28
2019	5	4	3	2	2	1		1		5	2	1	26
Avg	2	2	4	2	4	2	1	2	2	3	2	1	24

Source: Fire Brigade Department, Myitkyina.

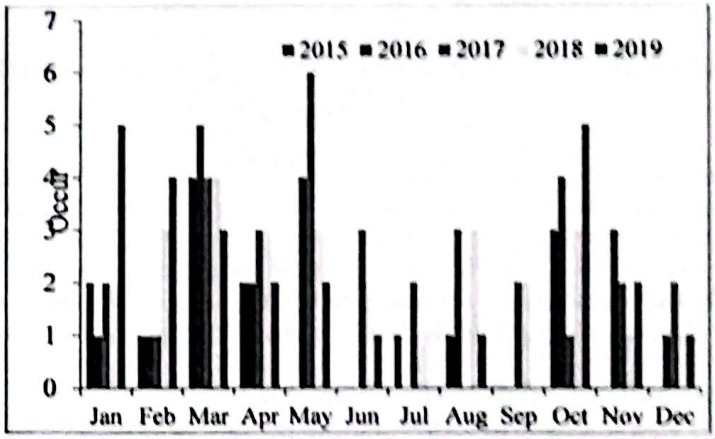


Figure (4) Distribution of Monthly Fire Outbreaks in Myitkyina (2015-2019)

Source: Based on Table 3.

According to Table 1 and figure 5, there were outbreak of fire in Tatkone, Sitapru, Aungnan, Rampu and Lekone Wards in the study year of (2015-2019). Tatkone Ward has 7.42 square miles, 3,665 buildings and a population of 17,944. Sitapru Ward has one industrial zone, 2.46 square miles, 1,949 buildings, and a population of 15,289. Aungnan Ward has 0.23 square miles, 579 buildings and a population of 5,770. Rampu Ward has 2.34 square miles, 4,045 buildings and a population of 18,846. Lekone Ward has 3.93 square miles, 2,930 buildings and a population of 17,944.

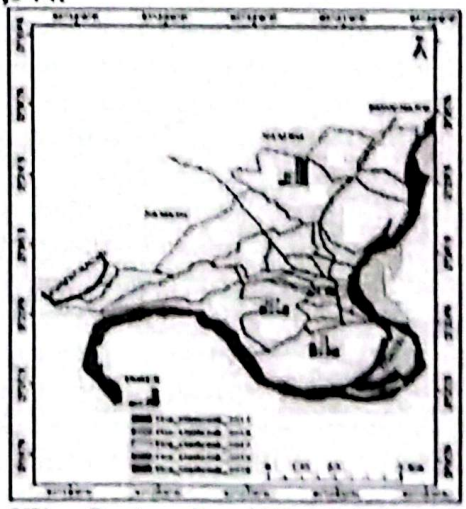


Figure (5) Distribution of Fire Outbreaks of Wards in Myitkyina (2015-2019)

Source: Based on Table 2.

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Management for the control and prevention of fire depends on the existence of fire stations, availability of water and the capability of the Fire Brigade Department. Therefore, spatial distribution of fire stations has been studied to examine the effectiveness of fire preventive measures. The study is carried out with Multi Ring Buffer methods. First of all the mean center for the location of fire stations is determined for Yazana Ward. It is also probable that fire outbreak varies with the distance from the central area-the lowest probability in the nearest areas and the highest probability in the farthest areas (Figure 6).

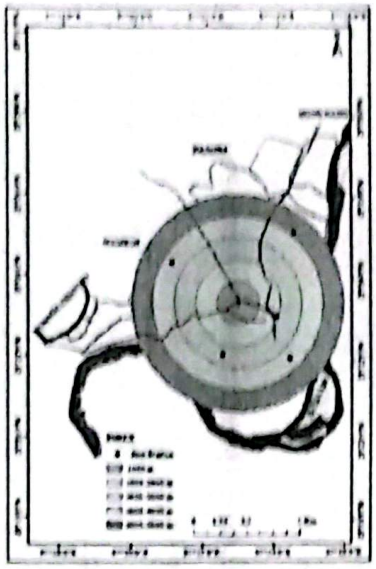


Figure (6) Spatial Distribution of Fire Stations in Myitkyina by using Multi Ring Buffer
Source: Computed by The Researchers, Field Survey.

When the distribution of fire stations was examined by means of Multi Ring Buffer method, it was found that there are 1 fire station in the 2000-meter radius from the mean center, 1 fire station in the 3,000-meter radius from the mean center, 2 fire stations in the 4,000-meter radius from the mean center, and 1 fire station in the 5,000 meters radius from the mean center. Therefore, it is found that the areas close to the mean center with fire station can get sufficient protection from the danger of fire.

Conclusion and Recommendations

Availability of water, population, buildings and types of economic activities, structure of road networks are critical factors in preventing the danger of fire. In the study area, Sitapru, Lekone and Tatkone Wards are particularly susceptible to outbreaks of fire and their dangers. Tatkone Ward has the largest number of houses and households due to the state policy and changes in urban land use. Moreover, there are many rental houses. They live there to perform various businesses in the surrounding areas. The rental houses are built of easily inflammable building materials such as bamboo and timber. The settlement of the majority of labor is also the major reason for easy occurrence and danger of fire.

Availability of water, the land use for the road structure, the housing structure, population, economic activities and governmental policies play a critical role in the study of spatial distribution of fire stations and effectiveness of fire preventive measures.

Outbreaks of fire can be effectively controlled when there is availability of sufficient water, systematic street structure and good socio-economic conditions. The prevention of fire has to meet with problems when there is difficulty in availability of water, poor road structure and poor housing structure of low income earning people. Governmental policy particularly plays an important role in allocation of fire stations for fire prevention and control.

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Myitkyina has five fire stations. Therefore, it is necessary to open new fire stations. The road should be systematically managed in the wards for easy movement of the vehicles for fire preventive measures.

If these problems can be solved, Myitkyina would suffer less loss of property by fire. Then, people of Myitkyina could live peacefully and securely, safe from the danger of natural disasters.

Acknowledgements

First of all, we would like to express our heartfelt gratitude to Dr Aung Win, Rector. Dr Aye Aye Ko, Pro-rector, Myitkyina University is to carry out the research for her permission and her encouragement. We are greatly indebted to Dr Ja Kham, Professor and Head of Department of Geography and Dr Seng Aung, Professor, Department of Geography, Myitkyina University for their exhortation and helpful comments on this research.

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Rural-Urban Migration in Banmaw Township

Aye Shin[1], Phyu Phyu Theint[2]

Abstract

Migration is the movement of people from one place to another; it may be on a temporary or permanent basis. This research focuses on the causes and effects of rural-urban migration in Banmaw Township. Migration includes rural-rural migration, rural-urban migration, urban-rural migration and urban-urban migration. Two kinds of measures are employed in this study. As a people have been moved from one place to another for the fulfillment of required and better facilities for safety and amenities that leads rural-urban migration in the study area. The main causes of rural to urban migration in Banmaw Township are job opportunities especially for government service, business opportunities especially for private business, education opportunity, security and other reasons. The effects of rural-urban migration are the volume of change in economic activity and the opening of IDP camps. In group (2) village tracts on the left bank of Taping River, because of occurring the more the number of migrants, the greater the density of the population, there are some cases which do not consider with positive correlation between two variables.

Keywords: Rural-Urban migration, Bamaw, education opportunity, security

Introduction

Migration, both in-migration and out-migration, is one of the factors for population change and urban development. The majority of people living here are Kachin ethnic group. As the armed struggle groups emerged soon after Myanmar attained independence, there was no security in the rural areas of Banmaw District. That is why, the rural to urban migration occurred in Banmaw Township. Migrations from rural to urban areas are generally the most important form of internal migration in Banmaw Township. Moreover, rural-urban migration occurred in Banmaw Township is also due to socio-economic opportunities. This paper attempts to analyze the rural-urban migration in Banmaw Township from the geographical point of view.

Aim and Objectives

The main aim of this paper is to examine the rural to urban migration to gain sustainable urban development in Banmaw Township.

The objectives are:

- to find out the reasons (causes) of rural-urban migration in Banmaw Township;
- to assess the effects of rural-urban migration in Banmaw Township; and
- to examine the factors for changing population growth and urban development.

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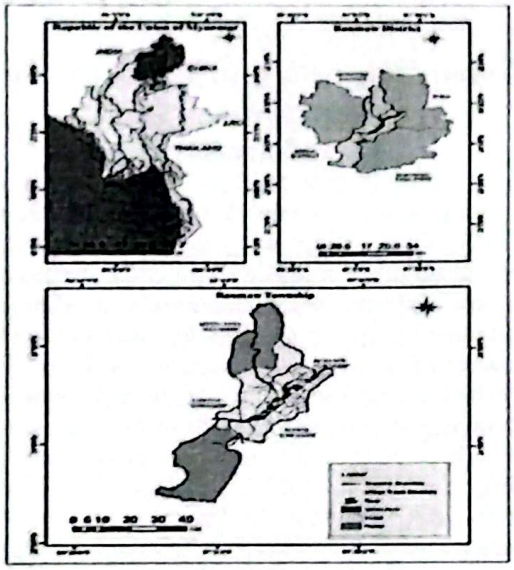
Data collection and Methodology

Firstly, secondary data were collected from library of geography department, university library and government offices especially Immigration and National Registration Department in Banmaw Township. Secondly, primary data were collected by questionnaire survey. The interesting information that relates somewhat to the problem would be obtained from internet downloading. For purpose of clarity and comparability, the data represented in tables, maps and figures, supplemented by occasional photographs.

Physical Bases of Study Area

Banmaw Township is located in the southeastern part of Kachin State. It is situated between the latitude of 23° 54' 8"- 24° 42' 23" N and between the longitudes of 96° 54' 36" - 97° 21' 13" E.

The Ayeyarwady River passes through middle part of the township and which flows from north to south direction within the study area. Therefore, about two-thirds of the township area occupied on the western side of the river and the mainly greater portion is on the eastern side of the Ayeyarwady River.



Map 1 Location of Banmaw Township

Source: UTM Map No. 2396-13, 2396-14, 2397-02, 2496-16, 2496-02, 2497-03, 2497-04, 2497-07, 2497-08

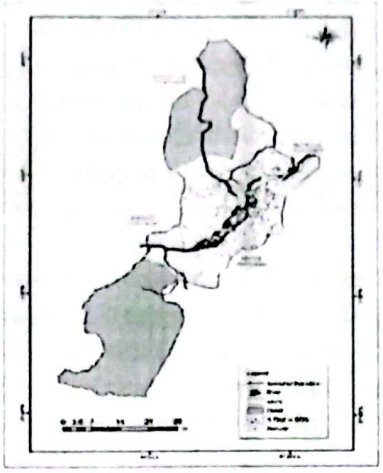
The total area of the township is 759.01 square miles or 486,258.6 acres. It includes (16) wards and (42) village tracts. Banmaw Township has an elongated shape. It is bounded on the east by Momauk Township, on the south by Mansi Township, on the west by Shwegu Township, on the north by Myitkyina Township (Map 1 and 2). The topography of Banmaw Township can be divided into three main parts: The Low Plain Region, The Highland Region and The Mountain Region. The main rivers are the Ayeyarwady River, Taping River, other small streams and their tributaries.

As Banmaw Township lies north of the Tropic of Cancer, it falls within the subtropical climatic zone. By examining the temperature and rainfall conditions of Banmaw Township, it is found that Banmaw Township receives the Humid Subtropical Climate (Cwa).

Social Bases of Study Area

Population factors play an important role in the economic activities. Production of commodities and other government services of a region are also a significant factor of a region. In 2018, the total population of Banmaw Township was 113,123 persons. The urban population was 52,767 persons and the rural population was 60,356 persons.

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Map (2) Population Distribution of Banmaw Township
Source: Immigration and National Registration Department, Banmaw Township

Most of the people live insafe and better activities for livelihood areas and geographically suitable for residential such as flat land area, which is easily accessible, arable land and along the river bank for water transport. In the study area, the population distribution is dependent upon the relief feature, transportation, communication, the availability of water for domestic use including drinking water, the economic conditions of a region and other natural factors. In Banmaw Township, the most populated areas are found along the river banks of the Ayeyarwady River, the Taping River and the Mole Stream. These areas are the larger areas with fertile soil, abundant water supply and good communication. The northernmost parts, the western parts and the southern parts of the township have sparsely populated, while the eastern part and environs of Banmaw Plain have a dense population.

In other residential areas of village tracts and villages, outside of Banmaw Town, the population distribution pattern is dependent upon the reasons mentioned above. People living in this area are facing with problems or difficulties which are major point of rural-urban migration in study area.

Patterns of Migration in Banmaw Township

The pattern of population movement takes place within the township due to the differential nature of availability of factors associated to migration. The spatial migration pattern of the township is analyzed by dividing five types as rural to rural migration, rural-to-urban migration, urban and urban migration, township-wise in-migration pattern and township-wise out-migration pattern.

Rural-to-Rural Migration Pattern

According to the data from the Immigration and National Registration Department of Banmaw Township, in the year 2018, there are 211 households with 251 persons migrated from village to village within Banmaw Township. Old Helone village moved to Mophein and Aungphyithar villages.

Rural to Urban Migration Pattern

For several reasons, villagers moved from their villages to Banmaw Town proper as well as to the nearby town. There were 120 households with 129 persons moved from villages to towns in Banmaw Township. The rural-to-urban migration is pronounced in Sintkin moved to Nampha, Shwekyina and Naungkho wards. Out of the total rural to urban migrants, in-migrants in Banmaw Town proper contributed about 3.5 per cent in the year 2018.

Urban-to-Urban Migration Pattern

In Banmaw Township, the total migrant in the year 2018 was 119 persons of which about 2.05 percent constitutes as urban to urban migration. The occurrence of urban to urban in-migration is pronounced in Momauk, Shwegu, Lweje, Mansi and Dawphoneyan moved to

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Banmaw Town. The reasons for the occurrence of urban to urban migration are government services, better economic opportunity, better education opportunity, marriage, better health opportunity and family movement. People from Momauk, Shwegu, Lweje, Mansi and Dawphoneyan are situated near border with China and socio-economic activities are good chance but insecurity of political situation is major point of inaccessibility in these areas that is pull factors of migration.

In-Migration Pattern

Banmaw Township, in terms of in-migration, contributes the largest number urban-to-urban of migrants in the year 2018. There were 199 in-migrants in Banmaw Township, where urban-to-urban migrants contributes 37.19 per cent followed by rural-to-urban migrants at 46.73 per cent and rural-to-rural migrants at 16.08 percent. The better facility for education, business and security attract a large volume of migrants into Banmaw both in the form of rural-to-urban and urban-to-urban migrants. People living in marginal areas within Banmaw Town are moved to the urban centres to approach better opopportunities or education, health care, and good access to business areas or markets centre.

Out-Migration Pattern

In the year 2018, there were 243 out-migrants in Banmaw Township. Among them rural to urban migrants contributed 37.45 percent followed by urban-to-urban migrants at 51.05 percent and rural-to-rural migrants of 11.52 percent. The poor facilities for education, business, and health and poor security effect were the large volume of migrants to other township. In respect of the out-migration from rural to rural is found to be highest in Banmaw Township proper with 7.47 percent.

Reasons for Rural-Urban Migration

The processes of human movement are always associated with a number of reasons including social, cultural, and political reasons, employment, business, education, marriage, family movement, etc. People move from one place to another for the fulfillment of the required and better facilities of amenities. The areas with appalling poverty, unemployment, low and uncertain wages, poor facilities for education, health security, political situation etc. move forward the people to migrate to another place where better facility prevails.

According to the data from the Immigration and National Registration Department of Banmaw Township, the reasons for rural-to-urban migration are divided into five groups. They are as follows:

(1) Job opportunity especially for government service,
(2) Business opportunity especially for private business,
(3) Education opportunity,
(4) Security and
(5) Other Reasons

Table 1 Volume of Rural to Urban Migration due to Different Reasons in Banmaw Township (2018)

Sr. No	Reasons	No-of Migrant	Percentage migrants
1	Job Opportunity Especially for government service	50	9.6
2	Business opportunity Especially for private Business	226	43.2
3	Education	51	9.8
4	Security	80	15.3
5	Other Reasons	116	22.2
Total		**523**	**100**

Source: Calculated by the Researcher

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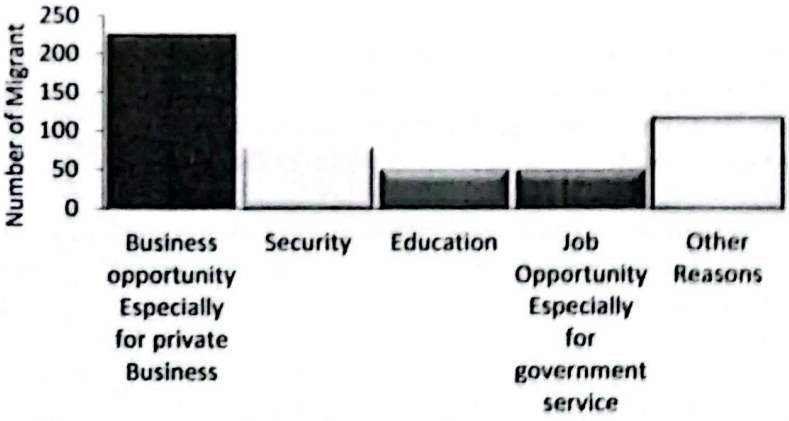


Figure 1 Volume of Rural to Urban Migration due to Different Reasons in Banmaw Township (2018)

Source: Based on Table 1

According to Table 1 and Figure 1, among all the effect factors, Business opportunity especially for private business 43.2 percent is considered as the single largest reason for in-migration of Banmaw Township.

Job Opportunity

Job opportunity especially for good earning and safely working places are major pull of the people. Computer training, language especially in English, Japan and Chinese training centre are located in urban areas in study area. Local people are trying to get market place for their daily family income and their children could approach to better schools and age old people are approaching toward better/good health center cause migration.

In 2018, 22 households with 50 persons from rural areas migrate into Banmaw Town due to job opportunity especially for government service. It is the largest number of in-migrants.

Business Opportunity Especially for Private Business

This reason is the most important and common reason for in-migrants of Banmaw township. Banmaw Township is centrally placed in relation to the rest of Banmaw District and Kachin State. It has more private business than other areas in Banmaw District. Moreover, it is also on the route of China border and is a very important center for overland trade with People's Republic of China. As a result of the largest number of in-migrants moved into Banmaw from the villages. The total in-migrants due to business opportunity especially for private business are 43.2 percent. It is the largest number of in-migrants.

Education Opportunity

Education opportunity is the reason for rural to urban migration in Banmaw Township. 9.8 percent of in-migrants are due to education opportunity.

Security

Soon after Myanmar attained independence, the armed struggle groups emerged. Kachin Independence Organization (K.I.O) was founded in 25th October 1959 and Kachin Independence Army (K.I.A) was founded in 5th February, 1961 for the wideness of 1947 constitution. Kachin Independence Organization (KIO) has returned into the legal fold on 24th February 1994 and co-operated with the government in the regional and rational development in almost all fields. However, the fighting between Tatmadaw (Myanmar army) and KIA are still continuing in Kachin State due to the political conflicts. As a result, people from villages migrated to Banmaw. 15.3 percent of in-migrants are due to security.

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Other Reasons

The other reasons for rural to urban migration in Banmaw Township are marriage, health opportunity, religious affairs and family movement. In 2018, 99 households with 116 persons move into Banmaw Township for other reasons of migration.

Seasonal migration: People living in flood plain or potential flooded areas are always moving to Khuntha ward in Banmaw.

Effects of Rural to Urban Migration in Banmaw Township

The rural to urban migration effects on the economic activity of Banmaw Township proper because of the largest number of migrants due to business opportunity especially for private business. Table 2 provides an overall picture of volume of change in economic activity in Banmaw Town proper. In this case the volume of change is ± 15.9. It implies that 16 percent points of the total number of private business was involved in change from different types of business to the others during 2018 over 2014. While the involvement level is above 20 percent point, it means a change of high rate in economic activity, between 10 to 20 percent points denote a moderate rate of change and fewer than 10 percent points involvement implies a change of low rate in economic activity (Jasbir Sungh and S.S Dhillan). This scale as a yardstick when applied to Table 2 brings to that in Banmaw under reference the overall volume of change in economic activity was of moderate rate or was moderately dynamic. It was observed that during the period under the significant increases were in the economic activity of fashion shape (+7.0) and rice mills (+3.8).

Table 2 Types of Private Business in Banmaw Township (2018)

Sr. No.	Types of Business	Quantity
1.	Computer printing works	13
2.	Photo studio	10
3.	Goods sales	20
4.	Phone sales	30
5.	Purified Drinking water factories	4
6.	Fashion shops	30
7.	Textile sales	25
8.	Food stalls	57
9.	Rice Mill	20
	Total	**209**

Source: Compiled by Researcher based on the field data

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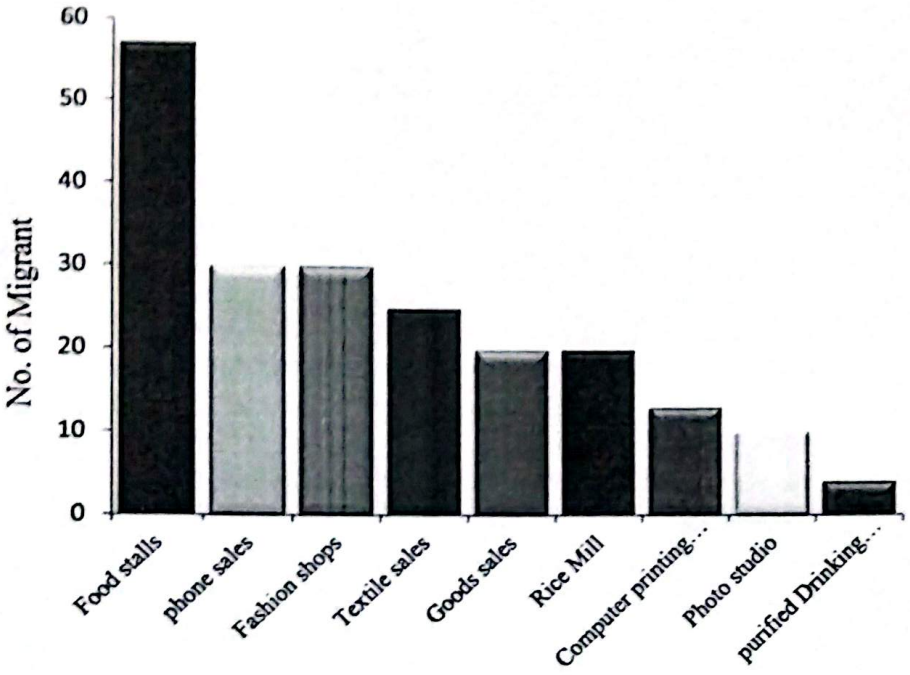


Figure 2 Types of Private Business in Banmaw Township (2018)
Source: Based on Table 2

In Banmaw Township, there are four IDP Camps. The first IDP camp, Roberts IDP camp was opened on 11th August 2011. According to table (5.30, the total numbers of Internally Displaced Persons in IDP Camp with in Banmaw Township is 5,094 persons in 2018 and among them 51.53 percent are females and 48.47 percent are male. Most of these IDP migrated from the eastern and southeastern parts of Banmaw Township for their security.

Table 3 Quantity of IDPs Camps in Banmaw Township (2018)

Sr. No.	Camp Name	House Hold	Quantity				
			Male	%	Female	%	Total
1.	Robert	641	1,978	49.12	2,049	50.88	4,027
2.	Aung Thar Church	12	26	50	26	50	52
3.	Htoi San Church	40	96	41.38	136	58.62	232
4.	Phankhar Kone	147	369	47.13	414	52.87	783
	Total	840	2,469	48.47	2,625	51.53	5,094

Source: Compiled by the Researcher Based on data from IDP Camps in Banmaw



Plate 1 Robert IDPs Camp, Nyaungbin Ward in Banmaw Town

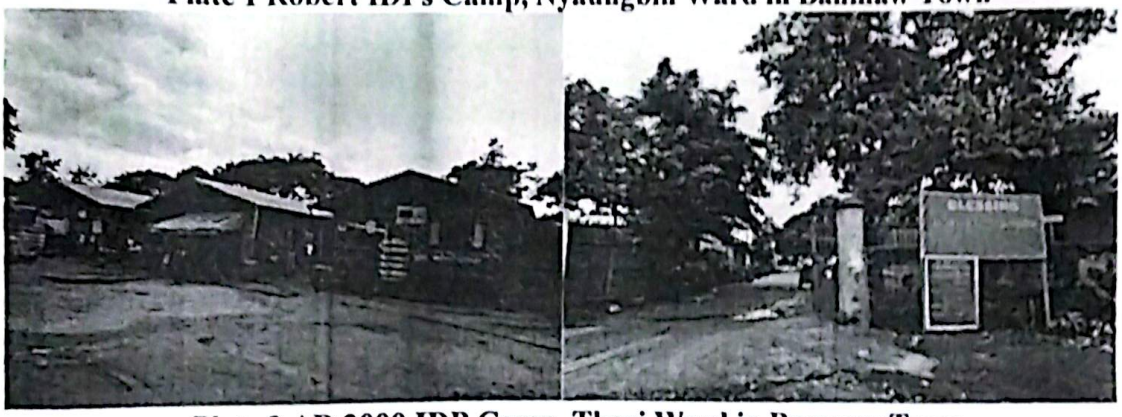


Plate 2 AD 2000 IDP Camp, Thazi Ward in Banmaw Town

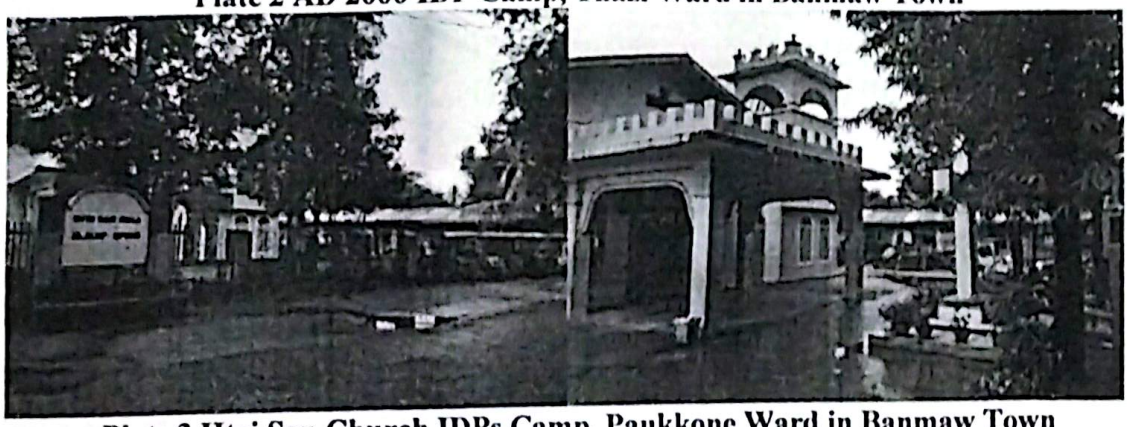


Plate 3 Htoi San Church IDPs Camp, Paukkone Ward in Banmaw Town

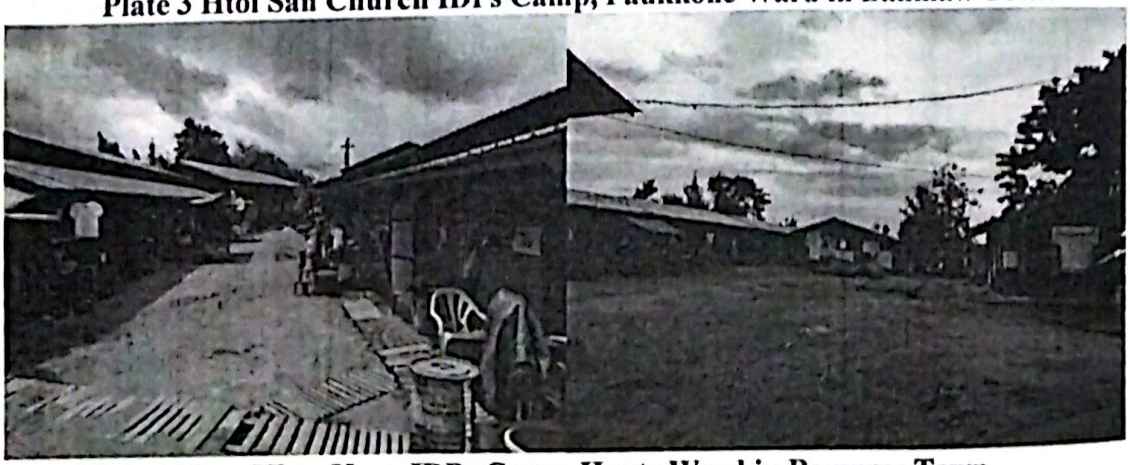


Plate 4 Phan Khar Kone IDPs Camp, Hante Ward in Banmaw Town

Source: Field Observation

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Analysis on the Rural-Urban Migration in Banmaw Township

There are several factors responsible for rural-urban migration, influence the migrant's migration status. Respondents who are household heads of the migrant females were chosen randomly and interviewed using both open ended and close ended questionnaires and for data analysis respondents were two divisions-temporary and permanent migrants. However, permanent migrants are only used in this study.

To calculation migration and density correlation, village tracts divided into five groups depending upon the location. Group (1) includes nine village tracts. They are in the eastern bank of Ayeyarwady and north of Taping River. Village tracts on the left bank of Taping River are regarded as the village tracts group (2). Group (3) includes seven village tracts in the east bank of River. Group (4) includes six village tracts in the eastern part of Banmaw Township. Group (5) is on the western bank of Ayeyarwady River and it included 12 village tracts.

Analysis between Population Density and Migrants

By using the Pearson's Product Moment Correlation Coefficient, population migrants and population density was analyzed as follow. In this process, the required values are calculated by using the following formula;

$$\text{The Correlation coefficient } (r) = \frac{\frac{1}{n}\sum(x-\bar{x})(y-\bar{y})}{\delta_x \delta_y}$$

There is a low degree of negative correlation between migrants and density. Thus, it can be assessed that there is low negative correlation degree between the population density by village tract group (1) and the area of Banmaw Township. It means that the density is high and the less in population migrant in the study area because the people work at their own agricultural lands. (Figure 3)

The correlation value(r) is + 0.14 indicate that there is high degree of positive correlation between population density and number of migrants. In group (2) because of occurring the more the number of migrants, the greater the density of population, there are some cases which do not consider with positive correlation between two variables. (Figure 4)

Group (3) has negatively low degree of correlation with r= -0.067. It means that the population is high and the migrants are low in the village tracts of Group (3). (Figure 5)

The correlation value of Group (4) has -0.067. It is low degree of negative correlation between density and migration. So it can be said that the higher in the population density and the lower the migrants. (Figure 6)

According to the calculation, there have low degree of negative correlation with r = -0.013 Group (5) means that population density is high and the less number in migrants in Group (5). (Figure 7)

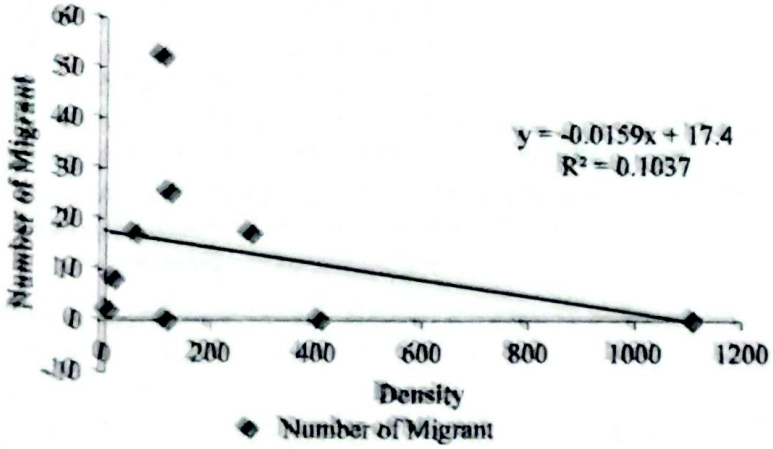


Figure 3 The Correlation between Population Density and Migrants of Village Tracts in Banmaw Township (Group 1)

Source: Calculated by Researcher

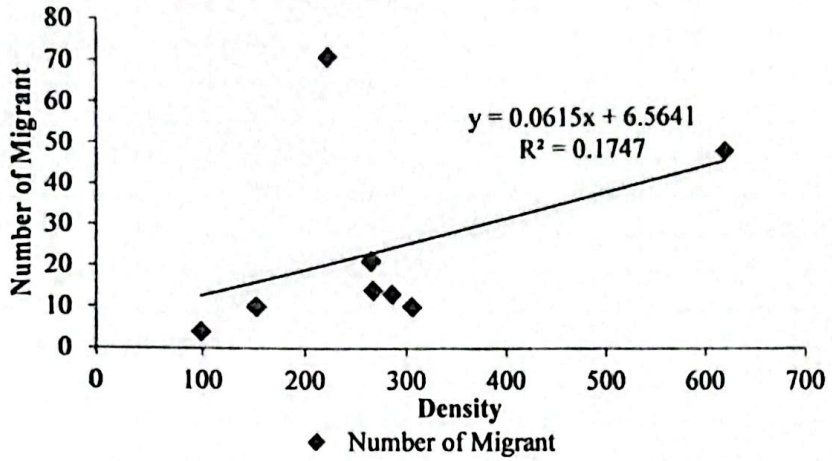
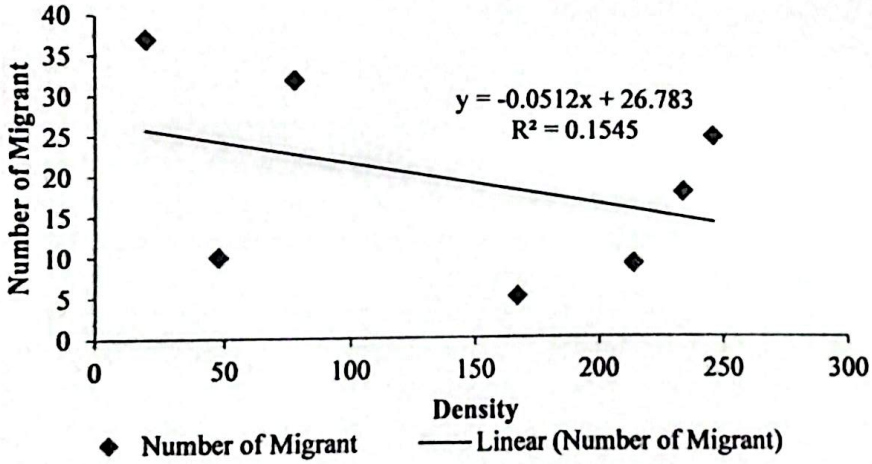


Figure 4 The Correlation between Population Density and Migrants of Village Tracts in Banmaw Township (Group 2)
Source: Calculated by Researcher



The Correlation between Population Density and Migrants of Village Tracts in Banmaw Township (Group 3)
Source: Calculated by Researcher

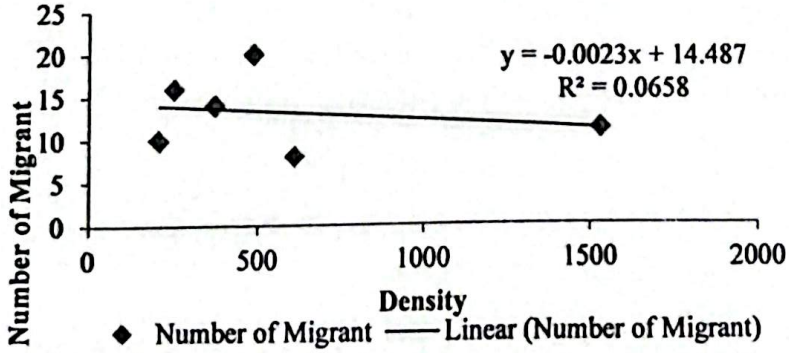


Figure 6 The Correlation between Population Density and Migrants of Village Tracts in Banmaw Township (Group 4)
Source: Calculated by Researcher

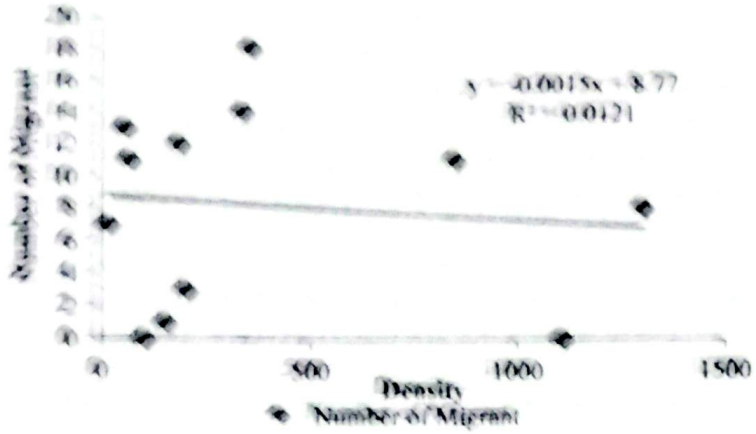


Figure 7 The Correlation between Population Density and Migrants of Village Tracts in Banmaw Township (Group 5)

Source: Calculated by Researcher

Discussion

Banmaw Township is composed of Banmaw Town proper and 42 village tracts. Some people living in villages are moving to Banmaw Town proper in order to have their security and development. After examining and analyzing about the rural to urban migrations within Banmaw Township the findings and results are obtained as follows.

The most population of Banmaw Township live in the rural regions and their main economic occupation is agricultural activities. According to the data collected in the 2018, 523 persons which amounted to 5.7 percent of the total number of the population of Banmaw Township are job opportunity especially for government service, business opportunities especially for private business, education opportunity, security and other reasons.

Because of no security in Banmaw 's environ village tracts in other townships, they moved to Banmaw. Therefore, IDP Camps (Internally Displaced People Camp) were opened in Banmaw Township.

The influence of factors of migration over migration status was known the determinants which coerce the rural dwellers to migrate. People migrate to urban mostly economic reasons, as well as natural disasters. It is found that flow of migration to the major areas in Banmaw is the result of rural-urban dichotomies in income; employment opportunity, religion, education qualification and occupation of the household head have positive dried effects on migration. Moreover, the principal factor that encourages people to leave their homes in their native villages.

In case of urban attraction, there is a consensus that the most dominant factor is high employment opportunity in the urban centers. Finally, it can be deduced that economic reasons play as built predominan push and pull factor in rural- urban migration and in same causes environmental reasons also become a significant push factor. The main reason of migration in Banmaw Township was low income because there were social and natural hazard within Banmaw Township its environs of other township which cause less and weakness for the security.

Conclusion

The processes of human movement are always associated with a number of reasons including social, cultural, political reasons, employment, business, education, marriage, family movement, etc.

According to the data from Immigration and National Registration Department of Banmaw Township, The groups of effect factors for in-migration are found in Banmaw Township. They are job opportunity especially for government service, business opportunity especially for private business, education opportunity, security and other reasons. The people

moved out of one village to another village due to five reasons within Banmaw Township. These reasons for out migration government service, low income, poor facilities for education, poor security and other reasons.

In Banmaw Township, 226 (43.2%) migrated due to business opportunity, 50 (9.6%) migrated in search of job opportunity, 80 (13.5%) migrated due to security, 51 (9.8%) in search of education and 116 (22.2%) migrated as a result of other reasons.

The pattern of population movement takes place within the township due to differential nature of availability of factors associated to migration. In the year of 2018, there are 230 households with 279 persons migrated from rural to rural within Banmaw Township.

For several reasons, people moved from their villages to Banmaw Town proper. There were 142 households with 187 persons moved from villages to Banmaw. The rural to urban migration is pronounced in Banmaw Township.

Acknowledgements

We would like to express my thanks to Dr. Seng Aung, Professor and Head, Department of Geography, University of Myitkyina, for allowing us to do this research paper. We are also indebted to Dr. Aye Aye Chit, Professor, Department of Geography, University of Myitkyina, for her encouragement, various supports and instruction. We also very thanks to Dr. Nang San, Associate Professor, Department of Geography, Banmaw University for her reading and supplying the necessary for the data. Our thanks are due to the office staffs from various Governmental Departments and various villages of administrators in Banmaw Township for helping us in collecting necessary data. Finally, we also very thanks to all of our teachers from Department of Geography, University of Myitkyina, for helping us to complete the work in time and necessary one.

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Geographical study on Environmental Hazards in Southeast Asia

Ja Ngai[1]

Abstract

This paper is studied on environmental hazards in Southeast Asia. There are different types of hazard including cause by human impacts. The environment can be considered as having four fundamental sets of components, physical, chemical, biological and cultural. Physical hazards involve environmental hazards that can cause harm such as earthquakes, floods, hurricanes as climate change effects etc. Chemical hazards are causing significant damage to the environment. Environmental effects consist of five basic types of pollution and impact of environmental pollution caused by two mains ways that harm human health but also pollutant on environment will be discussed. Environmental hazard is one of the biggest and the most troublesome change are facing today, not only the potential to threaten the surrounding natural environment and adversely affect human's health. So environmental hazards, types of hazards, characteristics of hazards, responses to hazards, hazards measurement, environmental health hazards and impacts of hazards are need to be studied to sustain, save for perfect to clean, green and beauty environment.

Keywords: environmental hazards, hazards measurement, environmental health, impacts

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Introduction

In Southeast Asia, there are several tectonic plates causing earthquakes, volcanic eruptions, tsunamis etc. This region is located between Pacific and the Indian oceans causing seasonal typhoons and tsunamis in some areas.The regions that have a history of devastating natural hazards that caused economic and human losses across the region.All types of natural hazards are typhoons, floods, earthquakes, tsunamis, volcanic eruptions, landslides, forest-fires, and epidemics that threaten life and economic lost.Typhoon is always causing destruction to human life, buildings, agriculture and infrastructure and also causing flooding and landslides in many areas including Myanmar. For example, the tropical cyclone Nargis in May 2008 in Myanmar. Over 600 hectares of agriculture land was flooded, killing about 50% of draught animals. It caused estimated damages of 4 billion USD and killed 138,366 people making it the deadliest tropical cyclone in SEA's history.The study focused on natural hazardssuch as earthquakes, tropical cyclonic storms (typhoons), floods, landslides, tsunamis, droughts, and forest fires and their effects such as economic losses (Collins Santhanasamy (2021):Emergency and Disaster Reports).

Aim and Objectives

The aim of this study is to analyze disaster risks by member states in Southeast Asia and sharing information to promote participation and cooperation of Myanmar.
The objectives are:

- to find out the environmental hazards and related consequences;
- to explore the environmental characteristics; and
- to understand environmental hazards and impacts on socio-economic and human health

Methodology

Literature survey and library search were carried out. Descriptive research methodology was used in this study. The hazard risk data for the region was extractedmainly from Synthesis Report on Ten ASEAN Countries Disaster RASEAN Disaster Risk Management Initiative (2010) and internet search.

Geographical structure

Southeast Asia covers a total land area of 4.48 million sq. km and has a population of 593 million (2009). The region is home to large river systems such as the Mekong and Ayeyarwady, and major water bodies. Climate has hot and humid tropical climate, an exception being the mountainous areas in the Indochina Peninsula that experience a milder temperature and drier landscape.The population in the region lives in riverine plains, delta and coastal plains and the most populous areas are hazardous such as flood, sunami, and cyclone.

Southeast Asia is border with the People's Republic of China to the north, the Pacific Ocean and Papua New Guinea to the east, Australia to the southeast, the Indian Ocean to the south, Bay of Bengal and Andaman-Nicobar Islands (India) to the west and India and Bangladesh to the northwest. The region is geographically diverse and make up of high hills and rugged mountains, elevated plateaus, highlands, floodplains, coastal plains and deltas such as the Tonle Sap and Lake Toba, being the largest volcanic lake in ASEAN region.

As Environmental Geography, Southeast Asia is forested region, nearly 7 million tribal people living in the mountainous border between Burma and Thailand. The deforestation, damages watersheds, landscapes are denudedand wildlife habitat destroyed in Southeast Asia. Smoke and Air Pollution, increasingly poor air quality from urban smog, dry conditions, smoke from clearing forests for other uses, as Physical Geography, Rugged uplands/mainland topography including mountains along the Thailand-Myanmar border, associated with large rivers including Mekong, Ayeyarwady, Red and ChaoPhraya (ASEAN Disaster Risk Management Initiative (2010).

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Patterns of Physical Geography influence climate of the Monsoon which bring hot and rainy season from May to October, dry and generally hot conditions from November to April, tropical monsoon and tropical wet climates in Southeast Asia, a region of numerous islands (Indonesia has more than 13, 000 islands), and the western half of New Guinea - Philippines has 7, 000 islands.

In Southeast Asia, equatorial Island climates is more complex climate than on the mainland Southeast Asia and receives rain during the Northern Hemisphere's winter. Typhoon: tropical hurricanes that bring heavy rainfall to the northern reaches of insular Asia and Islands experience very little seasonality because the equatorial influence and rainfall is higher and more evenly distributed throughout the year as compared to the mainland.
Population and Settlement: Subsistence, Migration, Cities, Areas of infertile soil and rugged relatively dense populations are found in the region's river deltas, coastal areas, and zones of fertile volcanic soil. Indonesia has the largest population of the region (200 million).

The geographical layout of this region comprisesa wide range of characteristics and includes archipelagos and continental land masses with both low plains and mountainous terrain.

The continental or mainland and a string of archipelagos that extend to the south and east of the mainland (insular Southeast Asia). The continental projection is connected to India and China and extends south into what has been called the Indochina peninsula or Indochina, a name given to the region by France. This continental region is made up of the countries of Cambodia, Laos, Myanmar, Thailand and Vietnam. The insular region consists of the islands of Southeast Asia: Brunei, Timor-Leste, Indonesia, Malaysia, the Philippines and Singapore.

In 2019, Southeast Asia was home to a total population of 660,617,919 people of which 50 % of the population resided in urban areas. The average population density in Southeast Asia is 154 per Km² with the median age being 30.2 years. Indonesia has the highest population (270.6mil) and Brunei the lowest (0.43 mil) (Emergency and Disaster Reports 2021; 8 (2): 1-51).

Insular Environments

Countless islands: Indonesia has more than 13,000 islands (Major islands: Sumatra, Borneo (Kalimantan), Java, Sulawesi, and the western half of New Guinea – Philippines has 7, 000 islands (Luzon and Mindanao).



Photo1: Agricultural economy in Southeast Asia.
Source:https://encrypted-tbn0.gstatic.com/images?q=tbn:
ANd9GcQss9oDxgIGnhRBU7dBvjqXQl3S8IKfAwEdPw&usqp=CAU

Environmental Hazards

According to ASEAN Disaster Risk Management Initiative (2010), during the last 40 years (1970-2009), 1,211 reported disasters have caused over 414,900 deaths. Out of the reported disasters, 36 per cent were floods, 32 per cent were cyclonic storms, 9 per cent were earthquakes, 8 per cent were epidemics, and 7 per cent were landslides. Cyclones (storms) caused the maximum number of deaths (over 184,000), followed by earthquakes (114,000) and tsunamis (83,600).

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Table 1 Causal agents and some example

Causal agent of natural hazards	Example
Hydrologic	Drought, Floods, and Flash-Floods
Atmospheric	Hurricanes, (Cyclone), tropical storm
Seismic	Earthquakes, volcanic eruptions
Environmental pollutions	The contamination of the physical and biologicalcomponents of the earth are included

Source: www.rand.org



Photo 2Driver of natural hazards

Source:https://www.google.com/search?client=firefox-b&sxsrf=APq-



Photo 3 Disasters in Southeast Asia

Source:https://www.google.com/search?client=firefox-b&sxsrf=APq-

Characteristics of Hazards:

Hazard: a threat (natural or human) that has the potential to cause loss of life, injury, property damage, socio-economic disruption.

- Hazard event: the occurrence of a hazard.eg earthquake.
- Disaster: a major hazard event that causes widespread destructions to a community or region
- Risk: the probability of a hazard event causing harmful consequences (loss of life, injuries and damage).
- In a work environment, employees can face numerous health risks.

Characteristics of Hazards can be studied as natural hazard events can be characterized by their magnitude or intensity, speed of onset, duration and the area they cover.Hazards occur at different intensities over different time scales.In general, the longer the return period (the less frequent the hazard)are the greater the intensity of the hazard, spatial distribution, earthquakes, hurricanes and droughts.

Significant flood events occurred in 1991, 1994,1996, 1999, 2001, 2002, 2004, 2005, 2006, and2007 in Cambodia. According to recited by Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment (2010), the December 26, 2004 earthquake (magnitude 9.1) and tsunami events killed 165,708 people, affected more than 0.5 million people and caused an economic loss of $4.45 billion in Indonesia. Indonesia lies in a region with low to very high seismic hazard. The uncontrolled population growth, improper development and management of rivers cause floods during the rainy season and droughts during the dry season almost every year in some parts of Indonesia. In January 2007 in the Jakarta region killed 68 people, affected 217,087 people and caused an estimated damage of about $ 971 million. Droughts also cause significant socio-economic losses in the country. A major drought in the

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year 1997 killed 672 people, affected 1.07 million people and caused an estimated damage of $ 88 million.

Table 2Four categories of environmental Hazard

Hazard	Behavior/cause	Example
Physical	Natural disaster	Floods/fire earthquakes
Chemical	Carcinogens	Water/soil
Biological	Animal attacks	Sewage
Cultural	Risky behavior	Smoking Drugs use

Source: www.sciencedirect.com

Biological /Epidemics: The recent global COVID-19 pandemic placed immense pressure on healthcare systems across the Southeast Asian bloc. In addition to COVID-19 related deaths and the increased demand for intensive care, the pandemic has highlighted the major repercussions on health outcomes of other diseases at a time when resources and personnel have to be diverted towards fighting the pandemic, especially the challenges faced by low and middle income countries.

Hazard Measurement

Environmental hazards are threats to people and the things value. They have many different origins.Classify hazards according to their causal agents.

Naturals events that are infrequent (earthquakes and hurricanes) and relatively common (blizzards and coastal erosion), technological events (extreme and common events such as nuclear power plant accidents or chemical spills), social disruptions (terrorism, riots, and warfare) biohazards (climate change, pollution and environmental degradation).

Disaster Characteristics

The variety of disasters is vast and it would not be feasible to have a specific response plan for each particular type of event. How to help the survivor of a hurricane versus a terrorist attack, need focus on certain key characteristics that research will identify as tending to influence survivors' psychological reactions to their experiences. What matters is less the specific type of disaster than factors such as event size, cause, and timing. Those patterns provide an important basis for understanding how a specific event is likely to affect people.

Consider the factors that made this disaster, a unique event. Why would it be helpful for a mental health responder to have an understanding of the characteristics of this event before meeting with the family? As characteristics in preparation for the training, think about how you could translate your understanding into providing more effective assistance. This will focus on disasters themselves, in particular on key event characteristics that tend to impact survivors' reactions. These characteristics directly affect survivors in terms of the length and nature of trauma they experience, which are strong predictors of mental health reactions. In addition, these same characteristics often influence the logistical demands faced by emergency responders and community members before, during, and after disasters. Since the degree of success responders have in managing those demands impacts resulting conditions in the community, these characteristics also indirectly influence individuals' reactions by shaping the recovery environment. Consider a basic question: What constitutes a disaster? There is no single universally accepted definition, an event that is experienced as a disaster in one setting might be perceived as a routine emergency in another. The general description can be broadly applied. "A disaster is a natural or human-caused catastrophe that causes destruction, frequently including loss of life, with permanent changes to an environment and a community" (Halpern & Tramontin, 2007).

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The main factor that sets disasters apart from more individual types of traumatic events is that they occur at the collective, community level. While an experience certainly feels disastrous to the person who goes through it, generally we can assume that his or her natural sources of support- friends, family members, and neighbors-have not been directly affected, so they're available to provide comfort and assistance to the survivor and recovers from the event. If the neighbor who might offer shelter to a family displaced by an individual house fire has also lost their home to a wildfire, each family is left in need. Rather than helping each other out, both may need to rely on outside assistance in the form of, for example, Red Cross shelter where their specific requirements may not receive much attention amid the demands of housing and feeding all who have been impacted. Compounding that collective impact, disasters often permanently reshape the communities where they occur. Infrastructure may be damaged or destroyed, leaving people unable to get around, without hospitals and healthcare services, schools and places of worship. This means that the recovery environment is disrupted and unfamiliar. The sense of community and stability rely on is suddenly gone, and it may take considerable time to regain it. It's not uncommon to hear residents say things immediately after an event like "We'll rebuild and make it just the way it was before!" only to come to the painful realization that it will never be exactly the same again. Some community members may choose to move away rather than risk living through another weather event they now realize they're vulnerable to; some may not be able to afford to rebuild; some may have died. While ultimately the community should be able to achieve some type of "new normal" getting there involves accepting and mourning the loss of the old way of life. So, will be able to apply a training in treating individual forms of trauma to work as a disaster mental health helper, keep in mind how disasters shape not only survivors' actual experience of the event, but also the context in which their recovery must occur, especially the constrained ability to rely on their usual sources of support.

Climate change is causing more extreme weather events worldwide as well as increasing the spread of many diseases, and creating general anxiety about food insecurity and other future effects. Climate change is increasing the frequency and strength of many weather and climate-related events, population increases worldwide result in more people living in areas that are prone to regular natural disasters like wildfires or floods or typhoons/ storms, so more people may be impacted when an event does occur than in previous times. All of this means that the need for mental health services for disaster survivors has never been higher.

Table 3 Characteristics of Disaster

Disaster characteristics	Individual characteristics	Response characteristics
-Was it human-caused or natural, or a combination? -Was there a warning period? -Was there a clear end point to the disaster, or uncertainty about it recurring or about its long-term health effects? -How widely was the community infrastructure damaged (scope)?	-If there was a warning period, did the individual take protective action? -How directly was the individual impacted? (i.e., injury), loss of home, death of loved one) -Did the individual have pre-existing strengths ore-existing strength vulnerabilities that might impact response? -Does the individual have an intact support network to draw on? -Did the individual have previous disaster experience?	- The community have pre-existing resources to aid recovery? -How were survivors treated immediately after the disaster and in the longer-term recovery stages?

Source: James Halpern and Karla Vermeulen (2017).

The Disaster Management

According to James Halpern and Karla Vermeulen (2017), a basic rule of disaster management is that the response always begins at the local level and is scaled up as necessary to meet needs that exceed local capacity. Preparedness begins at the community level and emergency managers must plan for the best possible local response and to understanding how to bring in more aid as needed. It would be impossible to predict and plan for every possible contingency, so plans often use an "all-hazards" approach that could be applied to any kind of disaster rather than focusing on narrowly defined events. Improveplans for the next event should be learned from each response. As the disaster management,understanding of human behavior and some familiarity with research on psychological reactions to disasters, mental health professionals can contribute is important ways.

1. Planning and Preparedness Potential hazards are identified and local response capacity and infrastructure are assessed. Plans are created to determine specific roles and responsibilities for those involved in the immediate and longer-term responses. Mental health professionals can contribute to planning by incorporating past research on disasters in order to identify psychologically vulnerable populations within the community and to provide insight into how people can be expected to react to warnings, as well as during and after events.
2. Mitigation-Focuses on prevention or reduction of the threats identified in the first phase. This could involve the implementation of stronger safety such as strengthening building standards in an area with significant seismic risk, the relocation of at-risk populations living in flood plains or the improvement of individual preparedness such as developing a campaign to encourage residents to create family emergency plans. Mental health professionals can help to identify potential sources of resistance to mitigation efforts, and to structure messages to improve compliance.
3. Response- During the response phase, the emergency plans are implemented in reaction to an actual or expected event. The focus is on containing physical damage, saving lives and treating the injured, ensuring that survivors' basic needs for shelter and sustenance are met, and restoring essential services like power and communications. If an event was expected, mental health professionals may be present during the response phase, for example, to provide Psychological First Aid and early assessment as displaced residents arrive at shelters. Also, may provide mental health support to emergency responders and managers to help maintain workforce resilience in a time of great stress.
4. Recovery- Efforts in the recovery phase focus on returning the community to its pre-event condition if the event was fairly small, or on creating that new normal since changes from a largescale event are often permanent. While this work generally occurs at the local level, many outside organizations may be involved, providing financial and material resources as well as services such as feeding and sheltering. Mental health professionals play an essential role during this phase.
5. Evaluation- Finally, a careful evaluation of the entire event should be conducted.

- Were the plans thorough and appropriate or did gaps become apparent?
-Can additional targets for mitigation be identified in hopes of preventing or reducing harm from a repeat event?
- Were the response and recovery efforts carried out as planned, or were there lapses in communication or other problems of implementation?
-Every aspect should be considered thoughtfully and the conclusions should then be incorporated into updated plans, completing the cycle. It would be regrettable if personal defensiveness were allowed to get in the way of maximizing preparedness. Mental health professionals can assist in this evaluation by reminding those involved that this is not a critical assessment of individual or agency performance but an opportunity to improve and protect the community better in the future.

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Table 4 Disasters in Indonesia (1970 - 2009)

Disaster type	Total no of dead(1970-2009)	Disaster type	Dead/ Year (1970-2009)
Landslide	1845	Landslide	46.13
Volcano	661	Volcano	16.53
Wildfire	300	Wildfire	7.5
Earthquake	97.166	Earthquake	2429.15
Tsunami	83.525	Tsunami	2088.13
Flood	5.42	Flood	135.35
Epidemic	3.886	Epidemic	97.15
Storm	1.692	Storm	42.3
Drought	1.329	Drought	33.23

Source: ASEAN Disaster Risk Management Initiative (2010)

Table 5 Responses to a hazard

Short-term (days and weeks):	-Mainly involve search and rescue and helping – injured, countries search and rescue teams. Short-term or immediate responses occur in the days and weeks immediately after a disaster
Mid-term (weeks and months):	- re-opening transport links and water supplies operational - Ongoing – medical rehabilitation - Re-building/connection/open- schools/hospital
Long-term(months and years):-	- rebuilding destroyed houses, schools, hospitals - kick-starting the local economy. - countries creating enterprise zones to encourage investment

Source: www.prevention.web.net

Environmental hazards are threats to people and the things value, and they have many different origins.Classify hazards according to their causal agents.Naturals events that are infrequent (earthquakes and hurricanes) and relatively common (blizzards and coastal erosion), technological events (extreme and common events such as nuclear power plant accidents or chemical spills), and social disruptions (terrorism, riots, and warfare), biohazards (climate change, pollution and environmental degradation).

Air (Global warming, acid rain, and pollution), Water (Drinking, oceans, ground), Ecosystems (Forests, habitats, wetlands), Health and safety (Mold, pesticides, sun) are included. Environmental pollution is the contamination of the physical and biological components of the earth to such an extent that normal environmental processes are adversely affected.

Save Environment: a safe environment plays an important role in the existence of life on the planet.Protect the environment means making efforts save our environment which include consume less, up cycle more, shop secondhand, walk, bike, or carpool and buy local and afforestation is another essential way to save our trees and forests.

Vulnerability

According to ASEAN Disaster Risk Management Initiative, 2010, the social vulnerability ranking of each country was estimated based on the average number of people killed per year per million (relative social vulnerability).In Myanmar, the relative social vulnerability is more than 3.5 times that of Indonesia (the second highest).In terms of relative social vulnerability ranking, Myanmar has the highest economic vulnerability ranking followed by Indonesia, Philippines, Thailand, Vietnam, Lao PDR, Cambodia, and Malaysia. The economic vulnerability ranking of each country has been estimated in terms of likely economic losses that an event with a 200-year return period cause as a percentage of that country's Gross Domestic Product (GDP). According to this categorization, Myanmar has the

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highest economic vulnerability ranking in the region, followed in descending order by Lao PDR (Laos), Indonesia, Cambodia, Vietnam, Philippines, Thailand, and Malaysia.

Table 6 ASEAN GDP (PPP) per capita (Int $)

Name	GDP
Singapore	101,649
Brunei Darussalam	64,848
Malaysia	29,620
Thailand	19,277
Indonesia	12,335
Philippines	9,302
Vietnam	8,397
Lao PDR	8,173
Myanmar	5,370
Cambodia	4,583

Source: Emergency and Disaster Reports 2021; 8 (2): 1-51

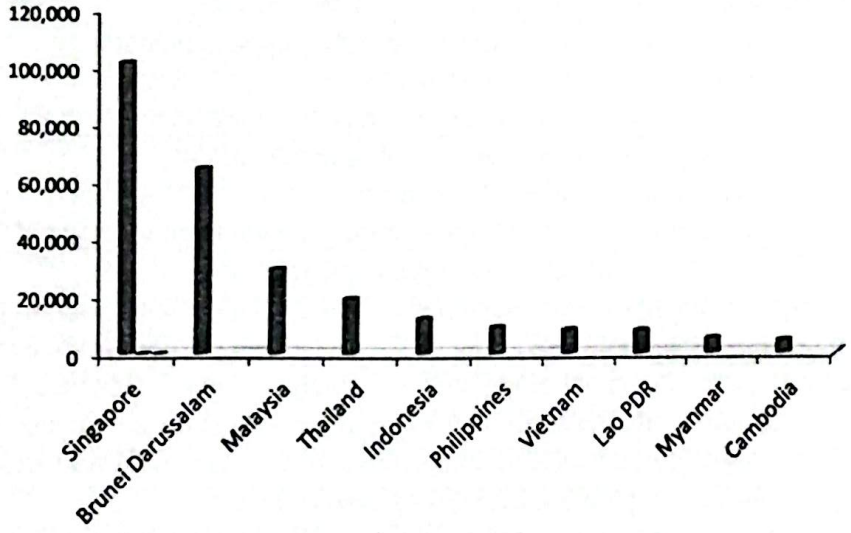


Figure 1 ASEAN GDP (PPP) per capita (Int$)
Source: Table (6)

Urban areas are especially vulnerable to the adverse impact of disasters. Capital cities: Manila, Jakarta, Bangkok, Hanoi, and Singapore are amongst the most populated cities in the ASEAN. In terms of earthquake risk, Manila is at highest risk followed by Jakarta and Bangkok and flood risk, Manila is also at highest risk followed by Jakarta, Bangkok, and Hanoi. In terms of tropical cyclonic risk, Manila is also at highest risk followed by Hanoi, and Jakarta. Overall risks from these hazards, Manila is at highest risk, followed by Jakarta, Bangkok, Hanoi, Singapore, Kuala Lumpur, Naypyidaw, Phnom Penh, Vientiane, and Bandar Seri Begawan.

Vulnerability indicators such as the number of disaster events, deaths, affected population andeconomic losses have been plotted against hazard types shows the total number of deaths, affectedpopulation and economic losses against each hazard type. Among all hazards, earthquakes and tsunamis combined together caused the largest number of deaths (180,691) followed by floods (5,420), landslides (1,845), typhoons/storms (1,692), droughts (1,329), volcanoes (661) and wildfires (300). Floods affected the largest number of people (7.581 million), followed by earthquakes and tsunamis combined together (7.477 million) and droughts (4.600 million). Earthquakes and tsunamis combined, also caused the highest

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economic loss ($9.412 billion), followed by wildfires (9.329 billion), volcanoes ($344 million), droughts ($160 million and landslides ($122 million).

The period 2000-2004, number of deaths (168,588), 2005-2009 the number of people affected (7.203 million), economic losses in the period 1995-1999 ($10.213 billion), mainly due to the 1997- 98 wildfires, 1996 floods, 1998 earthquake and 1997 drought. Floods had the highest frequency (3.20), followed by earthquakes (2.10), landslides (1.03) and volcanoes (0.93). The relative vulnerability was highest for earthquakes (10.11), followed by tsunamis (8.69) and floods (0.56). Forest fires, earthquakes and tsunamis combined, and floods are the dominant risks in Indonesia, Distinct disaster events in Southeast Asia can be extracted as the following Table 7.

Table 7 Loss of Natural hazards in Southeast Asia.

Countries	Type of disaster	Period	Loss of life/ killed	Economic loss of $	Affected people
Myanmar	Nargis cyclone	4,May, 2008	133,000	-over $ 4 billion -over 600 hectares of agriculture -killing about 50% of draught animals	Over 2.4 million people
Philippines	typhoon Fenghsen	21,June,2008	573		at least 4 million people
Philippines	cyclone Pepang (Parma)	October, 2009	539 people	592 million	4.5 million people
Indian Ocean	Indian Ocean tsunami	26, May, 2004			
Philippines	Luzon earthquake	16,September, 1990			
Indonesia	Yogyakarka earthquake	26, May,2006			
Philippines	Volcanic eruption of Mount Pinatubo	June 1991			
Thailand		2005			
Vietnam	Droughts	1997			
Philippines	Cyclone Ketsana/ Ondoy	September ,2009			
Vietnam	Catastrophic flood	October,2008			
Vietnam	Flood	January, 2007			
Indonesia	Forest-fire	September ,1997			
Brunei	Forest fire disaster	1998		$ 2 million	
Brunei	Floods, landslides, a pandemic, serious fire outbreak and the haze	2009			
Brunei	Landslides, floods and strong winds	2008			
Brunei	Floods and strong winds	2007			
Cambodia	Flood	July-Aug,2000	347 people	$160 million	3.45 million people
Cambodia	Drought	2002		$38 million	650,000 people
Cambodia	Drought	1994-1996		$100 million	5million people
Cambodia	Cyclonic storms, Linda Typhoon	November ,1997		81fishing boats	
Cambodia	Typhoon Ketsana	5,September-Oct,2009	43 people		49,000 families

Cambodia	Floods	1995-1999	1,245 people	$532 million	9.66 million
Cambodia	Floods	2000-2004	750	$302.5 million	7.537 million
Cambodia	Floods, the highest frequency (0.35) Epidemics Cyclones	2001-2004	31.13 (death rate) 1.36 0.05		
Indonesia	Flood Drought Storm Epidemic Tsunami Earthquake Landslides Volcano Wildfire		5420 1329 1692 3886 83525 97166 1845 661 300	10,639.52	
	Forest fire	September ,1997	240	$8.0billion (estimate)	32070 people
Indonesia	Earthquake (magnitude9.1)	26, December , 2004	165,708	$4.45 billion	More than 0.5 million

Source:

Discussion

These events can disrupt the social, economic and environmental status of societies at a number of different levels. The social impact of disasters includes loss of livelihoods, assets and infrastructure, as well as harm to emotional and physical well-being. Disasters can cause social unrest and environmental losses are often significant. Monitoring issues and warning of disasters cause by natural hazards are important approach to mitigation toward cooperation actions of disaster risk management is necessary. The way interprets risk and uncertai nty from hazards is interesting and important for individuals and society at large. Promote regional cooperation is necessary for civil protection and disaster preparedness and prevention in Southeast Asia because high vulnerability of environmental hazards. Climate change is considered as one of the most significant developmental challenges confronting Southeast Asia nations in the 21st century.

- These climatic changes have brought massive flooding, landslides, and droughts in different regions and have caused extensive damage to property, assets, and human life.
- Urban areas are especially vulnerable to the adverse impact of disasters.
- Capital cities: Manila, Jakarta, Bangkok, Hanoi, and Singapore are amongst the most populated cities in the ASEAN.

Analysis and data are presented by Environmental hazards and relation between the events and socioeconomic losses depends on socioeconomic conditions and their impacts to become familiar with the physical, demographic and economic characteristics of study area and can be understand the unique geography of Southeast Asia in this paper presentation.

Conclusion

In Southeast Asia, equatorial Island climates is more complex climate than on the mainland Southeast Asia and receives rain during the Northern Hemisphere's winter. Typhoon: tropical hurricanes that bring heavy rainfall to the northern reaches of insular Asia and Islands experience very little seasonality because the equatorial influence and rainfall is higher and more evenly distributed throughout the year as compared to the mainland.

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The Study on the Ayeyarwady River Chanr Khaung Hpu Villages in Myith

Zaw Man Aung[1], Zaw .

Abstract

This research paper attempts to study river channel shifts.
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Village in Myitkhina Township. It lies at the intersection
east longitude 97° 18' 38". In this area, there appeared an
and river bank erosion. In this study using 1994, 2004
Images, the Ayeyarwady River channel shift is being stud
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and they block the waterways of Ayeyarwady River for k

Keywords: channel shift, oxbow lake, bank erosion, allu

Introduction

The Ayeyarwady River is the country's lar
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miles from its source (i.e. confluence) to its mouth (i.e
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flows across high mountain ranges, uplands and rugge
this situation creates the formation of defiles along its

[1] Tutor, Department of Geography, University of Myitkyina
[2] Associate Professor, Department of Geography, University of M

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The Study on the Ayeyarwady River Channel Shift near Tarlawgyi and Khaung Hpu Villages in Myitkyina Township

Zaw Man Aung[1], Zaw Ja[2]

Abstract

This research paper attempts to study river channel shifts. The study area is located in the western part about 2 miles 4 furlongs of Tarlawgyi Village and about 2 miles of Khaungphu Village in Myitkhina Township. It lies at the intersection of north latitude 25° 4' 44" and east longitude 97° 18' 38". In this area, there appeared an oxbow lake caused by river flow and river bank erosion. In this study using 1994, 2004, 2014 and 2021 Google Earth Images, the Ayeyarwady River channel shift is being studied and analysed. It is found that the channel pattern of this river shift started in 2004 according to the Google Earth Image. The Ayeyarwady River Channel had shifted in the southern direction near Khaungphu village in 2004. As the hydrodynamic process of river, it gradually made channel cut off and formed an Oxbow Lake in the eastern side of river (Google Earth Image 2004). It separated channel as the abandoned channel. This channel shift ruined the cultivated lands (over 1000 acres) in Tarlawgyi village tract of Myitkyina Township. Deposition of sediments results in the formation of sizable alluvial islands and sandbars in the channel, and they block the waterways of Ayeyarwady River for local people.

Keywords: channel shift, oxbow lake, bank erosion, alluvium, Google Earth Image

Introduction

The Ayeyarwady River is the country's largest river and the most important commercial waterway. Originating from the confluence of the N'mai and Mali rivers, it flows relatively straight North-South before emptying through the Irrawaddy Delta in the Ayeyarwady Region into the Andaman Sea. Its drainage basin of about 404,200 square kilometres (156,100 sq mi) covers a large part of Burma (From Wikipedia, the free encyclopedia). The Ayeyarwady River, the life artery of Myanmar, is measured about 1,238 miles from its source (i.e. confluence) to its mouth (i.e. Gulf of Mohtama). The confluence occurs at about 28 miles 4 furlongs north of Myitkyina, the capital of Kachin State. The river flows across high mountain ranges, uplands and rugged topography in this upper reach and this situation creates the formation of defiles along its course. In addition to the topographic

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effects, some climatic elements (i.e. rainfall), also favorable for high velocity and discharge and the records show that the annual rainfall of this upper portion accounts between 80 and 100 inches.

Aim and Objectives

The main aim of this paper is to explore the Ayeyarwady River Channel Shift.
The research aims:

- to find out the Oxbow Lake caused by river flow and river bank erosion and
- to examine the impacts of river channel shift on the local people.

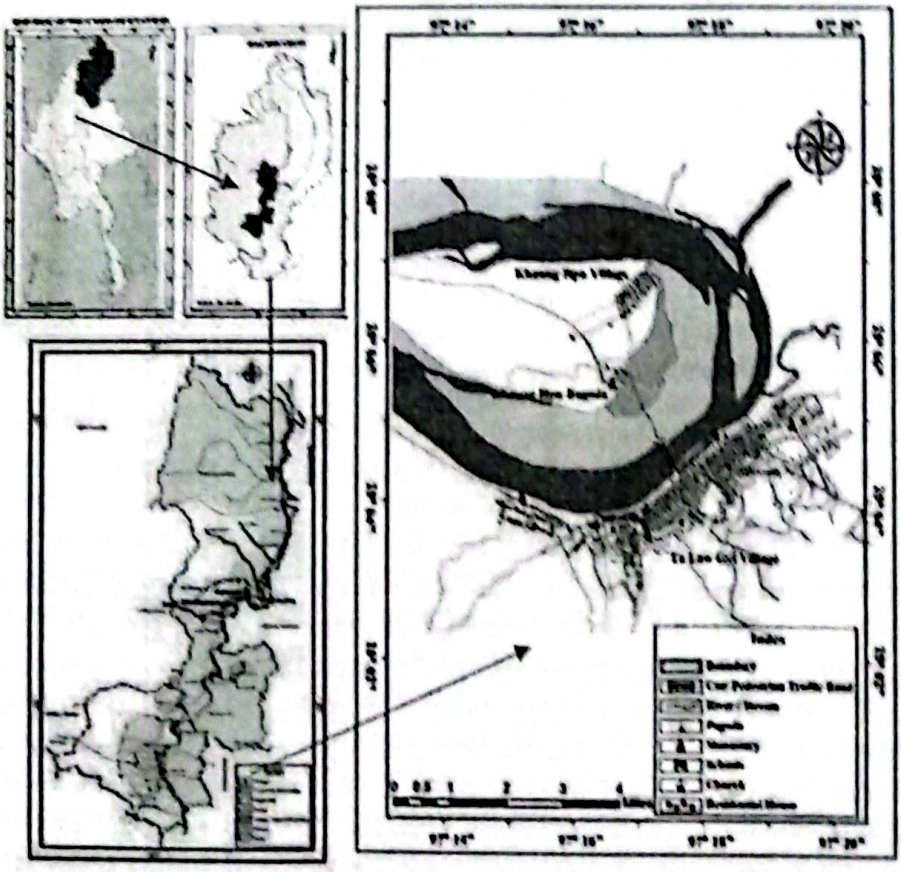
Methods and Materials

Using UTM map and Google Earth images (1994, 2004, 2014 and 2021), the Ayeyarwady River channel shift and an oxbow lake caused by river flow and river bank erosion is studied on desk. Other necessary data for this study are collected by field observation.

Physical Background of Study Area

Myitkyina Township is one of the six townships in Myitkyina District of Kachin State. It is located in the temperate zone close to the Tropic of Cancer, particularly between Latitude 24° 32′ North and 26° 12′ North and between Longitudes 96° 40′ East and 97° 30′ East. Myitkyina is the Capital of Kachin State as well as the head quarter of Myitkyina District. Myitkyina Township has an area of 2510.45 square miles or 1,606,429 acres.

The study area is located in the south- eastern part of Myitkyina Township, near Talawgyi and Khaungphu Villages. It is also located in the eastern bank of Ayeyarwady River.It liesin the intersection of North Latitude 25° 4′ 44″ and East Longitude 97° 18′ 38″. It is about8miles from Talawgyi village and 2 miles from Khaungphu village. Talawgyi village tract is 191464 acres and Khaunghpu village is 121459 acres. The study area is an oxbow lake which occurred by river banks erosion and river channel changes. In study area, Mali and Dabak chaung flow into the Ayeyarwady River from eastern bank.



Map 1 Location of Study Area
Source: UTM 2597-7, 2597-08

Climate

Climate is also an important factor that influences physical conditions of a region. The factors which control the climate of Myitkyina are its location in inland area and remoteness from the sea, and falling within the sub-tropical zone. Due to these factors, Myitkyina receives a rich in rainfall and high temperature.

Being situated in the sub- tropical Zone of Myanmar, Myitkyina receives in rainfall. During the 15 years period from 2004 to 2018, the average annual rainfall is 97.12 inches. In 2004, the largest amount of rainfall is received in May and the lowest amount of rainfall is received in December. These months received about 22.56 inches and 0.0 inches, respectively. In 2005, the largest amount of rainfall is received in August and the lowest amount of rainfall is received in February. These months received about 19.85 inches and 0.4 inches, respectively.

Geology

The study area is located south- eastern part of Myitkyina Township. Metamorphic rocks of phyllitic state are found in the eastern part of the area especially near G.T.C Collage, Myitkyina Township. Therefore, the study area is mainly composed of sedimentary rocks and metamorphic rocks formed at various geological episodes. Geology of the study area is mainly composed of recent alluvium sediments underlain by Irrawaddy Formation.

The study area is located eastern flood plain of the Ayeyarwady River. Therefore, alluvial soil is mainly found in this area.

River System

In the upper course of a river, water flow velocity is high, and V-shaped valley and vertical erosion are dominated. Moderate velocity with vertical and lateral erosion occurred in the middle course. Meander stream and alluvial fans are also found in this course. In the lower course, water velocity is low. Lateral erosion, flood plains, braided channels, levees, oxbow lakes, meanders and delta are dominated Figure 2.

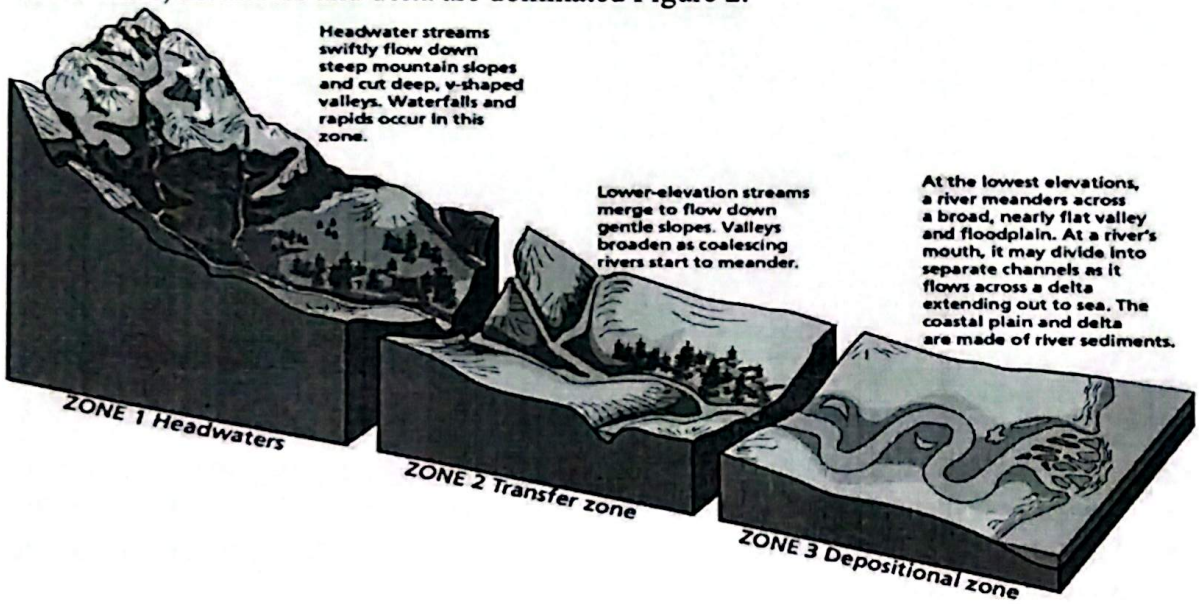


Figure1 River System
Source: Wikipedia.com

Ayeyarwady River Channel Changes and Formation of Oxbow Lake

In the study area, lateral erosion of Ayeyarwady River caused meander channel. The river deposits sediments on the inside of a meander bend as pointbar and erode cut bank along the outside of the bend. The Ayeyarwady River Channel had shifted in the southern direction in 2004. As the hydrodynamic process of river, it gradually made channel cut off and formed an Oxbow Lake in the eastern side of river (Google Earth Image 2004). The river course had changed direction, near Khaungphu village, from flowing southwest to northwesterly between

2003and 2004.It separated channel as the abandoned channel or the sand stream (Figure 2). This channel shift ruined the cultivated lands (over 1000 acres) in Khaunghpu village of Myitkyina Township. The river is meandering across the valley and erodes laterally. Figure 4, 5, 6, and 7

Hydrodynamic process and river channel changes are strongly influenced in this area. Oxbow lake is a U-shaped lake and it is formed when a river creates a meander, due to the river's eroding the bank. After a long period of time, the meander becomes much curved, and eventually the neck of the meander becomes narrower and the river cuts through the neck during a flood, cutting off the meander and forming an oxbow lake (Wikipedia.com).

The meander is formed naturally but gets bigger because of the erosion of the river banks. The process is known as abrasion which is the load of the channel rubbing against the banks.

A river with many meanders is called a sinuous river.The loops increase is size as erosion continues on the outside bank and deposition continues on the inside bank. As meanders grow, they migrate over the floodplain. As they migrate they may start to erode towards each other. Gradually the neck of the meander narrows until it is completely broken through (usually during a flood) to form a new straighter channel.

The neck of the meander gradually becomes more eroded away again by abrasion. This becomes very narrow and is separated by a small piece of land. The old meander loop is cut off by deposition from subsequent flooding to form an oxbow lake. Over time, continual erosion and deposition narrows the neck of the meander. Often during a flood, the river will cut through the neck of the meander. The river continues on its straighter path and the meander is abandoned. Fig. 3

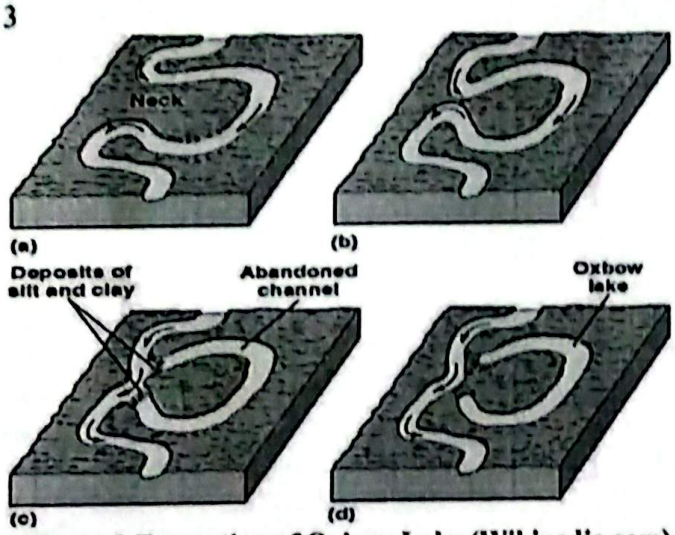


Figure 2 Formation of Oxbow Lake (Wikipedia.com)

Source: Wikipedia.com

According to a given website (https://www.bbc.co.uk/bitesize/guides/z6jx382/revision/4.)

- The river is meandering across the valley and erodes laterally.
- Most water is directed towards the outside bend, there is also reduced friction and increased velocity.
- The fast flowing water erodes the outside bends using hydraulic action, when the sheer river water dissolves minerals from the rocks and washes them away and corrosion, when the river banks are eroded by the load hitting against them.
- There is less water on the inside bend, an increase in friction and a decrease in velocity. As the river has less energy, it deposits material so its course is changing.
- Over time, continual erosion and deposition narrows the neck of the meander.
- Often during a flood, the river will cut through the neck of the meander.
- The river continues on its straighter path and the meander is abandoned.
- The fastest current will now be flowing in the Centre of the river channel and deposition is more likely to occur beside the banks.

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- A new deposition seal off the ends and the cut-off becomes an ox bow lake that will eventually dry up, except during periods of very heavy rainfall https://www.bbc.co.uk/bitesize/guides/z6jx382/revision/4. This process is naturally but human impact is made happen quickly.



Figure 3 Meandering River Channel (1994)
Source: Google Earth Pro

Figure 4 River Channel Shift (2004)
Source: Google Earth Pro

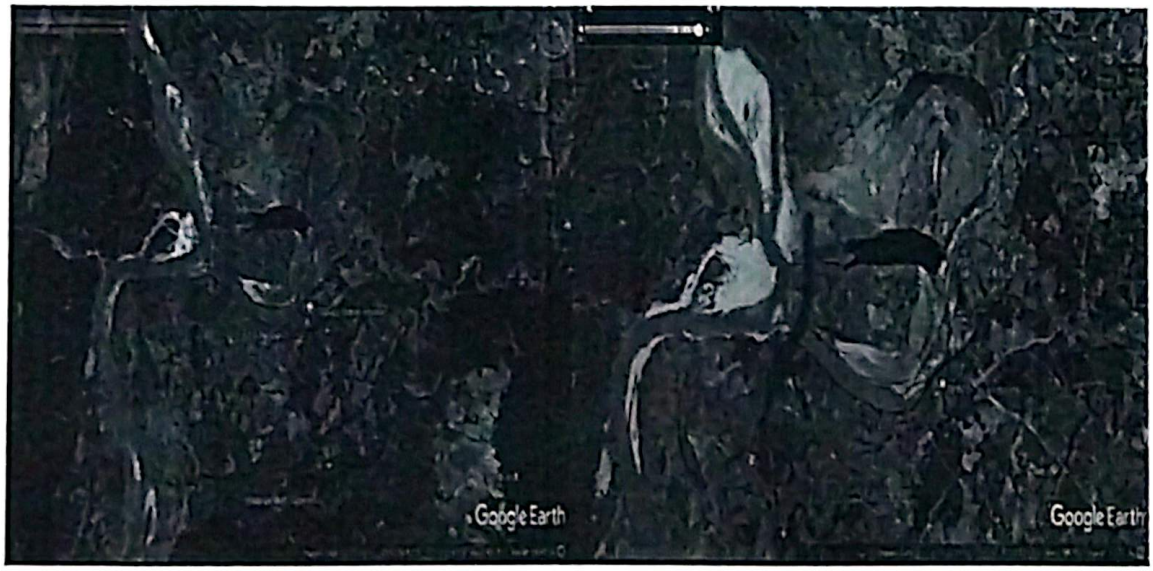


Figure 5 Formation of Oxbow Lake (2014)
Source: Google Earth Pro

Figure 6 Oxbow Lake in Khaunghpu and Tarlawgyi Village Tract (2021)
Source: Google Earth Pro

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Plate 1 near Khaunghpu Village
Source: Field Observation (21.1.2022)



Plate 2 Kone Law Ywar Thit



Plate 3 Bamboo Bridge

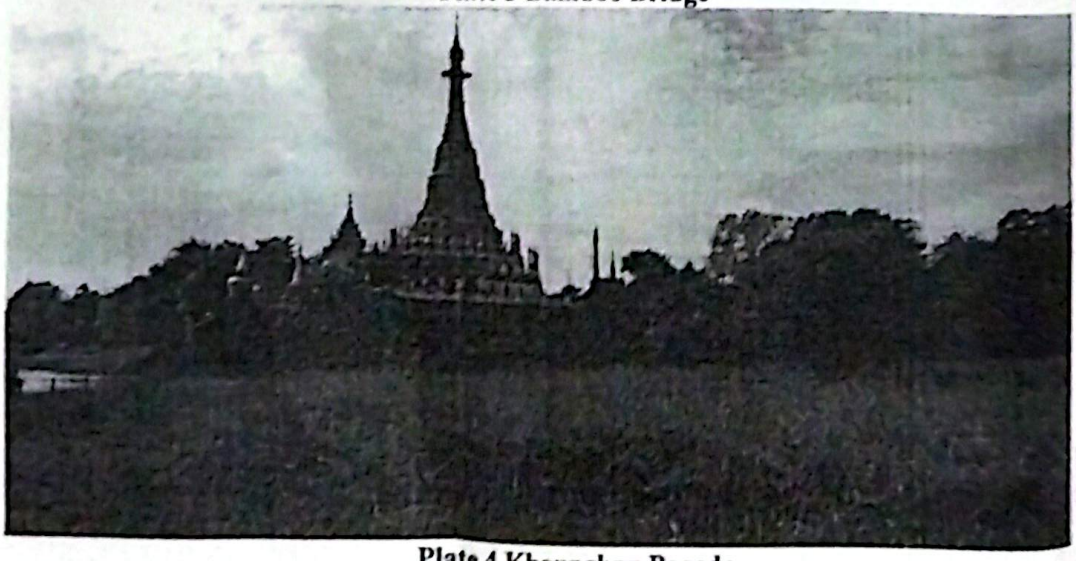


Plate 4 Khaunghpu Pagoda
Source: Field Observation (21.1.2022)

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Finding and Results

Different forms of channels are found depending upon the water flow. As a river is performing erosion, transportation and deposition along its course, the position of the river channel is found to change with time and place year by year. The width and the flow of the channel are also found to change with time and place. The flooding of water in the broad plain resulted a braided pattern with multiple branching and re-branching channels forming a network with intervening alluvial islands and sandbars. The river deposits sediments on the inside of a meander bend as point bar and erode cut bank along the outside of the bend. The Ayeyarwady River Channel had shifted in the southern direction in 2004. As the hydrodynamic process of river, it gradually made channel cut off and formed an Oxbow Lake in the eastern side of river (Google Earth Image 2004). The river course had changed direction, near Khaung Phu village, from flowing northeast to southwesterly in 2004. It separated channel as the abandoned channel (Figure 2). This channel shift ruined the cultivated lands (over 1000 acres) in Khaung village of Myitkyina Township. Deposition of sediments results in the formation of sizable alluvial islands and sandbars in the channel, and they block and retard the waterways of Ayeyarwady River.

The Ayeyarwady River Channel has provided the advantages for socio-economic purposes of floodplain in the study area. The impact of Ayeyarwady River Channel upon the socio-economic life of environment in the study area and its environs is assessed. Regarding changes of physical features, channel bars including islands, point bars, oxbow lake and thalweg of the Ayeyarwady River Channel has also shifted and moved at the study area. Although there are changes within Ayeyarwady River Channel with some geomorphological variables, measurements for changes of river channel cannot be carried out now in this research. Therefore, further research on Ayeyarwady River Channel with other researchers will carry on more thoroughly than this work.

It has been discovered that the local people are affected by the occurrence of oxbow lake. Khaung Hpu Pagoda was located eastern part of the Ayeyarwady River before the River channel shift. It is now located in the western part of the Ayeyarwady River. Khaung Hpu village is an also village where Dabak and Mali under to the oxbow lake from the east of river flow. Khaung Hpu Pagoda, the most prominent Pagoda in Kachin State, is also located in Khaung Hpu village. Water pollution due to riverbank erosion; it is discovered navigation is become more difficult. Therefore, it is learned that the Khaung Hpu villagers focused on the Ayeyarwady River before the change of river channel shift.

It is learned that the local people are making a living by fishing in this river. It is also found that they live and work in the farm for business. The main crop grown on the farm are maize, sorghum, peanuts and watermelon. It is learned that the local people are mainly engaged in farming. More than an acre of farmland was lost due to river channel shift. It is also found that it is very difficult for the local people to work and eat. Farmland is also infesting by pests, making it difficult for farmers to grow crops. Insecticides have been reported in the plantations to prevent pests from entering the fields, and the villagers have been told that the pests have moved to the fields and the crops have been destroyed.

It is learned that the previous voyage took about one hours by motor boat. It is reported that the river has become a river channel shift, making it is not easier to travel. Because roads are not always accessible. It takes only 3 hours by motorbike. Well water is mainly used for drinking water. It is learned that about 60 feet have to be dug to get water in the village. There is a sense of serenity in the local people. According to the local people, there is peace and stability due to the river channel shift.

The study results many discussions from earth observations concerning channel shift and oxbow lake in Tar Lawgyi, study area dynamic changes of river morphology in the Ayeyarwady River. This result is useful to support difficulties of water transport, fishing economic activities and agricultural practices for local people and riverbank protection

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planning and formulating mitigation measures for local communities that are affecting by riverbank erosion, sedimentation, deposition by human impacts in up river system.



Figure 7 Ayeyarwady River, River meander
Source: Google search Image



Figure 8 Meandering channel of river system
Source: Google search Image

Discussion

Parallel chains of mountain ranges that run north to south from the extremity of the Himalayan Mountain rang give birth the most important the Ayeyarwady River. The catchment area of the river is 49,000 km^2 and it originates at snow- cap mountains and arranged the river flow from north to south. There are a lot of deep forest with full of small streams and rapids. Water drains directly from high rain fall and melting of snow can cause flood during rainy season.

Continuously, flow is changing pattern of channel, sand beds, landslides due to rapid water force. Ayeyarwady River is navigable to Mandalay by boats.

The big scale hydropower development in Ayeyarwady Basin above Myitkyina and economic forces are driving the over exploitation of natural forest, water resources and river channel shift and natural ecosystems.

The impact assessment, identification and analysis need to be done in economic, social and environmental change to avoid adverse impacts and to ensure long-term benefits for sustainability of Ayeyawady River.

This accelerating degradation of natural resources increasingly threatens local and regional prospects for long-term sustainable development and is limiting its future options.

Economic structure for local people is needed to ensure successful implementation for sustainable development goal for local people in study area.

Its outstanding biophysical features of Ayeyarwady River are important highlight as locally, regionally and internationally. Potential impacts on local livelihood, public health and systematic social and environmental impact and geomorphologic assessment are needed.

Hydropower development in upriver portion and a series of dam construction projects namely, Myitsone, Lasa,Chiphwi, Yenam, Hkaunglamhpu, Wusot and Pisa (BAGA,2009) are

directly impact to river channel shift, strong banks erosion, deposition and sedimentation to form oxbow lake.

According to Arcadis Nederland B.V, (6.12.2017), about 40 miles upstream from Myitkyina, the rivers Mali Hka and N Mai Hka merge to form the start of the Ayeyarwady River. There are currently no less than six new dams planned. The largest (Myit Sone) is already under construction not far downstream from the confluence, still upstream of Myitkyina. Of the remaining five, three are planned on the N Mai Hka River, and two on the Mali Hka. All of the dams are (to be) constructed by foreign firms from bordering countries.

Various fields of study at river channel shift, oxbow lakes, measure of rate of channel discharge, velocity, erosion rate, sedimentation rate are urgently needed.

According to BANCA, Oct. 2009, there are numerous gold mines along both Nmai Hka and Mali Hka Rivers, impacting the river environment, will certainly increase river bank erosion, the sedimentation, and deposition along the Ayeyarwady River channel to form channel shift and oxbow lake. Hydraulic mining (about 50%) are situated on the banks of rivers and streams and use the most powerful engines like 100 or 200 HP is causing mass bank erosion on slope and the river banks is the most destructive to the environment and river banks collapse, causing landslides and river channel changes because this method of mining produces large amount of hazardous mercury deposits. Gold mining by bucket dredges of gold mining operation ruins the river beds and cause the river banks to collapse, which is extremely destructive to the river channel environment. This gold mining is common on both Nmai Hka and Mali Hka Rivers. Soil erosion, river regime changing and sedimentation problems are effecting in agriculture for people living along Ayeyarwady River.

River morphology changes is one of the key issues in Ayeyarwady River which cause impacts on navigation, riverine habitats, fishing activities, agriculture lands, communities and livelihoods in study area and also near the bank of the river.

GIS and remote sensing tools need to apply to analyze changes in channel shift, river morphology to determine how the dynamic behavior of river channel shift and effect of river morphology changing under the influence of high water flows in particularly from extreme flood events and land use change from mining and deforestation in upriver portion area. It would be observed that some meandering of the riverbank, which results in the movement of sediment downstream and created new meandering channel shift. Several large islands have formed due to the stabilization by vegetation and are enforced by sedimentation while many small bars were formed and migrated dynamically due to changes in water levels and flow velocity in the wet and dry seasons. The main channel was changed to secondary channel in some sections of the river is resulting a channel shift and oxbow lake. Some villages were facing riverbank erosion which can force villagers to relocate their agricultural lands.

River bank erosion and deposition influence the natural sediment balance of Ayeyarwady river channel. Remote sensing could be used to assess bank erosion and sedimentation in meandering river assessment of fluvial geomorphological change in Ayeyarwady. Monitoring of River channel should have a higher priority for future detailed investigations about riverbank erosion, sedimentation, deposition and river channel shift. Action plan on vulnerable riverbanks and possible strategy for bank erosion, measure of sediment and deposition to improve infrastructure and navigability are need urgently.

The development of detailed survey for geology, soil, geomorphology and land cover would be useful for future research and planning regarding vulnerability to riverbank erosion, deposition and channel shift. Remote sensing with extensive fieldwork would be helpful to advise government and people about the areas to solve problems of Ayeyarwady River channel shift and appearing oxbow lake in study area.

According to recited by Dan Chen & etal. (2020), the Irrawaddy is considered one of the major tropical river systems in the world (Syvitski et al., 2014). Its basin covers 60% of Myanmar's territory and is home to over 90% of the population of Myanmar, that is heavily

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dependent on the river and its resources for livelihood (Furuichi et al., 2009) is pointed to focus any situation change in any portion of Ayeyarwady River.

Conclusion

Near Tarlawgyi and Khaungphu Villages, an oxbow lake is found by river banks erosion and river channel changes. Lateral erosion of Ayeyarwaddy River caused meander channel in the area. Gradually, hydrodynamic process made the channel cut off and formed oxbow lake along eastern side of the river. The Ayeyarwady River Channel had shifted in the southern direction in 2004.The impact of Ayeyarwady River Channel upon the socio-economic life of environment in the study area and its environs is assessed.

Acknowledgements

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Uncovering the Significance of Birds Depicted on the Manau Pillars through Kachin Mythology

M Roi Nau[1]

Abstract

The purpose of writing this paper is to explain the colorful pictures of birds on the *Manau* pillars, which were erected at the center of *Manau* dance place. It is believed that the formation or origin of the *Manau* dance, as well as traditions and customs was not just imaginary invention of the Kachins, but they imitated from actual events. For example, the Kachins learned Manau dance from behaviors of birds which hovering over a banyan tree before consuming the banyan fruits. As a result, the Kachins have pictured the birds on the *Manau* pillars for remembrance of birds, which were the first developers of the dance. According to Kachin folktale, birds distributed roles or responsibility among themselves to participate in the dance. In this paper, I will present some Kachin traditions, sayings, and proverbs along with the Kachin traditional folk-tales. It was said that these became traditions of Kachins for centuries.

Keywords: customs, festivals, pedigree, settlement, traditions

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Introduction

The ethnicity of Kachin includes six tribes: Jinghpaw, Lhaovo, Lachid, Rawang, Lisu and Zaiwa. Among the ceremonies used to be held by Kachin tribes, Manau is the biggest and the most long-lasting festival. The descents of the Kachin family clans is based on the chant, oral history. The forefathers of the Kachins handed over their oral history generation by generation. While inhabiting in *Hkrang Hku Majoi*, the Kachin tribe had the historical event which helped them to develop a plan for the technical Manau dance. It is said that there were many banyan trees growing at only one place of Hkrang Hku Majoi. The birds were organizing at the meeting for equally distributing of banyan fruits and then they used to dance Manau dance. There was a young man called "Ma Ding Yau" in Hkrang Hku Majoi. He could understand birds' language. A young man named Ma Ding Yau had learned every detail of the Manau dance from birds and people started to dance it later on. There is a saying that people have learned to celebrate the Manau festival since then.

Manau festival is the oldest and biggest clebration of the traditional celebration which is celebrated by the Kachin People. The Kachins are identified as the people who are comprised of the tribes Jinghpaw, Lacid, Laovo, Lisu, Rawang and Zaiwa. Their main cultures are uniform. The descents of the Kachin family clans is based on the chant, oral history, which the poem and verse teachers such as Dumsa, Jaiwa, Laka, Nchyun, Gumhpoi recited in Manau and wedding ceremonies. The forefathers of the Kachins handed over their oral history generation by generation.

Every place along the route is called "Majoi" which the Kachin people settled down and reposed together. The term, 'Majoi' in Kachin indicates the particular region which is related to the time of duration. In that every 'Majoi' they have always celebrated the Manau festival.[1]

Kachin tribes used to point out the North of Majoi Shingra Bum as the original place of their ancestors. Since this place is Gobi desert in Mongolia having Zaibru hka lwi ai ginra sands, it is said that Kachin people are tribes of Mongoloids descended from Mongo upland.[2] In the oral history of Kachin, the term "Majoi Shingra Bum" is the essential word as well as the origin of their history. Until now, Majoi Shingra looks like a dream from Majoi Shingra as the word "Majoi Shingra Bum" is not precisely described. Kachin people were descended from the North to the South eventually.

The traditional belief of the Kachin is that their first great father *Pawng Yawng Wa* (a descendant of the *Duwa*) got married to the daughter of *Madai nat.* Therefore, the Duwas added a ceremony which is given a respect or dedicated to their in-law relative or *a Madai nat*. In other words, the reasons that they held the Manau festival are to make the *Madai Nat* pleased, to become the increase of prosperity, to be reproduced with paddy, rice and water resource, to receive good health; and to pray to the Madai nat for receiving these things.[3] The term '*Manau'* in Kachin Language means crown which denotes a pinacle or apex. The ruling classes, the Duwas only have opportunity to hold the *Manau* festival and offer to the *Madai* nat.[4]

Traditionally, it was believed that the Sun god were the first to celebrate the Manau festival before human beings know about the Manau festival. The Sun god invited the birds to join with them in the first Manau celebration.

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[1] Gum Ja, Lamai, *Kachin State day Speech*, Chairman of Accomplishing Committee of the Manau Festival, Jinghpaw mungdaw nsen magazine, Yangon, Moon Offset, 2010, P.15

[2] Wan hkant Aung, *hukawng Thein Hpaw,* Yangon, Thein Than Oo press, 2010, P.12 (Henceforth: Wan Khant Aung, 2010)

[3] Nang Grawng, *A philosophical study of "Nat" Worship in Relation to Christianity in Kachin culture*, Ph.D Dissertation, Department of Philosophy, University of Mandalay, 2008, P.30

[4] Felix Nlam Zau Hkawng, ***Brief History of Kachin State Day and the Kachin Manau Dance,*** Myitkyina, National Manau Park, 2009, P.3 (Henceforth: Zau Hkawng, 2009)

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It was included in the narrative of Kachin traditional folktale recited by the professional narrator of the Kachin traditional folktale (Jaiwa Dumsa). Sun land (*Jan Ga)* was the origin of the Manau celebration. The professional narrator of the Kachin traditional folktale (*Jai wa Dumsa)* keeps the value on the Sun land *(Jan Ga)* very much. However, the Kachin people were supposed that the Sun land (*Jan Ga)* was existed in heaven.

The Kachin people who are descended along the rivers, which stream out of the Tibet plateau, were separated for several centuries. So their language and dialects have also been different. They lost and left all their properties and possessions. When Kachin people migrated to Majoi Shingra Bum (Tibet highland), they became prosperous. Kachin males living in that place are called as ka-ang La ni.

At that time, there was the two famous couple among the inhabitants in Majoi Shingra region. They are a man called Shapawng Jingman and his wife Numraw Ja Nang. Chinese people also joined with them in terms of mutual relationship because of the two couple's reputation. According to the oral history of the Kachin people, Numraw Ja Nang, wife of Shapawng Yawng or Shapawng Jingman is a very beautiful woman. As she was a descendant from the snake-dragon clan, she has a bad smell in her body. Although how she tried to take a bath a lot with the water in which the herbal plants or leaves to go away the bad smell from her body, it does not go away. So finally, she could make the bad smell from her body to go away by taking a bath with Hkinji *Kumbang* grass. The traditional custom of Kachin wedding is based on that the bride has to walk over the lemon grass called *Kumbang grass* on the wedding day.[1]

Shapawng Jingman and his wife Numraw Ja Nang revealed the Manau dance, which was celebrated in Sun land (*Jan Ga*) by the ancient kachin people. According to the oral history based on the chant of Jaiwa Dumsa (the professional narrators of Kachin traditional folktale), the Kachin people had arrived to Shih Huang Ti, Chinese emperor between BC 240-210.[2] During that time, As Ka-ang La (Middle men in English) were invited by Chinese emperor Shih Huang Ti to attend to his enthroning ceremony, they brought 100 viss of *Makrat na*, 100 viss of cotton (*Pasi)* and jade presents with them to offer to Chinese king Shih Huang Ti. In their return trip, Chinese King Shih Huang Ti presented them with crown, Bar Hui fans, long sword, and long gown *(Yanghpau lawng)*.[3]

In celebrating Manau festival, the middle men (*Ka-ang La)* of Majoi shingra Bum region chose the leader called Nau shawng in Kachin, to lead Manau dance. During Manau dancing, the leader of Manau dance (Nau Shawng) have to wear crown, long knife, hold fan and wear long gown which are given by King Wanti.[4]

The Kachin tribe descended from Tibet called Majoi Shingra Bum region to Assam called Mungnun. They settled down in Mungnun region (Assam region) for ages. And continuously, they moved into Putao plain northern part of the upper Myanmar land called *Mali Hku Majoi* region from the valley of Kumon mountain range called *Hkinmung Bum* in kachin. There are blocks of gold, pieces of gold and solid of gold in plenty on the river bank of *Mali Hka.* Therefore, the men living in that region are called *Ja Tawng La ni* (Men from the golden land). They set up new land or region to settle down in that region. For establishing that new land, a strong brave man called Ja Tawng Naw Mazut led the establishment of new

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[1] Lawang Li, *Jinghpaw Wunpawng Shan i Nag Yu Hkrat wa ai Ahtik Labau Laika,* (Migration Route of Kachin), 1992, P.10 (Henceforth: Lawang Li, 1992)

[2] Brang Hpa, Jinghpaw: *Their Tradition, Custom and Religion, N.A Thesis*, Department of History, University of Mandalay, 1998, P.7 (Henceforth: Brang Hpa, 1998)

[3] Lawang Li, 1992, 15

[4] Lawang Li, 1992, 23

land in that region. Therefore, the Kachin people call Mali Hku majoi region as Ja Tawng Ga (Ja Tawng Land).[1]

After passing away King Shih Huang Ti, Mali Hku Majoi was a very useful route for Silk trade between India and China at about 3 BC. Pre-Jinghpaw inhabitants who inhabited early, in Mali hku majoi region could use the pillars made of sandstone (*Gagam ga)* when the kachin moved into Mali hku majoi. The Kachin people learned making and using stone pot from the Pre-Jinghpaw inhabitants of Mali hku majoi. Therefore, the Kachin people exchanged to call the region of making of stone pot (Gagam Di galaw ai shara) instead of the Mali Hku majoi. In other words, that region is understood as stone pot make region (Gagam di Ga). The stone pot business is still being found in the west of Putao till today.[2]

In Mali Hku majoi region or Gagam Di ga or in Putao plain land, Kanem Ing Raw, daughter of Kanem Du Wa became famous for her beauties.[3] Wanghkye Naw was one of men, who wanted to get married with her. Wanghkye Naw was famous as a rich Chinese man. The Kachin people call Wanghkye or Miwa (Chinese in English). At last, Wanghkye Naw prepared for a war and to take Kanem In Raw by force because Kanem Du wa agreed with Ja Tawng Naw to get married to her daughter. During that time, Ja Tawng Naw owned a powerful and strong empire which was organized with Jinghpaw, Rawang, Lisu people in the surrounding area. At that time, there had been a war between Wanghkye Naw and Ja Tawng Naw because of Kanem Ing Raw. In the war all Chinese people in Mali Hku Majoi region were beaten by *Ja Tawng Naw*. From that war, one poem called *Ja Tawng Naw Ningchyin* in kachin had been composed about a war which Ja Tawng Naw and group could continue to fight till in China. And the Kachin people celebrated victory Manau called Padang manau in Kachin language. As they conquered war on Wanghkye Naw, a Chinese rich man.[4]

The Kachin tribe population became increased and crowded in Mali Hku Majoi region and they have to face with the problems of different kinds of diseases. So they decided to move and find a new land again. Migrating from Malihku Majoi, Kachin people arrived in malihku Hpung nawm, today's Putao plain and the meaning of this location is the place of abundant mud or the original place of Ayeyarwaddy River. In Putao plain or malihku Hpung nawm, residing of other ethnic groups is not found. When Kachin people settled down in Malihku Hpung nawm, Dinghta masha who descended from chilly region died of Malaria. So, they moved to the mountain in Western site and stayed there for a while. This mountain is called Hkring Bum until now. Then, they moved to Malihka River in order to find a new territory in the East. As there is range of Kumon Mountains in the South West part, they gave up and tried to move to the Eastern region. This is the place located far away from downstream of Malihka River.[5]

Kachin people difficulty passed Malihka River by putting the big stones down in the place where the shallowest and the slowest stream of the river was. Until now, this place is called by Jinghpaw as "Ginru Ginsa Numrap" (former passer of the river). In Ginru Ginsa Numrap, after they had passed through Malihka River and led to the North, they noticed that they arrived in an old place in the descending route from Du Long Khu before. When they realized that they were on former route, they traced back. So, this place is named as Htang ga (the place of turning back) until now. After turning back from Htang ga, they descended to the South region and arrived in the original place of Chyai Hka stream. The geographical

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[1] Lawang Li, 1992 , 19
[2] Brang Hpa, 1998
[3] Du Wa Hkyeng La Awn, ***Ja Tawng Ningchyin hte Wayang Mung Labau*** (Ja Tawng Chant History of Wayang Land), Myitkyina, type script, 2012, P.1
[4] Lawang Li, 1992, 20
[5] Lawang Li, 1992, 20

location between Chyai hka and Phat Hka Rivers is gentle, smooth, safe from other tribes and abundant of fish and meat. They settled down in that place which is named as "Chyai Hku Majoi".[1] In Chyai Hku Majoi, the tribes from Assam region of India, Yunan state of China, border of Tibet came and lived altogether.[2] In that region, all the tribes met again to settle down there. Those tribes are Laovo (Maru), Lacid (Lashi), Zaiwa (A Zi) descended from Nmai Hka River (May Hka) and Jinghpaw, Rawang, Lisu descended from Mali Hku Majoi region. Finally, the kachin tribes cooperated together and became powerful.[3] In Chyai Hku Majoi region, Dinghta Gum Seng La Shabrang and Hpungdim Kai Nang initiated to lead "*Ju Manau*" as well.[4]

In going down from *Chyai Hku Majoi* because of increasing the population in Chyai Hku Majoi, they arrived to *Hkrang Hku Majoi* region. Hkrang Hku Majoi region was the last region of the historical places where the Kachin people inhabited together. The Hkrang Hku majoi Region brought together the Kachin society: Lacid, Laovo, Rawang and Zaiwa. The Kachin society inhabited there for many years. Therefore, it is called, Uma Ga to Hkrang Hku Region. The Kachin people usually add the word, Uma in the name of the youngest son to be used as a metaphor. While inhabiting in *Hkrang Hku Majoi*, the Kachin tribe had the historical event which helped them to develop a plan for the technical Manau dance.

It is said that there were many banyan trees growing at only one place of Hkrang Hku Majoi. And different species of birds came ate the banyan fruits at every banyan fruits bearing seasons. The birds were organizing at the meeting for equally distributing of banyan fruits and then they used to dance Manau dance that they learned from Sun Land (*Jan Ga* in Kachin) and they used to eat the banyan fruits during manau festival.[5]

The different species of banyan trees are collectively grown at only one place. Then the different species of birds eat the banyan fruits. But they were not called "banyan fruits". But the professional narrators of kachin traditional folktale (*Jaiwa, Dumsa)* called "Sut Kum Yan hpun si" to banyan fruits. There was a young man called "Ma Ding yau" in Hkrang Hku Majoi. No one wanted to deal with him well because he never did any work for his livelihood. One day, the villagers made a bamboo basket and arrested and put Ma Ding yau into it; and tied with a string to branches at the top of a banyan tree.[6] Ma Ding yau could understand birds' language because he was grown up under that same banyan tree by making a tent.[7]

Fortunately, it was coincident with the time, which the banyan trees bearing fruits while *Ma Ding Yau* was hung up under the banyan tree. He saw what the birds were talking about and how the birds performed the Manau dance.[8] The bird called "Chya-nyet u" out of the birds pronounce "nyet nyet" which means birds should eat altogether. And the bird called Nbring pri u also seconded the pronouncement of the former by pronouncing "Bring pri, bring pri", which means "Let us enjoy the banyan fruits together peacefully and righteously. The

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[1] Wan Khant Aung, 2010, 11

[2] Lawang Li, 1992,

[3] Sumlut Gam, ***Wunpawng Htunghking Labau Laika*** (History of Kachin), Myitkyina, Jinghpaw Kasa press, 1982, P.36 (Henceforth: Sumlut Gam, 1982)

[4] Ja Yaw, *Manau Dum ai Nizparat Ninghpang* (The Origins of manau), Myitkyina, Type Script, 2002, P.9, (Henceforth: Ja Yaw, 2002)

[5] Ja Yaw, 2002, 9

[6] Dashi Naw, Lawhkum Ja Doi and Sumlut Gam, ***Wunpawng Htunghking Laika*** (The Kachin Traditions) myitkyina, May offset, 2001, P.213 (Henceforth: Dashi Naw, 2001)

[7] Lawang Li, 1992, 26

[8] Zau Hkawng, *Brief History of Kachin State Day and the Kachin Manau Dance*, Myitkyina, National manau Park, Type Script, 2009, P.2 (Henceforth: Zau Hkawng, 2009)

bird called "Hkung rang u" also suggested eating the banyan fruits only after when they finish the celebration of the Manau festival.[1]

The bird called, "Kataw naw u" used to warn the birds whenever doing the meeting by shouting with the pronouncement, "bret, bret, bret...." which means "here, here, the kite are coming". At that time, all the birds usually went into the bush nearby hide from the kite hostile". When they come out of the bush, the birds had not ever seen the kite even once. For the fact of that, they could not celebrate the Manau festival. Every day, they used to be afraid of the kite and run away from the kite. The birds supposed that the bird Kataw naw u lie to them; the bird kataw Naw tricks them. So all the birds prepared to sell the bird 'Kataw Naw u" to Assam called "Mungnun Ga".[2]

All the birds request Uju Naw that has white hair on the head, to tell the fixed price. But Uju Naw refused their request to fix the price. He said that, "No, though I have this white hair on my head, I am so ignorant about the social systems; for I have this white hair as my bird-mark. So they asked the other bird called "Nga Nchyawng u" to make decision for the fixed price. And the bird, Nga Nchyawng u, having accepted their request, declares its statement: "Sam hawng, ha hawng, huk hawng, si hawng" which literally means; "Rawng[3] three, Rawng Four, Rawng Five, Rawng six." The birds were not satisfied with that price he fixed. Therefore, they went and ask the bird called "Shingbwi shun u" to determine the price again that the bird, Kataw Naw should be sold out in exchange of either Rawng 30 or Rawng 40. This suggestion is being agreed by all the committee members, and they deposed Kataw Naw u to "Mungnun Ga" (the land of Mungnun) in exchange of Rawng 40. Based on that, the Kachin people call Hkang sa joi to Rawng 40 and the amount Rawng 40 is equivalent to the coin price 140 rupees. Rawng 30 is called, "Gumhpraw joi" and the amount Rawng 30 is equivalent to the coin price 100 rupees.[4]

In the process of marriage activity, the ancient kachin usually used *Hkang sa joi* and *Ru Joi* as the fees for raising daughter (Bride price). Viewing that fact, the Kachin tribes lived with Shan tribes very closely during dwelling in *Hkrang Hku Majoi* region. In that time, the Kachin tribes were supposed to use silver coins.[5]

After the bird "*Kataw Naw u*" had been sold out, the birds continued to conduct the meeting, but the birds were eaten by the kite till the bird generation is gone. Therefore, they discussed to call back the bird, Kataw Naw u from Assam. In this way, the bird, *Kataw Naw u* is carried on the back of the bird called Ubyit La in the journey back to Hkrang Hku Majoi. The bird, Kataw Naw u was so worried for the bird Ubyit La is so tiny its physical size is just one-half smaller when it is compared to *Kataw Naw U*. The bird, *Kataw Naw u* becomes less and less confident about being on the back of *Ubyit La U*, so *Kataw naw U* holds around the neck of *Ubyit la u* tightly. The longer distance of trip *Ubyi La* is taking, the lesser confidence *U Kataw naw* being upon its space flight. Consequently, its holding arms around the neck of *Ubyit La* slowly tightens and they finally cause the crop of *Ubyit La* to trun up and dislocate at the back side of the neck.[6]

As the journey is so long, they prepared to stop. While doing to stop for a while at Hkin du yang village, Mali Hkrang Walawng region, the bird, *Kataw Naw U* fell down from

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[1] N-gan Tang Gun, ***The Origins of Kachin Manau***, Myitkyina , Moon Offset, 2011, P.17 (Henceforth: Tang Gun, 2011)

[2] Tang Gun, 2011, 18

[3] Rawng one is equivalent to unit of money, (2.50). This system of exchange rate has been used in Kachin land during the British administration. With the effect from theis traditional folk lore, kachin culture adopted it and used Rawng 30 in equivalent to 100 Indian rupees and Rawng 40, in equivalent to 140, Indian rupees.

[4] Dashi Naw, 2001,215

[5] Sau Ka-mai,*Beyond the Himalaya Evidence of our Ancestors*, Kachin Research Journal, Laiza Sinpraw Majoi Manau Wang, 2009, P.91 (Henceforth: Sau Ka-mai, 2009)

[6] Dashi Naw, 2001, 215

the back of the bird Ubyit La. The final result is that *Kataw Naw U is* badly damaged and wounded on the buttocks because of the thorny bushes of *Hkindu* grass. From that time, it said that Kataw naw has owned the blood stain red colour on his buttock.[1]

When the bird, Kataw Naw u arrived, he was again coincident with the time to fruit the banyan fruit. The Manau festival working committee delegated the task to celebrate Manau festival and to eat the banyan fruit righteously and systematically as follows.

(1) To "*U Ra U……* " the Manau priest *(Manau Jaiwa)*, a professional narrator of Manau festival to recite on history, its traditional story from the very beginning;
(2) To *"Uka la U"*----- the teacher, preacher and a priest of Manau *(Manau Hkinjawng and Dumsa)*
(3) To "*U Krang Naw*"------ the future-fortune teller (*ningwat Dumsa)*
(4) To "*U Gum U*"---- the priest of the third order being assistant to a priest of the first order. *(Hpung Lum in Kachin)*
(5) To "*U Hkru Tu*"----- the pounder of rice
(6) To "*U Gam U*"---- to collect food for the Manau celebration
(7) To *"U Ri U"* ---- the collector of vegetables for the Manau celebration
(8) To "*Chyik Taroi U*" ----- the cutter of raw meant into pieces for the cooks.
(9) To "*U Graw U*"---- the bundler of Manau food into package *(manau si shat makai);*
(10) *To "Kumba Udut U"* ----- the beater of the Manau drums (Manau chying dum)
(11) *To "Tsau GawngU"* ------ the player of the Manau gong
(12) *To "Uyen Gawng U"* ----- the general cleaner during Manau celebration
(13) *To "U Yung Yu U"* ------ the census taker or registration manager (Jahpan hta)
(14) To "*Shingra Set U*" ---- the master of ceremony during the Manau celebration
(15) *To "Chyanyet U"* ------ the announcer for the Manau food to eat equally
(16) To "*U Tu U*" --------- the distributor of the Manau food.
(17) To *"Nbring Pri U"* ---- `the peace maker at the Manau festival
(18) To "*Tsau Gawng U*" ----- the in charge to be an inviter for the manau festival
(19) To "*Kataw Naw U*" ------ the security in charge of the Manau festival
(20) To *"Lamung Sinwa U"* ------ the Leader of Manau dance

The birds above participate to take the responsibility and role, so the presentation of the Manau dance is in the highest point.[2] All the birds are taking their respective responsibility. Although some birds are employed in the Manau festival, they participate in Manau dance. The Leader of one Manau festival is "*Hkung rang U*"*."Lamung Sinwa U" is* leading director of the Manau dance called *"Nau shawng"*. While demonstrating the Manau dance, at lunch time, "*Utu U" distributes* the food. "*Utu U"* distributes food by looking the physical size: small or big. Utu U pronounces in spoken words like this, *"Dari a gaw dari, Dara a gaw dara"*which means distributing amount of food by looking physicall size: small or big. Since then, the proverbs, "Dari a gaw dara, Dara agaw dara" was initiated to appear.[3] The words of orientation enrage "*Shingra Set U"*, who is a master of ceremony of the Manau celebration. Though a tiny bird, it has a long sword. It goes straight to Utu U, while still speaking, and strikes Utu at the middle of the head. The blood bursts out and the body of *Shingra Set* is all covered by it. This traditional narrative makes the Kachin people believe that *Shingra Set U* becomes a beautiful blood stained bird since that time.[4]

Hkung rang U, leader of Manau festival accomplishing come to appear the social problem. Hkung rang U stays away from home because he has been busy with the administration. However, he keeps the confidential matter and finance matter. As a result of this, U Ka La, Hkinjawng (animist priest) has been fall in love with Madam *Hkung rang U* when implementing the above matter.

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[1] Tang Gun, 2011, 17
[2] Tang Gun, 2011,17
[3] Sau Ka-mai, 2009, 9
[4] Tang Gun, 2011, 30

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Madam Hkung rang U becomes to be pregnant of *U Ka La*. She has lost her conscious mind because of her shameful behavior. From that time, other birds criticize on Madam *Hkung rang* U that she lost her conscious mind is brainless. The Kachin people base on the *Hkung rang U* for her shameful behavior; they usually criticize the persons who have been shameful for their indecorous action. Finally, the bird gets to be born is called, *'Gawle Hka U'*.

The problem in which the *Manau* festival gets to face is that the *Shingtung U* has not got any beautiful costumes to wear at *Manau* festival when she is invited to join. She thus refuses to join the *Manau* celebration. Therefore, every birds share one feather each. At last the bird *Shingtung U* gets beautiful feathers. As a result of that, the bird *Shingtung U* become to be proud of her beautiful feather very much. The bird *Shingtung U* failed to give a respect to other birds. *Shingtung U* becomes to be selfish. Therefore, all the birds circle *Shingtung U* and pull out the feather dress. Shingtung U also gets to be shameful. Based on that, the Kachin people usually remind if someone is too much proud, by calling the name of the bird Shingtung U.[1]

The *Shingtung U* felt lonely and was half naked, finally walks nearby the local village of humans and it becomes friendly with domestic hens and cocks. Soon after developing friendship, a cock sings to attract *Shingtung U* to mate. Eggs are hatched and as a result young chicken called *'Kaitawng U';* are raised. These chickens remain half naked. The Kachin elders, ancestors and leaders used to tell this story when they want to admonish their younger children and urge them to be faithful and friendly to people of all walks of life, in the time of poverty and in the time of wellbeing.[2]

After getting danced, the *"Kahpu kanau"* called the bird brothers who are related to each other, picked up banyan fruits from the eastern part and eat together called *"Sut Kum yan hpun si"* by pronouncing the spoken words, *"Wa tsit nawt ai"*.

The birds relative, *Dama* from the side of son–in-law say, the spoken words, "lahpaw set ai" and they picked up and eat banyan fruit in the upper reach of a river called in Kachin *Hka nam*. The bird relative of *Mayu,* the group from the sided of daughther–in-law pick up and eat the banyan fruits in the topmost part of a river called in Kachin, *"Hka hku"* by saying the spoken words, "Mading grim ai".

When celebrating the Manau festival, according to the style and behavior of the birds, the Kachin people divide dancing time as follows: the bird siblings relatives dance by pronouncing the spoken words, *"Wa tsit nawt"* as well; the birds relative Dama, the clan of the groom side celebrate the Manau dance by pronouncing, *"Lahpaw set "as well;* and the bird relative *Mayu,* the clan of the bride dance by pronouncing, *"Mading grim"* as well.[3]

During that time, the rich couple, *Jawa Rum Ja* and his wife *Madai Ma Hpraw Nga,* was preparing to celebrate the *Sut* Manau festival in *Hpu um* region from the Hkrang Hku majoi. Jawa Rum Ja call back *"Mading Yau"*, who was hung up on the banyan tree, because *Mading Yau* understands the bird language and has learned a technical system and practical function of Manau from the birds. At last *Mading Yau* is appointed to be a leader of Manau committee on behalf of Ja Wa Rum Ja.[4]

The Kachin propitiate six benevolent spirits and celebrate the Manau festival by uprightly installing six Manau dance poles, one for each of those lord spirits.[5] There must be at least four to at most twelve Manau poles to be installed a Manau frstival in to celebrated. The practice is different from place to place. The latsai hpun (Margosa wood) is used for making Manau poles. The two poles in the middle are called Dungla, other two slightly shorter poles flanking beside are called Dung-yi and Dung-noi, the other four poles crossing each

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[1] Tang Gun, 2011, 30
[2] Tang Gun, 2011, 33
[3] Dashi Naw, 2001, 217
[4] Tang Gun, 2011, 33
[5] Tang Gun, 2011, 94

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other are called Dung-chyai, and two Dung bye poles with the heads of Hornbills symbols and one Dung tep pole, all make twelve in number.[1]

At the foot of Manau pole is a picture of Hornbill (Hkung rang U). The pole with a hornbill on it is called Dung-bye. The Hornbill symbolizes the bird which led the Manau dance long before human beings learned to dance Manau and its picture is used to remind people of the manau leader the Hornbill.[2]

Long before the Kachins celebrated Manau communal dance, Hkung rang U (Hornbill) took the leading role the Manau among the birds. For the sake of remembrance, Hkung rang U (Hornbill) pictures are depicted on the Manau poles. There are nine pictures drawn between Hornbill head Hkung rang baw and Hornbill tail Hkung rang mai tsan depicted on the Manau pole. Those pictures are:

1. Shata (the moon)
2. Shagan (the star)
3. Nga Sumla (fish)
4. Lagat gatkung (beehive)
5. Lanung Sinwa (black king bird)
6. Chying (Manau drum)
7. Bau (gong)
8. Nga nrung (buffalo horn)[3]

Lanung Sinwa (black king bird) is the leader of all birds. This black king bird is leading all kinds of birds in unity.

When Kachin tribes arrived at Hkrang Hku Majoi, Jawa Rumja could celebrate the Sut Manau festival, the ritual of Madai nat. This Sut Manau was the very first Manau festival of Kachin people. The earliest Sut Manau festival of Jawa Rumja had been celebrated at Hpu-um-Ga (Triangle). Hpu-um-Ga had been known as a village over a thousand years and an old place where Kachin tribes had inhabited. Later, Sut Wa madu, grandson of Jawa Rumja, moved from Hkrang Hku Majoi area to the north, the west mountainous are of Hkrang Hka, for exploring a new land. Then he arrived in a land named Kadit yang and he built villages and settled there. In Kadit yang, Sut Wa madu held a Sut Manau festival based on the idea of Manau dance of his grandfather Jawa Rumja. He named the place of the festival as Naura Yang (Dancing Floor) and the name of the place remain and well known until now. This Manau festival is known as the second one of Kachin ethnic.[4]

Marip wa Kumja Ma Gam held Kumran Manau festival at Ning Rang Ga and this was the third manau festival. After this, Matsaw Wa Nhkum celebrated another Manau festival, the fourth Manau festival of Kachin tribes. It is known that a monument of 15 feet width and 10 feet high, together with a banyan tree, was planted in Ning rang Ga area by marip Wa KumJa Ma Gam and Matsaw wa Nhkum. This evidence shows that all the Kachin tribes had been living in Ning rang Ga.[5] The third Manau festival that held in Ning rang Ga is found in the east of Malihkrang Walawng Htingnan village and is 40 miles from Sumprabum.[6]

In conclusion, the Kachin spirit priests, *Dumsa Jai Wa*, have recited Kachin mythology, folktale and oral history before celebration of marriage, *Manau festival*, harvest festival, house warming ceremonies and so on. In the recitation of *Manau* dance, the spirit priests usually include the detail of the origin of *Manau* dance, which was said to be learned

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[1] Roi Nau, 2014, 176

[2] Tu Lum, J.P, ***Kachin Yoeya Manau Pwe*** (Manau Festival), Myitkyina, Hanson Press, 2009, P.23

[3] Kachin Time, ***Shdung Dungbat***, Myikyina, Padang Offset, 2015, P.42

[4] Dashi Naw, 2001, 44

[5] Dashi Naw, 2001, 45

[6] BZ, Zau Li, ***Wunpawng loe Hkaw de Kachin Lumyo*** (The Kachin Named Wunpawng), Yangon, Nan Thazin press, 2016, P.36

from birds. They also recite a pedigree of the Kachins, their settlement, traditions, customs, and festivals.

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A Study of Lhao Vo Culture

Zung Wang[1]

Abstract

Lhao Vo, one of the 135 Myanmar national races, particularly resides in the *Maykha and Malikha* River basin in Myanmar with a population of more than 60,000. According to the record, it is known that the *Maru* who would become Lhao Vo, stayed Ngo Laung Ban, northern Sichun state, China in 12 A.D. Culture is the lifeblood of every tribe and nation. Therefore, researcher chose this topic and conducted this research paper. The main purpose of this paper is to promote and preserve the culture of the ethnic group and to better understand the cultural history. For the compilation of this paper, descriptive and field research method is done. Related data were collected through some published data and interviewees. By studying the scarce pieces of evidences, it is believed that the suitable period of *Lhao Vo* migration into Myanmar should be about 1500 years ago. Since the ancient culture of *Lhao Vo* tribe is a soundly sleepy history, it is hard to take accurate dates. As the primary sources are rare, it is written based on *Lhao Vo* oral history, and this paper cannot be written in order of historical periods but written as a whole. This research paper is also a precursor to further research on culture, custom, tradition of ethnic history. It will also create a sense that future generations will need to preserve cultural heritage.

Key words: settlement, pedigree, literature, administration, festivals

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Introduction

Lhao Vo had been migrated, from the upper reaches of *Yangtzi* river, in northern *Sichum* province, to the *Maykha* valley in the northern Myanmar, following along the line of *Mekong* and *Thanlwin* rivers. According to the historical records, migration began in about 12 century A.D., it is estimated. The raison deter of *Lhao Vo* It's estimated that migration was said to be the attack by the Mongol on the *Nanchao* Kingdom at *Tali,* in the northern extreme of *Yangtzi* province.[1] Proto – Burman had found lived in the doab of *Maykha* and *Malikha.* [2]Therefore, it can be said that *Maru* or *Lhao Vo, Ahzi* or *Zaiwa* and *Lashi* or *Lacheik* are of that of Proto – Burman group. Among them, *Lhao Vo* had been settled at the villages of *Chaungde* (the village where the water, oozing out from the stone flows) and *Ngayaw* (the village where banana groves are found), in the *Htawlan* village tract, *Sawlaw* township. The highest numbers of *Lhao Vo* are found settled in the *Htawlan area* (NU – 1006). But they spread up to the *Sadon* area (SD- 6551). Thus, in practical term, these people have lived between the latitude 25° 30' North and 27° 00' North.[3] This fact can be attributed to be the reason for the similarity between the languages of *LhaoVo* and Bamar, such as archaic words and current words.

Settlement of Lhao Vo

Lawkhaung, one of the principal settlement areas of *Lhao Vo* is once the headquarters of the secretary for Hill tract Administration. In this area are included *Maykha* valley with *Chiphwekha* valley (SE – 0299) and *Tanukha* valley (SD – 8791), the later two emptying into the former, *Lawkhwang* area is bounded in the north by the jurisdiction of *Sawlaw* hill tract chief, in the northeast and east by *Htawgaw* hill tract chief, in the southeast by China, in the south by *Sadon* mountain ranges and in the west by triangle region in the west of *Maykha* river. Till 1910, *Lawkhawng* remained a village of *Lhao Vo* tribe. At that time, the British had built a fort at *Htawgaw,* about forty miles in the northeast of present day *Chiphwe* town, from where Deputy Secretary for Hill tract administration, ruled *Chiphwe* and *Lawkhawng* areas. In 1930, the headquarters for Hill tract Administration moved from *Htawgaw* to *Lawkhawang.* From this new place, the British ruled *Htawlan, Chiphwe, Mankyi, Sawlaw, Htawgaw, Sadon, Nozumbaw* and *Panwa.* When the British withdrew from *Lawkhang* in 1942, Kuomintang forces ruled these areas. On 27 November 1943, Japanese forces occupied these areas. Soon, Japanese forces were being repulsed by the *Lhao Vo* people, who, on account of Japanese atrocity, joined with the American Levy Rangers in going against the Japanese. From 1944 to 1948, *Lawkhawng* remained as a hill tract administrative area. In the independence era, in 1951, Yokchaung Duwa Shawng Gyung" was elected to the parliament as the nationality representative for the *Lhao Vo* people. According to 1955 data, in the *Lawkhawng* hill tract chief jurisdiction were included twenty – one Daing area, 143 villages, and 1565 houses, with 8867 peoples. *Chiphwe, Lanngyaw* (NY – 9803) and *Mukhaung* (NY – 9607) were biggest and most populous villages, where *Lhao Vo* predominated, with some mixture of *Lashi, Lisu* and a few Chinese. When the Frontier Administration began in 1960, *Lawkhawng* became frontier district town.[4] In the study of *Lhao Vo* people, *Lawkhawng* village on the *Lawkhawng* Mountain cannot be Passover, for it is a historical place for the people in term of their culture and their Socio – cultural life.

Another place, where a large number of *Lhao Vo* peoples are residing, is the *Sawlaw* area, which was constituted in November 1955, by separating it from the *Htawlam* region. The first hill tract chief of the newly created *Sawlaw* area was *Duwa Gyung" Dau*, a *Lhao Vo.* Under the hill tract chief, there were fifty – six administrative units, fifteen hill tract heads, forty-two *Duwas* and eighty village headmen. *Sawlaw* region encompasses primarily *Maykha* valley and the lower part of *Ngawchankha* valley. It is bounded in the north by *Htawlam* area, in the east by the upper part of *Ngawchankha* valley of *Htawgaw* area, in the south by *Htawgaw* and *Lawkwang* areas and in the west by Triangle area of *Sumprabum* region. According to the 1955 data, there were forty-six villages, 575 households with 3405 peoples

in *Sawlaw* area, where *Lhao Vo* forms the majority, with small minorities of *Lashi* and *Lisu (yawyin).*[5] The other area, where *Lhao Vo* lived and prospered, is *Htawlan* , bounded in the north by the jurisdiction of *Khaunglanphu* hill tract chief, in the south by the jurisdictions of *Sawlaw* and *Htawgaw* hill tract chiefs and in the west by Triangle region.

In *Htawlaw* area, *Lhao Vo* people mostly live in the *Maykha* valley, *Makkharami* valley (NU – 2428), *Armak* valley (NU – 3343) and *Lakinchaung* valley (NU – 1302). According to the 1955 data, there were ninety-eight villages, 575 house- holds with 5692 people. The administration of *Htawlan* was divided into thirty – one units. Under the hill tract chief were five hill tract heads, and a total of 122 Duwas and headmen.[6]

Among the *Lhao Vo* settlements, the most outstanding are those of ancient sites, known as *Labyu* cave and the Bat cave. *Labyu* cave is located on the *Shanban* Mountain, four miles in the northeast of *Chiphwe* town. *Lhao Vo* people also call *Labyu* cave as *Lbyu* corner (*gyaung*), in that *Labyu* means the origin of ancient man and corner (*gyaung*) stand for cave. The cave is also known as *Wamhte* cave, after the fact that, the area was administered by the *Lhao Vo* nationality Wamhtezok Khao Leim". Facing to the north, the entrance of *Labyu* cave has a measurement of six feet into four feet. Just after the entrance, there is a large chamber measuring about thirty feet in breadth. On the wall of it is what the blurred wall paintings seemed. From this chamber, one can precede to the interior throng the three openings, each measuring about nine x nine feet leading to north, east and south directions. By the condition of cave structure, it can be assumed that, it is a Neolithic site. Local *Lhao Vo* people also thought that the cave is their forefathers growing ground. All these facts show that the distribution pattern of *Lhao Vo* settlements depends upon the geographical distribution mountains, plains and valleys. As *Lhao Vo* people settled at the places mostly in the plains and valleys, villages and towns emerged and developed there. On the mountainous area, as the people settled temporarily, no big settlements of towns and large village, but small villages only can be found. Therefore, some small settlements had already been disappeared.

Genealogy

It was said that such nationals of *LhaoVo, Lashi, Mengsa, Phoon, Danu, Intha, Taungyo, Dawei and Rakhine* lagged behind Myanmar, who descended down to the *Kyaukse* plain in 9th century A.D., from northern Shan plateau passing Yunnan highland in China.[7] Among them, Rakhine people went to the west, *Intha, Taungthu* and *Taungyo* proceeded to the east and *Lhao Vo, Lashi* and *Azi* went on staying on the northern mountains.[8] These facts are attested by the linguistic studies, for example,

Bamar	**Lhao Vo**	**Jinghpaw**
A phay	*A - pho"*	*Ah Wa*
Ah may	*A – myhi"*	*Ah Nu*
Yaukkya	*Yauggai*	*La*
Meinma	*Myi: qe:*	*Num*
Thami	*Zo: Myi:*	*Sha yi sha*
Yaukkhahti	*Yaug pho"*	*Ka tsa*
Let	*Lo,*	*Lata*
Chay	*Khyid*	*Lagaw*
Na	*No:*	*Na*
Chaungso	*Khyaung: Zhug'*	*Jahkru*
Htaungthi	*Thaung ra"*	*Htu ai*
Kaungthi	*Gai: ra"*	*Kaja ai*
Makaungbu	*M – gai*	*N - Kaja*
Nga Ah may	*Nga" Myhi"*	*Nye Nu*

The very term *Lhao Vo* indicates the word *Lhao* standing for **"North"** and *Vo* meaning **"Group" or "Community", implying "the group that lives in the north".** Sometimes, these

people are called as the persons who live along the stream. The *Lhao Vo* tribe is made up of six sub-tribal groups, namely;

1. Jyunphauk (*Jeim Phaug'*)
2. Lanin (*La Nhae*)
3. Gachaung
4. Chawdong (*Cao: Dung:*)
5. Gyumzam (*Jeim Zang*) and
6. Zawbok (*Zao" Bug'*)

But now, according to the study of *Lhao Vo* people, their tribe is consisted of the following sub-tribal groups;[9]

1. Bar ne (*Ba Nhae*)
2. Baw ne (*Bo" Nhae*)
3. Chaw ne (*Cao: Nhae*)
4. Gelan awng lauk ne
5. Khawng ne (*Khaung: Nhae*)
6. Kha ne (*Kha: Nhae*)
7. La ne (*La Nhae*)
8. La phawk ne (*La Phaug' Nhae*)
9. Hmyaw ne (*Myao: Nhae*)
10. Phawk ne (*Phaug' Nhae*)
11. Wu lan ne (*Vu Lam" Nhae*)
12. Wu ne (*Vu Nhae*)
13. Tawng ne (*Tau Nhae*)
14. Htan ne (*Thang: Nhae*)
15. Zaw ne (*Zao" Nhae*)
16. Yaw ne (*Yao Nhae*)
17. Zan ne (*Zang Nhae*)

Other tribal brothers call *Lhao Vo* variously, Such as:

Maru	by	*Jingphaw*
Lalaw	by	*Rawang*
Lamwu	by	*Lacheik*
Lanwa	by	*Azi*
Chawpha	by	*Lisu* and
Lansu	by	the Chinese people.[10]

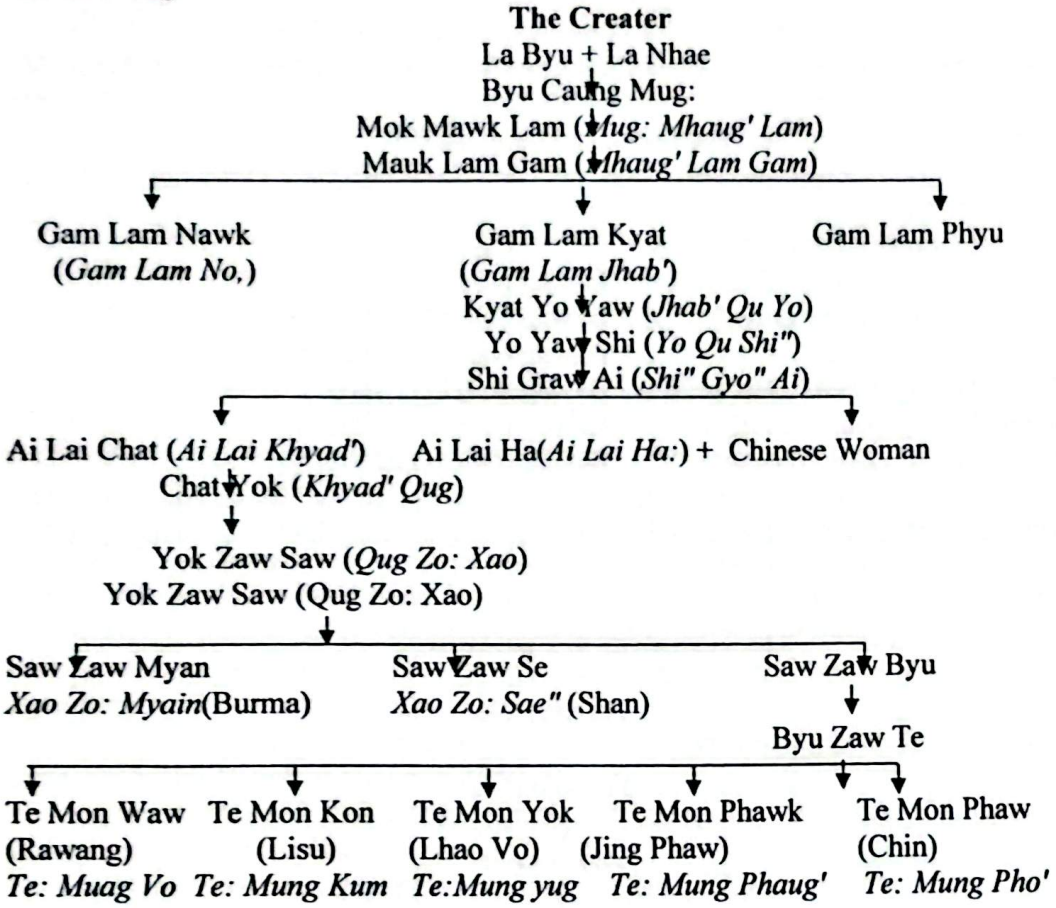
In these attributions some are found offensive, such as ***Maru*** by *Jingphaw,* which means **prurigo** implying **blockhead.** For this reason, the Cultural Department of Kachin State issued to call them *Lhao Vo* on 20 August 1969.[11] Then, at the inauguration ceremony of *Lhao Vo* literature, on 30 April 1974, Lawkhawng Duwa Shawng Gyung" put up a proposal, denouncing the use of ***Maru*** which was supported by Duwa Phug' Jaung Dau Hhao". On 9 October 1994, the *Lhao Vo* literature and Culture Committee sent a letter to the State, dated 9 October 1994, letter No. Layama – 15/94, requesting to call them ***Lhao Vo*** as the tradition dictate. Therefore, the Kachin State Law and Order Restoration Council issued an order; dated 18 April 1995, letter No. 113/ 1-1/ pasata (Kachin), notifying all the people and organizations, to use the name ***Lhao Vo*** regarding them.[12]

With regard to the origin of *Lhao Vo*, the legend had it that, there were two brothers, by the name of Kha Ye Nawng and Kha Ye Gam, who were natives to the *Nga Lawng Bam* region, where the six great rivers take their sources. The two brothers in due course, migrated to the areas where tender grass and clear water are there. First they migrated to the village of *Mashaw,* then to Gum Ma Kyaw, then to Dum Ngut and finally to Wa Sut, where the two brothers diverted from one another, Kha Ye Gam following along the line of the river, who later became **Bamar** and Kha Ye Nawng went on stayed behind on the mountains, who later

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became known ***Lhao Vo.*** This story is widespread on the mountains and thus regard that Bamar and *Lhao Vo* are brothers by blood since the days of forefathers.

Another story was like that once there lived Mug: Lam Gam at *Nga Lawng Bam* region. He had three sons, called GamLam No, (the black), Gam Lam Jhab' (the Yellow) and Gam Lan Phyu (the white). Among them, the pedigree of Gam Lam Jhab' was said to be like the following:[13]



By the above pedigree, Te Mon Yok was the progenitor of *Lhao Vo* people. It went on said that Te MonYok had nine sons, from them, the present day *Lhao Vo* tribal groups came into existence, namely;[14]

1. from Yok Mon Chawng (*Yug Mung Khyaug'*)- Gyum Phawk and La Phawk clans
2. from Yok Mon Htan (*Yug Mung Thang:)* - Saw Hne, Yaw Hne and Gyami La Pha clan
3. from Yok Mon Phaw (*Yug Mung Phyug*)- Tawng Hne and Htan Hne clans
4. from Yok Mon Zaik (*Yug Mung Zag*) - Zaw Bok clan
5. from Yok Mon Htawk (*Yuug Mung Thaug'*)- Myaw Hne clan
6. from Yok Mon Gyan (*Yug Mung Gyain"*) - Zan Hne clan
7. from Yok Mon Phyok (*Yug Mung Phyug'*)- Baw Hne, Ba Hne, Khawng Hne and Kha Hne
8. from Yok Mon Cham (*Yug Mung Gu)* - La Hne clan
9. from Yok Mon Axi (*Yug Mung Aung)*- Ge Lam and Gyi Hne clan.

The merit of these stories is that both stories tell some truth about the racial origin of *Lhao Vo* people and their brethrens in Myanmar. Mhaug' Lam Gam's three sons of Gam Lam No, Gam Lam Jhab' and Gam Lam Phyu can be analogized into those of the great race of the world: Europoid (the white), Mongoloid (the yellow) and Negroid (the black). As we all know, all the races of Southeast Asian and East Asian countries are the offspring of the primal

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Mongoloid. Like that, Gam Lam Jhab' (the yellow) had his progeny of a range of racial ethnic and tribes in Myanmar, where all the national races of the country are those of Mongoloid origin.

Nevertheless, *Lhao Vo* belongs to the Tibeto – Burman group, from which Burmese and Proto – Burmese groups appear, who migrated from the Asian central highland to the mountains of Burma, following the valley of Maykha. The above mentioned tribal groups are different, only in their localities, not in the costume culture and traditions.

In naming heir sons and daughters, *Lhao Vo* have included the name of father, for instance,

U Gyon Dawng (*Gyung" Dau:*)

Son	Daughter
Dawng Khaung (*Dau: Khao*)	Dawng Naw (*Dau: Nao"*)
Dawng Lwam (*Dau: Leim"*)	Dawng Noi (*Dau: Nyoe:*)
Dawng Ze (*Dau: Zo*)	Dawng Nan (*Dau: Nain"*)
Dawng Haung (*Dau: Hao"*)	Dawng Se (*Dau: Nhae"*)
Dawng Zaung (*Dau: Zaung"*)	Dawng Lam (*Dau: Lham*)
Dawng Gyom (*Dau: Gyung"*)	Dawng Nyee (*Dau: Nyi"*)

This naming practice looks like that of the genealogy of Pyusawhti, the legendary king of ancient Bagan. Such practice can also be found in China from the Nan Quing dynasty onwards.

The Genealogy of Pyusawhti[15]

Hti Min Yin
↓
Yin Min Paik
↓
Paik Thayle
↓
Thayle Kyaung
↓
Kyaungdurit

From this fact, one thing we can say its that this is the attestation to the *Lhao Vo* claim who asserted that they are the people of ancient culture and race.

In the study of the history of a national race, the kinship system is very important. According to the community of Kachin race, there are three kinds of kinship.[16] These are

1. kinship along the line of brother[17]
2. kinship along the line of mother-in-law[18]
3. kinship along the line of son-in-law[19]

However, kinship can be relative of only three kinds mainly; by clan, by marriage and by adoption. Of the kinship, the ones from the line of father are regarded close relatives. Uncles from the line of father are called Phamaw (great father – *Aphaygyi*), *Ah Lae* (middle father *Aphaylat*) and *Angaing* (youngest-father – *Aphayhtwe*).

The English who met the *Lhao Vo,* living at the confluence of *Maykha* river and *Mali* stream (NU – 2428), called them as *Nan Wa* or *Nan Waw* tribal group. The English also called them as *Marume* (Black Maru), for the complexion of these people are of dark colour, due to not taking bath. However, the name *Nan Wa* or *Nan Waw* might be a corruption of *Lhao Vo* by the British, which is the appellation of the people themselve.[20]

According to the Oral History of *Lhao Vo*, there were four principal villages, where *Lhao Vo* had been settled since about 200 B.C.,

Gadan Galawmok (B.C. 200 – 100)
Zaelaung Wahangaung (B.C. 100 – A.D. 200)
Lukhumok (A.D. 200 – 900)
Chaungdeyaw (A.D. 900 – 1400)

Of these four villages, the village *Chaungdeyaw* still exists today in *Sawlaw* Township. It is said that *Chaungdeyaw* was the first village, where *Lhao Vo* had settled, when they entered Burma. In Kachin State, majority of *Lhao Vo* can be found settled at the following places;

1. *Maykha* valley centered *Htawlan*, covering *Armetkha* (NU – 3343) valley in the north and eastern triangle region
2. The lower valley of *Ngaw Chamkha* (NZ – 2835) in *Lawkhawng* area and *Phyephat* mountain between *Lawkhawng* and *Htawgaw* (NZ- 1623)
3. the *Shin Ngawkha* valley (BD – 6581), a tributary of *Maykha* river
4. the region in the south of *Sumprabum*
5. Sadon and Bhamo areas.[21]

At present, *Lhao Vo* are found settled and mixed with other nationals. The question of when *Lhao Vo* came into Myanmar is hand to answer. But *Phaunggyan* village (NZ – 0897) in the south of *Htawlan* Mountain is one of *Lhao Vo* centers. According to Duwa of *Phaunggyan* village uttered in 1957, *Lhao Vo* have been settled there for about twenty – five generations. By the words of Duwas of *Khayankaung* village (NZ – 0867), about eighteen generations of Duwas have been ruled there. So also the long rule is found in villages of *Mangyi* village (NZ – 0662) and *Sawlaw* village (NZ – 0548), for about fifteen generations of Duwas.[22] If we take sixty years for a generation of Duwa, the ruling period of these Duwas will be found covering about 1500 years, indicating they had been there for more than 1500 years before.

Depending on their localities, various patios are found in the speaking language of *Lhao Vo*. Major Patios of the people are:

Dagot Laungbit dialect (*Zaungbok* dialect), spoken at places of Chiphwe,Sawlaw, Waingmaw and Myitkyina.

Gayammawk dialect, spoken at places of Sumprabum
Htawlan dialect, spoken at place between Sawlaw and Putao.
Lasu dialect, spoken at places where *Lhao Vo* settled with Rawang people.
Banshay dialect
Lakein dialect

The last two dialects are now near extinct. Therefore, effort should be made to maintain and sustain these dialects, as a national heritage of the Union Nationals.

Different dialects may mean that different tribal group distinguish themselves by maintain their own dialect. Sometimes they keep their identity by family names. There also are some indistinct patios, such as *Warmyit*, *Phaunggyar* and *Myitshazaw*, which are local dialects, only different in stress and intonation. In the Upper reaches of *Maykha* River, there are such villages of *Lakin*, *Waryoke*, *Temyi*, *Byilaung* etc. each of which have their own dialect, but speak *Zaungbok* dialect in common communication. The *Lhao Vo* who settled from the *Pakawk* village (NZ – 0675) towards south, till the northern part of Bhamo and places in Shan State, speak the Angaung Ongngaw dialect. The *Lhao Vo* tribe as a whole, more or less understand this Angaung Ongngaw, for which it can be regarded that this dialect is the common spoken language of the tribe. It is said that Azi and Lashi languages are the offshoots of this Angaung Ongngaw language.[23]

A distinguishing feature of *Lhao Vo* language is its near similarity, with that of Burmese language. Though there are some differences in stress and intonation along with the usage of words, *Lhao Vo* language is near similar to that of Burmese language. The following

comparison between the two languages shows some similarity. Words are directly translated into English.

English	Burmese	Lhao Vo
hand	let	Lo,
feet	chay	Khyid
ear	nar	No:
I	nga	Ngo
fish	ngar	Ngo:
join	set	Xe'
horse	myin	Myao:
monkey	myauk	Myaug
moon	la	Lho"
fire	mi	Myi:
cough	chaungsoe	Khyaung: Zhug'
hundred	taya	Da Yo
soap	satpya	Sa" Pya:
six	chauk	Khyaug'
ten	tase	Da Xe
father	Apay	A - Pho"
mother	Amay	A – Myhi"
husband	yaukkya	Yaug Gai
wife	meinma	Myi: Qe:
daughter	thami	Zo: Myi:

This close similarity may mean that *Lhao Vo* language might come out of the early Burmese language.

Literature

Of the development of a people, literature plays a key role. In the recognition of a people as a race, there are three criterions: land, people and literature. Only the national race with these criterions can establish a country or a state. Though some people have the occupied land, they could not establish a country, for they lack literature. Here, it can be found that literature is a crucial benchmark, for a people in attaining the full-fledged race hood. In the case of *Lhao Vo* people, this criterion is more pronounced. According to the oral history of the people, they once had their own literature. However, there is no hard evidence, to support this claim. But in about 1930, *Lhao Vo* people had formed a literature Committee, which tried to invent the *Lhao Vo* literature.[24]

The committee invented *Lhao Vo* literature, by the help of Christian missionary Robert Moss, who resided at that time in *Putao*, using the Roman alphabet. But as it was not satisfactory, the *Lhao Vo* literature Committee was again reformed, on 8 May 1965. On the 21 of December 1968, U L-Hhung: Hhao" Leim" [25] successfully completed the invention of *Lhao Vo* literature, based on the thirty – six Roman alphabet. Then, the committee went on teaching programs on the newly created national literature in total villages of *Lhao Vo* people, in the years 1969, 1970 and 1971. On the 25th of March 1974, the first *Lhao Vo* primer, ever printed, came to appear. On March 30, 1974, the inauguration ceremony of *Lhao Vo* literature to the people of *Lhao Vo*, was held.[26]

The *Lhao Vo* literature consists of twenty-one consonants, five vowels, eight compounded vowels, twenty-five compounded consonants and six devowelizers.[27]

Twenty – one consonants are

B. C. D. F. G. H. J. K. L. M. N. P. Q. R. S. T. V. W. X. Y. Z.

Five vowels are

A. E. I. O. U.

Eight compounded vowels are

AE. AI. AO. AU. AUI. EI. OE. UI.

Twenty – five compounded consonants are

HH. JH. KH. LH. MH. NH. PH. QH. RH. SH. TH. VH. YH. ZH. MYH. NYH. NGH. BY. GY. KY. MY. NY. PY. KHY. PHY.

Six devowelizers are

B. D. G. M. N. NG.

There are six tonal sounds, in the *Lhao Vo* litrature. The tones are expressed by the symbol Δ, roughly, for instance.[3]

La	= air	pronounced lā	(normal sound or tone)
Lo,	= hand	pronounced Lō	(short low tone)
Ngo:	= fish	pronounced Ngaw	(long tone)
Ngho'	= bird	pronounced ngaw.	(short tone)
Nō,	= deep	pronounced nō	(long low tone)
Lho	= moon	pronounced law	(high tone)

Literature reflects social life in every community. Life is relative and real. Literature can convey one and everyone's opinion, idea and thought. It can well and guide the individual and the society. It also can create a rational life for everyone. Life and literature are inseparable in the present day society.

Costume

Like literature, plays a key role in the development of a people and its community. To get their clothing, *Lhao Vo* people grow cause cotton and *lasat* plant. To obtain dye for the clothes, a dye-plant, called in *Lhao Vo* as *Maing ei* is grown. From this plant, *Lhao Vo* people got the dye-colour blue and black. To get it, the leaves of *Maing ei* are either immersed in the water or boiled in the water. It wanted blue colour, it needs to immerse the clothes for some days, for black colour, a long immersion is needed. For these reason, *Lhao Vo* clothes are coloured by blue and black only. As a traditional headdress, *Lhao Vo* women usually wear a black turban, wrapping their head high with it. This high turban with black shawl is the most distinguishing style of clothing, from other nationalities in the Union. At the time of puberty, *Lhao Vo* girls begin to wear the black high turban. To wear it, the woman is needed to do her hair at the top of her head, after that the head is wrapped by a long black shawl or towel, measuring about 162 inches (13.5 feet) in length and 14 inches (1.17 feet) in breadth, by which the height of the turban can be as much as 10 inches. As an adornment, some colourful tassels, made of silk, are dangled from the turban. Girls of not of come of age, usually wear white shawl. By seeing the headdress turban, one can easily distinguish the *Lhao Vo* woman, whether she is married or unmarried. Unmarried *Lhao Vo* woman usually has her headdress turban with tassels, whereas married woman does not have tassels. But now, as some married women wear tassels in their headdress just for the sake of beauty, it is not easy to distinguish women, whether she is unmarried or marry.

Lha Vo women usually wear ear rings and ear drops. Mostly old women have their ear bored, at three places: at the top, at the middle and at the earlobe. At the earlobe, they wear earrings, studded with beads. Some women have two holes, bored one over another, where at the upper hole worn with big copper earrings and at the lower hole, worn with small metal earrings. Young girls wear silver eardrops, or earplugs, some of which sometimes measures about 6 inches to 8 inches long, adorned the tip of it with coloured bead, or eardrops, made of beads or ornamented with silver strings.

The lower garment of *Lhao Vo* woman is a *Lungyi* having a measurement of three cubic and one span in length, which is worn at the waist by wrapping it around the waist, a flap of the cloth is left down diagonally in front of the body. They wear their *longies* in short style, uncovering their calf. To cover the calf, stockings made of white coarse cloth are worn. At the waist, there is a waist band, called *chwelan* or *pan shawng* or *khayanhtan*, it is made of blue cloth. Besides these, there also are a range of belts: cane bet, called *kha nō*, dyed black; cane belt, called *kha nē*, dyed red; a belt, studded blue colored coral beads, called *gnimo* and a belt, studded along the edge with cowries, called *khawbaw*.

The Lhao Vo men's dress are at the head – a white turban, wrapped by white shawl; at the body – a long sleeve white shirt, over which is a black short sleeve shirt. The lower garment is a longyi of chequered pattern with black and white colours only. At their waist is a belt, adorned with black, white and red colours.[29] This description is as much as we can at the moment. According to some saying, the dressing style of *Lhao Vo* people have been changed continuously, passing seven steps or styles at least. Dressing style change might be caused, due to the changes, in their living environment, in their long journey of migration; the expanding social relation; the easy accessibility and their rich imagination.

Administration of Lhaovo

The established customs and traditions are a firm foundation for a developed society. If a society is firmly established, they there set in the governance or the administration. The governance of *Lhao Vo* people is, by any standard, is not so much low. Two types of governance have found developed: *Jang* administration system and *Zug:* administration system. In the *Jang* administration system, the leader is selected from the group, who shall be the strongest among the group, in addition to the ability to lead the group, for the convenience of food, cloth and shelter. In this system, the leadership is not hereditary. The system, in other words, implies that it works on the basis of consensus, or by popular choice or by democracy. In the *Zug:* administration system, the role of leadership can be hereditary, which came out on the basis of landownership. It means only the rich can become a leader. This *Zug:* administration is most developed in regions of *Sawlaw, Chiphwe* and *Phimaw*. This administration system is well established in *Sawlaw* in such areas of *Gyawmaw, Gyamaw, Htawlan, Mankyi, Chaungde, Ngayaw, Kyishin, Myawchaung, Lakin* and *Phaunggya*; in *Chiphwe* Township in such areas of *Wamhte, Yokchaung, Lawkhaung, Phalar, Lamgyaw, Smikyan, Htawgaw, Nozumbaw* etc. When the administration system becomes widespread, there came into existence the hierarchy, which is the beginning of the central administration system. The hierarchy of *Zug:* administration is as follow:

Mong: zug: (area administrator)
Vo Zug: (village administratoror village headman)

Vo gyi (Assistant villageheadman)
Khaung: Mo (Ten houses head)

Mong: Zug: usually administered villages, numberings from twenty to thirty villages, whereas *Vo Zug:* governed a village only. It was said that this *Zug:* administration system was first begun by *Zao" Bug'* clan, at *Gyamaw* village, *Sawlaw* Township. In their respective domain, *Zug:* administration were the most influential persons, will highest authority. The resident house of *Mong: Zug:* and *Vo Zug:* were large and magnificent, in their own right, with as much as sixteen rooms in a house. In colonial period, the British went on recognized the administration of *Mong: Zug:* and *Vo Zug:*, with their hereditary transfer of power.[30] The outstanding features of *Lhao Vo* administration are

- the executive power always rests in the hands of the nationality
- no administration on the basis of landownership or by force, upon the ordinary people.

Festivals

In the *Lhao Vo* society, festivals are held on the occasion of one or another of agricultural activity. These festivals are:

- *Mibaw (Myi Bao" Poe")* festival[31]
- *Yawhmyaw (Yo: Myo: Poe")* festival[32]
- *Gyaw Zaing Htaung (Jao' Zai Da' Poe")* festival[33]
- *Khupye (Khu: Pye Poe")* festival[34]
- *Lawhtaung (Lho" Thaung: Poe")* festival[35]
- *Lawkawkphat (Lao" Ko, Phag', Poe")* festival[36]

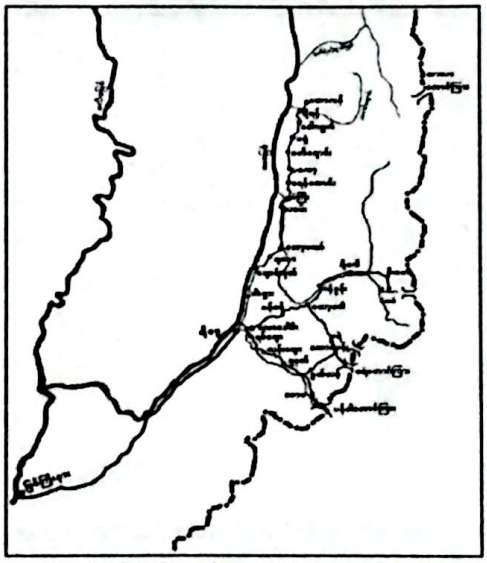
- *Gaukshe (Gaug", Sag" Poe")* festival[37]
- *Gaukawzaw (Gaug', Au: Zo: Poe")* festival[38]
- *Chawphyitchumhtaung (Chyao Phid. Cao: Htaung' Poe")* festival[39]

These festivals are traditionally held since the days of forefathers in *Lhao Vo* community. The annual holding of the traditional festivals can be of help in the struggle of a tribal community for the survival.

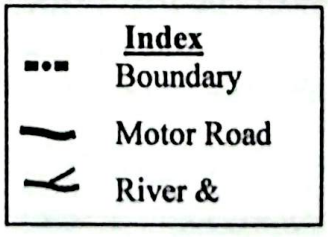
Conclusion

Lhao Vo peoples are a national tribe, belonging to the Proto – Burman. Their features and characters are very close to those of Burmese people. According to their oral history, they believe that they are the younger brother of Burmese people. Their native land in general is the region between the *Maykha* and *Malikhia* rivers. They have been settled in the mountainous plains of *Chiphwe, Sawlaw, Lawkhaung, Htawgaw* etcetera. As they understood the importance of literature for the development of the people, a *Lhao Vo* national himself developed the *Lhao Vo* literature. The dressing styles of the people also have been found developed according to the dictate of modern day.

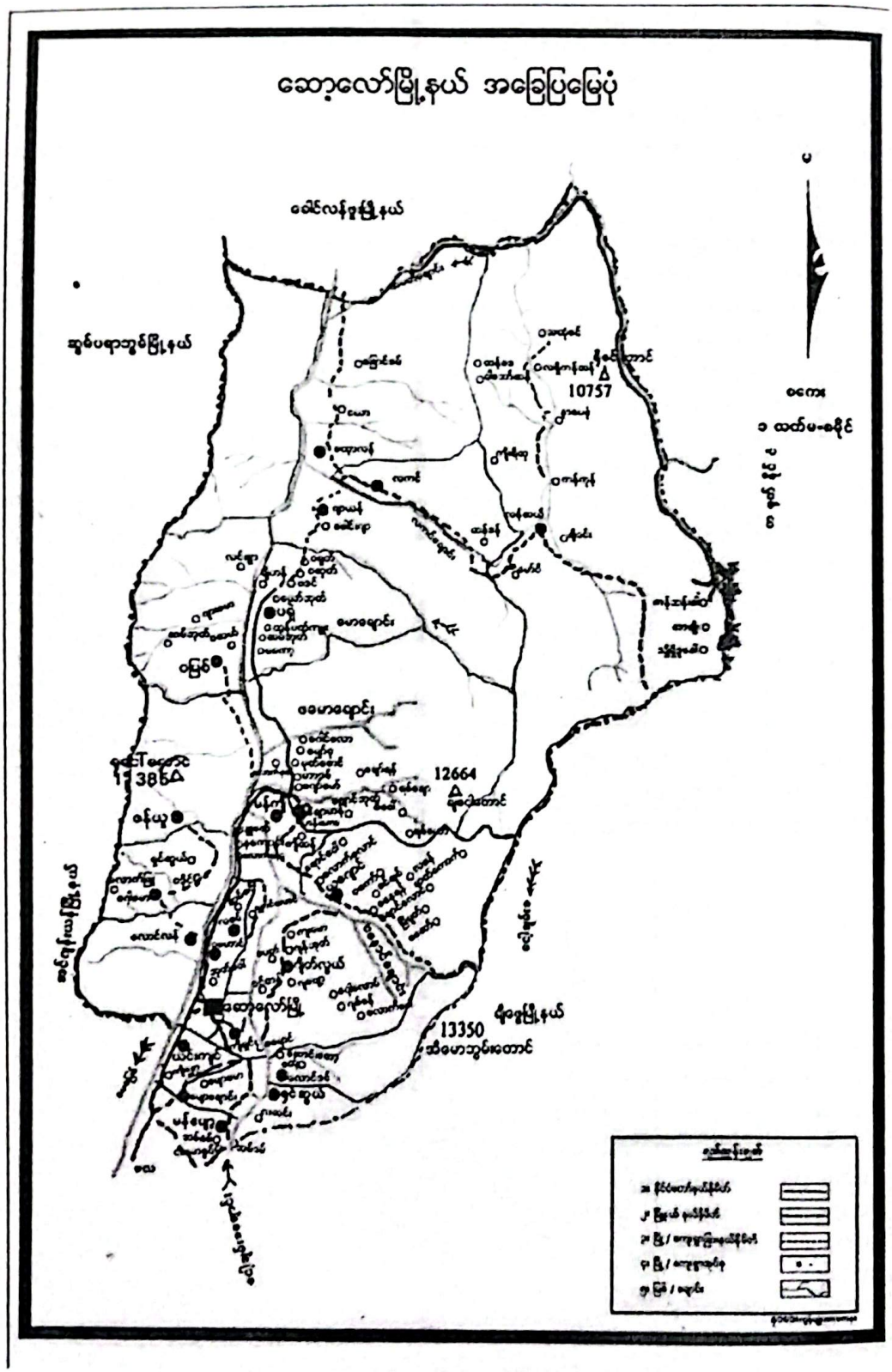
When the ancestor of *Lhao Vo* beings wore a tiny beautiful animal bone or stone on the head or in front of the chest, that ornament meant a choice of beauty and since then *Lhao Vo* people life has become even more colourfully rich. When we see the ornaments unearthed in the tombs of the Shangzhou Period and Quin and Han dynasties, we are amazed to find that they are quite the same as or similar to what the *Lhao Vo* people use and wear today! This is of course not incidental, but it is evidence that they are inherited from their ancestors. The ornament the *Lhao Vo* use today are even better in quality and more beautiful in appearance compared with the ancient ones. With the gradual establishment of *Lhao Vo* society, Their history came to firmly established. *Lhao Vo* people regards their *Taungya* fields as their lifeblood, for which they usually settled near the *Taungya* fields, living in clans of tribal groups. They invariably hold a range of traditional festivals, leading to the peaceful and stable life.



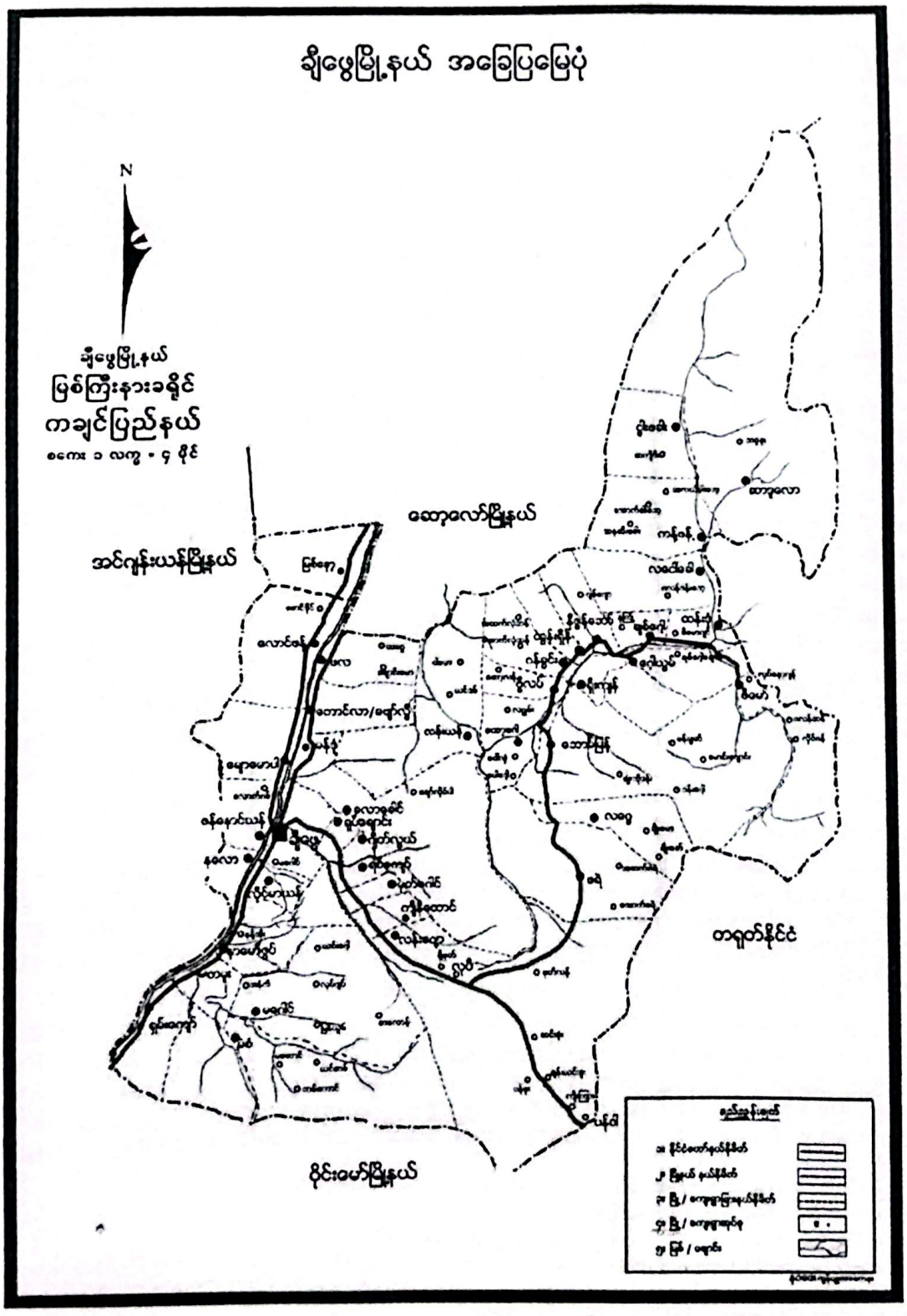
Map of Distribution of *Lhao V o* people
(Source: Yein Nwe Pa, 1957, pp.80-81)



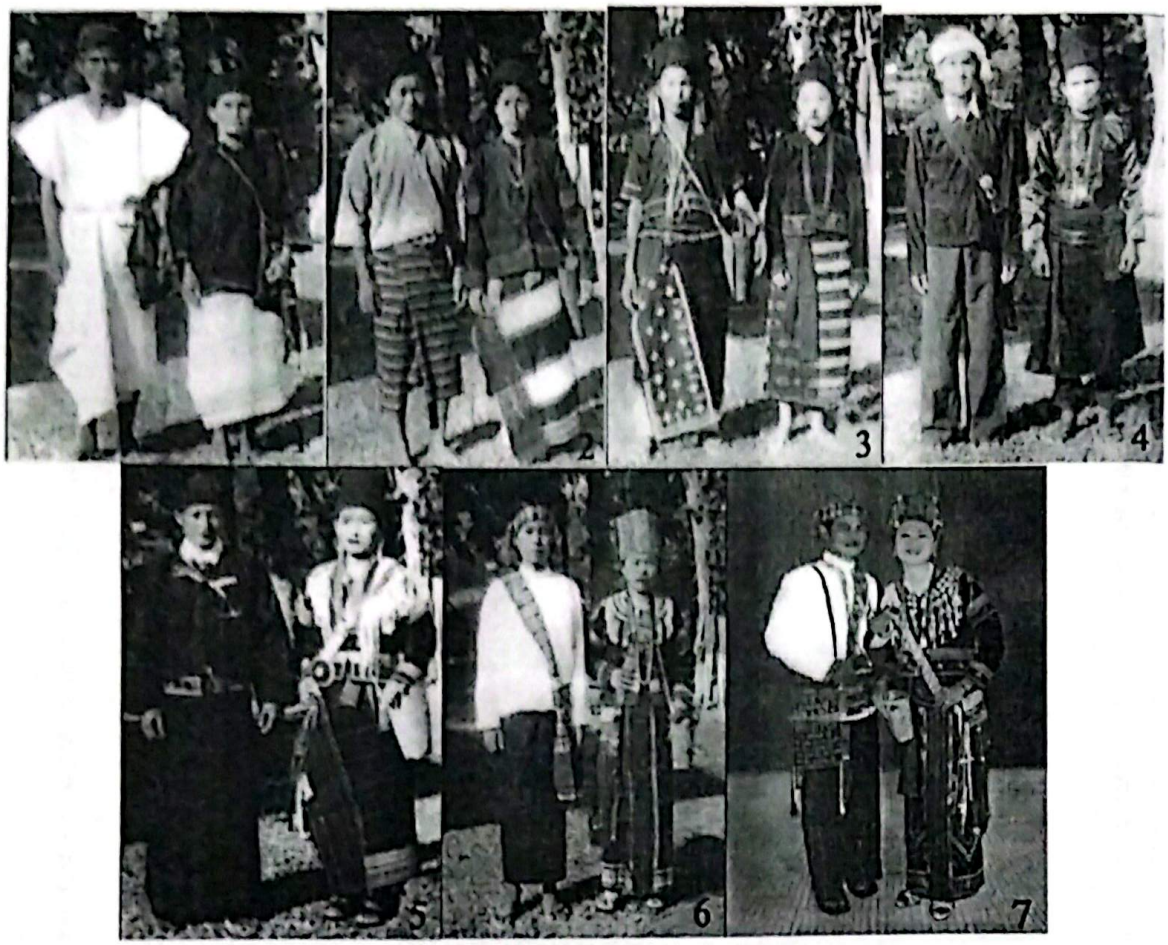
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Map of *Sawlaw* Township
(Source; Peace and Development Council, *Sawlaw* Township)



Map of *Chiphwe* Township
(Source; Peace and Development Council, *Chiphwe* Township)



Evolution trend of costume
(Source: U Lalao Hao: Khao", Sitapru,Myitkyina)

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U L-hung: Hhao" Leim", born on 18 October 1936, at No.80, Word No.2, Waingmaw, on 3 November 2010

U Vabo: Ze Zaung", born on 15 March 1935, at No. 10, Word No.32, Waingmaw, on 2 November 2010

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Changes in the Kachin Ruling Class under the British Rule

Kaw Nan[1]

Abstract

The objective of writing this paper is to present the fact that before and during the British occupation, old administrative system of Kachin *Du-wa*ship gradually waned away under the colonial administration and new set up of administrative system took place. Organizational formation of Kachin administrative pattern, different nature of judicial administration, different classification between criminal cases and civil suits are also discussed. The laws, regulations, rulings and judgments of some important orders were issued by senior Kachin elders. During the Colonial Period, Kachin administrative pattern was dominated by the customary law. This paper also examines the continuities and changes of legal administration, status of ruling class and society.

Key words: settlement, pedigree, traditions, customs, administration

Introduction

The Kachin lived in the northernmost of Myanmar. In Kachin's traditional administrative system, there were three basic types which were *Gumrawng Gumtsa*, or Feudal System, *Gumchying Gumsa*, or Feudal System, and *Gumlau*, or anti-feudal system. Under the Myanmar kings, the exact number of faithful Kachin chiefs or *Taung-sa* [2]was not known. After the annexation of Upper Myanmar in 1885 there were began anti-imperialism by the Kachin. After the British organization of the Kachin Hill regions, the Kachin Hill Tribes Regulation of 1895 was enacted. Under the British that the *Du-was* and *Agyi-wa* were separately appointed and instead of *Taung-sa* in the Myanmar kings, *Taung-oks* were appointed. The duty of *Taung-ok*[3] was to collect the number of houses, a list of guns, and collected taxes and decided upon the Kachin ethnic group according to Kachin Customary Law. The Kachin gained new experiences and knowledge and became literate, and educated, government servants and officers. Although there were many changes in Kachin until 1930, their traditional administration system and jurisdiction were not changed. The British government also permitted their traditional administration system.

Changes in the Kachin Ruling Class under the British Rule

During Konbaung Period, there lived the Kachins called *Thein- phaw* in the northern part of Myanmar, northeast- mountain ranges and West Kamti region, east Chindwin, Uru-se-ywa, Mogaung Region, Bhamo- Katha Region, Moemeik, Moe Hlaing, Mansi, and Hsenwi Shan Region.[4] Similarly, there lived the Kachins in Assam Region, East Assam, northernmost Myanmar, northeast mountain ranges, and Yunnan Province along the border of China under British rule.[5] The name "Kachin" comprises Jinghpaw, Gauri, Maru, Azi, Lashi, and Lisu ethnic groups, etc. The ethnic groups included in Kachin tribe have different dialects and different customs.[6] So, according to the estimates of Western scholars, the Kachins had probably descended from the Mongolia Plateau between the eastern plateau and West Szechwan.[7] There are four dialects spoken by the Kachins, upon which the political ideology depends.[8]

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[1] Dr, Lecturer, Department of History, University of Myitkyina

[2] Kachin Traditional Chieftain

[3] Ethnic Chief

[4] Kyan, Daw, *Myanmar Naing-ngan A-chay A-nay (1885-86) (The Situation of Myanmar Naing ngan (1885-86)*, Yangon, Sape Beikman Press, 1978 p. 171 (Henceforth: Kyan, *1971*)

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[8] Leach, *1964*, 50

Kachins Settlement in Myanmar

The Kachins began to make settlements in the northernmost regions of Myanmar, starting from about 1st century A.D., and then they began to occupy the regions to the south, southeast, and west; to the north, the Sumprabum surroundings, the triangle area between N'mai and Mali Hka; to the west, the Hukawng Valley and Assam, to the northeast, Maru and Lashi settled themselves along the Saw-law, Htaw-gaw, and Ngo - Chang Creek; to the southeast, they live in scattered regions in the surrounding areas of Sinlumkaba, Sadon, Sima and Bhamo, to the south, and the surrounding areas of the Indawgyi, respectively.

Before the British came, in Hukawng Regions, where the *Du-was* ruled, there lived Daihpa *Du-wa*, Walaw Bum *Du-wa*, and other Shan *Saw-bwa* or Lords.[1] The Hukawng Valley is a region where the Shans and the Kachins lived together, but in the Triangle Area, there lived only the Kachins. However, there had been contacted between the Kachins of Hukawng Region and the Triangle Area.

Clan Tribes

Among the Kachins were five main ethnic groups: Lahpai, Lahtawng, Marip, Maran and N'hkum. Generally, those who lived in Hukawng were called Tsasen; the Kachins living in the Triangle Area were Hka Hku, those living in Putao Plains, Duleng; those living in the northeast of Bhamo, Gauri; those living between Mogaung and Mohnyin, Htingnai; and those living in northern Shan State, the Sinli respectively. The regions were named according to the names of the races. Their dialects were also different in tone and accent, as their political concepts varied. Among those living in the surrounding area of Hukawng Valley, the Marips were the ruling *Du-was*; in Gauri and Sinli; the ruling races were the Lahpai and the Maran; in Triangle Area, the Lahtawng and in other regions, the Marip, the Lahpai, and the Lathawng respectively.

Among the races of the Marips, they had different names. They lived in hilly regions to the west of Intawgyi Lake, in the surrounding area of the amber mines, jade mines, the Triangle Area, the Hukawng Valley, and along the west bank of the *Irrawaddy*.[2] The Marips in that region was the first Kachins who made the first contact against the invasion of the British and were the first to take refuge under the British.

Lahtawng descendants had their family names. The Triangle Area between N' mai Hka and Mali Hka was the original place of the Lahtawng. So, these Triangle Areas were under the control of the Lahtawngs.[3] They also lived widely near the conflue

nce of N'mai hka and Mali hka near Myitkyina, northern and Hsenwi, Moe- Meik. When the British came, the Lahtawngs, except Sana Lahtawng, did not revolt against the British imperialists.

The Lahpais, according to the British, were the strongest ethnic group.[4] They live in all hill regions where the Kachins live: on the east and west banks of the *Irrawaddy*; northeast of Bhamo, along the Phon-Kan Hill; northeast and north of Mogaung; southern Hsenwi, and Moe- meik. Sima Lahpai and Szi Lahpai were the most well-known ethnic groups among the Lahpais. Moreover, Gauri Lahpais were powerful Lahpais to the northeast of Bhamo.[5]

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[1] Ma Nawng, Kawlu, *The History of Kachin of the Hukawng Valley*, translated and noted by J.L. Bombay, Time of India Press, 1944, p.42 (Henceforth: Ma Nawng, *1944)*

[2] Scott and Hardiman, *1900*, 375

[3] Scott and Hardiman, *1900*, 375, 376

[4] Scott and Hardiman, *1900*, 376

[5] Scott and Hardiman, *1900*, 377

Kachin Traditional Administrative Systems before the British Rule

In Kachin's traditional administrative system, there were altogether three basic types which were *Gumrawng Gumtsa*,[1] *Gumchying Gumsa* or Feudal System, and *Gumlau* or anti-Feudal System. By these three systems together with the chiefs of *Du, Magam, Agyi*, and *Salang*'s supervision, the Kachins lived. Those traditional administrative systems were practiced from 1500 to 1900.[2] The establishment of those traditional administrative systems related to the structure of Kachin society. In Kachin society, *Thing-gaw* or family is the smallest and a village was also the narrowest in social affairs. In the south of Kachin State and plain regions, the village was called *Ka-htawng* and *Ga*, or *Yang* in the northern regions. A town was called *'Mare,'* the State *'Mung daw'* the country, *'Mung'*. Such *a Mung* term was directly borrowed from the Shan *Mong*.[3] They were *Du-was* of *the Gumchying Gumsa* system, *Magam* in *Gumrawng Gumtsa* , and chiefs of *Gumlau* were *Agyi*, *Salang*.

Among the three administrative systems, the most ancient was *Gumrawng Gumtsa* system in which *Magam* chief was elected by the public. That system was practised upper Putao Region of Hpatkha stream, Machanbaw, Nogmon, and Khawbode of northern Myanmar by Rawang tribes, Lisu villages, and Duleng Jinghpaw villages between Htingnan and Hpatkha stream.[4] There were chiefs in every village in that system, the ruling power was not in the hand of a certain person or tribe but in the hands of the public or the villagers. In such villages, a person who could lead in social, peaceful, and legal affairs became automatically the chief or *Magam*[5] and he would survive as a *Magam* as long as he got the villagers' trust and respect, or else, he would be left out. Therefore, when there was a vacancy for a *Magam*, in the case of being left out or death, the villagers found another person with the abilities mentioned above.[6]

The rank of *Magam* was not for the descendants. Sometimes, there were no *Magams* in a village for three or four years. In such times, villagers of knowledge together carried out the village affairs. In such villages, the growing sites were in the hands of first settlers' tribe leaders and they were called Lamu *Ga* Madu ni or landowners. Those lands were inherited by the eldest sons. If a village was established by the Marip tribe, the village was named Marip *Ga*, and all the area was possessed by the Marip tribe. According to *Gumrawng Gumtsa* System, though it was said that the landowner was not concerned with the administration, sometimes in some villages, the landowner is Magam.

In the later *Gumchying Gumtsa* or Feudal System, the powerful men are *Du-wa* Chiefs. They made Mare *Agyi* or Mare *Salang* or the village headman and *Ramma-ning-baw* or the youth leader as their attendants and administer the peace and restoration of the village. This system was assumed to have derived from *Gumrawng Gumtsa* system. In other words, *Magams* became *Duwas*. This change was assumed to have changed and adopted the administrative system of the nearby tribes, especially the Chinese and Shans. It was because the *Gumsa* chiefs were named the Chinese word *'Zau'*, and the Shan word *'Hkun'* from Shan *Saw-bwas* as imitations.[7]

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[1] *Gumrawng* means liberty and *Gumtsa* means one hundred people, *Gumrawng Gumtsa* means people who have liberty

[2] Bunghku, *Jinghpaw the Ginra*(Jinghpaw and Place), Myitkyina, Computer Script , 2009, p.195 (Henceforth: Bunghku, *2004)*

[3] Leach, *1964*, 121

[4] Naw Awn, Thing Bai, *Ginru Ginsa* (the Origin of Kachin), Maymyo, Typescript, 1956, p.95 (Henceforth: Naw Awn, *1985)*

[5] Kachin ruling class

[6] Leach, *1964*, 206

[7] Naw Awn, *1985*, 99

Unlike Myanmar kings, the feudal system of Kachin hills had many *Du-wa* or rulers. Each of them administered his fixed estate according to his law.[1] *Gumsa* chiefs classified their estate according to the area and power. They are:

1. *N'kawn Sha Du-wa* - who got the tax from his people.
2. *N'kawn N'sha ai Du-wa* - who did not get tax from his people.[2]

The *Gumsa Du-was* accepted themselves as the most powerful masters in their estate and their possessions were inherited by their descendants. In this acceptance, they changed taxation upon their fellow villagers. In this way, the honoured *Du-wa* stood as an except class in their estate they chanced to get a leg of any four-legged animal of other tribe villagers, except the same tribes, killed for propitiating or from hunting. Moreover, the villagers had to volunteer in growing the *Du-wa*'s fields or Taungya.[3] That charge was not necessary to be paid by *Du-wa* but he had the chance to get the paddy and crops from every household as an annual present. Such *Du-was* were called taxed *Du-was* or a thigh-eating *Du-was*. Their possessions, which came from the villages, became plentiful and his house became one like the rice barn. The Kachin chief's political authority is based on his ability to preserve the prosperity of his domain by making sacrifices to the sky spirit, *Madai Nat*, and to the earth spirit, *Shadip Nat*. He has this ability under his descent from a remote clan ancestor. This ritual power is inherited automatically only by the youngest son of a thigh-eating chief. Chiefs are concerned to establish their legitimacy as members of a 'youngest son lineage', *Uma Du*, and also to establish their seniority relative to other chiefs over a wide area.[4] Such a thigh-eating *Du-was* were the inheritances in *Gumsa* system. So, in *Gumsa* system, the *Du-wa* and his tribe were governing class. For example, Lahpai tribes were the governors in the estates where Lahpai *Du-wa* ruled and the other tribes were ruled by them.

In other words, *Gumsa* system could be called a clan administration system. In some small villages, even the *Agyi* got the *Du-wa* title with the background of their tribe. Some seniors thing eating *Du-was* gave the strangers the free land of their estate and the chance to live and set up the village and made them junior *Du-wa* or the village headmen. But they did not have the chance to a thing eating. Though they were acknowledged as junior *Du-was*, they did not have the chance to get the annual present of crops and free volunteers. They were called *Du-was* who did not get tax or *N'kawn N'sha ai Du-wa*.

Gumsa Du-was made the governing system a clan administrative system and made unfair taxation upon their villagers and dealt with the villagers as their slaves, the ordinary villagers became against them and revolted. *Gumlau* or anti-feudal system was the system that was the result of the revolt against traditionally ruled *Du-was* and landowners. The revolt spread from the north triangle regions to west Malikha during the 18th and 19th centuries. Some *Gumsa Du-was* fled to Hukawng Valley.[5] *Gumlau* is one of anarchic republicanism. Each man is as good as his neighbours, there are no class differences, no chiefs, a protestant theory. Among the *Gumlau*, factionalism is rife, each little local unit is a political entity on its own.[6]

The word *Gumlau* is mentioned even in an English source as early as 1828. Kawlu Ma Nawng recorded specifically relates to the *Gumlau* of the Hukawng Valley.[7] The *Gumlau* area which was regarded as the *Gumlau* movement by the English writers of the 1890s was that of the Triangle area which includes the domains of Sagri Bum and N'Gum La. This area was

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[1] Leach, *1964*, 114

[2] Branghpa Collections

[3] Leach, *1964*, 206

[4] Leach, *1964*, 127

[5] Ma Nawng, *1977*, 26

[6] Tegenfeldt, H.G, *A Century of Growth: The Kachin Baptish Church of Burma*, California, William Carey Library, 1974, p.41 (Henceforth: Tegenfeldt, *1974)*

[7] Ma Nawng, *1944*, 26,39

supposed to have become *Gumlau* for the first time around 1870.[1] In all three administrative systems of Kachin, the rulers and rich people bought and owned slaves. Especially, *Du. Magam* of Gumchying *Gumsa* used slaves in administration, politics, warfare, economy, and agricultural works.[2]

Myanmar went and attacked Assam from 1817 to 1820.[3] They, then, met the Jinphaws, who was then regarded as the uncivilized ethnic groups from Mogaung and Hukawng Valleys. In Assam and Hukawng Valley regions, the Kachin *Du-was* were very powerful in battles. The *Du-was* were then very well-known as the Pyisa and the Daihpa *Du-was*.[4] The Myanmar troops marching towards Assam organized one thousand Kachin Jinphaws, and came to Assam.[5] Again, the regions along Hukawng Valley were under the Kachins while Mogaung was placed under the administration of Myanmar *Myo-ôks*[6].

Kachin Traditional Administration Systems under the British Rule

After the British had occupied Upper Myanmar, a list of Kachin *Du-was* living in Bhamo, Mogaung, and Indawgyi Lake was submitted from Magwe *Wun-dauk* to Assistant Deputy Commissioner and British officers. According to the list of *Taung-sa* [7] *Du-was* dated 30th March; 1888; there are 53 hills to the east of Bhamo. These hills have chiefs of their own. Of the 53 chiefs, 43 are influential. A Kachin chief has control over 50 to 60 houses. In each house, there are from 20 to 25 families. The chiefs are Magistrates. Their orders are final. Every year they assess a tax in the form of a basket of paddy from each family. The office of a chief is hereditary. No taxes were levied on the chiefs, but there was an octopi duty on the fruits and other country produce brought into Bhamo. There are three chiefs and 28 lesser chiefs in the districts around Mogaung. Under each of the chiefs are from 40 to 50 houses, and under each of the lesser chiefs from 10 to 20 houses. In each house, there are between 20 and 30 families. As at Bhamo, the chiefs are also Magistrates. There was a duty of 10 percent, levied on jade stones.

Before the British rule, the Kachin *Du-was* were mentioned as the *Taung-sa Saw-bwas*. It was only under the British rule that the *Du-was* and *A-gyi-was* were separately appointed and instead of *Taung-sas*, *Taung-ôks*[8] were appointed. The number of *Taung-ôks* was not as many as the *Du-was*.

On 28 November 1885, the British occupied Mandalay, and they occupied Bhamo on 28 December.[9] Then, General Norman cleared the forests around Bhamo, and built barracks. On 1st January 1886, the British declared Upper Myanmar as the British Empire, and there started the administration in Bhamo. The first Bhamo deputy commissioner was Major Cook.[10] The

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[1] Ma Nawng, *1944*, 26,39

[2] (a) Tegenfeldt, *1974*, 37

(b) Brang Di, Maran, *Prat Ningnan Wunpawng Ahtik Labau Kadun* (Modern History of Kachin) New Delhi, Pan Kachin Development Society, 1996, p. 41 (Henceforth: Brang Di, *1996)*

[3] Woodman, Dorothy, *The Making of Burma*, London, Cresset Press, 1962, p.63 (Henceforth: Woodman, *1962)*

[4] (a) Brang Di, *1996*, 52

(b) Ma Nawng, *1944*, 26, 42

[5] *"Kachin-de-ta-yet-swe-tha-maing (AD 556-1885)"* (Chronology of Kachin Region), Collection Research of Kachin Historical Records, Myitkyina University, History Department, 2002, pp, 20, 21 (Henceforth: Yet-swe, 2002)

[6] Town officer

[7] Kachin Traditional chieftain

[8] Ethic chief

[9] (a) Sir Charles Crosthwaite, *The Pacification of Burma*, London, Frank Cass & Co. Ltd, 1968, p.7 (Henceforth: Crosthwaite, *1968)*

(b) Woodman, *1962*, 335

[10] Dawson, G,W, *Burma Gazetteer, Bhamo District*, Rangoon, Superintendent Government Printing, 1960, p.21 (Henceforth: Dawson, *1960)*

eastern regions of Bhamo were then under the rule of the *Du-was*. Among them, the Mahtang *Du-wa* was the most powerful.[1] Thus, despite the uprisings after occupying Bhamo, the British tried to organize the other regions gradually. Thus, the British tried to keep control of the Kachin hills.

After the occupation of Bhamo, in February 1886, the British troop led by Major Cooke marched to Mogaung along the Irrawaddy River. They met the local officers in Mogaung, and appointed only the former Mogaung *Myo-ôk* once again. While the British troop headed by Major Cooke marched to Mogaung, the Kachin *Du-was* in Bhamo first revolted against the British. The leader was Hpungkan *Du-wa*, who also refused to take refuge under the British rule.[2] He organized the Kachins and made attacks on the British troops. To suppress the revolting Hpung Kan *Du-was*, a troop was stationed at Mansi on the way to the village of Hpung Kan *Du-wa*.[3] But till the end of 1886, the British could not control the surrounding area of Bhamo.

However, in early 1887, the British military police from India came and reinforced the civil administration. A fortress was built in Sinbo, and a battalion of Indian soldiers was stationed there.[4] Then they marched to occupy Mogaung, to control the jade mines. The army officers were given instructions to prevent frights among the local people along the route, and a civil officer was ordered to accompany the troop, and negotiate with the Kachins.[5] On 14th January 1888, the British came back to Mogaung, via Mogaung, they continued to march to Kamaing, and after negotiating with the chiefs over the jade mine area, named Kansi Nawng and Kansi La, had the jade mine area under their control.[6] So, the British had the jade mine area under their administration without causing any problems.

In the late 1891s, the Kachin *Du-was* were convinced that their powers could not match the British, and many came to take refuge under the British. But there remained many other regions free from their rule. So, plans were made for having all *Du-was* under their control. The Kachin *Du-was* accepting the British rule were appointed Sanad[7], and went to collect house taxes.[8] In 1892, in Sadon, a fierce battle broke out between the strong anti-British patriots and the British. Many fell on both sides. Captain Harrison fell, so Sadon was later named Fort Harrison.[9] In Sima Village a battle broke out. Captain Mortan fell, and Sama Fort was re-named, Fort Morton. After Sama Battle, there were no more confrontations. Administration, jurisdiction, and tax collection were done only through the British appointed *Du-was*. The *Du-was* were ordered to rule their regions. So, in 1893, suppressions in Kachin hill regions came to an end.[10]

After occupying the Kachin hill regions, the British first appointed the Kachins in Bhamo Military Police Battalion in April 1898. From 1898, every year in summer, new recruitments were organized among the Kachins. The *Du-was* appointed by the British, had to give help for this purpose.[11] From 1898 onward, the Kachin soldiers were recruited as military police at Bhamo Military Police Battalion stationed in Bhamo. First, they served as ordinary soldiers,

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[1] Scott and Hardiman, *1900*, 332

[2] Scott and Hardiman, *1900*, 332, 333

[3] Scott and Hardiman, *1900*, 333

[4] Crosthwaite, *1968*, 237

[5] Hertz, W.A, *Burma Gazetteer, Myitkyina District*, Vol.A, Rangoon, Government Printing and Stationery, 1960, p.26 (Henceforth: Hertz, *1960)*

[6] Crosthwaite, *1968*, 255

[7] Gun

[8] Hertz, *1960*, 54

[9] Hertz, *1960*, 56

[10] Hertz, *1960*, 62

[11] *The Kachin Military History, the Army Military Pensioners Ex-servicemen's Association*, Bhamo, 1954, 26 (Henceforth: *Kachin Military History, 1954*)

and in 1907, a Coy of Kachin soldiers was organized. In 1914, the World War I broke out, and the three Coy comprising Kachin soldiers were sent to the Western European front- lines: and were to fight in the frontlines of Mesopotamia and Turkey.

Du-wa and *A-gyi* was from Marip, Lahtawng, Nhkum, Maran, Gauri, Maru, Azi, Lachik and Lisu were among the soldiers. They took the lead in Kachin forces. These Kachin military policemen came from Bhamo to Pyin Oo Lwin in 1916; in Pyin Oo Lwin, they received military training. In 1917, via Mandalay and Yangon, they left for Calcutta and Bombay of India and joined the wars in Europe and they joined the war against Germany.[1] Thus, the Kachin soldiers got war experience and other knowledge.

Christian Missionaries in Kachin Land

In the years after 1837, Kincaid came to Bhamo and Mogaung and from then on one Christian missionary after another came to the Kachins. And then the American Baptist missionary, Taylor Rose in 1862,[2] 1868 Taylar Rose and Josiah N. Cushing came to Bhamo.[3] Since 1877, the American Baptist missionary started the Kachin Baptist missionary. The first Kachins who became Christians were 7 Kachins including the Bumwa *Du-wa* family to the east of Bhamo. It reached the Mahtang *Du-was*, the most powerful among Gauri Kachin *Du-was*. The Bumwa *Du-was* gave up the tradition of the Deities and were converted to Christianity. So, before the British rule, only a few Kachins were Christians. From then on the Kachin Christians studied the Bible, and stayed at boarding schools. That was the beginning of schools.

The Christian missionaries started teaching religion and education. Only the Roman Catholic and American Baptist missions could assume those duties, opening the missionary school. The American missionary opened boarding schools together with the Karens. So, missionary schools were first opened in large villages around Bhamo. In early 1890, in A.B.M. school, there were about 30 students.[4] Most of them were the children of those Kachins who had converted to Christianity.[5] At the end of 1890, as the American missionary, Ola Hanson came. He invented the Kachin alphabet in the form of Roman letters. He translated the Bible into Kachin. So, the propagation of the Christian religion became effective. Then, in 1892, Mr. George J. Geis came to Bhamo and via Bhamo, went to Myitkyina. In 1895, when he reached Myitkyina, he opened a school 1896. In 1897, there were Christians in Myitkyina, and Manhkring Village was set up as a village of Kachin Christians 1898. In 1904, there were 25 Christian families, and in 1902, the Lisu were first converted to Christianity. In 1899, with the aid of the British government, a school was opened the first boys- girls schools. So, from 1897 to 1911, the number of students increased from 6 to 75.[6]

The Christian missionaries opened schools almost in the areas under their missionary through the aid of Kachin Christian. So, the population of students attending the school opened by the American Baptist Mission in Bhamo increased from 30 to 221 from 1885 to 1911, in Myitkyina, from 1897 to 1921, from 6 to 75.[7] In those schools, the Kachin *Du-was* sent their children to towns with school for their education. Only the *Du-was* who were educated at the specified level was awarded the positions of *Taung- ôk*.[8]

On the other hand, in Kachin Hill Region, there appeared schools were opened by the British government, and many educated Kachin youths were produced. The *Du-wa*'s children who lived in regions with no schools were sent to boarding schools in Bhamo, Sinlum Kaba and

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[1] *Kachin Military History, 1954*, 86
[2] Tegenfeldt, *1974*, 85
[3] Tegenfeldt, *1974*, 85
[4] Tegenfeldt, *1974*, 114
[5] Tegenfeldt, *1974*, 115
[6] Tegenfeldt, *1974*, 122
[7] Tegenfeldt, *1974*, 126
[8] Hertz, *1960*, 85

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Myitkyina, etc. Finally, they became government servants. So, among the Kachins, only the children of the Kachin *Du-was* were the first to be educated. Moreover, headquarters were established in Bhamo and Myitkyina, and the Kachins were organized and recruited into the military police force, to become literate, educated, government servants, and officers, gaining new experiences and knowledge. On the other hand, in the late 1895s, Ola Hanson invented the Kachin Jinghpaw language literature, thus resulting in opportunities for the Kachin in gaining knowledge. After 1898, the Kachin literature was taught to the Kachins, including by the military police.

Thus, Kachin literature had become a compulsory subject. The Kachin Newspaper was published from 1914 to 1927 and informed politics, social affairs, health, and education.[1] The Kachins, reading the newspaper, gained knowledge about the outside world while they learned about war experience and other experiences by serving in British troops.

Though educated, the Kachins had no change of administration. Only the *Du-was* were allowed to rule the Kachins, according to race and traditions. But these *Du-was* were appointed only by the British government for the ruling. The *Du-wa* and *A-gyis* were in the same position as *Thu-gyi* appointed in Lower Myanmar. Above the *Du-was* and the *A-gyis*, was appointed a *Taung- ôk* each for one Kachin hill area boundary. The first *Taung- ôk* under the regional assistant inspector was appointed in 1897 at Sinlumkaba to the east of Bhamo.[2] When the regional assistant inspector toured, he was accompanied by a *Taung- ôk* from village to village. The *Taung- ôk* duty was to collect the family population list, the list of guns, and the number of houses, and collect taxes. Moreover, minor cases among the Kachin ethnic groups were decided upon according to Kachin Customary Law.[3] In that year, Sima *Taung- ôk* was appointed, and the Marus in the surrounding area of Sima were to pay taxes to Sama *Taung- ôk*.[4] In 1911, the British administration was settled in Htaw-lang, Lakein regions where the Lhavo- Lachiks lived, in Law-hkawng, one hill region assistant inspector was appointed and the administration began. In 1914, Sam Kha Lum was appointed *Taung- ôk* by the local people, and negotiations were made with the British. Again, for Law- hkawng region, U Chan Tu was appointed *Taung- ôk* by the British; in 1922, Gawlu Palaung La; in 1930, U Bok Yan Haung for Saw-law *Taung- ôk*.[5]

Though *Du-was* and *Taung- ôks* were appointed, everything had been under control. The British government appointed regional officers, regional assistant officers, and hill region assistant officers, but in reality, they scarcely had direct contact with the local Kachins. So, the fundamental administration of the hill region administration was done effectively by the *Du-was* and the *Taung- ôk* appointed. So, the British hold the Durbars to organize the Kachin leaders and exert a stronger influence. Such meetings were held annually or on suitable occasions.[6]

Conclusion

To sum up, in the sector of administration of the Kachins, the traditional administration of the chiefs was roughly similar: the ruling was done in the line of inheritance. But depending on the region, their political concepts have differed. The *Du-was* had ruled these regions from generation to generation in the line of ancestry in those regions. The Kachins are of five races: Marip, Maran, Lahtawng, Lahpai, and N'hkum. The influential boundary was that of the

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[1] Jinghpaw Shilaika, 1914-27, Branghpa Collection

[2] Dawson, *1960, 29*

[3] *Report on the North-Eastern Frontier for the year 1897-98,* Yangon, Government Printing, 1898, pp.24, 25 (Henceforth: *RNEF, 1898)*

[4] *RNEF, 1898*, 4

[5] Lhovo Literature and cultural committee, "Lhovo –Thamaing – Achine- chok" (A Brief History of Lhovo) , Waingmaw, typescript, 1967, p.14 (Henceforth: Lhavo, 1967)

[6] *Report on the North-Eastern Frontier for the year of 1909-1910,* Yangon, Government Printing, 1910, p.1 (Henceforth: *RNEF, 1910)*

Marip races: they ruled Hukawng valley, jade mine, and amber mine areas and the region along the west bank of the *Irrawaddy* as the powerful race. When the British invaded the boundary, they first fought against the colonists and were the first to take refuge under the British rule.

During the Myanmar Kings' rule, the Kachin *Du-was were* called *Taung-sa*. The list of *Taung-sas* acquainted with the Myanmar Kings was submitted by the former Myanmar Officers recently after the British annexation of Myanmar. The lists of *Taung-sa* were concerned with those living in Bhamo and its environs, Mogaung and the environs of the Indawgyi Lake, jade mines, and amber mines region. No contact existed with the Kachins living in Hukawng and the Triangle Area and along the China border. During the rule of the Myanmar Kings, the Kachin chiefs were addressed as *Taung-sa*. They lived according to the tradition of their ancestry. After 1886, the British organized the regions under the Kachin *Taung-sas*, the Kachin *Taung-sas* from various regions came to take refuge under the British, who issued official certificates of appointment to those who subjected themselves and assigned them to the duties of administration, jurisdiction, and tax collection, as well as the local security duty. They were allowed to continue their administration as before.

So, the British waged operation in Kachin hill tracts from 1886 to 1893 during the period of Pacification, organized one region after another under their rule and issued certificates of appointment, and assigned duties to those loyal subjects. On the other hand, they fiercely suppressed the opponents. Formerly, the *Du-was* followed the traditional administrative pattern and ruled their territory. In the administrative pattern, they had the authority to deal only with minor cases according to the traditional customs, because, in 1895, the Kachin Hill Tribes Regulation of 1895 was enacted, which restricted the authority of the Kachins. To have special administration on Kachin Hill tribes, the Kachin Hill Central Headquarters was set up in Sinlumkaba. One assistant hill officer was appointed. Below him was a *Taung-ôk*, whose duty was to tour and collect taxes, make a list of dwelling houses in his boundary, and make a decree on certain cases. Only the literate *Du-was* were appointed to the position. Also under the British rule, the *Du-was* were appointed and granted authority for administration, jurisdiction, and tax collection according to the customs. Though other Kachins might be educated, it was the *Du-was* only who took the lead in religion, education, and social welfare tasks, and such tasks led by the *Du-was* came to be a great success.

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The Ethical Issue of Domestic Violence in Myanmar Society

Aye Mon Thein*

Abstract

The aim of this paper is to explain that domestic violence is an ethical issue and avoiding violence in the family is socially and ethically important for the welfare, unity and progress of society. This paper examines why domestic violence occurs in the Myanmar family in spite of the excellent traditional ethical guidelines to living a good life in Myanmar society. Domestic violence here refers to unacceptable violent behavior between two individuals who are spouse or partners or members of a family; most of the victims also happen to be women and children within the family. This paper will highlight how such domestic can be avoided in the light of Buddhist ethics, both theoretical and applied. First the basic principles of Buddhist ethics consisting of the Eightfold Noble Path, the Law of *Kamma* and the Four Cardinal Virtues (*Brahma Vihāra*) will be clarified for they are important to understand why ethics is vital in living a good life. Next the notion of *Hiri-Ottapa*and *Gārava* for they are necessary to know how '*Gārava*' applies both in morals and manners to protect domestic violence in the family. The methods to be used in this paper are the Descriptive Method and the Evaluative Method. This will be concluded with the Buddha's teachings in the *SingalaSulta*. This paper will contribute towards understanding that through the family without domestic violence, the welfare, unity and progress of society can be built. Hence the ethical principles and religious teachings should be imparted to the young.

Keywords: Domestic Violence, Buddhist Ethics, Family

Introduction

Humans have engaged themselves throughout history in asking questions about the good life whether in the East and West. We not only ask question about what is good life but we frequently make judgments about what is the right and wrong thing to do. It is an integral part of human experience and it is from this point that the study of Ethics begins. Ethics is a study of the foundation and principles that determine morality and moral values that guide human beings. It is a reflective search for moral criteria in respect of individual actions and interactions of people in society. Ethics plays thus a vital role in human life since it lays down guidelines for good or bad behavior.

Morality describes the principles that govern our behavior. In morality, it can be analyzed into two kinds, (1) moral standards with regard to behaviors and (2) the sense of moral responsibility refers to our consciousness. However, these two kinds are important in moral and social behaviors because if there is no morality, there will be violence and brutality that will finally lead to the collapse of group or society. Morality is therefore necessary for the survival of any society. Ethics is also the practical application of morality to life and that application is a necessary condition for the human life. The application of the ethical term non-violence is the basic requirement for moral behavior.

Non-violence is based mainly on toleration, kindness and compassion. In Buddhism this term means to return *metta*(love and kindness) in return for *dosa*(anger and hatred). Non-

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violence is a desire to end all forms of physical and mental harm against other living beings. It is directly opposed to violence in conduct whether verbal or physical within the social and moral spheres. This kind of action has no giving any harm to self or others by tolerating. Today, however non-violence has become a remedy for redressing oppression and injustice in the social sphere. People have different reasons for avoiding violence. Some advocate non-violence as an effective technique for bringing about desired social changes. Others seek to practice non-violence as a way of life. Some activists seek to avoid loss of life and damage of property. In the handbook for Nonviolent Campaign (2014), it is defined as:

> ...Non-violence is more than absence of violence and more than saying 'no' to mental, verbal and physical abuse.[1]

Non-violence as a way of life one can apply based on personal religious or moral grounds for becoming a vegetarian and leading ascetic life. But in this paper the conception of non-violence is socially and ethically important for the welfare, unity and progress of society. Human being has been acknowledged as the most intelligent of all living creatures on this earth. The moral and ethical dimension is the distinguish nature of human being. Only humans make choices and pass judgments on what is good or bad, right or wrong on such grounds and doing violence to others has been categorized as wrong and evil since ancient times.

Human nature itself is a combination of violence and non-violence. Therefore, an ethical concept is concerned with human emotions, with how humans conduct themselves and determines how they relate to other beings and behave towards others. Ethics studies the conduct of individual as an agent, interacting with other individuals. It aims at character building of individual by cultivation of moral values such as truth, love, sympathy, tolerant, self-control and non-violence. Thus, non-violence is basically an ethical principle and it becomes a guide to action when applied to human relationships. This paper is an attempt to examine why domestic violence occurs in the Myanmar family in spite of the excellent traditional ethical guidelines to living a good life in Myanmar society. Domestic violence here refers to unacceptable violent behavior between two individuals who are spouse or partner or members of a family; most of the victims also happen to be women and children within the family. Violence is usually considered to be physical violence committed by one spouse against another or towards children by parents. However, it should be understood that one must avoid violent thoughts from festering in the mind and that violent speech of abuse can lead to serious social conflict.

This paper will highlight how such domestic violence can be avoided in the light of Buddhist ethics, both theoretical and applied.

The Issues of Domestic Violence

The fundamental ethical issues are concerned with all human beings regardless of race, cultural or gender such as, questions about freedom and determinism, and egoism and altruism. As human beings, the conduct of men and women needs to be considered ethically. Women and men as members of society need to have a good relation for peace and security but also for survival and continuation of society which thus bring in ethical consideration and ethics deals of human behavior which need to be judge by moral principles of the society concerned.

Every human society and culture lays down the rules of conduct for the benefit of each member as well as for the community as a whole. But not all customs or social traditions are moral even though they may prove useful for life in society. However, human beings are influenced by their respective culture, religion and social institutions. Traditional ethical principles were sought after to provide guidance for the living of a good human life but they controversial especially in the sphere of practical life. There are ethical issues relating to

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[1] Handbook for Nonviolent Campaign (2014). Published by War Resister's international; second edition. p.10

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greed, anger, ignorance and feelings or emotions or passions of human beings that occur in both women and men.

The issue of domestic violence is one of the ethical issues common to both genders but it is a violation of women's right. Thus, it is a special ethical issue pertaining to women. It can be said one of the feminist ethical issues. The distinctive feature of domestic violence is that it indicates a general motive to control the other. Domestic violence is a form of violence, but the general motive is to control the wife or a member of a household. It is the outward form of a lack of care and respect. As there are many cases of domestic violence throughout history, the impact on society is considerable, it should not be ignored. From the views of applied ethics, domestic violence can be examined with the criteria of deontology and utilitarian ethics. In the western philosophy these two ethical standpoints are relevant to domestic violence because both moral views are directly concerned with human behavior. Deontological ethics lays emphasis on duty and the need to treat human beings as ends and not as means. Utilitarian ethics emphasizes the greatest happiness for the greatest number.

Domestic violence happens within the family. It is usually considered to be physical violence committed by one spouse against another or violence of parents against children. In western society, although women's status in the family has improved to some extent, the traditional marriage ceremony still reveals that man is the master who controls the family. In some cultures, the transfer of property is understood as a part of the marriage contract and is accompanied by exchange of money as well. Sally said that:

.....A wife is merely a part of the property of a man.[1]

There is also the tradition where the wife takes over name of the husband's family. Moreover, social beliefs about the proper role of the wife and mother further support a man's rights to rule his home according to whatever means he deems appropriate. A wife there must live under the control of her husband. Therefore, in real life woman is a man's instrument and her happiness are lost. So ethical principles and rules seem not to apply.

Domestic violence is usually considered to be physical violence but it is not physical alone. Domestic violence is any behavior the purpose of which is to gain power and control over a spouse, partner, girl/ boyfriend or intimate member. It is usually thought in terms of physical assault that results in visible injuries to the victim. This is only one type of abuse. The United States Department of Justice defines "domestic violence as a pattern of abusive behavior in any relationship that is used by one partner to gain or maintain power and control over another intimate partner." According to this definition, there are five types of domestic violence: physical, verbal, emotional, economic, and sexual abuse.

Physical abuse is any physically aggressive behavior, withholding of physical needs, indirect physically harmful behavior, or threat of physical abuse. Domestic violence was mostly associated with physical violence. Since the man holds the power to control, he is using violent and non-violent behavior as a way to control his partner. At some point, the victim of the abuse will begin to make choices about her life and her actions in response to this control. The control that her partner exercises over her will limit either what she can do or not do, with no autonomy within the household. This shows that they are not following the duty of respect. If they fail to show respect for another individuals' autonomy, they have committed a moral wrong. Physical violence violates the duty to respect the dignity or worth of others, so it is morally wrong.

Furthermore, domestic violence is a social evil in all countries, rich or poor, developed or undeveloped. Domestic violence against women is very common in patriarchal societies because the unequal power relationship between men and women in the society allows men to dominate over women. Some men believe in the husbands right to control their wives physically and be sexually abusive toward their wives. This not only violates human rights,

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[1] Sally J, Scholz. (2010). Feminism. New York: One orld publication. p.48

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but it has a major influence on the physical, mental, social and sexual health of a woman. According to the rece World Health Organization (WHO) report (2018),

> Between 1982 and 2011, about 38% homicidal deaths of women globally are due to murder by their husbands or partners.[1]

Domestic murders include stoning, bride burning, forced marriage, honor killing and dowry death. For instance, the problem of forced marriage also raises ethical issue. Forced marriages occur when either or both participants have been pressured into entering matrimony, without their consent. They may have been emotionally blackmailed, physically threatened or abused. The practice crosses boundaries of culture and class and happens worldwide, but it is especially concerned with those living in and originating from Asia. Domestic violence happens frequently to be burdens because a girl who is not well-off cannot afford to give a rich dowry to the intended bridegroom. This practice is still active in India in spite of laws prohibiting dowry marriages. It is also the case that a bride with a small dowry is often murdered when there is another girl with wealth and property to marry again. Sometimes domestic violence is due to poverty or other social ills such as alcoholism or adultery. Feminism contends that this happens because of the prevailing patriarchal system and because traditional ethics has ignored women's rights. Theoretical ethics lays down norms for human beings inclusive of both men and women but these norms and values are not for women but these norms and values are not beneficial for women in actual practice.

There is no single cause or factor that leads to domestic violence. A number of risk factors have been identified as associated with perpetrators of domestic violence. These include age, low academic achievement, low income or exclusion from the labour market, social disadvantage and isolation and exposure to, or involvement in, aggressive behavior as an adolescent. Many of these same risk factors have been linked to an increased probability of aggressive behavior and offending generally. Moreover, there are many reasons for domestic violence against women–lack education, sociocultural power relation, lack of awareness, poverty, alcohol addiction and economic insufficiency are identified as main problems.

Violence against women is still a major social problem in Myanmar and other Asian countries. It is considerable morality in the South East Asia region. The result indicated that among all types of domestic violence, about two-thirds of married women in Myanmar experienced physical violence. Women from rural areas were more likely to be abused physically and sexually by their husbands and partners and married women with the secondary and higher education in both cases were more likely to experience sexual violence. Women from richer backgrounds were more likely to face sexual violence and women from poor backgrounds were more likely to face emotional violence by their husbands or partners. It is found that lower education and lower wealth index have a significant association with physical and sexual violence.

The number of women is more than half of the population of Myanmar so the nation cannot progress without improving the situation of women. Despite government sectors and non-governmental organizations working together to eliminate gender inequality, the prevalence of domestic violence is still remaining in community. Thus, it is recommended that policymakers emphasis culturally appropriate outreach programmes to increase the awareness of domestic violence and to provide guidance on how to access physical and mental health services for domestic violence victims.

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[1] https://www.whoint/reproductivehealth/publications/violence/9789241564625/en/2018Dec10

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The Basic Teaching of Buddhist Ethics

> The basic tenet of Buddhist ethics teaches that a human being can withstand the trouble and sufferings of this world and be able to build up a successful and happy life only if it is based on sound moral principles such as the Five Precepts, the Eightfold Noble Path of the Majiimapatipada laid down by the Buddha.[1]

These principles are not only religious, they are the essence of Myanmar Theravada Buddhist morality and ethics. They refer to the practical guidelines of good conduct which must be followed in daily life.

The Eightfold Noble Path

The Buddha advised his followers to follow the Eightfold Noble Path (the Middle Path) so as to avoid the extremes of sensual pleasures and self-mortification. A person follows this Path, to enhance morality and not out of fear of any supernatural agency. Just as a traveler will need a map to reach a destination, all need the Eightfold Path which shows us the way to the final goal of human life·. To attain the final goal, there are three aspects of the Eightfold Noble Path to be developed by the devotee. One has to develop *Sila* (Morality), *Sãmadhi* (Mental Culture) and *Paññna* (Wisdom).

Right Understanding and Right Thought, which are Wisdom factors, will lead to good moral conduct. The three factors that will lead to moral conduct are Right Speech, Right Action and Right Livelihood. Right Speech involves respect for truth and respect for the welfare of others. It means to avoid lying, to avoid slander, to avoid harsh speech, and to avoid idle talk. Thus, to develop a harmonious society, one should control, cultivate and use speech positively.

Right Action entails respect for life, respect for property, and respect for personal relationships. It corresponds to the first three of the Five Precepts, that is, abstinence from killing, stealing, and sexual misconduct. Hence, one should not harm other sentient beings; one should not take what is not given; one should not commit adultery and should avoid sexual misconduct. These precepts are important for maintaining self-respect and the trust of those one loves as well as making society a better place to live in, for it creates harmonious relations.

Right Livelihood refers to how we earn our living in society. It means that one should earn a living without violating these principles of moral conduct, that is, without doing violence to others. Buddhists are discouraged from engaging in the five kinds of livelihood: (1) trading in other living beings (2) trading in weapons (3) trading in flesh by causing the slaughter of animals (4) trading in intoxicating drinks and drugs (5) trading in poison. These precepts are in line with present day principles of Human Rights.

The Four Cardinal Virtues

The Four Cardinal Virtues are loving-kindness (*Mettā*), compassion (*Karunā*), sympathetic joy (*Muditā*) and equanimity (*Upekkhā*). *Mettā* is extending unlimited, universal love and good will to all living beings without any kind of discrimination, just as a mother loves her only child. The chief cause of nearly all conflicts racial, political, economic, religious and gender conflicts is the lack of *Mettā* and compassion.

The second virtue is compassion (*karunā*). Its chief characteristic is the wish to remove the woes of others. A truly compassionate person lives not for himself but for others. He seeks opportunities to serve others expecting nothing in return, not even gratitude. It conveys the same sense as wishing a person who is in trouble, to be free from suffering or misery. If one can genuinely cultivate thoughts and feeling of loving kindness and compassion and put them practice they would prevent evils such as domestic violence, the trafficking in persons and looking upon women as sex objects. These would also follow respect for all forms of life.

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[1] AshinThittila (1986). Essential Themes of Buddhist Lectures. Bangkok; Publishing in Bangkok. p.18

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Sympathetic joy (*Muditā*) is not mere sympathy but altruistic joy which tends to destroy jealousy. The virtue of sympathetic joy helps a human to learn how to appreciate, with sincere heart, the prosperous conditions of other, to be generous in dealing with others and to share their happiness even by making it resound in one's own heart. *Upekkhā*, equanimity in its literal sense implies the enabling of a person to keep one's own mind in a balanced state. In spiritual practice, *Upekkhā* is understood in the sense of tranquility of mind in its neutral state, neither pleasant nor unpleasant. This means the stale, middle state of thought that causes the mind to remain serenely identical with itself in its calm state and prevents it from being carried away by any other object.

These four attitudes are said to be excellent or sublime because they are the ideal way of conduct towards living beings. They are also moral norms to lessen ignorance, greed and hatred and thereby contribute to social peace, and harmony. Efforts to cultivate these virtues can help to reduce tensions and social conflicts that arise in daily life, heal wounds inflicted in the struggle for existence, eliminate envy and jealousy, lessen egoism.

The Law of *Kamma*

According to the law of *Kamma*, it can be said that all human beings are reborn live continuously in the cycle of life because of his or her *Kamma* until they attain liberation. An action *Kamma* is like a seed which will sooner or later results in certain fruits arising to affect the doer of the action. In one life, they may be a man but in the next life he may be women, or animal. Moreover, some humans are rich, intelligent, and pretty but some are poor, dull, and ugly. According to the Buddha, this inequality is due not only to heredity and to environment or "nature and nurture", but also, to the operation of the law of *Kamma* or, in other words, to the result of one's own inherited past action and one's present doings. Human beings themselves are responsible for their own happiness and misery. Venerable NaradaMahathera (1998) said that:

> They create their own heaven. They create their own hell. They are the architects of their own fate.[1]

Therefore, human beings are required to seek good consequences concerning their conduct under the ethical guidance of the law of *Kamma.*

Then there are social and moral guidelines such as ***Gārava, Hiri-Ottapa*** and the ***Singala Sutta.*** '***Gārava***' is the principle of respect for oneself and others. The form of *gārava* which takes place in Myanmar social manners is respect shown to elders. The elders in tum must show kindness and compassion for youngers. However, members of a society living together in cooperation must have mutual respect. *Gāravais* related to *Hiri-Ottapa. Hiri* means a sense of shame to do immoral deeds. *Ottapa* means fear of the consequences of immorality. According to the Venerable AshinJanakabhivamsa edited and translated by U Ko Lay (1995),

> *Hiri* also includes self-respect and *ottapa* includes respect for others. The Buddha therefore attributed great importance to the need for *gāvaraor* respect.[2]

In the modem world today it can be said that *gāvara* is either lacking in the behavior of the people or *gāvara* is shown only to those with wealth power and position. Many wealthy and powerful people often forget to be modest and humble; they are usually proud and boastful. They tend to forget that true self-respect comes only with humility and respect shown to others whether they are one's elders, one peers or those younger than oneself. This was clearly set out by the Buddha in his teachings. When he laid down duties and obligations for

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[1] Venerable NaradaMahathera. (1998). Buddha and His Teaching Colombo: Buddha Dharma Education Association Inc. p.23

[2] AshinJanakābivamsa. (U Ko Lay (trans & edit)) (1995). Abhidhamma in Daily Life. Mandalay: New Burma Press. p.82

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people according to age, status and position in life in the *Singala Sutta*, he was stating implicitly that only if one fulfills his or her duties in life can a person be worthy of respect.

In this ***Sutta***, the Buddha laid out the duties of five significant relationships in society; Parent and Children, Teacher and Pupil, Husband and Wife, Friends and Friends, Master and Servant. There are the social duties the moral prescriptions for all human beings. If one observes these duties, one enjoys prosperity and high dignity, will fulfill in his or her life peaceful, harmony, and auspiciousness. Each of the world's peoples has are possibility to make its own particular contribution to peace and harmony by placing its spiritual and cultural her it ages and its ethical values at the service of the human family throughout the world.

Conclusion

There is a vast treasure of the Buddha's moral teachings that have been down through generation in Myanmar, where Buddhism is the prevailing religion and where Buddhist culture is rooted in Buddhism. Thus, we who are concerned about the moral awareness and the value systems of Myanmar youths of contemporary times, should pay heed and take into account the Buddha's views on child care and nurturing of youth. Buddhism teaches that in social life the morality of the individual or personal ethics should be cultivated from childhood. By morality is meant respect for life, that is, to recognize the right to life all living beings. Children should also be taught to understand that it is wrong to take by force or trickery what belongs to others; that it is wrong to blindly pursue sensual pleasures for it brings no benefit to oneself and to others and that trustworthiness is a virtue to be cultivated.

"According to the Lord Buddha every household is a preschool, and the parents are the "Pubbacariya"–the First Teachers. It is the foremost duty the First Teachers to wean away the children from evil and train them by example and precept, to tread the path of goodness".[1] Next to parents the Buddha also recognized the important role of teachers who have great influence on the child. In Myanmar culture, parents and teachers are revered after the Buddha, Dhamma and Sangha for children owe a debt of gratitude to them for their well-being. Children owe their life to parents and teachers mould their future life. Morality must be instilled from childhood by parents as well as teachers because it is the only guide to better human relationship. Therefore, it would be necessary to teach from young in what constitutes moral values and lessons.

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[1] TheroKaswatteAriyawimala. (1993). Chil Care in Buddhism, (J. Weerasuriya (Trans.). Srilanka: University of Kelaniya. p.xiii

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Acquisition of Trademark Rights in Myanmar

Ja Seng Mai[a], Nan Thwe Thwe San[b]

Abstract

Trademark can include names, words, letters, numbers, illustrated parts or combination of colors, or one such mark combined with another.Trademarks started to play an important role with industrialization, and they have since become a key factor in the modern world of international trade and market-oriented economies. Trademark protection under the Trademark Law is to establish a fair market competition system and to create a safe environment for consumers by prohibiting the entry of mark counterfeiting and counterfeit goods into the market, to improve the quality of regional products of Myanmar and to promote the economic development of people in these regions by penetrating the global market through protection of geographical indications.

Keywords: trademark, action, registration, civil and criminal

Introduction

Trademark is one of the categories of Intellectual Property. Intellectual Property (IP) can be described as intangible creation of human intellect or idea when first created, but become valuable in tangible form as products. IP includes creation, innovation, new design, literary, artistic works and scientific discover. Intellectual property is protected by law, for example, trademark law, patent law, and copyright law. IP enable people to earn recognition or financial benefit from what they invent of create. IP system aims to foster an environment in which creativity and innovation can flourish.

Generally, the intellectual property can be divided into two branches:

(1) Industrial property, and

(2) Copyrights.

Industrial property branch includes trademarks, service marks, trade name, designations, geographical indication of source, and protection against unfair competition. Literary, artistic and scientific works belong to the copyrights branch. And also include related rights which mean rights related to copyrights. Trademark is intangible property. But, if the trademark has goodwill, it will enable to earn recognition or financial benefit to manufacturers of traders. There are many types of trademarks. But their purpose is for the same which is to enable the consumers identify goods and services originating from a certain manufacturer of services provider.

Myanmar became a member of the World Intellectual Property Organization (WIPO) in May 2001.As an existing member of the World Trade Organization (WTO) and in keeping with TRIPS Agreement obligations, Myanmar was due to bring intellectual property laws. In 2019, Myanmar PyidaungsuHluttaw enacted new Trademark Law on 30th January. This law includes 24 Chapters and 106 Sections. It is an important step of government to attract

Trademarks protection plays an essential role for foreign direct investors in their consideration among in order to choose their business footing on a new territory. By protecting trademark, consumers may safely consume from counterfeited goods.

Acquisition of Trademark Rights in Myanmar

In 30th January 2019, the Pyidaungsu Hluttaw was enacted the first Trademark Law of Myanmar. The Trademark Law is the most impact on the investors and entrepreneurs. According to this law, trademarks rights can be acquire by first-to-file registration system.

Definition of Trademark

A trademark is a mark that indicates a product or service was created by a person or institution.

Section 478 of the Penal Code provided that a mark used for denoting that goods are the manufacture or merchandise of a particular person is called a trademark.[1]

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[1] Section 478 of the Penal Code, 1861

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Under section 2 (k) of the Trademark Law, "Trademark" means a mark that distinguishes the goods of one enterprise from those of another in the course of trade.[1]

According to section (j) of the Trademark Law, "Mark" means any visible mark, which includes names, letters, numbers, illustrated parts, or combination of colors, or one such mark combined with another, in order to distinguish a particular good or service from other goods or services. It includes trademark, service mark, collective mark and certificate mark.[2]

According to Black's Law Dictionary, "Trademark" is a word, phrase, logo, or other graphic symbol used by a manufacturer or seller to distinguish its product or products from those of others. The main purpose of a trademark is to designate the source of goods or services. In effect, the trademark is the commercial substitute for one's signature.[3]

Trademarks are another familiar type of intellectual property rights protection. A trademark is a distinctive sign which allows consumers to easily identify the particular goods or services that a company provides. Some examples include McDonald's golden arch, the Facebook logo, and so on. A trademark can come in the form of text, a phrase, symbol, sound, smell, and/or color scheme. Unlike patents, a trademark can protect a set or class of products or services, instead of just one product or process.[4]

Trademark can be divided into five types. Among these types can be divided into specific types such as, service mark, collective mark, certification mark, sound mark, trade name, and so on.

Acquisition of Trademark Rights

Before 2019, in Myanmar there is no method of trademark registration but property in or right in respect of a mark may be acquired by user. Because there is no particular statute or law on trademark .But it does not mean trademarks are unregistered in Myanmar. The trademark registration system has been operated under section 18(f) of the Registration Act and the Direction No.13 of the Inspector General of Registration.

Registration

Trademarks must be registered in order to have trademark rights in the world economy. WIPO (World Intellectual Property Organization) efforts to be internationally consistent in trademark registration. New trademark law has been enacted in Myanmar, which requires registration at a separate trademark registration office under this law. Trademark registration in Myanmar from "first to use" to "first to file" system started in 28thAugust 2020. If a mark finds the following grounds, the Registrar will refuse such mark and regard this mark not eligible for registration.

Under section 13 of the Trademark Law, any of the following characteristics of a mark constitutes absolute grounds for refusal and not eligible for registration:[5]

(a) lack of distinctiveness;
(b) containing only marks or indications of a good's or service's type, related information, quality, quantity, intended use, value, origin, time of manufacture, or other characteristics
(c) may be detrimental to public order, reputation, beliefs, the Union's reputation, or traditions valued by ethnic minorities;
(d) becoming common usage in contemporary expressions or becoming a part of traditions and is becoming used practically in the commercial area;
(e) in relation to subsection (b), misleading the public or commercial area;

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[1] Section 2(k) of the Trademark Law, 2019
[2] Section 2(j), Ibid
[3] Bryan A.Garner, Black's Law Dictionary, 9th Edition, 2009, p-1630
[4] www.inquartik.com
[5] Section 13 of the Trademark Law, 2019

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(f) directly copying or imitating or misleading, without the approval of relevant authorities, all or part of a country's flag, cememonial appearance, other marks and symbols, a legal mark indicating the management or guarantee by a State, or a mark of quality guarantee, or a multilateral international organization's ceremonial appearance, flags, or other marks, names, including said organization's acronyms, full name, or any part;

(g) use of marks and signs separately protected under the international agreements in which the Republic of the Union of Myanmar is a Party.

Section 14 of the Trademark Law provided that if any of the following applies to a mark, then it constitutes relative grounds for refusal and the mark is in eligible for registration.[1]

(a) if the mark misleads consumers through its use by being identical or similar to any other person's registered mark or mark for which registration or right of priority has been applied for beforehand for identical or similar goods and services for said marks;

(b) if it use, without the consent of a relevant person or legally formed organization, a mark which may be harmful to the individual rights of any person or the name and reputation of a legally formed organization;

(c) if it is a mark which may infringe upon the intellectual property rights of any other person;

(d) if the registration of a mark is applied for without good faith;

(e) if a mark registration application is made for a mark that misleads consumers by not only being identical or similar to a well-known mark but is also used in identical or similar goods or services;

(f) if a mark registration application is made for a mark that is identical or similar to a registered well-known mark but the goods or services are not identical or similar but may indicate that there is a connection between the owner of the well-known mark and the goods or services that the mark in question is being used for and such use may be harmful to the interests of the owner of the well-known mark.

Section 55 of the Trademark Law provided that the geographical indication is in eligible for registration if it meets any of the follow conditions:[2]

- it does not conform to the definition of a geographical indication stated in subsection (o) of section 2;
- the goods for which the geographical indication is used has become common usage or customary in the Republic of the Union of Myanmar;
- it is a geographical indication that is contrary to public order, moral or public policy.

Under the new law system, only registered marks are protected. If the mark are lack of distinctiveness, imitating or misleading other registered mark, and all or part of a country's flag, it will be absolute grounds for refusal.

According to section 16 of the Trademark Law, an application for trademark registration may be made either in Myanmar or English language. If the Registration Officer request, the applicant will translate the Myanmar language application into English or vice versa. The applicant must write a statement that the translation is true and correct and sign it.

Under section 17 (a) of the Trademark Law, the applicant for the registration of a mark shall include the following in the application:[3]

(1) an application for registration;

(2) name and address of the person or legally formed organization applying for registration;

(3) name, citizenship scrutiny card number, and address of the agent or representative if the applicant entrusts an agent or representative with this matter;

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[1] Section 14 of the Trademark Law, 2019

[2] Section 55,Ibid

[3] Section 17(a) of the Trademark Law, 2019

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(4) a clear and complete description of the mark;
(5) name and type of goods or services for which a request for registration is made and the category of international mark classification to which it belongs.

Under section 17 (b) of the Trademark Law, the following elements must be attached to the application if necessary:[1]

(1) if the application is made for a legally formed organization, the registration number, type and country of said organization;
(2) if the applicant requests the right of priority, an application for the right of priority together with sufficient evidence proving that he has the right of priority, and description;
(3) if the applicant requests the right of priority for trade exhibitions, an application for the right of priority for trade exhibitions together with sufficient evidence proving he has the right of priority for trade exhibitions, and description;
(4) if the mark is registered at the documents registration office, documentary evidence proving such registration;
(5) other requirements stipulated by the Agency and the Department from time to time. According to section 34 of the Trademark law, the term of a registered mark shall be 10 years from the submission date of the registration application. After this period, the applicant may renew the term of registration for 10 years at a time.[2]

If the owner of a mark wishes to renew the term of mark registration, he must carry out according to the following:[3]

(a) the renewal of the term of registration must be applied for within six months prior to the expiration of the term by paying the prescribed fees.
(b) after the expiration of the term of registration, the renewal application can be made within the grace period of six months. If the renewal application is submitted within this period, the applicant must pay the prescribed registration fee and overdue fee.

The Trademark Law, the Registrar must:[4]

(a) allow the renewal application for the term of registration for a mark if it meets the stipulated requirements. The renewal term is effective starting from the date of expiration of the previous term.
(b) examine the application for the renewal of the term of registration and grant the renewal for a term of 10 years if the application meets the criteria for renewal and make a public announcement in a manner that is consistent with stipulations.
(c) record the renewal of the term of registration and payment of the prescribed fee in the registration records.
(d) suspend the registration of the registered mark if the owner of the registered mark has not paid the renewal fees within the grace period of six months.
(e) record the suspension of the registration of the registered mark in the registration records and make a public announcement in a manner according to stipulations.

Electronic Trademark Registration System

The Ministry of Commerce declared for online trademark registration system under the New Trademark Law of "first to file" system. In order to follow other countries Intellectual Property Rights fields, this order make it work. If this system is widely used in Myanmar, trademark search will be easier. It is modern registration system for trademark.

On 28th August 2020, the Ministry of Commerce issued Order 63/2020 for the filing of applications to register trademarks pursuant to the New Trademark Law. This Order applies to existing trademark owners in Myanmar. Existing owners include both trademark owners

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[1] Section 17(b), of the Trademark Law, 2019
[2] Section 34,Ibid
[3] Section 35,Ibid
[4] Section 36, Ibid

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that have registered their marks with the Office of Registration of Deeds as well as owners of trademarks which though not registered with the Office of Registration of Deeds, remain in use throughout the country. This Order paves the way for the transition from the "first to use" to the "first to file" system for trademark registration in Myanmar.[1]

The new trademark system in Myanmar will operate in two stages:

(i) Soft opening period (from 1st October 2020 to 31st March 2021) and,

(ii) Grand opening (from 1st April 2021).

During the soft opening period, only applications for the following trademarks may be filed:[2]

(i) Trademarks recorded with the Registry of Deeds under the current system; and

(ii) Trademarks which are not recorded with the Registry of Deeds but have been used in Myanmar.

It is essential for existing registrants to re-file their trademark applications during the soft opening period in order to maintain the protection of their trademarks under the new law. If a registrant fails to re-file the application for existing rights during the soft opening period, the relevant trademarks will be available for registration by third parties from 1st April 2021. In addition, any existing rights obtained through the recordation of declarations of ownership with the Registry of Deeds will unlikely be sufficient for establishing ownership of a trademark after the grand opening. All trademark applications accepted during the soft opening period will be accorded the same filing date, which will be the date of the grand opening.[3]

Existing owners may obtain priority rights over the trademark and obtain for online filing starting from 1st October 2020. According to the Order, the date on which the application (along with filing fees and valid documentary evidence) is accepted will be considered the official filing date of the trademark. Existing owners will enjoy priority rights from this point onward.[4]

For the re-registration process, trademark owners must specify the exact list of goods or services for which the mark is used in the application. The re-registration process may not be used to expand the types of goods or services covered by a particular mark. The class of goods or services under which the mark is registered must be detailed as per the Nice Classification. The official application filing fees and the payment methods of such fees shall be declared before enforcement of the Trademark Law.[5]

The main requirements for re-filing or filing a trademark application during the soft opening period are:[6]

(i) A scanned copy of the recordation of the declaration of ownership or renewal with the Registry of Deeds;

(ii) A scanned copy of the last published cautionary notice;

(iii)Evidence of use of the trademark in Myanmar and the first date of use; and

(iv)A power of attorney duly legalised by the Consulate of Myanmar.

The Order states that re-registration application submissions must initially be directed through law firms and service provider companies as specified by the Department of Consumer Affairs. Later, the Existing owner may themselves apply for re-registration. This Order is a welcome move and represents a significant milestone towards formalizing the online trademark registration process in Myanmar.[7]

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[1] www.dfdl.com
[2] www.cms-lawnow.com
[3] www.cms-lawnow.com
[4] www.dfdl.com
[5] www.dfdl.com
[6] www.cms-lawnow.com
[7] www.dfdl.com

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Applications for new trademarks will not be accepted during the soft opening period and may only be filed from the grand opening on 1st April 2021. Other key features of the new trademark system in Myanmar will include:[1]

(i) The availability of public search;
(ii) Registration term of ten years;
(iii) Renewal term of ten years; and
(iv) Procedure for filing recordal of changes.

At the end of the soft opening period, the Myanmar Office of Intellectual Property will start accepting trademark applications from all other interested parties. Under the new trademark application procedure, trademark searches would be available, the opposition period is 2 months from the date of publication, oppositions would be available at the IP Court, the term of registration will be 10 years from the date of application, and renewal requests can be filed 6 months prior to the expiry of the registration. Whilst the Office of Registration of Deeds will continue to accept recordals of a Declaration of Ownership of a Trademark until the grand opening, after the grand opening, trademark applications will be granted on a first to file basis, and existing rights obtained through recordation with Office of Registration of Deeds and publication of cautionary notices will no longer suffice to demonstrate ownership of a trademark in Myanmar.[2]

Myanmar's new Trademark Law establishes the framework for a comprehensive trademark registration and protection system in line with international standards. This is an important step by the government to attract new investments, relevant for both foreign and domestic trademark owners. Although some details remain to be published, such as the fees, the enactment of the new law represents an important milestone in Myanmar's transition to a modern trademark system.[3]

Now Myanmar is trying to establish e-government. The new electronic trademark registration system in Myanmar is starting available now according to the Order of the Ministry of Commence. Trademark registration rights should be registered to control counterfeiting, especially in hazardous drugs and foods. According to the New Trademark Law, a person who first registers must enjoy the right of registered mark and owner of such mark. It does not depend on a person who first use.

Rights of Trademark Owner

Any trademark owner register in accord with the Myanmar Trademark Law, can enjoy the owner of a registered mark.

Under section 2(r) of the Trademark Law, "Owner of a registered mark" means a person or a legal entity recognized and registered in the Department's registration records as the owner of the mark.[4]

Section 2(s) of the Trademark Law described that "Right holder" means a person or a legal entity who is the owner of a registered trademark, the owner of a well-known mark, the owner of a geographical indication, the owner of a trade name or is a transferee of the rights relating to a registered mark or is a licensee of the rights relating to a registered mark.[5]

Legal Action for Trademark Infringement

A trademark owner has the right to file litigation, in criminal or civil actions, against an infringer. Myanmar is currently in the process of establishing special IP Courts that will then hear criminal and civil cases relating to trademark infringements.

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[1] www.cms-lawnow.com
[2] www.mondaq.com
[3] Ibid
[4] Section 2(r) of the Trademark Law, 2019
[5] Section 2(s),Ibid

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Criminal Action

Before 2019, Myanmar has no trademark law or particular statute regarding the protection and enforcement of trademark in Myanmar. But it does not mean trademark rights are unprotect able in Myanmar. Penal Code, Civil Procedure Code, Myanmar Merchandise Marks Act, Specific Relief Act, Registration Act and Sea Customs Act provide isolated provisions for the protection of trademark with effective remedies. Legal action for trademark infringement can be taken either criminal or civil actions. Myanmar Penal Code, the Myanmar's Merchandise Marks Act were applied for trademark infringement of criminal action.

The decisions of the highest court (Rulings) in different regimes stand as Case Law and had laid down prevailing principles on trademark rights protection upholding the discretionary power of the judge of the common law system so far relevant.[1]

Under section 482 to 489 of thePenal Code provided that using a false trademark or property mark, counterfeiting a trademark or property mark, selling goods marked with a counterfeit trademark or property mark are punishable with imprisonment up to three years or with fine or with both.

Moreover, the exhibits may be destroyed or disposed as the Court think fit. Therefore, a complainant may institute a criminal case under the Penal Code for using a false trademark, or counterfeiting trademark and making or possessing any instrument for counterfeiting a trademark, or selling goods marked with a counterfeit trademark. The accused is liable to be fined and/or imprisoned if found guilty.[2]

The Myanmar Merchandise Marks Act is a supplement to the relevant provisions in the Penal Code for more detailing procedure. One significant provision is section 15 of the Act, which reads that no prosecution shall be commenced after the expiration of three years next after the commission of the offence, or one year after the first discovery thereof by the prosecutor, whichever expiration first happens.[3]

U Han Kyi (The Creation Myanmar Co., Ltd.) Vs. Ko Mya Soe (Sein Gay Har Store)[4], in this case, the complainant sued Sein Gay Har Store of Latha Township under section 420 and 486 of the Penal Code for selling the forged Giordano properties with Giordano Trade mark, and that therefore his company suffered loss and damage.

The court decided that the accused Ko Mya Soe of Sein Gay Har has been convicted under section 486 of Penal Code and punished with fine K.20,000/- or in defamer with imprisonment of 4 months.

In the new Trademark Law provides the offences and penalties for trademark infringer.

Under section 87(a) of the Trademark Law, whoever is found guilty of any of the following offences for commercial purposes without the consent of the right holder shall be punished with a prison sentence of no more than three years, a fine not exceeding five million (5,000,000) kyats, or both:[5]

(1) counterfeiting a mark;
(2) using a counterfeit mark for goods or in relation with services;
(3) keeping any object or equipment mainly used to make a counterfeit mark or mainly used to use a counterfeit mark in goods.

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[1]Than Maung U, Legal articles on Intellectual Property rights,Wisdom House, 4th Edition,2019, p-287
[2] Judicial journal, IP rights enforcement in Myanmar Legal system and practice
[3]Than Maung U, Legal articles on Intellectual Property rights, Wisdom House,4th Edition,2019, p-320
[4] 2001, M.L.R, (HC)
[5] Section 87 (a) of the Trademark Law, 2019

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Under section 87(b) of the Trademark Law, whoever is found guilty of any of the following offences shall be punished with a prison sentence of no more than two years, a fine not exceeding five million (5,000,000) kyats, or both:[1]

(1) trading in and distributing goods using counterfeit marks or keeping such goods in possession for the purpose of trading and distribution;
(2) importing goods using counterfeit marks into Myanmar or exporting such goods from Myanmar.

Section 88 of the Trademark Law provided that whoever commits and is convicted of any of the acts in section 87 and has been convicted of the same offense previously shall be sentenced to prison for a minimum period of three (3) years to a maximum period of ten (10) years and, in addition, a fine not exceeding ten million (10,000,000) kyats may be imposed.[2]

Section 89 of the Trademark Law provided that whoever is convicted of using flags or symbols, which receive special protection under international agreements where the Republic of the Union of Myanmar is a Party, as a mark for commercial purposes shall be punished with imprisonment of not more than three (3) years, a fine not exceeding five million (5,000,000) kyats, or both.[3]

Section 90 of the Trademark Law provided that whoever is convicted of removing, destroying, altering, or adding to a registered mark with the intention of harming the owner of said mark, shall be punished with imprisonment of no more than one (1) year, a fine not exceeding three million (3,000,000) kyats, or both.[4]

Section 91 of the Trademark Law provided that whoever is convicted of any of the following acts may be punished with imprisonment of no more than (1) year, a fine not exceeding two million (2,000,000) kyats, or both:[5]

(a) issuing or causing to issue a counterfeit registration certificate of a mark;
(b) making or causing to make a false entry in the mark registration records without good faith.

The imprisonment under the New Trademark Law and under the Penal Code is similar term. Fine under the New Trademark Law is more than the fine of Penal Code.

Civil Action

Code of Civil Procedure and Specific Relief Act were applied for trademark infringement of civil action. Injunction is the suitable civil action for trademark infringement.

The most reliable choice for civil litigation among other might be the Specific Relief Act. An action for infringement of the trademark is maintainable by means of a civil suit under section 54 of this Act that authorises the court of law to grant a perpetual injunction against the infringer.[6]

According to Order 39, Rule 1 and 2 of the Civil Procedure Code, if any person suffers counterfeiting his trademark or injury of any kind from such trademark, he shall apply to the Court for a temporary injunction to restrain the defendant from such act.

Injunction is the most effective remedy obtainable on trademark infringement suits, the owner can seek preventive relief granted at the discretion of the Court by injunction, temporary or perpetual. Temporary injunctions are to continue until a specified time, or until the further order of the court. They may be granted at any period of suit, and are regulated by Order 39, Rule 1 of the Civil Procedure Code. Under section 54 of the Specific Relief Act, perpetual injunction can only granted by the decree made after hearing and upon the merits

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[1] Section 87 (b), of the Trademark Law, 2019
[2] Section 88,Ibid
[3] Section 89 of the Trademark Law, 2019
[4] Section 90,Ibid
[5] Section 91,Ibid
[6] Than Maung U, Legal articles on Intellectual Property rights,Wisdom House,4th Edition, 2019, p-320

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of the suit. The defendant is perpetually refrained from invading or threatening to invade the plaintiffs enjoyment of property.[1]

In the case of John Walker & Sons Ltd.(appellant) Vs. U Than Shwe (respondent)[2], suit for infringement of a trademark whether such a suit is maintainable in an infringement suit whether fraud must be established whether an owner of a trademark in respect of a particular commodity has a right to prohibit or prevent other persons from the use of such mark in connection with goods of a totally different character.

The appellant's case is that he is the owner of the trademark JOHNNIE WALKER (words) and the JOHNNIE WALKER striding figure representations which have been used on bottles of whisky sold by him in Burma (Myanmar) since the year 1925 that his trademarks are so well-known. The respondent was said to have used the words "Burmese JOHNNIE WALKER" with the striding figure of "JONNY WALKER" on his Blood Tonic bottles.

In the case, the appellant's commodity is whisky, an alcoholic whereas the respondent's merchandise is blood tonic, medicinal preparation without any trace of alcohol. The goods are admittedly different in character and class.

It was held that the court may grant perpetual injunctions in infringement suits under section 54 of the Specific Relief Act. The courts can provide the relief such as injunctions, damages and other ancillary relief. The most effective relief is an injunction.

In the case of U Tin Lat (a) U Sai Lat and one Vs. U KyawNyein[3] , the plaintiff was the manufacturer of "Taunggyi Mauk Mai", a special thanakar.The defendant had been producing a similar thanakar lotion for the skin under the name "Shan Maung Mai". Believing that its trademark was being infringed, the plaintiff brought an action for a perpetual injunction against the defendant under section 54 of the Specific Relief Act.While the case was awaiting trial, Yangon Divisional Court granted a temporary injunction against the defendant. Aggrieved by this action, the defendant filed a civil miscellaneous appeal in the Supreme Court. The Supreme Court admitted the appeal and dismissed the temporary injunction granted by the divisional court. The plaintiff then filed a special appeal to the Supreme Court rulings in this appeal are as follows:

- where there is a suit to be decided, it is incorrect to refuse a temporary injunction in a suit for perpetual injunction;
- in a suit for the granting of a perpetual injunction, the granting of a temporary injunction that restrains the defendant from using the trademark in question does not amount to a pre-judgement on the case; and
- if no temporary injunction is granted to restrain from manufacturing and selling the goods, the plaintiff is likely to suffer irreparable loss.

In this case, the Deputy Chief Justice and two Justices of the Supreme Court ruled that a mark used to indicate that goods are manufactured by or the merchandise of a particular person should be deemed a trademark. Although there is no law in Myanmar specifically governing trademarks and ownership rights, use of a trademark will generally strengthen claims to ownership or other rights benefits in passing-off actions. The infringing trademarks need not be an exact copy of the genuine mark and it is not necessary for marks on different goods to be identical in cases involving counterfeit trademarks. Therefore, the special bench of the Supreme Court affirmed the decision of the Divisional Court and granted a temporary injunction against the defendant.

In the case of DawThet Pu (Appellant) Vs. SayaKhin (Respondent)[4], plaintiff and defendant manufactured blood purifiers. Each gives the same name "Shwe Nan Theingi" and

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[1] Judicial journal, IP rights enforcement in Myanmar Legal system and practice
[2] 1968, BLR (CC),p-73
[3] 2001 M.L.R (Civil),p-216
[4] 1952, M.L.R, (H.C), p-245

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except for the name mentioned in the label, the get-ups were entirely different. The defendant had been manufacturing and selling medicine for the last 25 years but only selling medicine the trade mark and name. The plaintiff SayaKhin has been manufacturing this medicine for past 10 years or so applied for an injunction to restrain the defendant from using the same name.

Held: That the most important question is whether the name "Shwe Nan Theingi" has acquired a reputation in the market. The term itself was never meant to be a trade name and was given to this type of medicine long ago in Myanmar Royal Palace. The process of manufacture has also been published in "Tse-Kyan" (materiamedica).

In this case, two packets of blood purifier from both parties, which were produced as exhibits in Court could not be denied that the plaintiff's trademark is entirely different from that of the defendant. The label of plaintiff (SayaKhin) not only shows his own name but also his own picture in contrast to the label of the defendant, showing the picture of a Myanmar Royal Palace and the words. In his appeal before the Additional District Judge, Mandalay, SayaKhin was successful and the judgment and the decree of the of the trial Court was set aside and his suit was decreed. On the other hand, the trademark or name which is primarily descriptive of an article or its composition or its mode of manufacture must remain open to the trade and cannot be claimed for exclusive use by any one trader. In this case the judge reffered to numerous decisions. One of the cases, *Hommel V. Bauer & Co*,has a striking resemblance to the case, the plaintiff was selling a proprietary medicine which he called Hommel'sHaematogen, and sought to restrain the defendants from selling a similar product under the name "Haematogen". The action was dismissed. It was held that the fact that the bottle containing the medicine was marked, "Dr. Hommel'sHaematogen" showed that "Haemotogen" had not acquired this secondary meaning exclusively attaching it to Dr.Hommel's preparation.

In the present case, on the label of the plaintiff's it was clearly mentioned that "Shwe Nan TheingiThwese" was the manufacture of SayaKhin. For all those reasons the appeal must be allowed. The judgement and the decree of the Lower Appeallate Court are set aside and the plaintiff (respondent) SayaKhin's suit must be dismissed. Therefore where the plaintiff's name is habitually, used along with the trade name of his goods is difficult to establish that the trade name has, by itself, become distinctive of his goods.

In the case of 1.U KhinMaung Tin and 2.Daw San SanNwe (a) Daw Maw Su Vs. 1.Ma ThiriShwe Sin, 2.Ko Nay Lin Yi, 3.Ma HtatShwe Sin, 4.Ma Nin Shwe Sin and 5.Ma Myat Moe Shwe Sin[1],the plaintiffs were manufacturer of Loonyarkyar silk Acheik under the name of "Shwe Loon Eain". The defendants are producing a similar trademark "Shwe Loon Eain (amarapura)".

The plaintiff brought an action for a perpetual injunction under section 54 of the Specific Relief Act and compensation for kyats (100,000,000) and not to distribute goods with such trademark. The Township Court of Amarapura granted a decree of perpetual injunction and compensation for kyats (30,000,000).

The defendants are not satisfied the above decree and appeal to District Court of Mandalay. The District Court of Mandalay dismissed the appeal.

Again the defendants are filed second appeal to High Court of Mandalay Region. The High Court of Mandalay Region admitted the appeal and dismissed a decree of township court of Amarapura and district court of Mandalay.

The plaintiffs are not satisfied a decree of the High Court of Mandalay Region and appeal to the Supreme Court. In this case, the registration date of defendant is more eariler than the plaintiff. Moreover, trademarks' design and shape are not exactly the same. But both

[1] 2020, Civil Appeal, 9, SC

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trademarks contain the word "Shwe Loon Eain".This word shall become confuses among customer. This case is to examine the defendant counterfeit plaintiff's trademark or not.

During this dispute, trademark law of 2019 is not enacted. In the case of "U KyawVs. U Ba Aye" described that the first user of trademark must be owner of trademark and right to use such trademark. Therefore, in the case of counterfeit plaintiff must use eariler than the defendant.

In this case, the plaintiff has been using "Shwe Loon Eain" trademark since 1987 and the defendant has been using such trademark since 1985. And in the statement of no.2 plaintiff Daw Maw Su, she knows "Shwe Loon Eain (amarapura)" use eariler than her trademark last 30 years. According to the license of 2011, it is not assume that the plaintiff use eariler than the defendant. The Supreme Court dismissed the plaintiff's appeal with cost. The above cases are before the change from "first to use" system to "first to file" system by Notification No.63/2020.

In the case of 1.U Elisa (a) U KyawKyaw and 2.U Mohamad Arsharad (a) U Aung MyoHlaing Vs. U Kyi Yone[1], the plaintiff sued defendant under section 54 of the Specific Relief Act to grant perpetual injunction and compensation for kyats (10,200,000,000) for not to counterfeit "KLASOR" trademark's box design and sell to public. The High Court of Mandalay Region granted a decree of perpetual injunction against defendants and compensation for kyats (500,000,000). The defendants are not satisfied of the above decree and appeal to the Supreme Court. The Supreme Court confirms the decree of the High Court of Mandalay Region and dismissed this appeal case.

Section 18(d) of the Sea Custom Act of 1878 contains an explicit prohibition to import goods sporting counterfeit trademarks. Such goods can be impounded by the custom authorities. The owner of a trademark may, if he has knowledge of a shipment, inform the customs authorities accordingly.[2]

The new Trademark Law sets this system on a new and firm footing. It provides a procedure for a right holder to apply for a temporary suspension of the transport, the defences available to the importer, time frames, rules on the disposal of infringing goods and rules on expenses and damages.[3]

Conclusion

Trademark can be protected on the basic of either use or registration. Before the enactment of Trademark Law in Myanmar, trademark protection can be acquired by actual use in the market. According to the Trademark Law of 2019, a person who first registers must obtain the owner of trademark. But it does not mean only registered mark are protected. Because unregistered well-known and trade name are protected automatically. Currently Myanmar trademark registration system based on "first to file" system. It mean the first user have priority and owner of trademark.

The New Trademark Law of 2019 described a modern registration system. It is based on "first to file" system. Whoever before launching his/her products on the Myanmar market, product name or trademark should be register first. Then it will acquire trademark protection in Myanmar. The Ministry of Commence issued order for the filing of application to register trademark on 28th August 2020. It shall apply by e-filing system. The new trademarks are accepted for registration at the time of Grand opening. If this system is fully implemented, trademark search will become earlier and can follow other developed countries of their Intellectual Property Right field.

Laws are also needed to protect foreign investment that uses online registration. Easy and fast online search will make it convenient for those who want to register naturally.

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[1] 2019, Civil Appeal, 742, SC

[2] www.lincolonmyanmar.com

[3] www.lincolonmyanmar.com

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Counterfeiting and trademark infringement can be quickly identified and prosecuted. Therefore, specific law should be enacted to protect the trademark online registration of local and foreign business men.

Under the Trademark Law of 2019, trademark covers service mark, collective mark, certification mark, geographical indication, well-known mark and trade name. The Supreme Court of the Union has planned to open Intellectual Property Rights Court pursuant to the New Trademark Law. The offences under the trademark law are deemed as cognizable offences. Any dispute arise between two parties may be settled by negotiation, arbitration or litigation.

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1.U Elisa (a) U KyawKyaw and 2.U Mohamad Arsharad (a) U Aung MyoHlaingVs. U Kyi Yone,2019, Civil Appeal, 742, SC

Protection of Wildlife in Myanmar

Aye Sann Mya[a] , Nay Wah Wah Aung[b]

Abstract

Wildlife is traditionally refers to animals species but has come to include all wild plants and fungi that grow or live in their natural habitats. Myanmar's wildlife includes a mix of species from north and south in a wide range of habitats throughout the country. Wildlife plays a major important role in balancing the environment. Wildlife also provides stability to different kinds of natural processes.

Keywords: wildlife, environmental, protection, plant, preservation, natural

Introduction

The term wildlife is traditionally referring to animals' species but has come to include all wild plants and fungi that grow or live in their natural habitats. Biodiversity refers to the variety of life. It is seen in the number of species in an ecosystem, and is used as a measure of the health of biological systems. Myanmar's wildlife includes a mix of species from north, south and southeast Asia, which find shelter in a wide range of habitats throughout the country.

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Meaning of Wildlife

Wildlife means wild animals, plants and animals living in their natural habitats, not within possession or control of humans.

According to Black's Law Dictionary, wild animals mean animals of an untamable disposition; animals in a state of nature.[1] Animals, birds, insects, etc. those are wild and live in a natural environment.[2]

Wild animals mean natural bred animals such as birds, insects and aquatic animals in their natural habitats or from habitats to where living things live because of various ways. Moreover, this term also includes spawns, fry's, larvae, seeds and parts of animals.[3]

Wild plants mean trees, shrubs, climber, bamboos, canes, orchids, fungus, aquatic plant, etc., and their seeds growing in the natural habitats. Moreover, this term also includes their seeds, tissues and parts of plants.[4]

Causes of Wildlife Depletion

Myanmar is a country in South East Asia with phenomenally rich biodiversity and abundant natural resources. Myanmar possessed a long coastline of 2280 km over 800 islands, forest and woodland covers an estimated 47.9 percent and arable land 14.2 percent. There are only few types of habitats left on earth that cannot be found in Myanmar. It still has a high percentage of natural forest cover which is home to a rich diversity of flora and fauna.

About 250 mammal species, more than 1000 birds, 370 reptiles and 7000 plants are recorded in Myanmar, including 39 species of mammals, 45 of birds, 21 of reptiles and 38 of plants which are globally threatened.[5]

There is a general understanding that species are becoming extinct and that biodiversity is diminishing at an alarming rate primarily because of forest destruction as well as because of the disappearance of many other habitats, such as wetlands, and the pollution of seas and oceans.[6]

The 4th National Report on Biodiversity confirms that Myanmar is losing biodiversity due to socio-economic pressure with the main threats identified in habitat destruction especially related to forest depletion, degradation and climate change, and hunting and illegal wildlife trade. Myanmar still remains one of the ten countries in the world with the largest annual net loss of forest area. Illegal wildlife trade in Myanmar is considered to be widespread, causing with illegal hunting general decrease of wildlife population.[7]

Myanmar has conserved an extraordinary natural and cultural heritage that is in part represented in its protected area system. The expansion of agriculture and industry pollution, population growth along with uncontrolled use and extraction and ecosystem degradation, loss of biodiversity is the most pressing environmental problem because species extinction is irreversible. Realizing the urgency of Myanmar environmental challenges, several stakeholders, at national, international and regional level, have committed to support conservation and management of PAs.[8]

There are many reasons that lead to depletion or extinction of wildlife across the world. Over hunting is another reason for depletion or extinction of wildlife. This is very much the case in Myanmar, where hunting occurs in about 70% of PAs and threatens a number

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[1]Henry Campbell Black, M.A, Black's Law Dictionary,4th Ed., 1951, p.1771
[2]Oxford Advanced Learners' Dictionary, 8th Ed., Oxford University Press,2013
[3]Section 2 (b) of the Protection and Conservation of Biodiversity and Protected Areas Law 2018
[4]Section 2 (c), Ibid
[5]IstitutoOikos and BANCA, Myanmar Protected Areas (Context, Current Status and Challenges), 2011, p.1
[6]Elli Louka,International Environmental Law,Fairness, Effectiveness, and World Order, 2006, 1stEd.,Cambridge University Press,p.288
[7]IstitutoOikos and BANCA, Myanmar Protected Areas (Context, Current Status and Challenges), Milano, 2011. p.4
[8]Ibid, p.ix

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of species with national extinction.[1] Forest loss or degradation is mostly caused by the expression of agricultural land. Habitat destruction is a major cause for biodiversity loss. Habitat loss is caused by deforestation, overpopulation, pollution and global warming species which are physically large and those living in forests or oceans are more affected by habitat reduction. The other reason is that disposal of toxic chemicals into the water bodies such as rivers, lakes and seas.[2]

Wildlife extinction happens due to illegal trade, [3]over killing, or wounding a protected wildlife species without permission, possession, selling, transporting or transferring such wildlife or any part of wildlife.

Agriculture expansion, shifting cultivating, overfishing are also the main cause of wildlife depletion. Agricultural expansion includes unplanned and unrestricted agricultural expansion by rural populations. In mountainous regions of Myanmar, ethnic minority communities frequently practice forms of shifting cultivation, typically involving rotational systems of Swidden fields and regenerating follows.[4] In Myanmar shifting cultivation has destroyed most of the forests below 2,000 meters above sea level, and is threatening Natmataung National Park within southern Chin State. [5]

A significant proportion of Myanmar's human population is dependent on freshwater fish as a source of food or income. The use of poison for fishing has been identified as a threat to biodiversity at several sites in Myanmar.[6]

Myanmar's accession to CITES on 13th June 1997 was highly significant, in light of the significance of the wildlife trade as a driving force for over-exploitation of wildlife populations in the country.[7] But Government still weak enforcement to control illegal trade of wildlife and their parts.

The Director General may, with the approval of the Minister, exchange wildlife (Wild animals and wild plants) with foreign countries.[8]

Wildlife depletion is the loss of wild animals through over hunting and disappearance of natural habitats due to human expansion of agriculture. The largest scale killing of animals for food and trade is one of the many reason for the depletion of wildlife. Therefore, it is needed to protect of wildlife and ecosystem by cooperation of State and national to reduce of wildlife depletion.

Preservation of Areas for Wildlife

Preservation of areas for wildlife needs habitats for breeding, shelter, food, migration and any other facts of living. Preserved areas are very important for flora and fauna, for health of natural systems and processes. There are designated national protected areas for sustainable development of ecosystem for wildlife.

(1) National Protected Areas

(2) Categories of Protected Areas

(1) National Protected Areas

Protected area is generally perceived that biodiversity is more than protection from human pressure after those areas is designated and managed to achieve specific conservation objectives.[9]

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[1]National Biodiversity Strategy and Action Plan,2011.p.48

[2]Thein Aung, Assistant Director, Status of Biodiversity Conservation in Myanmar, Nature and Wildlife Conservation Division, Forest Department

[3]Rule 4 (b), Protection of Wildlife and Protected Areas Rule (2002)

[4]National Biodiversity Strategy and Action Plan,2011.p.50

[5]Ibid, p.52

[6]National Biodiversity Strategy and Action Plan,2011.p.49

[7]Ibidp.37

[8]Section 12 (c) of the Protection of Wildlife and Protected Areas Law. 1994.p.9

[9]Section 2(d) Conservation of Biodiversity and Protected Areas Law, 2018

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At the state of 20th century, there was only handful protected area in the world although many have existed for generation. Today, there are approximately 200,000 protected areas in the world, which cover around 14.6% of the world land and around 28% of the oceans. One of the most frequently used methods to protect area. Such areas are usually established by evicting the populations who happen to live there.

Myanmar has formulated National Biodiversity strategy and Action Plan (NBSAP) with the multi- consultation process. NBSAP is a comprehensive framework for biodiversity conservation, management and utilization in a sustainable manner, as to ensure to support the National sustainable Development strategy. The development of NBSAP has given opportunity for practicing the alternative PAs management that favors not only biodiversity, but also lives hood development.[1]

The protected areas of Myanmar conserve spectacular natural cultural and spiritual values and provide communities with opportunities for recreation and education. As natural areas different types of human pressure, it becomes increasingly urgent to maintain and improve the condition and management protected areas. Protected areas (PAs) are important tools for biodiversity conservation and sustainable development [2]

In 1997, creation of the Nature and Wildlife Conservation Division (NWCD) within the Forest Department which supervise protected areas and wildlife conservation. In 2009 Forest Department provided a list of 43 sites [3]

Categories of Protected Areas

The protected area system falls under the protection of Wildlife and Wild Plants and Conservation of Natural Areas Law (1994) which replaced the old Wildlife Protection Act (1936). This law regulates the establishment of seven categories of PAs (scientific nature reserve, national park, marine national park, nature reserve, wildlife sanctuary, geo-physically significant reserve, other protected areas determined by the Minister and of other nature reserves determined by the Minister of Forestry.

National Park

National Park is a park in use for conservation and maintained such as biodiversity and representativeness. No settlement or resource harvesting allowed visitors permitted.[4]

The Forest Department shall carry out preservation of varied ecosystem and organisms, permitting research and recreation within the natural park without causing damage to the natural environment.[5]

The Forest Department shall carry out the following functions and duties according to Section (17) of the Protection and Conservation of Biodiversity and Protected Areas law 2018 in conformity with the guidance lay down by the committee or the Minister. In National Park-
(a)Maintaining Biodiversity to continue to exit for a long time, permitting scientific research and public education without causing damage to Biodiversity.
(b)Permitting research and recreation purpose.
(c)Prohibition emphatically occupation and extraction due to damage that biodiversity and natural resources.[6]

In Myanmar there are 6 National Parks. The National Park includes 4 designated and 2 purposed.

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[1]NaingZawHtun ,Myanmar's Vision for Participatory Management of Protected Areas, Director Nature and Wildlife Conservation Division

[2]IstitutoOikos and BANCA, Myanmar Protected Areas (Context, Current, Status and Challenges)Milano, Italy, AncoraLibri, 2011, p-vi

[3]IstitutoOikos and BANCA, Myanmar Protected Areas (Context, Current, Status and Challenges)Milano, Italy, AncoraLibri, 2011.p.5

[4] JE Clarke, Biodiversity and Protected Area Myanmar, 1999, p.9

[5] Section 17(b)Conservation of Biodiversity and Protected Areas Law 2018

[6] Rule 23(b) of the Protection of Wildlife and Protected Areas Rules, 2002

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Marine National Park

Myanmar has a large marine territory. The coastline of Myanmar has from the Nif River, the dividing line between Bangladesh Myanmar, kawthaung at the border with Thailand. Along the southern coastline the Myeik Archipelago is made at of more than 800 islands.[1]

Marine National Park is apart consisting of an area of sea or lake, island and coastal environment. There are approximately 57 Marine National Park in the world.

The territory sea and Marine Zone Law (1997)and Myanmar Marine Fisheries Law (1990)have provisions to promote conservation of marine and coastal biodiversity and sustainable use of its components. As Myanmar Marine and Coastal Region have high potential for ecotourism, precautionary measures have been taken into consideration for tourism development in the coastal zone.[2]

The Ayeyarwady Division is considered an important area of fishery production, but in recent years, fish and fishery products are becoming scarce and the prices of fish, shrimp as well as other products such as dried fish, dried prawns and shrimp pastes have risen sharply. Marine living organisms entirely depend on the sustainability of the coastal mangroves and other forest resources.[3]

National Protected Areas are thirteen hundred marine protected areas covering percent of the oceans. There are one hundred thousand designated protect land areas covering about 12.7 percent of the earth's surface. This expansion of protected areas has been called by some the largest conscious land change in history. Marine protected areas (MPA) have been proposed for the recovery of valuable fisheries and the protection of endangered marine ecosystems and species. Some MPA Are created as reserve zone in which the removal or disturbance of resources is absolutely prohibited.[4]

In Marine Park, either the Forest Department or the Ministry of Forestry shall perform the following duties:

(a) Maintaining Biodiversity to continue to exist for a long time.
(b) Permitting scientific research and public education without causing damages to Biodiversity.
(c) Permitting research and recreation purpose.
(d) Prohibition emphatically occupation and extraction due to damage that and extraction due to damage that biodiversity and natural resources.[5]

Wildlife Sanctuary

Wildlife Sanctuary is a natural area which is used for preservation the endanger species and migratory birds from extinction. In Myanmar, the total numbers of wildlife sanctuary are 26. Among them 23are designated and 3 proposed Wildlife Sanctuary also include bird sanctuary and Wildlife Park.[6]

Bird Sanctuary is an area that is to prevent bird species and their habitats from extinction. Wildlife Park mean wild animals held in captivity and in the wild but on a fairly small range for recreation and education.[7] No settlement or resource harvesting allowed visitors encouraged.

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[1] Supplement to MCRB's Briefing Paper on Biodiversity .Human Right and Business in Myanmar.2017
[2] Third National Report on Biodiversity submitted By Myanmar, p.17
[3] Myanmar Agenda 21, National Commission for Environmental Affairs, Yangon 1997, p.17
[4] Elli Louka, International Environmental Law, Fairness, Effectiveness and World Order, 6th Ed., 2006, p.290
[5] Rule 23(c) of the Protection of Wildlife and Protected Areas Rules, 2002
[6] InstitutoOikos and BANCA, Myanmar Protected Areas(Context ,Current Status and Challenges)Milano,Italy,Ancora libri,2011,p.15
[7] JE Clark, Ph.D. Biodiversity and Protected Areas Myanmar,1999 p.17

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Nature Reserve

Nature reserve is that maintains biodiversity or natural process to continue to exist for a long time and manage to use by public without damages natural resources.

In Myanmar protected areas currently include 35 designated and 8 proposed PAs. That was established in the period 1918-2010. The 43 PAs cover 49500km^2 which is equivalent to 7.3% of the total country area.

List of Myanmar Protected Area of Wildlife in Myanmar are as follows:

1.	Alaungdawkathapa	(National Park)
2.	Bawditataung	(Nature Reserve)
3.	Bumhpabum	(Wildlife Sanctuary)
4.	Chatthin	(Wildlife Sanctuary)
5.	Hlawga	(Wildlife Park)
6.	Hponkanrazi	(Wildlife Sanctuary)
7.	Htamanthi	(Wildlife Sanctuary)
8.	Hukaung Valley	(Wildlife Sanctuary)
9.	HukaungValley(Extension)	(Wildlife Sanctuary)
10.	Indawgi Lake	(Wildlife Sanctuary)
11.	Inlay Lake	(Bird Sanctuary)
12.	Kahilu	(Wildlife Sanctuary)
13.	Kelatha	(Wildlife Sanctuary)
14.	Khakaborazi	(National Park)
15.	Kyaikhtiyo	(Wildlife Sanctuary)
16.	Kyauk-Pan Taun	(Wildlife Sanctuary)
17.	Lampi Island	(Marine National Part)
18.	Lawkanada	(Wildlife Sanctuary)
19.	Lenya	(National Park)
20.	Lenya(Extension)	(National Park)
21.	Laimwe	(Protected Area)
22.	Maharmyaing	(Wildlife Sanctuary)
23.	MainmahlaKyun	(Wildlife Sanctuary)
24.	Minsontaung	(Wildlife Sanctuary)
25.	Minwuntaung	(Wildlife Sanctuary)
26.	Mosco Island	(Wildlife Sanctuary)
27.	Moyingyi Wetland	(Bird Sanctuary)
28.	Mulayit	(Wildlife Sanctuary)
29.	NatmaTaung	(National Park)
30.	Panlaung-Pyadalin Cave	(Wildlife Sanctuary)
31.	Parasar(Par Sar)	(Protected Area)
32.	Pidaung	(Wildlife Sanctuary)
33.	Popa	(Mountain Park)
34.	Pyin-Oo-Lwin	(Bird Sanctuary)
35.	Rakhine Yoma Elephant Range	(Wildlife Reserve)
36.	Shinpinkyetthauk	(Wildlife Sanctuary)
37.	Shwesettaw	(Wildlife Sanctuary)
38.	Shwe-U-Daung	(Wildlife sanctuary)
39.	Tanintharyi	(National Park)
40.	Tanintharyi	(National Reserve)
41.	Taunggyi	(Bird Sanctuary)
42.	ThamihlaKyun	(Wildlife Sanctuary)
43.	Wenthikan	(Bird Sanctuary)

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Theestablishment of the PAs is conservation of the forest and biodiversity. Therefore, management of PAs is essential for protection of wildlife in land and to implement for government policy for natural conservation.

Protection of Wildlife

Myanmar has a wide variety of natural ecosystems ranging from land, forest ecosystems to marine, coastal and mountain ecosystems. These various ecosystems provide the country with rich biological resources. Myanmar has a long and rich tradition of biodiversity conservation.

The country is endowed with an impressive fauna and flora. There are about 7,000 plant species, more than 300 mammals and 400 reptiles, and 1,000 bird species which have been identified of the wildlife species, quite a number of them are listed in the IUCN Red Data Book. Many ecologically fragile and endemic species are highly endangered and risk extinction.[1]

In Myanmar, global threat assessments have only been conducted for mammals, birds, amphibians, some reptiles (turtles and crocodiles), some plants some invertebrate species and a few marine species. Furthermore, recent information on the status of most globally threatened species in Myanmar accounts to a few survey records from a few sites where surveys were possible. For many species, there are no recent field records from Myanmar.[2]

According to the 2004 IUCN Red Lists, excluding species restricted to marine ecosystems, a total of 163 globally threatened species occur in Myanmar, of which 28 are Critically Endangered, 42 are endangered and 83 are vulnerable (IUCN 2004).[3]

The globally threatened species comprise 40 mammal species, 49 bird species, 26 reptile species, one invertebrate species and 43 plant species, nine of these species are endemic to Myanmar.[4]

The Director General shall declare according to the following categories of wildlife species which are to be protected from extinction with the approval of the Minister in Myanmar.

(a) Completely protected wildlife species
(b) Protected wildlife species
(c) Seasonally protected wildlife species[5]

Completely protected wildlife species mean according to Forest Department declaration endanger species of wild animals designated areas from extinction and perform measures for the conservation of wildlife species under their promulgation.[6]

Protected wildlife species mean although does not meet with extinction circumstances which are progressively being become the loss of endangered species and threated wild nature. This is it the Forest Department promulgated notification to mention and protect above wildlife species. Moreover this term includes the parts of wild animal and wildlife products by coordinated with relevant department.[7]

Seasonably Protected Wildlife Animal means to permit hunting for low of the endanger level of extinction or threaten level of extinction and it has numerous numbers and the abandon of naturally bred and to conserve at eh limited term without affecting the growth of their naturally production within their habitant and that wildlife animal is declared by the

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[1]Myanmar Agenda 21, 1997, p.166
[2]National Biodiversity Strategy and Action Plan, 2011. p.60
[3]Ibid
[4]Ibid.p.60
[5]Section 19 (a) Conservation of Biodiversity and Protected Areas Law,2018
[6]Section 2(u), Ibid
[7]Section 2(v) Ibid

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notification of the Forest Department. In this term, it is included the wildlife animal that is determined by the notification or part of the migrate animals.[1]

Under Section 17 of the Protection of the Conservation of the Biodiversity and Protected Areas Law, 2018, the Forest Department shall carry out the following functions and duties according to the category of protected area in conformity with the guidance laid down by the committee or the Minister;

(a) Preservation to enable conducting research on natural evolutionary system of Scientific Reserve.

(b) Preservation of varied ecosystems and organisms, permitting research and recreation within the National Park without causing damage to the natural environment.

(c) Preservation of marine and related ecosystems and organisms and permitting research and recreation within the Marine National Park, without causing damage to the natural environment.

(d) Protection and sustainable management of significant ecosystems and rare wildlife species in the Managed Nature Reserve.

(e) Preservation of wildlife including migratory birds and habitats incorporation with international communities.

(f) Conservation of unique landscape and culture heritage within the protected landscape.

Environmental problems are widespread complexity long term. The environmental challenges may be the most difficult and the most critical that people of the world have ever faced. United Nations call the States to participate for preservation of wildlife in connection with the ecosystem, habitats, biodiversity and forest etc.

Myanmar also participate the following convention;

1. Convention on International Trade in Endangered Species of Wild Fauna and Flora (Since 1997)
2. ASEAN Wildlife Enforcement Network (ASEAN-WEN)
3. Trade Record Analysis of Fauna and Flora in Commerce (TRAFFIC)
4. Wildlife Conservation Society (WCS)
5. ASEAN Centre for Biodiversity (ACB)
6. The Monitoring Illegal Killing of wildlife of Wild Elephant (MIKE)
7. Ramsar Convention.

In compliance with Myanmar's National Environment Policy, Myanmar Agenda 21 was developed in 1997 and it was a collaborative effort made by various government agencies in order to strive for the sustainable development of the country. Myanmar Agenda 21 is a blue print for all natural resource management and environment conservation work and the pursuit of the activities contribute to Biodiversity conservation throughout the country; for example, efforts made in sustainable forest management sustainable tourism and sustainable transport and infrastructure development with a reduced impact on biodiversity. Within the framework of Myanmar Agenda 21, important measures for biodiversity conservation are summarized as follows:[2]

1. Strengthening protected area management
2. Promoting international cooperation
3. Developing a national database of biodiversity
4. Strengthening laws and legislation for biodiversity conservation management
5. Protecting threatened and endangered species of plants and animals
6. Strengthening sustainable use of natural resources
7. Enhancing institutional capacity for biodiversity conservation and management

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[1]Section 2(w), Ibid

[2]National Biodiversity Strategy and Action Plan, 2011. p.26

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8. Promoting education awareness and involvement of local communities in biodiversity conservation and management
9. Studying the economic issues related to biodiversity[1]

Biodiversity in Myanmar has been under severe pressure due to increasing demand of human from natural resources. In above condition is that direct threats to biodiversity habits degradation and the loss of biodiversity have resulted. The loss of Habitats also threatens the biodiversity of territorial forest systems on other hands Myanmar's costal habitats are important for numerous elements of biodiversity.

The ministry of Livestock and fishery regulated the Animal Health and Development Law (1993), the Law Relating to Fishing Rights of Foreign Fishing Vessels, Myanmar Marine Fisheries Law (1990), the Freshwater Fisheries Law (1992), and the Territorial Sea and Maritime Zone Law (1997). Under these laws, efforts are made to control diseases, pollution and environmental destruction that could do harm to animal husbandry, aquaculture, and fisheries production.[2]Due to being of Myanmar environmental challenges, the Government enforcement to maintain and adopted law relating to wildlife inhabit within the State.[3]

To ensure the conservation of endangered species of wildlife from extinction, the following laws, policy and rules are provided;

1. Elephant Preservation Act,1879
2. The Wild Bird and Animals Protection Act,1912
3. The Wildlife Protection Act,1936
4. Forest Law,1992
5. The Protection of Wildlife and Conservation of Natural Areas Law,1994
6. Forest Policy,1995
7. Rules relating to the Protection of Wildlife and Conservation of Natural Areas,2002
8. Protection and Conservation of Biodiversity and Protected Areas Law, 2018.

Registration

The Government draft law relating to wildlife species to reduce the cause of depletion in Myanmar. The first law was become in 1936 and then the Government amended this law that protection of wildlife species in 1994.

In recently in 2018 May 25, Pyidaungsu Hluttaw was enacted new regulations and laws relating to wildlife species to maintain or to reduce that being progressively became depletion due to the many reasons, such as overhunting, illegal trade, expansion of agriculture and the habitat loss of ecosystem in Myanmar. The following are the Government enacted rules, regulations and laws to control and promote the extinction of wildlife species within the existence of Myanmar.

(a) A person who possesses as a souvenir or weaves as a traditional custom any part of a completely protected wildlife species, before this Law comes into force shall register at the relevant possesses as a souvenir or weaves as a traditional custom any part of a completely protected wildlife species in the manner prescribed by the Minister of Forestry.

(b) With the exception of a person who has in heritage under a traditional custom from a person registered under sub-section (a), a person who received in any other manner shall register at the relevant Township Forest Department in the manner of prescribed by the Ministry of Forestry.

(c) For the purpose of research of a completely protected animal after this Law comes into force, government department, government organization or non-government

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[1]Ibid

[2]National Biodiversity Strategy and Action Plan, 2011.p.46

[3]STATUS of Biodiversity Conservation in Myanmar, Thein Aung, Assistant Director, Nature and Wildlife Conservation Division, Forest Department

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organization which has been permitted to capture or possess under Section 21 (a) and which is desirous of possessing any part of thereof to conduct research or as souvenir shall register in the manner prescribed by the Ministry of Forestry.[1]

A Forest officer, who has been assigned to perform the functions of registration by the Director General, may

(a) scrutinize the application for registration under section 31 in the prescribed manner and register or refuse registration.

(b) if registration is effected under sub-section (a) shall issue a certificate of registration to the applicant.[2]

The Minister shall

(a) form a Supervisory Body and prescribe the functions thereof to supervise each of the zoological garden or botanical garden permitted to be established under Section 26 sub-section (a) if necessary,

(b) re-constitute or abolish the Supervisory Body as may be necessary.[3]

The person, who wants to hunt, must apply to relevant Township Forest Department to get hunting license within natural resources except wildlife and completely wildlife species.[4]

The person who has been permitted a hunting license,

(a) No using toxic for capture
(b) No hunting by using trap, snares, nets and baits.
(c) No hunting from lockout or under a hollow space.
(d) No hunting with searchlight
(e) No hunting on the back of the elephants and any vehicles.
(f) Not killing to wildlife by threat or destroying to cause the riot of the wildlife
(g) No capture or killing without so yard of monastic building within the area of 50 yards.
(h) No hunting by using exploding materials
(i) Don't be hunt by using greyhound
(k) No capture the bred and female
(p) No capture by using electricity
(q) No hunting with tools except by permitting tools in license
(r) No hunting the exceeding by permitting time and quantity
(s) Must notify to near township Forest Department the diversity of prey and quantity after hunting.[5]

Biodiversity in Myanmar has been under severe pressure due to increase demand of human has using wildlife products for their accessory.

The causes of biodiversity loss are the economic value of wildlife products gets extremely profits due to this matter that people attempt to commit illegal hunting and illegal trade by communities or individuals.

The reason why the Forest Department, dispense the hunting license is that to reduce or control the problem of illegal hunting or killing and there is designated that the protection of wildlife in three diversity by the Forest Department. If the person killed or hunted wild animals without hunting license that person shall be liable to suffer with imprisonment or fine or both.

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[1] Section 31Conservation of Biodiversity and Protected Areas Law, 2018
[2] Section 32, Ibid
[3] Section 27 of Conservation of Biodiversity and Protected Areas Law, 2018
[4] Rule 44 of the Protection of Wildlife and Protected Areas Rules, 2002
[5] Rule 46, Ibid

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Taking Administrative Action

Forest staffs are empowered to take administrative action in respect of reach; seizure and disposal of exhibits carry out in the manner prescribed.

Under Section 34, a Forest Officer may pass an administrative order causing a fine which may extend from Kyats 10,000 to Kyats 30,000 to be paid, on a person who commits any of the following acts within a protected area within zoological garden or botanical garden which is administered by the government of towards which the government gas subscribed share capital;

(a) Entering a place where the public is permitted to visit for recreation, without conforming to the condition stipulated;
(b) Trespassing a prohibited place other than a place where the public is permitted to visit for recreation, without permission;
(c) Grazing or free grazing or permitting domestic animals to trespass;
(d) Beating or willfully disturbing protected wildlife;
(e) Plucking, breaking or holding in possession without permission of wild plants and any cultivated plant.[1]

The administrator may pass the administrative order causing a fine which may extend from 30,000 to 100,000 to be paid on a person who commits any of the following ants within the protected area or zoological garden or botanical garden which is administered fully by the Government or partly by the Government which has subscribed share capital.

(a) Entering a totally prohibited area without permission;
(b) Filming or video recording without permission;
(c) Digging on the land, cultivating or carrying out any activity;
(d) Natural plant, removing, collection or injuring any cultivated plant in any manner.[2]

A Forest Officer may pass an administrative order causing a fine which may extend from Kyats 70,000 to 200,000 to be paid, on a person who kills, hunts, wound or raises a seasonally protected wildlife without permission during the close season.[3]

The Administrator shall,

(a) When passing an administrative order confiscate the production of a protected area or of the zoological garden or botanical garden which is administered fully by the Government or partly by the Government which has subscribed;
(b) Dispose the confiscated produce in the manner prescribed;[4]

Rule 29 provided that,

(a) Department of Government, Government or non-governmental organization must apply to do scientific research of the completely protected wildlife with the permission of the Director General.
(b) According to Rule 29(a), Director General analyzed the application to do scientific research of completely protected wildlife species is not a level of endangered species, according to Rule16(a) may capture and holds in possession designated rules, making research with the approval of the Minister.
(c) Rule 29(b), Director General is allowed to do scientific research, seizure and place and time of collecting region of the completely wildlife species and also must be designated seizure and transportation of the completely wildlife species.

According to Rule 30, any person who has been permitted in accord with Rule 29(b) must:

(a) Pay tax and value fees fixed by the Forest Department,

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[1]Section 34 Conservation of Biodiversity and Protected Areas Law, 2018
[2]Section 35,Ibid
[3]Section 36, Ibid
[4]Section 37, Ibid

(b) Submit the findings of scientific research to the Forest Department within the defined period
(c) Allow the staffs from Forest Department to cooperate and participate in performing the scientific research
(d) Manage not to impact to the environment in doing the scientific research.
(e) Give and implement the management for doing researched animals not to be cause diseases and depletion.[1]

The provision of Section 38 mentioned that a person dissatisfied with an administrative order passed by a Forest Officer may file an appeal to the Director General within 30 days from the date of such order. The decision of the Director General shall be final and conclusive.[2]

Offences and Penalties

There are seven sections for committing to relating with the wildlife from the provisions of Section 39 to Section 45 in the Protection and Conservation of Biodiversity and Protected Areas Law, 2018.

Whoever commits any of the following acts shall, in conviction be punished with imprisonment for a term which may extend to 3 years or with fine which may extend to Kyats 200,000 from Kyats 500,000 or with both;

(a) Hunting without a license;
(b) Violation of any condition of the hunting license;
(c) Farming protected and seasonally protected wildlife species without permission for commercial purposes;
(d) Causing water and air pollution, causing damage to a water-course or poisoning water;
(e) Possession or disposal of pollutants or mineral wastes in a protected area;
(f) Establishing and operating a zoological garden or a botanical garden without a license.[3]

Whoever commits any of the following acts shall, on conviction be punished with imprisonment for a term which may extend to 5 years or with fine which may extend to Kyats 300,000 from Kyats 100,0000or with both;

(a) Killing, hunting or wounding a protected wildlife species or seasonally protected wildlife species without permission; possessing, selling, transporting or transferring such wildlife or any part thereof;
(b) Removing, collecting or destroying in any manner any protected wild plant within the designated area without permission;
(c) Destroying ecosystems or any natural setting in the protected area;
(d) Altering, removing, destroying or defacing without permission any boundary mark of a protected area or any boundary mark of a zoological garden or botanical garden fully administered by the Government or partly by the Government which has subscribed shares.[4]

Whoever commits any of the following acts shall, on conviction be punished with imprisonment for a term which may extend to 3 years from 10 years of with fine.

(a)Killing, hunting or wounding a completely protected wildlife species without permission; possessing, selling, transporting or transferring such wildlife or any part thereof;
(b) Exporting without the recommendation of the Director General a completely protected wildlife or protected wild plant species or any part there of;[5]

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[1]Rule 30 of the Protection of Wildlife and Protected Areas Rules, 2002
[2]Section38 of Conservation of Biodiversity and Protected Areas Law,2018
[3] Section 39, Ibid
[4]Section 40, Ibid
[5]Section 41, Ibid

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Recent Wildlife law Enforcement action in Myanmar by Swe Win, June 20,2018, following the publication of the MECAP, and the Voices for Momoscampains, there has been greater focus and awareness around Elephant poaching. The CID (Criminal Investigation Department) was directly assigned by the Ministry of Home Affairs. They organized a team to trace illegal wildlife trade and traced the source from the killing of Elephants in Ayeyarwady Division. The police have done investigation and taken coordinated action in 3 separate Divisions in the last week. Six men have been arrested and charged.

7 June: Ban Bwegone, Myan Aung Township, Ayeyarwady Division

9 June : Pyay, Bago Division

9-10 June: Mandalay was found to be the main location for wholesale trade.[1]

On 9th June, Myanmar Police and Forest Department seized at Chan Mya Thazi Township, Mandalay Division:708 kilograms of Gaur horn,667 kilograms of deer horns,421 kilograms of Sambar horn,12.4 kilograms of Serow horn,9.8 kilograms of Elephant skin,4 cat skin, 4 barking deer skin, 1 snake skin, and 8 kilograms of 10 other wildlife heads.

The owner claimed that he bought officially with bid from Custom Department. However during investigation, he was not able to show any single document. On 11th June 2018, the organized IWT trace team investigated again the responded house and found 2 bags of total cash amount 93,400,000 (71,000 USD). At the same time, the team found out 3 Gaur horns, 7 deer horns and 28 Sambar horns hanging on the wall.

In other raids: elephant hides, antlers of numerous deer species, bison horns, turtle shells and flesh, porcupine quills, bare bones, claws, and paws and skulls of a variety of wild animals. Police and Forest Department are continuing to trace the source of the material for follow up investigation and punishment.

"Due to the market demands of neighbouring countries, there are many people storing and trading these (wildlife parts)," said U Khin Maung Myint, Director of Forestry Department of Ayeyarwaddy Region. "This market emerged as the horns and hides of the animal are hung on the walls of decorative purposes, made into hand wear accessories, and mixed with other medicinal roots for medicine."

WCS is now collaborating with Forest Department in Mandalay on inventory of seizure and species identification. We will compile the confiscated wildlife parts from Mandalay after listing.[2]

In the case of U Kyaw Zin Tun v. Kyaw Win Tun(a) Ar Mwe,[3] the Forest Department set up boundary mark of a protected area besides Namsantar stream within Indawgyi wildlife Sanctuary of Mohnyin Township. That notice board was destroyed by tractor trailer and that was owned by Nay Kyaw Win Tun (ArMwe) from Nyung Pin village. According to Section 36 of the Protection of Wildlife and Protected Areas Law (1994). Nay Kyaw Win Tun (Ar Mwe) son of U Tin New has guilty who conviction be punished with fine which may extend to Kyats 30000 or if he fail to payment that he suffer with imprisonment for a term which may extend to six months.

The protection of the endanger species from extinction, killing, hunting or wounding, exporting and selling a completely wildlife species without permission. If the person contrary to the provisions concern with wildlife, he will be liable with fine or imprisonment, or with both.

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[1] http://myanmar.wcs.org.com

[2] Ibid

[3] 2018, Criminal Regular Case,(No.54)

Conclusion

There are several reasons for the loss of species and then how much biodiversity exists and how much is lost or diminishing every day is the main subject of Myanmar.

In present day, Myanmar is losing biodiversity due to socio-economic pressure with the main threats identified in habitat destruction especially related to hunting illegal wildlife trade. Similarly the world also faces to the above conditions. Wildlife plays an important role the ecosystem and provides stability to different natural processes of nature. Human depend on ecosystem to purify our environment. Every person, (all) protect and conserve the wildlife.

The conservation of wildlife refers to the well-planned practice of ensuring protection for wild animal's species, their habitats, and plants. It can be a preventive step to safe prior to unforeseeable environmental issues. In nature, different species are connected through various foods webs. The conservation of wildlife is also linked to the acceleration of ecotourism on a national level by designating of national parks.

The loss of an animal that isn't especially important economically or culturally could unexpectedly affect a type of animal that is, therefore, prevention and conservation of wildlife is a vital for solution of unforeseeable problems.

It is need to ensure the conservation of wildlife for present and future generation in line with the provisions of national law to reduce the extinction of wildlife in the world. The State shall endeavor to protect and improve the environment and safeguard the forest and wildlife of the country.

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(D) Case

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Importance of International Commercial Terms

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Abstract

Incoterms' is an abbreviation of International Commercial Terms. These terms have been published by the International Chamber of Commerce (ICC) since 1936 and have been subject to review and updating since that date. The most recent updates were announced in Paris by the ICC on 16 September 2010. The terms set out exactly who is under the obligation to take control of and/or insure goods at a particular point in the shipping process. Incoterms clarify responsibilities of parties to a sales transaction. The latest version of the Incoterms® 2020 rules is now published by International Chamber of Commerce (ICC) and protected by copyright. The revised rules reflect the latest developments in commercial transactions. As of January 1, 2020, all sales contracts should include references to the Incoterms® 2020 rules.

Keywords: Incoterms, obligation, exporter and importer

Introduction

The objective of this research is the common Incoterms, Ex Works (EXW), Free On Board (FOB), Free Carrier (FCA), and Cost, Insurance and Freight (CIF), were he most important factor for the trade agreement. Import and export are the key components of all industries, particularly those related to production where the importing of products or raw materials are required for the production process to export the final products abroad. Incoterms are the regulations or terms of product delivery that are a set international standard for making a sales contract between the buyer and seller. "Incoterms" is a registered trademark of the ICC. The first work published by the ICC on international trade terms was issued in 1923, with the first edition known as Incoterms published in 1936. The Incoterms rules were amended in 1953, 1967, 1976, 1980, 1990, 2000, and 2010, with the ninth version Incoterms 2020 having been published on September 10, 2019.

International Trade Law

International trade law includes the appropriate rules and customs for handling trade between countries.[1] International trade law should be distinguished from the broader field of international economic law. The latter could be said to encompass not only WTO law, but also law governing the international monetary system and currency regulation, as well as the law of international development.[2]

The international trade law includes rules, regulations and customs governing trade between nations.[3] International trade law focuses on applying domestic rules to international trade rules and applying treaty-based international trade law governing trade.[4] International Trade Law is an aggregate of legal rules of "international legislation" and new lexmercatoria, regulating relations in international trade. "International legislation" – international treaties and acts of international intergovernmental organizations regulating relations in international trade. **lexmercatoria** - "the law for merchants on land".[5]

Principles of International Trade Laws

- National Treatment Principle: Imported and locally-produced goods should be treated equally — at least after the foreign goods have entered the market. The same should apply to foreign and domestic services, and to foreign and local trademarks, copyrights

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[1] *www.law.berkeley.edu*
[2] *WHO FCTC Secretariat's Knowledge Hub on legal challenges. 2017-04-07*
[3] *Warburton, Christopher E.S. (2010-03-30). 'Internatioanl trade law and trade theory"*
[4] "Internatioal Trade Law".www.law.georgetown.edu.Retrieved 2021-07-20
[5] "Lex Mercatoria: Lex Mercatoria: International Commercial Law& E-Commerce Infrastructure Monitor(1993-2009)" www.jus.uio.no.Retrieved 2019-10-03

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and intents. These principles apply to trade in goods, trade in services as well as trade related aspects of intellectual property rights.

Most Favored Nation (MFN) Principle: The MFN principles ensures that every time a WTO Member lowers a trade barrier or opens up a market, it has to do so for the like goods or services from all WTO Members, without regard of the Members' economic size or level of development. The MFN principle requires according to all WTO Members any advantage given to any other country. A WTO Member could give an advantage to other WTO Members, without having to accord advantage to non- Members but only WTO Members benefit from the most favorable treatment.[1]

World Trade Organization

In 1995, the World Trade Organization, a formal international organization to regulate trade, was established. It is the most important development in the history of international trade law.[2]

The purposes and structure of the organization is governed by the Agreement Establishing The World Trade Organization, also known as the "Marrakesh Agreement". It does not specify the actual rules that govern international trade in specific areas. These are found in separate treaties annexed to the Marrakesh Agreement.[3]

The scope of WTO:[4]

i) provide a framework for administration and implementation of agreements;
ii) forum for further negotiations;
iii) trade policy review mechanism; and
iv) promote greater coherence among members economics policies

Principles of the WTO:[5]

i) A principle of non-discrimination (most-favored-nation treatment obligation and the national treatment obligation)
ii) market access (reduction of tariff and non-tariff barriers to trade)
iii) balancing trade liberalization and other societal interests
iv) harmonization of national regulation (TRIPS agreement, TBT agreement, SPS agreement)

International Commercial Terms (Incoterms)

INCOTERMS (International Commercial Terms) are an internationally recognised set of trade term definitions developed by the International Chamber of Commerce (ICC). The terms define the trade contract responsibilities and liabilities between a buyer and a seller. They cover who is responsible for paying freight costs, insuring goods in transit and covering any import/export duties, for example. They are invaluable as, once importer and exporter have agreed on an INCOTERM, they can trade without discussing responsibilities for the costs and risks covered by the term.[6]

Incoterms have been refined every decade, and have gradually developed into the essential trade terms widely recognized in the globe.[7]

Incoterms 2020 is the ninth set of international contract terms published by the International Chamber of Commerce, with the first set having been published in 1936. In 2010, there is the reduction in the overall number from 13 to 11. Incoterms 2020 defines 11 rules, the same number as defined by Incoterms 2010.[8]

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[1] "Principles of the Trading system". World trade Organization. Archived from the original on 2000-08-17. Retrieved 2010-07-12.

[2] "Member and Observers". Archived 6 September 2011 at the Wayback Machine at WTO official website

[3] Ibid.

[4] Ibid.

[5] https://www.freepdfhosting.com

[6] "Central Hong Kong". July 10, 2020. Central Hong Kong. July 10, 2020.

[7] "Incoterms 2020 | ICC

The new rules have been separated into two classes rather than the previous four categories. The current two classes of terms are:[1]

(i) rules for use in relation to any mode or modes of transport

(ii) rules for sea and inland waterway transport

Incoterms 2010 is divided into 2 categories based on delivery method, i.e. 7 terms applies in general and 4 terms applies specifically for delivery through sea transportation. As a review, the 13 terms in the Incoterms 2000 i.e.:

1. EXW (place name): Ex Works, the seller determines where he/ she should be taking of goods.
2. FCA (place name): Free Carrier, the seller is only responsible to arrange the export permission and deliver the goods to the party carried in the place that has been determined.
3. FAS (departure port name): Free Alongside Ship, the seller is responsible until the goods are located in the port of departure and ready at the side of the ship to load. It only applies to water transportation.
4. FOB (departure port name): Free On Board, the seller is responsible to arrange export permission to load goods in the ship that is ready to go. Only applies to water transportation.
5. CFR (destination port name): Cost and Freight, the seller bears the cost until ship with loaded goods arrived at the destination harbor, but the responsibility of only until the time when the ship departs from the port of departure. It only applies to water transportation.
6. CIF (destination port name): Cost, Insurance and Freight, like CFR with an addition, the seller is obligated to pay for the insurance of goods sent. Only applies to water transportation.
7. CPT (destination place name): Carriage Paid To, the seller bear the cost until the goods arrive at the destination, but the responsibility of only until the time of goods delivered to the transporter.
8. CIP (destination place name): Carriage and Insurance Paid to, like CPT with an addition, the seller is obligated to pay for the insurance of goods sent.
9. DAF (place name): Delivered At Frontier, the seller arrange export permissions and responsible until the goods arrive at the border of the destination country. Customs and import permission to become the responsibility of the buying party.
10. DES (destination port name): Delivered Ex Ship, the seller is responsible to the ship with loaded goods arrived at the destination harbor and ready to disassembled. The import permission became the responsibility of the buying party. It only applies to water transportation.
11. DEQ (destination port name): Delivered Ex Quay, the seller is responsible to the ship with loaded goods arrived at the destination harbor and the goods has been disassembled and stored in the dock. The import permit became the responsibility of the buying party. It only applies to water transportation.
12. DDU (place name purpose): Delivered Duty Unpaid, the seller is responsible for transporting goods up to the destination, but not including the cost of insurance and other costs that may arise as the cost of imports, customs and tax from the country of the buying party. The import permit became the responsibility of the buying party.
13. DDP (destination place name): Delivered Duty Paid, the seller is responsible for transporting goods up to the destination, including the cost of insurance and all other fees that might appear as the cost of imports, customs and tax from the country of the buying party. The import permit also became the responsibility of the seller.

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[1]ICC introduces new International Commercial Terms

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Defined terms in Incoterms

There are certain terms that have special meaning within Incoterms, and some of the more important ones are defined below:[1]

- Delivery: The point in the transaction where the risk of loss or damage to the goods is transferred from the seller to the buyer
- Arrival: The point named in the Incoterm to which carriage has been paid
- Free: Seller has an obligation to deliver the goods to a named place for transfer to a carrier
- Carrier: Any person who, in a contract of carriage, undertakes to perform or to procure the performance of transport by rail, road, air, sea, inland waterway or by a combination of such modes
- Freight forwarder: A firm that makes or assists in the making of shipping arrangements;
- Terminal: Any place, whether covered or not, such as a dock, warehouse, container yard or road, rail or air cargo terminal
- To clear for export: To file Shipper's Export Declaration and get export permit

Parties adopting Incoterms should be wary about their intention and variations. The desire of the parties should be expressed clearly and casual adoption should be refrained. Also, making additions or variations to the meaning of a certain term should be carefully done as parties' failure to use any trade term at all can produce unexpected results.[2]

The Eleven trade terms under Incoterms© 2020

Seven of them (EXW, FCA, CPT, CIP, DAP, DPU, DDP) can be applied independently by which the goods are transported in a combined multimodal way. Whereas the remaining four terms (FAS, FOB, CFR, and CIF) are clauses mainly for water or inland waterway transportation.[3]

Commonly used INCOTERMS

EXW – Ex Works (named place of delivery)

The seller makes the goods available at their premises, or at another named place. This term places the maximum obligation on the buyer and minimum obligations on the seller. The Ex Works term is often used while making an initial quotation for the sale of goods without any costs included.

EXW means that a buyer incurs the risks of bringing the goods to their final destination. Either the seller does not load the goods on collecting vehicles and does not clear them for export, or if the seller does load the goods, they do so at buyer's risk and cost. If the parties agree that the seller should be responsible for the loading of the goods on departure and to bear the risk and all costs of such loading, this must be made clear by adding explicit wording to this effect in the contract of sale.

There is no obligation for the seller to make a contract of carriage, but there is also no obligation for the buyer to arrange one either - the buyer may sell the goods on to their own customer for collection from the original seller's warehouse. However, in common practice the buyer arranges the collection of the freight from the designated location, and is responsible for clearing the goods through Customs. The buyer is also responsible for completing all the export documentation, although the seller does have an obligation to obtain information and documents at the buyer's request and cost.

These documentary requirements may result in two principal issues. Firstly, the stipulation for the buyer to complete the export declaration can be an issue in certain jurisdictions (not least the European Union) where the customs regulations require the

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[1] *Mayer, Ray August, with revisions by Don; Bixby, Michael (2013). International business law : text, cases, and readings (6th ed., international ed.). Harlow [etc.]: Pearson. ISBN 978-0273768616.*

[2] *Vishny, Paul H. (1981). Guide to international commerce law. St. Paul, MN: West Group. ISBN 0070675139.*

[3] Global, Hong Kong July 10 2020

declarant to be either an individual or corporation resident within the jurisdiction. If the buyer is based outside of the customs jurisdiction, they will be unable to clear the goods for export, meaning that the goods may be declared in the name of the seller by the buyer, even though the export formalities are the buyer's responsibility under the EXW term.[1]

Secondly, most jurisdictions require companies to provide proof of export for tax purposes. In an EXW shipment, the buyer is under no obligation to provide such proof to the seller, or indeed to even export the goods. In a customs jurisdiction such as the European Union, this would leave the seller liable to a sales tax bill as if the goods were sold to a domestic customer. It is therefore of utmost importance that these matters are discussed with the buyer before the contract is agreed. It may well be that another Incoterm, such as FCA *seller's premises*, may be more suitable, since this puts the onus for declaring the goods for export onto the seller, which provides for more control over the export process.[2]

DPU – Delivered At Place Unloaded (named place of destination)

This Incoterm requires that the seller delivers the goods, unloaded, at the named place of destination. The seller covers all the costs of transport (export fees, carriage, unloading from main carrier at destination port and destination port charges) and assumes all risk until arrival at the destination port or terminal.

The terminal can be a port, airport, or inland freight interchange, but must be a facility with the capability to receive the shipment. If the seller is not able to organize unloading, they should consider shipping under DAP terms instead. All charges after unloading (for example, import duty, taxes, customs and on-carriage) are to be borne by buyer. However, it is important to note that any delay or demurrage charges at the terminal will generally be for the seller's account.

Some uncertainty has emerged since Incoterms 2020 were adopted as to the meaning of "unloaded" when goods are delivered in a container, usually by sea, as the removal of the container from the incoming vessel may suggest that it has been "unloaded", but the goods themselves are not yet "unloaded" while they remain in the container[3].

FCA - Free Carrier

The seller must 'deliver the goods to the carrier ... nominated by the buyer ... at the named place'. This term is suited for international sales with minimum obligations for the seller. Its advantage over EXW is that the seller is responsible for any export licensing and Customs export clearance, which eases the problem of proof of export, and the seller must load the goods (which is usually the case).

There is a new focus on 'FCA ... seller's premises' as the appropriate term for international sales when the seller wants to limit their obligations to the loading of the goods and export clearance.[4]

CPT Carriage Paid To

The seller pays for carriage. This term is used for all kinds of shipments. Risk is transferred from the seller to the buyer upon handing over of the goods to the first carrier at the place of shipment in the country of export.

CIP - Carriage and Insurance Paid

Any mode of transport. The seller must 'deliver to the first carrier at the named place'. It's strongly recommended that the parties define the place of delivery (in the seller's country) as well as the place of destination (in the buyer's country) due to the fact that risk passes to the buyer at the named place of delivery in the seller's country.

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[1] "Customs Information Paper(11) 89"(PDF).HMRC.Archived from the original (PDF)*on 20 December 2016*. Retrieved 13 December 2016

[2] *"Evidence of export". Strong & Herd.* Retrieved 13 December 2016

[3] Mantissa Elearning, Showdown at the container yard, accessed 28 January 2021

[4] Lloyds Bank, international commercial term

'When CPT or CIP terms are used, the seller fulfils their obligation to deliver when it hands the goods over to the carrier, and not when the goods reach the place of destination.' So these are ' shipment contracts' not ' arrival contracts'. Therefore, it is strongly recommended that the place of delivery, in the seller's country, is identified as precisely as possible in the contract.

DAT - Delivered at Terminal

The seller pays for carriage to a nominated 'terminal' or 'point', except for costs related to import clearance. The seller also assumes all risks up to the point that the goods are unloaded at the terminal.

DAP would be inappropriate in these circumstances as the seller has only to place the goods 'ready for unloading'.

DAP – Delivered At Place (named place of destination)

Incoterms 2010 defines DAP as 'Delivered at Place' – the seller delivers when the goods are placed at the disposal of the buyer on the arriving means of transport ready for unloading at the named place of destination. Under DAP terms, the risk passes from seller to buyer from the point of destination mentioned in the contract of delivery. [1]

Once goods are ready for shipment, the necessary packing is carried out by the seller at their own cost, so that the goods reach their final destination safely. All necessary legal formalities in the exporting country are completed by the seller at their own cost and risk to clear the goods for export.

After arrival of the goods in the country of destination, the customs clearance in the importing country needs to be completed by the buyer, e.g. import permit, documents required by customs, etc., including all customs duties and taxes.[2]

Under DAP terms, all carriage expenses with any terminal expenses are paid by seller up to the agreed destination point. The necessary unloading cost at final destination has to be borne by buyer under DAP terms.[3]

DDP - Delivered Duty Paid

Seller is responsible for delivering the goods to the named place in the country of the buyer, and pays all costs in bringing the goods to the destination including import duties and taxes. The seller is not responsible for unloading. This term is often used in place of the non-Incoterm "Free In Store (FIS)". This term places the maximum obligations on the seller and minimum obligations on the buyer. No risk or responsibility is transferred to the buyer until delivery of the goods at the named place of destination.[4]

These are only used for conventional sea or inland waterway transport;[5]

- **FAS** - Free Alongside Ship (...named port of shipment). If the goods are containerised, use the FCA term.
- **FOB** - Free On Board (...named port of shipment). The seller must deliver the goods by 'placing them on board the vessel ... at the loading point'. The FCA term should be used where the goods are handed over to the carrier before they are on board the vessel – goods in containers, for example.
- **CFR** - Cost and Freight (...named port of destination).
- **CIF** - Cost Insurance and Freight (...named port of destination).

The seller must deliver the goods by 'placing them on board the vessel'. Where the goods are handed over to the carrier before they are on board the vessel – goods in containers, for example, the CPT or CIP term should be used.

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[1] Ibid

[2] Ibid

[3] *"Incoterms® rules 2010-ICC-International Chamber of Commerce" iccwbo.org*

[4] *"Delievered Duty Paid –Incoterms Explained. incotermsexplained.co.*

[5] Lloyds Bank, international commercial term

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When CFR or CIF terms are used, the seller fulfils its obligation to deliver when it hands the goods over to the carrier and not when the goods reach the place of destination. So it's important that the port of shipment is identified as precisely as possible in the contract.

In Yaakub et al. (2018) Incoterms in the production industry in Malaysia toward export efficiency. Incoterms affected the export efficiency.[1]

In Shanginacase (2007) studied the factors influencing the decision-making of an international trade agreement for the export of seafood from Norway to Japan and Russia since the export protocol was related to and controlled by different laws. Incoterms were the most important factor for the international seafood trade. In general, the quantity or value and the delivery control, which were the legal obstacle, were the factors affecting the selection of the Incoterms the most. Each country had different criteria for selecting the trade terms depending on the location, convenience of the suppliers, laws and regulations, etc.[2]

In the case of Szu (2014) Incoterms to enhance the export efficiency. This quantitative research was conducted in Malaysia, and the sample group was from the Federation of Malaysian Manufacturers (FMM). Cronbach's alpha and descriptive analysis were used to analyze the reliability. The results indicated that Free on Board (FOB) was the Incoterms that were generally used in Malaysia and the relationship of the Incoterms selection affected the export efficiency.[3]

In Sabariah and Szu (2017) aimed to identify the factors affecting the choice of incoterms and figure out the most regularly used incoterms among Malaysian manufacturers. The factors can be divided into two types: The first is the internal environment, the strongest influence comes from mode of transportation, habits and practices of the organization and experience of the company. The second is the external environment, the strongest influences are freight issue, transport issue and tariff classification. The results showed that FOB (Free On Board) were the most frequently used Incoterms.[4]

In the case of Hien et al. (2014) Incoterms use and to analyze the impact of the choices of Incoterms on export performance, both the internal and external business environments are essential in the selection process and its contribution to improved export performance. Moreover, Incoterms utilization training also increases export performance in order to increase the awareness of the strategic dimension of Incoterms.[5]

In Malfliet (2011), Incoterms 2010 are not appropriate. The seller does not 'deliver' the container on board the vessel, but most often hands over the goods to the carrier at an inland point or terminal. Therefore, this research aimed to identify the underlying rationale. Also proposing criteria that might be applied to choose the proper Incoterm intends for supporting traders as the following aspects:[6]

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[1]Yaakub, S., Szu, L. Y., Arbak, S., & Halim, N. A. (2018). INCOTERMS selection factors and its effect on export performance. Journal of Advance Research in Business, Marketing, and Supply Chain Management, 2(1), 9-18

[2]Shangina, O. A. (2007). Main factors in choice of delivery terms: a multiple case study of Japanese and Russian importers in seafood trade with Norway. Retrieved August 7, 2020 from https://doi.org/10.1080/00102208946937

[3]Szu, L. Y. (2014). Relationship between Incoterms choices, selection factors and export performance: a case of manufacturing companies in Malaysia. Retrieved August 7, 2020 from https://doi.org/10.1530/EJE-14-0355

[4]Sabariah, C., &Szu, L. Y. (2017). Factors influencing the choice of Incoterms among Malaysian manufacturers. In: 6th International Conference on Social Sciences Research 2017, 4th December 2017, Kuala Lumpur, Malaysia. https://repo.uum.edu.my/23069

[5] Hien, N., Laporte, G., & Roy, J. (2014). Business environment factors, incoterms selection and export performance. Operations and Supply Chain Management: An International Journal, 2(2), 63-78. https://doi.org/10.31387/oscm040017

[6]Malfliet, J. (2011). Incoterms 2010 and the mode of transport: how to choose the right term. Management Challenges in the 21st Century: Transport and Logistics: Opportunity for Slovakia in the Era of Knowledge Economy, 163-179

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- The nature of the goods: containerized, manufactured goods, bulk goods or commodities, etc.;
- The means of transport: maritime, non-maritime or multimodal;
- The conditions of payment and the documentary requirements imposed by these conditions;

In Bergami (2006) investigated the relationship between international delivery terms and documentary requirements of the letter of credit. Based on survey results suggested that exporters, who were contracting on international delivery terms, may be exposed to non-payment risks. However, it is possible to reduce payment risk by the strategic use of international delivery terms.[1]

The lase case of Schaefer (2017), the negotiation and communication for making decisions on the logistics between sellers and buyers. It's found that the important issue of an efficient supply chain was the Incoterms that were normally applied by the seller and buyer to agree on the responsibilities. However, inappropriate Incoterms might lead to a communication error on the responsibilities and reveal the cost and risk to another party and that had a communication error caused by the domestic logistics to find the solution.[2]

Categories of Incoterms

Incoterms have been grouped into 4 categories:[3]

First: ("E" Terms-Ex work), seller delivered goods to the place by their own.

Second: ("F" Terms, FCA, FAS, and FOB), seller delivered goods to the place appointed by the buyers.

Third: ("C" Terms, CFR, CIF, CPT and CIP) seller sign the transportation contract without bearing the risk of loss or damage of goods or additional charges occurred after shipping.

Fourth: ("D" Terms, (DAF, DES, DEQ, DDU, and DDP) Aseller bears the cost and risks that requiring or arising in the transport of goods to the destination country.

In the international transaction, delivering goods by using the Incoterms is basically related to the responsibility for goods that are traded. In the process of delivering goods from the seller (exporters) until into the hands of the buyers (importers), there are 11 obligations.[4]

1. Preparing the land transportation in the seller's country to the main transportation
2. Arranging the export formality in the seller's country
3. Paying taxes and levies from others in the seller's country
4. Loading to main transportation in the seller's country
5. Paying for the cost of the main transportation
6. Arranging and paying for transportation insurance
7. Disassembling goods from main transportation in the buyer country
8. Arranging the formality of imports in the buyer country
9. Paying taxes and fees collected in the buyer country
10. Preparing the land transportation in the buyer's country
11. Bearing the cost and other risk in buyer's country.

Ex Works (EXW) represents the obligation of the seller at a minimum, where the obligation of the seller is limited to deliver goods in the warehouse of the seller.

Free Carrier (FCA) means that the seller delivers goods to the carrier or another person nominated by the buyer at the seller or other place designated. It means the seller is required to send goods into the transporter or someone who insist that has been determined by the buyers.

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[1]Bergami, R. (2012). Incoterms 2010: Comments on the new revision of delivery terms. ActaUniversitatisBohemiaeMeridionales, 15(2), 33-40

[2]Schaefer, T. J. (2017). Incoterms (R) use in buyer-seller relationships: A mixed methods study. Dissertation, University of Missouri-St. Louis

[3]**ICC introduces new International Commercial Terms**

[4] J. Coetzee, Incoterms: Development and Legal Nature – A Brief Overview, 13 *Stellenbosch Law Review 2002*, p. 116

Carriage Paid To (CPT) means the seller delivered goods to the company noted that the main itself, so that all costs required to carry to the destination that has been determined over the responsibility of the buyer. After the delivery of goods by the seller to the buyer, all costs, collections and risk that arise in the journey toward the buyer becomes the responsibility of the buyer.

Carriage and Insurance Paid To (CIP) means the seller delivered goods to the transport company that they pointed themselves, so that all costs required to carry to the destination that has been determined and insurance against the risk of delivery of goods to the destination over the responsibility of the buyer. After the transfer of goods by the seller to the buyer, all costs, collections and risk that arise in the journey toward the buyer becomes the responsibility of the buyer.

The handover of CIP conditions require the seller to pay for the cost of insurance against the risk of goods. But usually the risk insured is only a minimum. If the buyer wants the wider, then the cost of insurance becomes the responsibility of the buyer. Carrier means that everyone who is responsible for transportation contract do or guarantee the implementation of transport with trains, road, Air, Sea, rivers or a combination of transportation. If the handover of goods using some kind of transportation, then all risks to the sent items are given to the first transportation company. The handover of CIP conditions require the seller to arrange the export formality. CIP conditions can be used for transportation air, land and transportation of various vehicle (multimoda transport). Writing the delivery of goods with CIP in trade contract: CIP (the contents of the name of the place of the handover in the buyer country)

The Calculation of the Selling Price Based on Incoterm 2010, to easily understand the calculation of selling price based on the following incoterms, the following is an illustration example of the terms, especially for CIP terms. Point assumption is CIP warehousing area in the port of destination. In this CIP terms, the costs become the responsibility of exporters (seller) which include;[1]

(a) Export Packing, costs of export packaging,
(b) Export Clearence, license and other authorizations (cost of export formality, export permits and forms of formal obligation from the government),
(c) Inland Freight, (land transportation costs from sellers's location to the port/ terminal),
(d) Loading Charges and Terminal Charges, (loading costs including the cost of goods in the departure port handling),
(e) Freight, (the costs of goods transportation trip, often from the port of departure to the destination port),
(f) Insurance, (premium insurance; main transportation in the minimum amount of cover, except in other agreement),
(g) Destination Arrival Charges, (costs of ship handling at the arrival port, but not including the cost of disassemble).

Then the responsibility of the seller will cover the cost of:

(h) Unloading Charges, (disassemble goods cost from the main transporter means),
(i) Import Customs Interior, (cost settlement of formality of import customs, such as PPJK services, import license arrangement, and others),
(j) Determination of Export Price by Incoterms 2010 for providing land transportation in the exporters country (driving to destination country/state borders transportation; arranging the export formality in exporters country; paying taxes and fees in other exporters country; loading goods into main transportation; the cost of the main transportation; transportation insurancecost; and teardown of main transportation). Buyer (importers) is responsible for the

[1] J. Coetzee, Incoterms: Development and Legal Nature – A Brief Overview, 13 *Stellenbosch Law Review 2002*, p. 116

formality of imports the exporters country and other taxes and fees in the importer country; land transportation in importer country; and other cost and risk in importer country. Conditions of the handover with CIF can only be used for sea and river transportation only.

Conclusion

Incoterms are essential tool of international sale contracts. The selection of the Incoterms for the import and export of the automotive parts industry is the key factor for the company to consider since these would be the conditions that the buyer and seller would have the same understanding about the payment, transport, and liability. Moreover, the agreed terms and conditions that the seller and buyer had settled upon and the laws and regulations of the partner's country.

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Firstly, I would like to express my heartfelt thanks to Dr Aung Win, Rector, DrAye Aye Thant, Pro- rector and Dr Zin Mar Latt, Pro- rector, Myitkyina University, for permission and encourage to do this research work.Secondly, I would like to express my sincere gratitude to teachers of department of law and our friends who have helped out with great kindness.

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Legal Entitle on Gift of Myanmar Buddhist

Phyu Phyu Hlaing[a], Zin Mar Shwe[b]

Abstract

Gift is recognized and practiced in Myanmar society for a longtime under Myanmar Customary Law. In making a gift, Myanmar Buddhists have to abide the provisions of Myanmar Customary Law. Gift is the voluntary transfers of an existing property from one person to another without any consideration. Every Myanmar Buddhist may make gift of their own moveable or immoveable property.

Keywords: gift, Myanmar customary law, immoveable property, moveable property

Introduction

Gift is that the donor voluntarily transfers an existing moveable or immoveable property to the donor without any consideration. Every Myanmar Buddhist may make gift of their own moveable or immoveable property under Myanmar Customary Law. a valid gift, there should be a donor and a donee, the possession of the property, should donate voluntary without consideration, delivery of the property and acceptance by the donee in the lifetime and attested by the donor or his or her agent and if immoveable property, the instrument should be registered. Myanmar Buddhist make a gift at the time of washing the head of a new born baby, placing a baby in the cradle, naming a child or at the time of marriage of the child and at the time of Shinbyu ceremony. Myanmar Buddhist cannot claim any immovable property by way of gift except by a registered instrument in accordance with the provision of Section 123 of the Transfer of Property Act.

Definitions of Gift

Gift means the voluntary transfer of property to another without consideration.[1] Another means a gratuitous transfer or grant of property. A legally valid gift must normally be effected by deed, by physical delivery in the case of chattels or by donation mortis causa; the donor must intend ownership to pass a gift. A gift by will takes effect only on the death of the testator.[2]

According to Section 122 of the Transfer of Property Act, gift is the transfer of certain existing moveable or immoveable property made voluntarily and without consideration, by the donor to the donee and accepted by or on behalf of the donee during of lifetime of the donor and while the donor is still capable of giving.

And a gift comprising both existing and future property is void as to the latter.[3]

Ordinarily the Transfer of Property Act applies to all cases of gifts between Myanmar Buddhist. But when a question of succession, inheritance, marriage, religious usage of institution arises in a case of gift, Myanmar Customary Law should be applied in determining the validity of such gift.[4]

Kinds of Gifts

Concerning with the various kinds of gifts, it is provided in Manugye Dhammathat as follows; the parents donate their children at the time of performing any domestic ceremony

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[1] Bryan A Garner, Black's Law Dictionary, 9th edition, P-757
[2] Oxford Dictionary of Law, 8th Ed., P-283
[3] Section 124 of the Transfer of Property Act, 1882
[4] Ma PhwarSwe Vs Ma Tin Nyo, 11 U.B.R (02-03) P-1

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such as washing the head of a new born baby, placing a baby in the cradle, naming a child, or at the time of marriage of the child and at the time of the son's shinbyu ceremony constitute and the grandparents also donate their grandchild.[1]

There are three kinds of gift under Myanmar Customary Law.[2] They are-

(1) Death-bed gifts
(2) Shinbyu gifts and
(3) Grandparent's gifts

Generally, the gift is available to Transfer of Property Act and Contract Act. However, the question of succession, inheritance, marriage, religious usage of institution arises in a case of gift, Myanmar Customary Law should be applied in determining the validity of such gift.[3] The Shinbyu gift is relevant with Myanmar Customary Law.[4]Grandparent gift is relevant with succession. When the grandparents die, grandchildren inherit from their grandparents so that they must not be losed by the competition between their ancestors.[5]

Every Myanmar Buddhist, his own moveable or immoveable property can give voluntary without consideration. But it is a general principle. However, a Myanmar Buddhist cannot give all his possession of property against the interests of inheritors.[6]

In Yazathat, Dhammathat and Manugye Dhammathat, there expressed that if the hen gives only one of the chicks the food they are looking for, the chicks will be spoiled and eaten and it is not appropriate for the heirs to accumulate only one heir.[7]

The instrument of a gift which donates the immoveable property to a monk, contains the conditions for sale and the sale of the property shall be performed in accord with the conditions after the death of the donor. This instrument is, in fact, a will and Myanmar Buddhists are not to do so.[8] In other words, Myanmar Buddhist are not allowed to make a will if the gift is valid after the death of the donor.[9]

A will is an official declaration of how the owner wants to manage his property at the time of his death and his purpose under the case of Daw Lay Tin Vs U Aung Win and two others.[10]

The fact that Myanmar Buddhists do not have the right to make will under Myanmar Customary Law is still valid now. However, some Myanmar Buddhists seek to evade the concept of the Law by attesting deeds, which result in a will. A mother donates her land to her three children among five with the instrument of gift, which contains the conditions that is valid only after her death. Therefore, this instrument is a will. So, it is invalid in accordance with Myanmar Customary Law under the case of Ma Thin Myaing Vs Maung Gyi and five others.[11]

Essential Elements of a Valid Gift

Section 122 of the Transfer of Property Act defines a gift which has the following essential requisities:-

(1) There should be a donor and a donee;
(2) There must a transfer of ownership of a property from the donor to the donee;
(3) The property should be certain and existing property;

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[1]Mya Sein, U, Myanmar Customary Law, 13th Ed., 2018, P-441
[2]Mya Sein, U, Myanmar Customary Law, 13th Ed., 2018, P-443
[3]ThetPe, U, Knowledge of Transfer of Property Act, 4th Ed., 2008, P-301
[4] U Aung Tun Vs U Tun Tin, 1966, M.L.R, P-755
[5] Ma Me Ei Vs MaungLaukHnya, 3 UBR, (1917-18), P-228
[6]ThetPe, U, Knowledge of Transfer of Property Act, 4thEd., 2008, P-303
[7] Ibid
[8]Maung Thu Kha Vs U Thu NandaVol- 5, Ygn, 371
[9] U Tezawunta Vs MaungZawPe and another 10, Ran 224
[10]Daw Lay Tin Vs U Aung Win and two others, 2001, M.L.R, P-392
[11] Ma Thin Myaing Vs MaungGyi and five others, 1 Ran, P- 351

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(4) The transfer should be voluntary;
(5) It shall be without consideration;
(6) It can be of moveable or immoveable property;
(7) In the case of immoveable property, there must be either a registered instrument property attested by at least two witnesses. In case of moveable property should be made by delivering or by registration;
(8) The transfer should be accepted by the donee in his lifetime from the donor;
(9) The acceptance of the transfer by donee must be during the lifetime of the donor and he must be still capable of giving;
(10) Thus during gift, both the donor and donee should be living persons;
(11) In the event of the donor dies before acceptance, the gift is void.[1]

Not only the moveable property but also immoveable property can be given. But only material things can be given. In addition, the property must be present at the time of delivery. And it is impossible to donate the property that will appear or be acquired at a later under Transfer of Property Act. Likewise, an indescribable object cannot be also donate.[2]

The Dhammathats recognize as in other systems of law the necessity for transfer of possession or delivery to constitute a valid gift otherwise it would be a mere promise without consideration and unenforceable as an agreement unless it comes under and complies with Section 25(1) of the Contract Act.[3]

According to Section 25(1) of the Contract Act, an agreement made without consideration is void, unless it is expressed in writing and registered under the law for the time being in force for the registration of documents, and is made on account of natural love and affection between parties standing in a near relation to each other.

According to Ma Thin Myaing Vs Maung Gyi,[4] since 1893 in the City of Rangoon, and since 1905 in most of the important places of Burma, and since 1922 in practically the whole of Myanmar, the provision of the Myanmar Customary Law that gift must be completed by delivery of possession has been abrogated by Section 123 of the Transfer of Property Act.

Concerning with the essential elements of a valid gift, it is signified in the case of U Tun Tun Vs U Myat Zaw Aung.[5] In this case, the plaintiff U Myat Zaw Aung sued the defendant U Tun Tun that the suit for declaration of the possession of the land and the interests arising from the land and took possession the premises in Civil Regular No – 124/2005, Mandalay Region Court. It was decided that the plaintiff is the nephew of U Kyaw Wai and has been lived since he was young till U Kyaw Wai died. The defendant is a son of Daw Sein Yin (sister of Daw Mya Sein) (the deceased U Kyaw Wai's wife) and she lived in the accused land when Daw Mya Sein died. U Kyaw Wai give the plaintiff the accused land with the registration of gift No – 1557/2005. Therefore, the defendant was not heir of U Kyaw Wai.

According to the written statement of the defendant, U Kyaw Wai and Daw Sein Yin has been adopted the defendant since he was one years old. Therefore, as he is Apathihta son, he has the right to inherit.

According to the plea, the Mandalay Region Court issued and decided in favour of the plaintiff. After passing of the decree, the defendant – respondent applied to the Supreme Court of the Union as an appeal. The Court cited that Daw Lay Tin Vs U Aung Win and three others.[6] The case said that according to Section 122 of the Transfer Property Act, to be a valid

[1]www.latestlaws.com
[2]ThetPe, U, Knowledge of Transfer of Property Act, 4th Ed., 2008, P-299
[3] Chan Toon, Principles of Buddhist Law, 1894, P-125
[4]Ma Thin Myaing Vs MaungGyi, 1 Ran, 351
[5] U TunTun Vs U MyatZaw Aung, 2007, MLR, P-52
[6]Daw Lay Tin Vs U Aung Win and three others, 2001, M.L.R, P-392

gift, there shall be the donor and the donee, the possession of the prope voluntary without consideration and delivery of the property. And the donee property in the lifetime, attested by the donor or his or her agent.

Therefore, in U Tun Tun Vs U Myat Zaw Aung case, the Supreme C held that the registration of the gift is inappropriate with the provision of S Transfer of Property Act. So, the gift is invalid. For this reason, the court dis with cost.

According to Section 122 of the Transfer of Property Act, in r immoveable property, the transfer must be effected by a registered instru on behalf of the donor, and attested by at least two witnesses. In the case and 5 others Vs Ma Than Than Cho,[1] according the plaint, deposition a the case, it is clear that the register deed of gift No - 15/80 has not been e by the donee. Therefore, in this case, the Court held that the instrument of Section 122 of the Transfer of Property Act and also held that the gift is i

Gift relating to moveable property

For the purpose of making a gift of moveable property, the trans by a registered instrument signed by at least two witnesses or by delivery be made in the same way as goods sold may be delivered.[2]

A valid gift of movable property may yet be made by mere del But, in the case of gift instrument, it is necessary to take the stamp in Stamp Act.[4] Under Chapter VII of the Transfer of Property Act, gift death-bed gift of movables.[5] The donee must accept the gift[6] but the require acceptance on the part of the donee in the case of Maung Ba M 40 I.C 854 (855).[7]

Still there can be a valid gift if there be both delivery of posse acceptance of the gift by the donee. So, a valid gift of movable prope mere delivery of possession.

Gift relating to immovable property

As the immovable property, the Transfer of Property Act w since 1922. At the beginning of this year, gift of immovable prope Transfer of Property Act.

For the purpose of making a gift of immoveable property the (whatever be the value of the property) by a registered instrument s the donor, and attested at least by two witnesses.[8]

According to Section 123 and Section 124 of the Transfer c of immovable property should be made;

(1) The instrument
(2) Signed by at least two witnesses
(3) Attested by the donor or his or her agent and
(4) Registration.

Regarding with immoveable property, in case of Maung E held that a gift of immovable property amongst Myanmar Buddhi

[1]U Maung Mya and 5 others Vs Ma Than Than Cho, 2001, M.L.R, 290 (291)
[2] Section 123 of the Transfer of Property Act, 1882
[3] Ibid
[4] Article 33 of the schedule 1 of the Stamp Act, 1899
[5] Section 129 of the Transfer of Property Act, 1882
[6] Section 122, Ibid
[7] S.C, Lahiri, Principles of Modern Burmese Buddhist Law, 6th Ed., 1957, P-
[8] Section 123 of the Transfer of Property Act, 1882
[9]Maung Pu Vs U ThaHpye, 1948, M.L.R, 717

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gift, there shall be the donor and the donee, the possession of the property shall donate voluntary without consideration and delivery of the property. And the donee shall accept the property in the lifetime, attested by the donor or his or her agent.

Therefore, in U Tun Tun Vs U Myat Zaw Aung case, the Supreme Court of the Union held that the registration of the gift is inappropriate with the provision of Section 122 of the Transfer of Property Act. So, the gift is invalid. For this reason, the court dismissed the appeal with cost.

According to Section 122 of the Transfer of Property Act, in making of gift of immoveable property, the transfer must be effected by a registered instrument signed by or on behalf of the donor, and attested by at least two witnesses. In the case of U Maung Mya and 5 others Vs Ma Than Than Cho,[1] according the plaint, deposition and the statement of the case, it is clear that the register deed of gift No - 15/80 has not been effected by delivery by the donee. Therefore, in this case, the Court held that the instrument of gift is invalid under Section 122 of the Transfer of Property Act and also held that the gift is invalid.

Gift relating to moveable property

For the purpose of making a gift of moveable property, the transfer may be effected by a registered instrument signed by at least two witnesses or by delivery. Such delivery may be made in the same way as goods sold may be delivered.[2]

A valid gift of movable property may yet be made by mere delivery of possession.[3] But, in the case of gift instrument, it is necessary to take the stamp in accordance with the Stamp Act.[4] Under Chapter VII of the Transfer of Property Act, gift has no application of death-bed gift of movables.[5] The donee must accept the gift[6] but the Dhammathats do not require acceptance on the part of the donee in the case of Maung Ba Maung Vs MaungPyu, 40 I.C 854 (855).[7]

Still there can be a valid gift if there be both delivery of possession by the donor and acceptance of the gift by the donee. So, a valid gift of movable property may yet be made by mere delivery of possession.

Gift relating to immovable property

As the immovable property, the Transfer of Property Act was ratified in Myanmar since 1922. At the beginning of this year, gift of immovable property shall be taken by the Transfer of Property Act.

For the purpose of making a gift of immoveable property the transfer must be affected (whatever be the value of the property) by a registered instrument signed by or on behalf of the donor, and attested at least by two witnesses.[8]

According to Section 123 and Section 124 of the Transfer of Property Act, if the gift of immovable property should be made;

(1) The instrument
(2) Signed by at least two witnesses
(3) Attested by the donor or his or her agent and
(4) Registration.

Regarding with immoveable property, in case of Maung Pu Vs U Tha Hpye,[9] it was held that a gift of immovable property amongst Myanmar Buddhist before the 1st April 1930

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[1] U Maung Mya and 5 others Vs Ma Than Than Cho, 2001, M.L.R, 290 (291)
[2] Section 123 of the Transfer of Property Act, 1882
[3] Ibid
[4] Article 33 of the schedule 1 of the Stamp Act, 1899
[5] Section 129 of the Transfer of Property Act, 1882
[6] Section 122, Ibid
[7] S.C, Lahiri, Principles of Modern Burmese Buddhist Law, 6th Ed., 1957, P-317
[8] Section 123 of the Transfer of Property Act, 1882
[9] Maung Pu Vs U ThaHpye, 1948, M.L.R, 717

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was valid without acceptance or delivery of possession provided there was a registered deed of gift duly attested by two witnesses. A Myanmar Buddhist cannot claim immovable property by way of gift except by a registered instrument.

But gifts made before the introduction of the Transfer of Property Act are valid merely by absence of a registered instrument in Lal Mohamed Vs Mya Tha Aung and one case.[1]

In fact a Myanmar Buddhist cannot claim any immoveable by way of gift except by a registered instrument in accordance with the provision of Section 123 of the Transfer of Property Act under the case of Lim Charlie Vs The Official Receiver.[2]

In the case of Ma Aye Yin Vs U Shwe Ni,[3] the land was transferred without registration deed of gift, in which it has a condition to pay annual allowance to the donor. In this case, the donor sued for recovery of the land against the donee because of without paying the allowance. The Court held that the gift was made without registration therefore it was invalid and also the donor existed as an owner the land in disputed.

In the case of Aung Rhi Vs Aung Kyaw Pru and one,[4] where one of the attesting witnesses to a deed of gift denies that he had attested its execution, if from other evidence the Court is satisfied that he had in fact so attested it, his signature on the deed is a sufficient compliance with the requirements of Section 123 of the Transfer of Property Act.

In the case of a gift of immovable property, the gift deed shall be registered in accordance with the Registration of Deeds Law. The instruments of gift of immoveable property shall be registered.[5]

The registration deed shall be stamped 0.5 % of the price of the property.[6]The instrument or deed shall be registered within 120 days from the date of its execution. Concerning with the registration period, it is provided in the Registration of Deeds Law. Any other documents except the will executed within the Union of Myanmar shall be presented to the proper registration officer within 120 days from the date of its execution.[7]

Gifts by Myanmar Buddhists

Myanmar Customary Law, there are three kinds of gift such as;

(1) death-bed gift,

(2) shinbyu gift and

(3) grandparent's gift

Death-bed Gifts

Death-bed gift is defined as a gift made by a donor when he or she was on a bed from which he or she was never to rise again.

According to Section 191 of the Succession Act, 1925 where a person, who is ill and expects to die shortly of his illness, delivers to another the possession of any moveable property to keep as a gift in case the donor shall die of that illness, it is known as a gift made in contemplation of death or donation mortis causa.

In order to prove death-bed gift under Myanmar Customary Law, it must be shown first that the donor was in fact on his death-bed and secondly that he had no hope of recovery at the time of making gift under the case of U Kyar Byu Vs Maung Aung Thein.[8]

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[1] Lal Mohamed Vs Mya Tha Aung and one, 8 M.L.R, P-185

[2] Lim Charlie Vs The Official Receiver, 12 Ran 238 (P.C)

[3] Ma Aye Yin Vs U Shwe Ni, A.I.R, 1927, Ran, 335

[4] Aung Rhi Vs Aung KyarPru and one, 1 Ran, 557

[5] Section 16 (a) of the Registration of Deeds Law, 2018

[6] Article 33 of the schedule 1 of the Stamp Act, 1899

[7] Section 21 of the Registration of Deeds Law, 2018

[8] U KyarByu Vs Maung Aung Thein, 1946, B.L.R,139

In Daw Thai Vs Daw Ngwot and one,[1] the donor, a Sino-Burmese Buddhist, nine days prior to her death, made a gift of her entire estate, when death was imminent, to strangers when there were natural heirs. In this case, the Court review that a death-bed gift to a stranger, even if accompanied by delivery of possession is invalid against natural heirs under Myanmar Customary Law as intended to defeat the personal law.

U Kyu Byu and another Vs Maung Aung Thein[2] which is relied upon by the learned Advocate for the appellant is easily distinguishable, as it is a case between the parties to a deed which expressly stated that the gift was "by way of partition of inheritance," the donors were adoptive parents of the donee, both the donors were still alive when they themselves filed the suit seven years later although one of them was ill at the time of the gift, the circumstances show that their death was not imminent when they made the gift and the gift was not of the entire estate but only by way of partition thereof. So the learned District Judge is right in applying Myanmar Customary Law and in holding that the said gift is void there under as a death-bed gift of the entire estate of the donor. The appeal is dismissed with costs.

In the case of U Tezawunta Vs Maung Zaw Pe,[3]an old lady had been ill for a few months so she was weak and infirm and was expecting an early death. When she was unable to walk without help she executed two registered deeds of gift conveying certain lands to a monk (her son) and a month and half later she died. The object of the first gift was to enable the monk to build a monastery for her after her death and that of the second gift was to enable the monk to complete the construction of the monastery out of the income of the lands and thereafter to make some charitable gifts to her grandchildren. It was held that the transfers were invalid as they practically amounted to a device to make wills under the guise of making gifts.

Shinbyu Gifts

In the case of Shinbyu gifts delivery of possession is not essential even under Myanmar Customary Law. When a son enters a monastery, as a monk or novice, his parents may dedicate property to his use, in which case the donee cannot take possession, since the rules of the monastery enter are against enjoyment of worldly belongings. The subject is treated in Section 124 of the Digest, which contains, an abstract of the following passage in the Manugye.

A gift of property made publicly by both the parents or by the surviving parent at the time of the son's shinbyu ceremony constitutions, as between the donor and the donee, a valid gift although possession of the property is not given. Such property remains absolutely at the disposal of the donor during his or her lifetime and if the donee predeceases the donor the gift comes to an end; but if the donor delivers possession to the donee, the property passes absolutely to the donee and the donor's power of disposal ceases. Shinbyu gift must be made during the actual celebration, else it is not a shinbyu gift.[4]

Where there has been delivery of possession of the property given that the property passes absolutely to the donee and the parents have no longer any power of disposal over it under the case of Hla U Vs Aung Doon.[5]

In the case of Pan Nyunt Vs Hla Sein,[6] it was held that a gift of property publicly by both the parents or by the surviving parent the time of the son's Shinbyu Ceremony constitutes, as between the donor and the donee, a valid gift although possession of the property is not given. Such property remains absolutely at the disposal of the donor during his or her lifetime and if the donee predeceases the donor the gift comes to an end. The donee

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[1] Daw Thai Vs DawNgwot and one, H.C, 1949, P-471
[2] U KyuByu Vs Maung Aung Thein, 1946, B.L.R.139
[3] U Tezawunta Vs MaungZawPe, 10 Ran. 224
[4] N.C. Lahiri, Principles of Modern Burmese Buddhist Law, 6th Ed., 1957, P-307
[5] Hla U Vs Aung Doon, 6 L.B.R, 32
[6] Pan Nyunt Vs Hla Sein,8 L.B.R.190

is to get the property only after the death of the donor and if it has not already been disposed of by them literally. Shinbyu gift must made during the actual celebration, else it is not a shinbyu gift. If shinbyu gift of immoveable property must be made by a registered deed.

In the case of Mg Pan U Vs Ma Kyu,[1] the Court may make decree to deliver the possession of the property to the donee. At the time of the son's shinbyu ceremony constitutes, if a gift of property was made without delivery of possession, during the surviving donor.

Grandparent's Gifts

Gifts made by a grandparent to a grandchild are valid without delivery of possession. Such gifts, like shinbyu gift, are merely contingent gifts and that the rules for such gift are intended to operate merely as rules of inheritance and do not give the donee any claim as against the donor during the latter's lifetime and the property so given remains absolute at the disposal of the donor during his or her lifetime. The object of such is obviously a matter of inheritance. The intention of such gift is to secure that the grandchild who, being presumably younger, might fare badly in competition with his elder uncles and aunts, shall receive such share of the inheritance as the grandparent considers fair.[2]

In the case of Ma Me Ei Vs Maung Lauk Hnya,[3] do not give the donee any claim as against the donor during the latter's lifetime and the property so given remains absolute at the disposal of the donor during his or her lifetime.

A gift made by the grandparents to their grandchildren during the lifetime of the parents is valid, whether such gift has been accompanied by delivery of possession or not.[4]

A gift made by grandparents to their grandchildren, whether or not accompanied by delivery of possession, shall not, on the death of either of the grandparents, be revoked by the survivor.[5]

As well as the grandparent, the parents make a gift to their children at the time of Shinbyu and washing the head of a new born and naming a child and marriage of their child. In the next section, there will describe whether such gifts are valid or not.

Gift by parents

According to the Dhammathats a gift of movable property is valid when it is made by the parents to the child at the time of performing any domestic ceremony such as washing the head of a new-born baby, placing a baby in the cradle, naming a child, or at the time of the marriage of the child.[6]But when parents make gifts to the children who are living apart, such gifts are not valid unless accompanied by delivery of possession.[7]

In the case of Maung Ni Vs Nga Po Min,[8] a gift to be valid there must be delivery of possession, there is a recognized exception as to gifts made by parents to a son at the time of his entering into the priesthood though the thing is not delivered at the time.

In Ma Shin Vs Ma Thin Kyi,[9]an owner of property may, if he wishes, allow another person to enjoy the use and advantages of his property; he does not there by lose his title thereto. Hence, a gift by a person to his children on condition that they would allow him to continue in the enjoyment of the income on the property until his death is not invalid.

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[1] Mg Pan U Vs Ma Kyu, SJ 30

[2] S.C, Lahiri, Principles of Modern Burmese Buddhist Law, 6th Ed., 1957, P-308

[3] Ma Me Ei Vs MaungLaukHnya, 3 U.B.R 228

[4] Gaung, U, Translation of a Digest of the Myanmar Buddhist Law, 1902, P-332

[5] Ibid, P-333

[6] Mya Sein, U, Myanmar Customary Law, 13th Ed., 2018, P-349

[7] S.C, Lahiri, Principles of Modern Burmese Buddhist Law, 6th Ed., 1957, P-306

[8] Maung Ni Vs Nga Po Min, R.S.J 44

[9] Ma Shin Vs Ma Thin Kyi, 1934, A.I.R. Ran.129

In the case of Daw Khin Khin Kywe and five Vs Daw Tin Tin Kywe,[1] where certain properties were purchased jointly in the names of the deceased and the plaintiff (a daughter by his first wife), and the plaintiff by virtue of such purchase, claimed a half share in the properties on the death of the deceased. In this case, on the evidence, the court held that the deeds did not affect any outright gift or transfer of the disputed properties to the plaintiff. Furthermore, they also cannot convey title to the plaintiff after the death of the deceased.

Gifts by Myanmar Buddhist Monks

There are three kinds of religious properties,[2] namely,

(1) Poggalika property,
(2) Sanghika property and
(3) Public property.

A gift whereby property is given away absolutely not to an individual monk but to a religious Order is called a sanghika property.[3]

Conclusion

Myanmar Buddhist cannot donate all his possession of property against the interests of inheritors under Myanmar Customary Law. Generally, the gift can be made under the Transfer of Property Act and Contract Act. The Transfer of Property Act is the promulgated law, if the Myanmar Customary Law is in contradiction with the former Transfer of Property Act, the former shall prevail. Therefore the donor must not only abide the Customary Law or religious law in making a valid gift but also the Transfer of Property Act. If the donors does not abide the provision of the Transfer of Property Act, the gift deed will be null and void. But a monk may make a gift of poggalika property at the time of death-bed. It is valid. The death-bed gift by a monk is not relevant with the restriction of the Myanmar Customary Law.

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DawKhinKhinKywe and five Vs Daw Tin Tin Kywe,1964, M.L.R 599
Hla U Vs Aung Doon, 6 L.B.R, 32
Lal Mohamed Vs Mya Tha Aung and one, 8 M.L.R, P-185

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[1] DawKhinKhinKywe and five Vs Daw Tin Tin Kywe,1964,M.L.R 599
[2] Mya Sein, U, Myanmar Customary Law, 13th Ed., 2018, P-475
[3] S.C.Lahiri, Principles of Modern Burmese Buddhist Law, 6th Ed., 1957, P-349

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Maung Pu Vs U ThaHpye, 1948, M.L.R, 717
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Mya Sein, U, Myanmar Customary Law, 13th edition, 2018, P-441
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Analytical Study on Rights

Khin Soe Soe Lina, Lu Lu Htoib

Abstract

Moral rights can be extended beyond the human race; historically it is the moral rights possessed by human beings. Of those rights, the most celebrated and significant, particularly for political philosophers, have been natural rights and human rights. Those two sorts of right are closely related. Historically the idea of human rights descended from that of natural rights. Indeed some theorists recognise no difference between them; they regard 'natural' and 'human' as merely different labels for the same kind of right. Human rights are the basic rights and freedoms that belong to every person in the world, from birth until death.

Key Word: Right, Legal, Moral, Human Rights

Introduction

Natural rights are those that are not dependent on the laws or customs of any particular culture or government. Natural rights are rights which are "natural" in the sense of "not artificial, not man-made" Legal rights are those bestowed onto a person by a given legal system. Legal rights are laws that protect people. Human rights are the universal rights any human being can enjoy while moral rights are the rights that are accorded according to the ethics or moral code, and legal rights are the rights formulated by the state or government for the privilege of its citizens. There are four basic kinds of right or liberty: biological, economic, cultural, and political.

Rights

Rights are legal, social, or ethical principles of freedom or entitlement; that is, rights are the fundamental normative rules about what is allowed of people or owed to people, according to some legal system, social convention, or ethical theory.[1]

Types of Rights

- Natural Rights:
- Legal Rights.

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[1] Stanford Encyclopedia of Philosophy". Stanford University. July 9, 2007

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- Moral Rights:
- Civil Rights:
- Political Rights:
- Economic Rights:

Natural Rights

As a result, whereas natural rights (such as life, liberty, and property) are rights that government protects from infringement by others, human rights (such as "housing" and "leisure") are often things that government is obligated to provide. Secondly, natural rightsare rights that believe it is important for all animals or even living beings to have out of natural law. These rights are often viewed as unalienable, meaning they can almost never be taken away. The concept of what are natural rights has varied throughout history.[1]

The most important natural rights are "Life, Liberty, and Property". In the United States Declaration of Independence, the natural rights mentioned are "Life, Liberty, and the Pursuit of Happiness".[2] The idea was also found in the Declaration of the Rights of Man. The purpose of government is to protect peoples' natural rights through a social contract (an implicit agreement among the members of a society to cooperate for social benefits).[3]

Natural rights are rights which are "natural" in the sense of "not artificial, not man-made", as in rights deriving from human nature or from the edicts of a god. They are universal; that is, they apply to all people, and do not derive from the laws of any specific society. They exist necessarily, inhere in every individual, and can't be taken away. For example, it has been argued that humans have a natural right to life. These are sometimes called moral rights or inalienable rights.[4]

Legal Rights

Legal rights refers to rights according to law. It exists under the rules of some particular legal system. Following is a case law defining the term legal right. A legal right is a claim recognizable and enforceable at law, 1981; the court held that parents have a natural and legal right to custody of their children.[5]

Legal rights refers to rights according to law. It exists under the rules of some particular legal system. The legal right and legal remedy are correlative.[6]

Legal rights, in contrast, are based on a society's customs, laws, statutes or actions by legislatures. Legal rights are sometimes called civil rights or statutory rights and are culturally and politically relative since they depend on a specific societal context to have meaning.

Moral Rights

Moral rights describe what ought to be, whereas legal rights are the rights that are on the books. Moral rights represent the natural law, versus legal rightsrepresenting the positive law. Unfortunately, both natural and positive law is in some sense confusing buzzwords.[7]

Civil Rights

Civil rights, on the other hand, are those rights that one enjoys by virtue of citizenship in a particular nation or state. In America, civil rights have the protection of the U.S. Constitution and many state constitutions. Civil rights protect citizens from discrimination and grant certain freedoms, like free speech, due process, equal protection, the right against self-

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[1] December, 2011, news
[2] English philosopher John Locke
[3] https://simple.m.wikipedia.org/wiki/Natural_rights
[4] Ibid
[5] Ibid
[6] https://definitions.uslegal.com/l/legal-right/
[7] 17 January 2017, UN News

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incrimination, and so forth. Civil rights can be thought of as the agreement between the nation, the state, and the individual citizens that they govern. [1]

Differences between Moral Rights and Legal Rights

Moral rights are rights accorded under some system of ethics. These might be grounded in mere humanity they might be rights that all people deserve just because they are humans, or because they are rational beings, or whatever. Examples might be the right to be treated fairly, or the right to privacy. If I have a right to privacy, then you (and others) are obligated not to invade my privacy.[2]

Legal rights are rights that people have under some legal system, granted by a duly authorized legal authority or government. And consumers have a legal right to know the basic ingredients and nutritional profile of packaged foods.[3]

There is likely to be lots of overlap between moral and legal rights. For example, in most places, someone accused of a crime has a legal right to know what they're accused of. But most people would argue that the law here is merely recognizing what is really a moral right it would be immoral to jail someone and put them on trial without letting them even know what they are being charged with.[4]

In State v. Sanders,[5] the court held that parents have a natural and legal right to custody of their children. This right is prima facie and not an absolute right.[6]

However, there is no legal right in a legacy under a will. Legatees under the will can only claim as equitable owners, not legal. Their rights are all equitable, and can only be enforced in the manner pointed out by statute or under equitable rules.[7]

Differences between Natural and Legal Rights

Natural and legal rights are two types of rights. Natural rights are those that are not dependent on the laws or customs of any particular culture or government, and so are universal and inalienable (they cannot be repealed by human laws, though one can forfeit their enforcement through one's actions, such as by violating someone else's rights). Legal rights are those bestowed onto a person by a given legal system (they can be modified, repealed, and restrained by human laws).

The concept of natural law is related to the concept of natural rights

The idea of human rights is also closely related to that of natural rights: some acknowledge no difference between the two, regarding them as synonymous, while others choose to keep the terms separate to eliminate association with some features traditionally associated with natural rights.[8] Natural rights, in particular, are considered beyond the authority of any government or international body to dismiss.

The proposition that animals have natural rights is one that gained the interest of philosophers and legal scholars in the 20th century and into the 21st.[9]

Differences between Human Rights and Natural Rights

At the time of the Founding, people spoke of rights as being natural (or God-given). Beginning in the 20th century, these were replaced by the thoroughly modern idea of "human

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[1]HG.org, legal resource, https://www.hg.org/legal-articles/what-is-the-difference-between-a-human-right-and-a-civil-right-31546

[2]Chris MacDonald, Co-Author, Concise Encyclopedia of Business Ethics, Jan 9 2017

[3]Ibid

[4] Ibid

[5]96 N.M. 138 (N.M. Ct. App. 1981)

[6]https://definitions.uslegal.com/l/legal-right/

[7]Ibid

[8]Jones, Peter. Rights. Palgrave Macmillan, 1994, p. 73

[9] "Animal Rights", Encyclopedia Britannica, 2007; Dershowitz, Alan. Rights from Wrongs: A Secular Theory of the Origins of Rights, 2004, pp. 198–99

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rights." Although both natural rights and human rights are universal, there are fundamental differences between the two.[1]

First of all, natural inalienable rights do not come from government. Governments only secure these rightsthat is, they create the political conditions that allow one to exercise them. Human rights, on the other hand, are bestowed by the state and have become a catch-all term for anything we desire and deem important. As a result, whereas natural rights (such as life, liberty, and property) are rights that government protects from infringement by others, human rights (such as "housing" and "leisure") are often things that government is obligated to provide.[2]

Secondly, natural rights, being natural, do not change over time. All men, at all times, have the same right to life, liberty, and the pursuit of happiness. Human rights, on the other hand, constantly change. A whole cottage industry has sprung up to advance an array of new "economic and social rights" conceived of, defined by, and promoted by government and international bureaucrats.[3]

Human rights are the drafted summary of some basic rights to live. Some countries has capital punishment regime, in some not. It includes basic rights of food, minimum education, shelter and security etc. However, no country fully adopted these rights. However, international organisation is keen to bring convergence.[4]

Human rights are "endowed" with at birth as human beings. No one guarantees them.

Legal rights are guaranteed by the government under the law.

Human rights are the basic rights and freedoms that belong to every person in the world, from birth until death.

Legal rights are Legally guaranteed powers available to a legal entity in realization or defense of its just and lawful claims or interests (such as individual freedom) against 'The whole world.'

Differences between Human Rights and Legal Rights

Human rights arise simply by being a human being. Civil rights, on the other hand, arise only by virtue of a legal grant of that right.

Legal rights, in contrast, are based on a society's customs, laws, statutes or actions by legislatures. An example of a legal right is the right to vote of citizens.

Legally guaranteed powers available to a legal entity in realization or defense of its just and lawful claims or interests (such as individual freedom) against 'The whole world.' Legal rights (like laws) affect every citizen, whether or not the existence suchrights is publicly known.[5]

Soering v. the UK (June 1989) case involving a man who was to be extradited to US to face charges of murder, where the crime was punishable by the death penalty. The Court took the view that to send him back to the US would be against the prohibition of torture, inhuman or other degrading treatment or punishment.[6]

Tyrer v. the UK (March 1978, in this case, the Court considered that corporal punishment as a punishment for juvenile offenders was against the ECHR because it violated the right not to be tortured or to have degrading and inhuman treatment or punishment, as guaranteed under Article 3. In the Court's words: "his punishment whereby he was treated as an object in the power of the authorities constituted an assault on precisely that which it is one of the main purposes of Article 3 to protect, namely a person's dignity and physical integrity". This

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[1] Julia Shaw,Are Human Rights the Same as Natural Rights? December 19, 2011

[2] Julia Shaw,Are Human Rights the Same as Natural Rights? December 19, 2011

[3] Ibid

[4] https://www.quora.com/What-is-the-difference-between-human-rights-and-natural-rights

[5] Business Dictionary

[6] Article 3, ECHR

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case is a good example of the living nature of the ECHR, where the Court keeps pace with the changing values of our society.

Kokkinakis v. Greece (April 1993) case, which dealt with the conflict between the rights of different people. It was based on the issue of proselytizing and whether the teaching of a religion (guaranteed under article 9 of ECHR) violates another person's right to freedom of religion. The court thought it necessary to make a clear distinction between teaching, preaching or discussing with immoral and deceitful means to convince a person to change his/her religion (such as offering material or social advantages, using violence or brainwashing).

DH v Czech Republic (November 2007) case taken by 18 Roma children in the light of the fact that Roma students were segregated into special schools for children with learning disabilities, regardless of their ability. This meant that they would also have little chance in subsequently accessing higher education or job opportunities. In its judgment, the Court for the first time found a violation of article 14 (prohibition of discrimination) in relation to a "pattern" of racial discrimination in a particular sphere of public life, in this case public schools. The Court ruled that this systemic pattern of racial segregation in schooling violated non-discrimination protections in the ECHR.[1] It also noted that a general policy or measure, couched in neutral terms, may still discriminate against a particular group and result in indirect discrimination against them. The case was a first in challenging systemic racial segregation in education.[2]

Legally guaranteed powers available to a legal entity in realization or defense of its just and lawful claims or interests (such as individual freedom) against 'The whole world.' Legal rights affect every citizen, whether or not the existence suchrights is publicly known.

Lawfully guaranteed powers a legal entity acquires from winning a court decision. Realization or defense of just and lawful claims or interests against 'The whole world' is the basis. Whether or not the existence such rights is publicly known, legal rights as laws impact every citizen.[3]

Human rights descended from that of natural rights. Indeed some theorists recognise no difference between them; they regard 'natural' and 'human' as merely different labels for the same kind of right.[4]

Natural rights have been conceived in two different ways.Natural rights were conceived as rights of the most fundamental moral importance. They represented the basic entitlements of all human beings and the first obligation of governments was to ensure that the natural rights of its citizens were respected.

Human Rights

Origin of the human rights are the UDHR. The UDHR consists of a preface and 30 articles setting forth the human rights and fundamental freedoms to which all men and women everywhere in the world are entitled, without any discrimination. It encompasses both civil and political rights as well as social, economic and cultural rights.[5]

- Right to Equality
- Freedom from Discrimination
- Right to Life, Liberty, Personal Security
- Freedom from Slavery
- Freedom from Torture and Degrading Treatment
- Right to Recognition as a Person before the Law
- Right to Equality before the Law

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[1]Article 14, ECHR

[2]http://www.un.org/en/globalissues/briefingpapers/humanrights/quotes.shtml

[3]Featuring Black's Law Dictionary Free Online Legal Dictionary 2nd Ed

[4] Peter Jones, Issues in Political Theory, p.72

[5]https://www.coe.int/en/web/compass/legal-protection-of-human-rights

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- Right to Remedy by Competent Tribunal
- Freedom from Arbitrary Arrest and Exile
- Right to Fair Public Hearing
- Right to be Considered Innocent until Proven Guilty
- Freedom from Interference with Privacy, Family, Home and Correspondence
- Right to Free Movement in and out of the Country
- Right to Asylum in other Countries from Persecution
- Right to a Nationality and the Freedom to Change it
- Right to Marriage and Family
- Right to Own Property
- Freedom of Belief and Religion
- Freedom of Opinion and Information
- Right of Peaceful Assembly and Association
- Right to Participate in Government and in Free Elections
- Right to Social Security
- Right to Desirable Work and to Join Trade Unions
- Right to Rest and Leisure
- Right to Adequate Living Standard
- Right to Education
- Right to Participate in the Cultural Life of Community
- Right to a Social Order that Articulates the UDHR

The **International Covenant on Civil and Political Rights** (ICCPR) and the **International Covenant on Economic, Social and Cultural Rights**(ICESCR) both came into force in 1976 and are the main legally binding instruments of worldwide application. The two Covenants were drafted in order to expand on the rights outlined in the UDHR, and to give them legal force (within a treaty). Together with the UDHR and their respective Optional Protocols, they form the International Bill of Rights. Each of them, as their names indicate, provides for a different category of rights although they also share concerns, for example in relation to non-discrimination. Both instruments have been widely ratified, with the ICCPR having 166 ratifications and the ICESCR 160 ratifications, as of November 2010.

The **Convention on the Rights of the Child** (CRC, 1989)recognises that children have human rights too, and that people under the age of 18 need special protection in order to ensure that their full development, their survival, and their best interests are respected. The **International Convention on the Elimination of Racial Discrimination** (1965) prohibits and condemns racial discrimination and requires states parties to take steps to bring it to an end by all appropriate means, whether this is carried out by public authorities or others.

The **Convention on the Elimination of All Forms of Discrimination Against Women** (CEDAW, 1979) focuses on the discrimination which is often systemically and routinely suffered by women through "distinction, exclusion or restriction made on the basis of sex which has the effect or purpose of impairing or nullifying the recognition, enjoyment or exercise by women in the political, economic, social, cultural, civil, or any other field". States undertake to condemn such discrimination and take immediate steps to ensure equality.[1]

The **Convention Against Torture and Other Forms of Cruel, Inhuman or Degrading Treatment** (CAT,1984) defines torture as "severe pain or suffering, whether physical or mental"[2], which is intentionally inflicted in order to obtain information, as punishment or coercion or based on discrimination.

The **Convention on the Protection of the Rights of Migrant Workers and members of their Families** (1990) refers to a person who "is to be engaged, is engaged or has been engaged

[1] Article 1,Convention Against Torture and Other Forms of Cruel, Inhuman or Degrading Treatment (CAT,1984)
[2]Ibid

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in a remunerated activity in a State of which he or she is not a national"[1], and to members of his/her family.

The **Convention on the Rights of Persons with Disabilities (CRPD)** marks a ground breaking shift not only in its definition of people with disabilities but also in their recognition as equal subjects with full and equal human rights and fundamental freedoms.

The **Convention on Enforced Disappearances** addresses a phenomenon which has been a global problem. The treaty prohibits the "arrest, detention, abduction or any other form of deprivation of liberty"[2], whether by state agents or others acting with the states' acquiescence, and accepts no exceptional circumstances whatsoever for this refusal to acknowledge deprivation of liberty and the concealment of the fate and whereabouts of victims.

Human Rights

Human Rights are the basic rights and freedoms to which all human beings are entitled, like civil and political rights, the right to life and liberty, freedom of thought and speech/expression, equality before the law, social, cultural and economic rights, the right to food, the right to work, and the right to education .

Human Rights are the basic rights and freedoms to which all human beings are entitled, like civil and political rights, the right to life and liberty, freedom of thought and speech/expression, equality before the law, social, cultural and economic rights, the right to food, the right to work, and the right to education. In short, human rights are freedoms established by custom or international agreement that protect the interests of humans and the conduct of governments in every nation.[3]

Human rights are generally thought of as the most fundamental rights. They include the right to life, education, protection from torture, free expression, and fair trial. Many of these rights bleed into civil rights, but they are considered to be necessities of the human existence.[4]

Human rights are rights inherent to all human beings, regardless of race, sex, nationality, ethnicity, language, religion, or any other status. Human rights include the right to life and liberty, freedom from slavery and torture, freedom of opinion and expression, the right to work and education, and many more. Everyone is entitled to these rights, without discrimination[5].

The rule of law and human rights are two sides of the same principle, the freedom to live in dignity. The rule of law and human rights therefore have an indivisible and intrinsic relationship. That intrinsic relationship has been fully recognized by Member States since the adoption of the Universal Declaration of Human Rights, in which it is stated that it is essential, "if man is not to be compelled to have recourse, as a last resort, to rebellion against tyranny and oppression, that human rights should be protected by the rule of law".[6]

The concept of human rights drafted in the Universal Declaration of Human Rights was adopted by the United Nations General Assembly (UN) on the 10th December 1948, as a resolution, which only has a legal status of recommendation. This means it is not legally binding. The declaration is to be said to be 'a common standard of achievement for all peoples and all nations'. However, it is commonly accepted as the so-called 'core rights' in the Universal Declaration having acquired the status of (binding) international customary law.[7]

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[1] Article 2.1, Article 1,Convention Against Torture and Other Forms of Cruel, Inhuman or Degrading Treatment (CAT,1984)

[2] Article 2, Convention on Enforced Disappearances

[3] https://www.hg.org/human-rights.html

[4] https://www.hg.org/legal-articles/what-is-the-difference-between-a-human-right-and-a-civil-right-31546

[5] https://www.un.org/en/sections/issues-depth/human-rights/

[6] https://www.un.org/ruleoflaw/rule-of-law-and-human-rights/

[7] Baehr, Peter, Human Rights: Universality in Practice. London: MacMillan Press Ltd. London.1999. p.4

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Conclusion

For centuries and across cultures, the theory of natural law was the moral foundation of societies. In its place today the emphasis is on human rights.

A reasonable concept of natural law allows us to understand the intrinsic differences distinguishing natural law as such, the law of nations, and positive legislation.

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The history of human rights and the history of the natural law are one, and that the discredit into which positivism for a period brought the concept of natural law. *The Natural Law*, inevitably involved similar discredit for the concept of human rights. The doctrines of natural law must not be confused with natural law itself.

Acknowledgement

I would like to express my heartfelt thanks to Dr Aung Win (Rector of Myitkyina University) for their permission and encouragement to do this research paper. Moreover, this work is dedicated to all our colleagues who have help out with great kindness and patience.

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in a remunerated activity in a State of which he or she is not a national"[1], and to members of his/her family.

The **Convention on the Rights of Persons with Disabilities (CRPD)** marks a ground breaking shift not only in its definition of people with disabilities but also in their recognition as equal subjects with full and equal human rights and fundamental freedoms.

The **Convention on Enforced Disappearances** addresses a phenomenon which has been a global problem. The treaty prohibits the "arrest, detention, abduction or any other form of deprivation of liberty"[2], whether by state agents or others acting with the states' acquiescence, and accepts no exceptional circumstances whatsoever for this refusal to acknowledge deprivation of liberty and the concealment of the fate and whereabouts of victims.

Human Rights

Human Rights are the basic rights and freedoms to which all human beings are entitled, like civil and political rights, the right to life and liberty, freedom of thought and speech/expression, equality before the law, social, cultural and economic rights, the right to food, the right to work, and the right to education .

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Human rights are generally thought of as the most fundamental rights. They include the right to life, education, protection from torture, free expression, and fair trial. Many of these rights bleed into civil rights, but they are considered to be necessities of the human existence.[4]

Human rights are rights inherent to all human beings, regardless of race, sex, nationality, ethnicity, language, religion, or any other status. Human rights include the right to life and liberty, freedom from slavery and torture, freedom of opinion and expression, the right to work and education, and many more. Everyone is entitled to these rights, without discrimination[5].

The rule of law and human rights are two sides of the same principle, the freedom to live in dignity. The rule of law and human rights therefore have an indivisible and intrinsic relationship. That intrinsic relationship has been fully recognized by Member States since the adoption of the Universal Declaration of Human Rights, in which it is stated that it is essential, "if man is not to be compelled to have recourse, as a last resort, to rebellion against tyranny and oppression, that human rights should be protected by the rule of law".[6]

The concept of human rights drafted in the Universal Declaration of Human Rights was adopted by the United Nations General Assembly (UN) on the 10th December 1948, as a resolution, which only has a legal status of recommendation. This means it is not legally binding. The declaration is to be said to be 'a common standard of achievement for all peoples and all nations'. However, it is commonly accepted as the so-called 'core rights' in the Universal Declaration having acquired the status of (binding) international customary law.[7]

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[1] Article 2.1, Article 1,Convention Against Torture and Other Forms of Cruel, Inhuman or Degrading Treatment (CAT,1984)

[2] Article 2, Convention on Enforced Disappearances

[3] https://www.hg.org/human-rights.html

[4] https://www.hg.org/legal-articles/what-is-the-difference-between-a-human-right-and-a-civil-right-31546

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Right of Private Defenence Extend to Causing Death

Win Thuzar Aung[a], Ei Ei Moe[b], Ei Ei Phyu[c]

Abstract

Right of private defence arises only when the alleged wrongful or unlawful act done or attempt to be done against a person or property. In Criminal Law, there are two classes of offences. The first is offences due to an act of commission and the second one is offences which are the outcome of illegal omission. Nothing is an offence which is done in the exercise of the right of private defence. The right may be exercised against one's own body or property or against the body or property of another. The right is provided in Penal Code, section 96 to 106. Section 100 describes the situations in which the right of private defence of body extends to causing of death.

Keywords: defence, private, property, person

Introduction

People have the right to protect themselves and another, this right is called the right of private defence of body. This right is provided under Sections 96-106 of the Penal Code. This right can only be exercised when the circumstances justify it and not otherwise. The right of private defence is subject to restrictions given under Section 99 of this Code. In certain circumstances, the right of private defence also extends to causing death of the person who poses such a danger. This right is provided under Section 100 of the Penal Code. There must be reasonable apprehension that death or grievous hurt might be caused, or incase of assault with intention of committing rape, abducting, wrongfully confining a person. Although the law permits causing of death in certain circumstances of private defence, it ensures that the person does not exceed this right. There has to be a reasonable apprehension of the threat although actual injury mayor may not happen. However, this right can only be exercised and must be guided by restrictions given under Section 99 of Penal Code, 1860.

Meaning of the Right of Private Defence

Private defence which covers the defence of person as well as of property. The law of private defence is found on the following two cardinal principles;

(1) everyone has the right to defence one's own body and property as also another's body and property because the law does not require him to be cowardly at the time of acute necessary ; and

(2) this right cannot be used as pretense for justifying aggression; i.e. for causing harm to another person , nor for inflicting for harm than what is necessary to inflict for the purpose of defence. [1]

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[1] Suresh Narain Mulla & Chhedulal Gupta, Nelson's the India Penal Code, 7th Ed., 1981, P.203

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Section 97 of Penal Code discusses the right of private defence of the body and of property:-Every individual has a right, subject to the limitations contained in section 99, to protect.

People have the right to protect themselves when state aid cannot be obtained and this right is called the right of private defence of body.[1]This right is provided under Sections 96-106 of the Penal Code.[2]

In Than Maung V. The Union of Myanmar[3], that on single stroke with the sword on the head, the appellant stabbed the deceased with the slaughtering spike suddenly deemed right of defence.

Self- defence

Everyone has a right to protect their reputation on body, and property. Which means nothing is an offence which is done in the exercise of the right of private defence. [4]

A police officer attempted without a search warrant to enter a house in search of property alleged to have been stolen and was obstructed and resisted. It was held that , even though the officer was not strictly justified in searching the house without a warrant, the person obstructing and resisting could not set up the illegality of the officer's proceeding as a justification of his obstruction, as it was not shown that the officer was acting otherwise than in good faith and without malice.[5]

The right, declared by section 96, is a defensive one. It is not a right of retaliation or retaliation or revenge against a completed offence. It is not a right to abuse and insult a person.[6]

Commence and Continuous of the Right of Private Defence

The right of private defence of the body commences as soon as a reasonable apprehension of danger to the body arises from an attempt or threat to commit the offence though the offence may not have been committed, and it continues as long as such apprehension of danger to the body continues.[7]

Reasonable apprehension of danger which must be founded on facts. Attempt or threat to commit the offence means any offence punishable under the code. Though the offence may not have been committed, if committed, the right still exists if there is a reasonable apprehension of further danger, but not otherwise for the object of the right is protective and not punitive.[8]

Limitation of the Right of Private Defence

According to section 99 of Penal Code provided that the limitation of the right of private defence; that is to say;

There is no right of private defence against an act which does not reasonably cause the apprehension of death or of grievous hurt, if done, or attempted to be done, by a public servant acting in good faith under colour of his office, though that act may not be strictly justifiable by law.

There is no right of private defence against an act which does not reasonably cause the apprehension of death or of grievous hurt, if done or attempted to be done by the direction of a public servant acting in good faith under colour of his office though that direction may not be strictly justifiable by law.

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[1] RATANLAL AND DHIRAJLAL, THE INDIAN PENAL CODE 173 (34th ed. 2014)
[2] PSA PILLAI, CRIMINAL LAW 199 (10th ed. 2008)
[3] 1970 B.L.R.86
[4] Section 96 of the Penal Code
[5] PukotKotu (1896) 19, Mad, 349
[6] Suresh Narain Mulla & Chhedulal Gupta, Nelson's the India Penal Code, 7th edition. 1981, P. 206
[7] Section 102 of Penal Code
[8] Hon'ble Mr Justic V. R Krishna Lyer, Ratanal&Dhirajlal's Law of Crime, 25th edition, 2002, P.481

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There is no right of private defence in cases in which there is time to have recourse to the protection of the public authorities.

The right of private defence in no case extends to the inflicting of more harm than it necessary to inflict for the purpose of defence.

The first paragraph applies to those cases in which the public servant is acting in good faith under colour of his office, though the particular act being done by him may not be justifiable by law. The case where an official has done wrongly, what he might have done rightly, but not cases where the act could not have been at all by the official concerned. Where a police officer acting bona fide under colour of his office arrests a person but without authority, the person so arrested has no right of self – defence against the officer. If the act of a public servant is ultra vires the right of private- defence may be exercised against him. A police officer, a holding search, without a written authority, cannot be said to be acting under colour of his office.[1]

The word colour of office refer to irregular as distinguished from illegal acts. The protection is intended to be given only to a public servant acting honestly in the legitimate discharge of powers conferred or of duties imposed upon him.[2]

The word not strictly justifiable by law are not intended to cure the want of jurisdiction but only an erroneous exercise of it. When the error affects the procedure rather than the principle, it would be covered by the clauses.[3]

Extent of the Right of Private Defence of the Body

The right of private defence is subject to restrictions given under Section 99 of the PC. Section 99 provides that the right to private defence cannot be availed when there is sufficient time to take recourse to the public authorities, and also not against a public servant acting in good faith under a legal duty unless reasonable apprehension is caused. It also provides that force used must not be excessive than is necessary to ward off the impending threat.

The right of Private Defence of the body extends to causing of voluntary death of the assailant in six circumstances that have been enumerated below. However, this right can only be exercised and must be guided by restrictions given under S.99 PC. Also, the assault under the six circumstances is not simply an assault but an aggravated form of assault. It means assault coupled with any other wrongful act.

- Such an assault as may reasonably cause the apprehension that death will otherwise be the consequence of such assault;
- Such an assault as may reasonably cause the apprehension that grievous hurt will otherwise be the consequence of such assault;
- An assault with the intention of committing rape;
- An assault with the intention of gratifying unnatural lust;
- An assault with the intention of kidnapping or abducting;
- An assault with the intention of wrongfully confining a person, under circumstances which may reasonably cause him to apprehend that he will be unable to have recourse to the public authorities for his release.[4]

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[1]Dhirajlal Keshaval Thakore and Manharlal Rantanlal Varkil, The India Penal Code, 22nd edition. 1959, P.70

[2]Hon'bleMr.Justic V. R Krishna Lyer, Ratanal& Dhirajlal's Law of Crime, 25th edition, 2002, P.362

[3] Ibid

[4]Section 100 of the Penal Code, 1860

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Reasonable Apprehension of Death or Grievous Hurt

The first and the second clause of S.100 lays down and stipulates that the right of Private Defence to the extent of causing death is available when the assault employed by the assailant reasonably cause the apprehension that death or grievous hurt will otherwise be the consequence of such assault.

In the case of James Martin v. State of Kerala,[1] lay down that there are a number of factors that need to be considered to find whether the right of private defence is available or not. Factors such as injuries received by the accused, imminence of danger to his safety, injuries that are caused by the accused and also the circumstances in which the injuries were caused are taken into consideration.

The accused just has to show that he was faced with a reasonable apprehension and whether the apprehension was reasonable or not, is to be determined from the facts and circumstances of each case. Also, there could be no laid down test to measure whether the force used is appropriate. It has to be judged subjectively and no "reasonable man" concept is there.[2]

In the instant case, there was a dispute between the two brothers regarding the agricultural field. Gurcharan Singh, the deceased, was the brother of Bakhtawar Singh and uncle of Darshan Singh. According to the prosecution story, Gurcharan Singh and his son were irrigating their field when Gurcharan Singh and Darshan Singh came to their field and started abusing the complainant party. They had gun and gandasa with them. Bakhtawar Singh gave a gandasi blow to Gurcharan Singh and in order to save himself, he also caused injury on the head of Bakhtawar Singh. After that, Darshan Singh fired two shots at Gurcharan Singh as a result of which, he died. However, according to the accused version, it was Gurcharan Singh who first inflicted injury on Bakhtawar Singh and then, in order to protect himself, Darshan Singh fired shots at Gurcharan Singh. The accused pleaded Right of Private Defence. The trial Court considered the defence of the version as more probable and acquitted the accused and put forth two questions as to who was the aggressor and who had the motive to open the attack. Also, it considered as to where did the incident take place. It came to a conclusion that Gurcharan Singh was the aggressor and he also had the motive to attack. The place where incident happened belonged to the accused. On this basis, it justified its decisions. However, the High Court reversed the judgment without giving any cogent reasons. Consequently, the appeal was allowed and the decision of the High court set aside. It was held that a mere apprehension is enough to put the right of private defence into operation and actual commission is not required. And in this case Darshan Singh had reasonable apprehension that Gurcharan Singh might also injure him. Also, it was held that even though the accused may not plead the right of Private Defence, still it need to be given to him.

The accused is not given the benefit of this Section if he does the act with the intention of taking revenge or in a sudden altercation as in that case there would be no reasonable apprehension of any kind as held in case of Vishvas Aba Kurane v. State of Maharashtra[3], in which a scuffle took place between one Jaywant and Akram in a local cinema where the deceased, Raghunath and few others intervened to solve the matter. Two days later, when Jaywant went to the bazaar to purchase something, he was given a blow with stick and axe by the accused. On hearing the cry of Jaywant, Raghunath along with his brother rushed to the bazaar. On seeing them, the accused started running behind them and caught hold of them assaulting them badly. As a result of which, Raghunath died. The trial court held that after the first assault on Jaywant, he turned back towards the accused with a view to retaliate and threw one of the accused on the ground, as consequence of which, the accused had acquired a right

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[1] (2004) 2 SCC 203 Para 16
[2] Darshan Singh v. State of Punjab, AIR 2010 SC 1212
[3] AIR 1978 SC 414

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of private defence. Also, as against the deceased, the court held that the accused assaulted the deceased in the heat of moment and sudden fight and thereby it amounted to culpable homicide not amounting to murder. However, the High Court interfered with the findings of the trial court. The plea of the appellants that they have exercised the right of private defence in causing the death of the deceased was rejected because, in this case, the accused failed to prove that there were circumstances giving rise to reasonable grounds for apprehending that either death or grievous hurt would be caused to him. The High Court held that they shared a common intention to kill the deceased and killing in the exercise of the right of Private Defence would be justified only when there is an honest belief of the imminent and real threat. Unless there is reasonable apprehension of the danger, the right of Private Defence is not available.

In U Than Aung V. Union of Myanmar [1]case, at night challenger U Hla Kyaw holding a sword and Ko Than Aung defending his life with a dagger fighting reciprocally and a continuous process of fighting with sword. U Hla Kyaw fought two strokes with his long sword and Ko Than Aung fought two strokes with his long sword and Ko Than Aung fought back defensively with his dagger two strokes of fighting U Hla Kyaw's fighting with his long sword might cause deadly result while U Hla Kyaw had no sword, Ko Than Aung stabbed him with his dagger. Such action may amount to grievous hurt and consequentially, wounded U Hla Kyaw succumbed to injuries. It does not include within section 100 of Penal Code. That action is beyond the scope of right of private defence in such cases as prescribed by ruling of Union of Myanmar V. Maung Tin Shwe.

Mere reasonable apprehension is sufficient to exercise this right and a person cannot avail this right once the apprehension is over. In Deo Narain v. State of Uttar Pradesh[2], There was a dispute with respect to a certain piece of land. So, one day the complainant party went to the landin question to prevent the accused persons from ploughing. So the complainant party used lathiin the dispute to which the accused answered with the spear to protect them. In the dispute, one of the persons from the complainant party died. So the question before the court was whether the accused person exceeded the right to private defence. The Court was of the view that the right to private defence of body commences as soon as the reasonable apprehension of danger arises and it is not necessary for the accused to show that he has sustained any injuries. And while protecting himself from the apprehended danger to his life, a person cannot be expected to measure the amount of force employed. So it's very normal that a person protects himself with full capacity against any danger to his life. Therefore the amount of force to be used to prevent the injury can't be judged on a golden scale and it has to be judged according to the facts and circumstances of each case. This was also stated in Puran Singh v. State of Punjab[3], that an individual while exercising the right of private defence must employ proportionate amount of force. However, there is no set of scales that determines whether the accused has exceeded the right or not. It has to be judged according to the facts and circumstances of the case.

Accused who were Sikhs, abducted a Muslim married woman and converted her to Sikhism. Nearly a year after the abduction, the relatives of the woman's husband came and demanded that she return. The accused refused to comply and the woman herself expressly stated her unwillingness to rejoin her Muslim husband. Thereupon the husband's relatives attempted to take her away by force. The accused resisted the attempt and in so doing one of them inflicted a blow on the head of the woman's assailants, which resulted in the latter's death. It was held that the right of the accused to defend the woman against her assailants

[1] 1997 B.L.R.85
[2] AIR 1973 SC 473
[3] MANU/SC/0184/1975 Para. 26

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extended under this section to the causing of death and they had, therefore, committed no offence.[1]

Workers of a factory threw brickbats from outside the gates, and the factory owner by a shot from his revolver caused the death of a worker, it was held that this section did not protect him, as there was no apprehension of death or grievous hurt.[2]

If, in the exercise of the right of private defence against an assault which reasonably causes the apprehension of death, the defender be so situated that he cannot effectually exercise that right without risk of harm to an innocent person, his right of private defence extends to the running of that risk.[3]

Section 106 should be together read with section 100. It provides for the risk which a person may have to run to defend himself against an assault reasonably causing the apprehension of his death.[4]

Assault with Intention of Committing Rape or Gratifying Unnatural Lust

The third and the fourth clause of S.100 stipulate that the right of Private Defence to the extent of causing death is available in cases of assault with the intention of committing rape of gratifying unnatural lust. This right, being a preventive right must be utilized with utmost care and caution. Since, the burden is on the accused to prove that he has exercised his right of private defence, he need not prove it beyond reasonable doubt but only on preponderance of probability that creates doubt in the mind of the judge.[5] Various cases are referred to analyses the clause in a better manner.

The leading Supreme Court case of Yeshwant Rao v. State of Madhya Pradesh[6] clarifies the position of law as regard to the third and the fourth clause of S.100. In this case, the deceased tried to have sexual intercourse with the daughter of the accused while she went to the toilet on the rear side of her house. The accused, on seeing the daughter being raped hit the deceased with the spade and the deceased died as a consequence. The Supreme Court held that the accused was justified in exercising the right of Private Defence of body against the deceased and hence was given the acquittal. Here it can be seen that the assault that took place on the daughter was sufficient to create reasonable apprehension in the mind of the accused and thereby his act was untitled under S.100. The right of private defiance.

In Bhadar Ram v. State of Rajasthan[7], where the appellant saved her widow sister–in-law from the clutches of one Nand Ram and assaulted him with gandasa while he was running was giventhe exception under clause third of S.100 IPC. In this case, the appellant's sister-in –law was a widow lady who was grappled by Nand Ram in the dead hour of the night in order to outrage her modesty for committing rape. Hearing her hue and cry, the appellant came prepared with a gandasa and assaulted Nand Ram while he was trying to commit rape of the widow lady. It can be seen here that there was reasonable apprehension of danger to the body of appellant's sister and thus the right of Private Defence in this case was rightly availed against the danger that was real, present and imminent.

This right of Private Defence is available to everyone irrespective of the moral character of the person exercising her right as in the case of State of Orissa v. Nirupamma Panda[8], where the woman while preventing herself from the non-consensual sexual intercourse stabbed the person when the deceased tried to rape her and she was given the benefit of this right. It was contented that the character of the accused was in doubt and thereby she should not be given

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[1]Nand Kishore Lal v. Emperor AIR 1924 Patna 789

[2]Mohinder Pal Jolly v. State of Punjab AIR 1979 SC 577

[3] Section 106 of Penal Code.

[4]Ratanlal Ranchhoddas, the Law of Crime, 25th edition 1971, P234.

[5] DR. HARI SINGH GAUR, INDIAN PENAL CODE 299 (14th ed. 2013).

[6] AIR 1992 SC 1683.

[7] (2000) Cr L.J. 1174 (Raj).

[8] (1989) Cr LJ 621 (Ori).

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the right of private defence. It was held that she was entitled for an acquittal as she had every right to save her honor even by causing death and her alleged immoral character is of no consequences. The Court also observes that while providing the right of Private Defence under thirdly S.100, the personal character of the accused is immaterial.

Assault with Intention of Kidnapping or Abducting

The fifth clause of S.100 IPC provides that the right of private defence is available when the assault is made with the intention of kidnapping or abducting. Abduction is an offence against the human body and takes place when a person is compelled to go from any place.[1]

Abduction given under fifthly of Section 100 IPC has to be taken in its plain meaning as enumerated in Vishwanath v. state of Uttar Pradesh.[2] In this case, the accused's sister left her husband's house and was residing with her father and brother. One day, the deceased husband came to the house and tried to take her wife away with her to which she rebelled and caught hold of the door. In the meanwhile, in order to protect her sister from the deceased, the accused took out a knife and stabbed the deceased husband. As a consequence, he died. The accused pleaded that he must be given the benefit under fifth clause of S.100. However, the prosecution contended that the right of Private Defence under this clause is only available when there is some other intent coupled with abduction. The Allahabad High Court gave the judgment in favor of the defendant and held that the accused will not be given the right of private defence as no there was no other intent coupled with Abduction. Allowing the appeal and setting aside the judgment of the high court, the Supreme Court rejected the contention and held that the word "abduction in clause fifth has to be read in a plain meaning as defined under S.362 of the IPC and therefore acquitted the accused. It held that this right is only available for Abduction simpliciter and only when compelled by force. In the second category of Abduction by deceitful means given underS.362, Private Defence is not available as there is no compulsion by force.[3] The Supreme Court said that at the time the accused intervened, his sister was forcibly compelled to go from the place of the accused and thereby, there was an assault with the intention of abduction underS.100 clause fifthly. The accused therefore had the right of private defence that could even extend to causing the death of the assailant. As soon as the accused is faced with the assault that is carried out with the intention of kidnapping or abduction, the right of private defence can be availed of. In Nand Kishore Lal v. Emperor[4], a married Muslim woman was abducted by the accused and converted to Sikhism. Nearly after a year, the husband of the woman and demanded her to return back to which the accused and the woman herself objected. The woman herself did not want to go back. Therefore, the husband and his relatives tried to drag her away with them to which she and the accused resisted and while resisting the attempt, the accused inflicted a fatal blow over one of the female assailants which resulted in her death. The court held that the accused would be given the plea under fifth clause of S.100 as he was trying to protect the woman against the assailants. It can be seen that the motive and intention of the accused does not matter at all and as soon as reasonable apprehension is caused, the right of private defence can be availed of.

Assault with Intention of Wrongful Confinement

The sixthly clause of S.100 provides that the right of Private Defence extending to causing death is available when an assault is carried out with the intention of wrongfully confining a person. However, in order to avail this right there must be a proof that there was an assault and that was with the intention of wrongful confinement. Also, it has to be proved

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[1] RATANLAL AND DHIRAJLAL, THE INDIAN PENAL CODE 177 (34th ed. 2014)
[2] MANU/SC/0027/1959
[3] MANU/SC/0027/1959 Para 7
[4] IR 1924 Pat. 789

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that the circumstances were such that caused reasonable apprehension in the mind of the accused that he will not be able to take recourse to the public authorities for his release.[1] Even if the act satisfies all the seprere quisites, it has to fall under the restrictions mentioned in S.99 of PC.

As stated in Abdul Habib v. State[2], when a person is wrongfully arrested and taken to the police station for being handed over to the police cannot be said to have reasonable apprehension that he will not have recourse to the public authorities for his release. In this case, the appellant tried to steal away the bicycle of one Swaran Singh. Swaran Singh made an effort to stop him and caught hold of his bicycle and the appellant in order to save himself gave a stab blow in the right elbow with a knife and ran away. Swaran Singh raised a hue and cry and many people joined in the pursuit of the fleeing appellant. One Naresh Kumar is said to have heard the slogans that the appellant must be arrested and therefore ran towards him but the appellant, in order to evade his arrest, struck a blow by his knife and stabbed him. Naresh Kumar attempted to commit an assault but the intention was to apprehend the appellant and take him to the police station. The question before the court was whether this act of arresting amounted to wrongful restraint or wrongful confinement.

Wrongful Restraint means voluntarily obstructing any person so as to prevent that person from proceeding in any direction in which that person has a right to proceed. Wrongful confinement means wrongfully restraining any person in such a manner as to prevent that person from proceeding beyond certain circumscribing limits. The court held that the intention was more of wrongful confinement to let him move only within the limits of the place of arrest. It was also held that that the circumstances were not such that any reasonable person would have apprehended that he would not be able to secure the help of the public authorities in obtaining his release. There was no right of Private Defence of person given in this case. Also, the court observed that in no case can a person inflict more harm than is necessary to ward off the danger. In this case, it cannot be said that the appellant had exceeded the right because he had no right of Private Defence in the first place.

Conclusion

Self-preservation is a principle of Criminal law and therefore the state provides individuals the right to protect themselves. The right of Private Defence of body comes under the justifiable defence where the focus is more on the act of the individual. The Courts while providing the defence under S.100have been very careful. The burden is on the accused to prove that he had exercised his right ofprivate defence. This right is also available to protect the body or property of any other person. It extends to causing of death of the assailant in certain circumstances. Thus, this right of Private defence is a wonderful weapon in the hands of the people that permits them to protect themselves and others against any threat under a legal justification. The terms 'Private Defence' and 'Self Defence' are synonymous to each other. In fact they carry one and the same meaning. However, this right can only be exercised when the circumstances justify it and not otherwise. There has to be a reasonable apprehension of the threat although actual injury may or may not happen. An act of throwing or administering acid or an attempt to throw or administer acid which may reasonably cause the apprehension that grievous hurt will otherwise be the consequence of such act.

The right of private defence can be exercised not only when any of the specified offences is being committed but also when an attempt is made to commit the same or reasonable apprehension of the same is there. For claiming the right of private defence, the accused is not only to prove that the right had commenced but also the right had not ended. The accused is also required to prove that he has not exceeded the right had commended but also the right had not ended. The accused is also required to prove that he has not exceeded

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[1] K.D. GAUR, THE INDIAN PENAL CODE 191 (4th ed. 2009)
[2] 1974 Cr. L.J. 248

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the right. The right of private defence is very helpful in giving citizens a right which in case is not misused, subject to certain restrictions, helps them to protect their and others' lives and property.

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The Importance of *Maṅgala Sutta* on Myanmar Society

San Shwe[1] , Thin Thin Mon[2]

Abstract

In Myanmar society, *Maṅgala sutta* is one of the greatest *suttas* to get a real life. Here, *Maṅgala* means whatever removes evil or whatever is beneficial. It is defined as auspiciousness. In this paper, the importance of *Maṅgala sutta* on Myanmar Society will be explored and it contains discourses as the foundation for Myanmar society. The purpose of this paper is to examine how the social and moral norms including in this *sutta* are applicable and useful for building a peaceful society. By practicing these social and moral norms, one can get peace, happiness and success.

Key words: auspiciousness, the social and moral norms

Introduction

Maṅgala sutta was the doctrine preached by the Buddha who was asked by a deity what the good fortune. It is one of the most widely known of the Buddha's discourses. Since Myanmar thought is primarily based on Buddhist thought, *Maṅgala sutta* is the foundation for Myanmar society. *Maṅgala sutta* contains thirty-eight good social and moral norms that can benefit every society. Practicing these norms will bring auspiciousness to any place and at any time.

The *Maṅgala sutta* will concern with blessings of social dealing, blessings of action and behavior, blessings of education, blessings of obligation and responsibilities, blessings of obligation, blessings of restraint, blessings of purification and blessing of forbearance.

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Material and Method

The data required for this paper were mainly collected from pāli literature and other miscellaneous religious literature. Firstly, *Maṅgala* sutta will be studied, secondly thirty-eight blessings will be divided blessings of social dealing, blessings of action and behavior, blessings of education, blessings of obligation and responsibilities, blessings of restraint, blessings of purification and blessing of forbearance. It explained by using the descriptive and evaluative methods are used in this paper.

Findings and Discussion

The thirty-eight blessings overcome the difficulties and these will gain success and prosperity in the present life as well as in the future life. The word '*Maṅgala*' means whatever removes evil or whatever is beneficial or whatever is auspicious or whatever gives happiness. For Myanmar, there are many kinds of '*Maṅgala*'. Among them, the '*Maṅgala*' such as naming ceremony (*nāmakaraṇa maṅgala*), initiation into the order of Buddhist monks (*sāsananuggaha pabbaja maṅgala*) and the marriage ceremony (*āvāha-vivāha maṅgala*) are popular.

Buddha expounded the M*aṅgala Sutta* containing thirty-eight principles that ensure one every success and all kinds of prosperity. Myanmar practice the thirty-eight blessings. The thirty-eight blessings are;

1. *Asevanā ca bālānaṃ* - Not to associate with the foolish
2. *Paṇḍitānañca Sevanā* - To associate with the wise.
3. *Pūjā ca pūjaneyyānaṃ* - To honour those who are worthy of hounour
4. *Patirupadesa vāso ca* -To dwell in a suitable locality.
5. *Pubbe ca Katapuññatā* -To be endowed with merits earned in the past
6. *Attasammā paṇidhi ca* -To observe right precepts and regain from doing evil
7. *Bāhusaccañca* -Indulge in profound learning
8. *Sippañca* -Perfect handicraft on vocational training
9. *Vinayo ca susikkhito* -Highly trained moral discipline
10. *Subhāsitā* ca *yāvā cā* -Pleasant words that are well- spoken
11. *Mātāpitu upaṭṭhānaṃ* -Caring for Parents
12. *Puttadārassa saṅgaha* -Cherishing wife and children
13. *Anakulā ca kammantā* -Peaceful occupation of live hood free from complications
14. *Danañca* -Doing deeds of charity
15. *Dhammacariyā ca* -Perform good deeds and lead a righteous life
16. *Ñātakānañca saṅgaho* -to support relatives
17. *Anavajjāni kammāni* -Indulge in blameless pursuits
18. *Āratī pāpā, viratī pāpā* -Avoid evil deeds physically, verbally or mentally
19. *Majjapānā ca saṃyamo* -Abstain from intoxicants
20. *Appamādo ca dhammesu* -To diligent in laws
21. *Gāravo* -Respect those worthy of respect
22. *Nivāta* -Be meek and humble
23. *Santuṭṭhi ca* - Be happy and content
24. Kataññutā - Be grateful, know the good done to with gratitude's
25. *Kālena dhammasavanā* - Timely discussion of the doctrine
26. *Khantī ca* - Be patient and practice forbearance
27. *Sovacassatā* - Listen and live up to the advice and admonition of the stages
28. *Samaṇanañca dassanaṃ* -To visit the monks, Timeliness, to do the right thing at the right time.

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29. *Kālena dhammassavanaṃ* -The discussion of the doctrine
30. *Tapo ca* - Restrain oneself of the six senses practices of self-control
31. *Brahmacariyañca* -To practice self-control in dailylife and to avoid self-indulgence
32. *Ariyasaccāna dassanaṃ* - To discern the four noble truths
33. *Nibbāna sacchikiriyā ca* - To realize the nirvana Aspire for attainment of Nirvana by the practice of the Eight Fold Noble Path
34. *Phuṭṭhassa lokadhammehi* - Way of mundane world are the fact of life
35. *Cittaṃ yassa na kampati* - Be strong of mind
36. *Asokaṃ* - Be free from anxiety
37. *Virajaṃ* - Be stainless pure
38. *Khemaṃ* - Enjoy perfect peace by attainment of Nirvāna

Maṅgala Sutta as the Foundation for Myanmar Society

The three important passages from the *Maṅgala sutta* are still having an impact on three ceremonies in Myanmar. These three ceremonies being practised in Myanmar societies are –

1. Naming ceremony;
2. Initiation into the order of Buddhist monks and
3. The marriage ceremony.

These three ceremonies are always relevant to one of the paragraphs from *Maṅgala sutta*. This paragraph is very common and familiar to everybody. It is mentioned in the *Maṅgala sutta* as "*puttadārassa saṅgaho*". So every household head of the family is obliged to initiate his children into the Buddhist order in terms of *sāsananuggaha pabbaja Maṅgala* together with *nāmakaraṇa Maṅgala*. Everybody knows this *nāmakaraṇa Maṅgala* is especially for the grown-up girls of a family. *Āvāha-vivāha Maṅgala* can also be applied to this paragraph of "*puttadarassa saṅgaho*".

These three ceremonies are very popular till today. It is one of the impacts on Myanmar *lokī Maṅgalā*.

The Importance of *Maṅgala Sutta*

1.Blessing Concerning Social Dealing

Asevanā ca bālānaṃ,
Paṇḍitānañca sevanā,
Pūjā ca pūjaneyyānaṃ,
Etaṃ maṅgala muttamaṃ.

Asevanā ca bālānaṃ is a *Pali* word that means not to associate with the fool. *Paṇitānañca sevanā* is a *Pali* word that means to associate with the wise and *Pūjā ca pūjaneyyānaṃ* means honouring those who deserve honour. These three blessings are good *maṅgala.*

Bālānam asevanā is the first maṅgala or blessing of the thirty-eight blessings. Here *bāla* means a folish one and *asevanā* not associating. So, *Bālānaṃ asevanā* is in the sense of not associating with the fool.

A foolish person is one who does not know that any action of his is for the benefit and prosperity of others or that it would cause much suffering to them. One may even have learnt the Pitaka. If, inspite of his learning, he fails to discriminate what is benefecial from what is harmful, he is just a foolish one. *Ajatassattu* and *Devadtta* are examples of the fool.

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Not associating with the fool also means not taking a foolish one as one's leader. *Devadatta* is classified as a foolish one. *Ajatassattu* is now still suffering in *Niraya* because he had *Devadatta* as his leader. *Devadatta* was one who could even compete with the Buddha. But he did nothing for the good of the people; instead, he had done much harm to them. For this reason, he was classified as a fool.

As for *Ajatassattu,* he was, in fact, a prince, an offspring of a king. He had also learnt much conventional knowledge. *Ajatassattu* himself was an educated prince, but because he had *Devadatta* as his teacher he killed his own father ane is suffering in *Niraya* up to this day.

Out of the therty-eight *maṅgalas* the Buddha has put the blessing of "*Bālānaṃ asevanā"* at the very beginning. This is because the fool being incapable of differentiating what is beneficial from what is harmful, if one were to have the fool as one's lead one would not be able to carry out any other blessings.

Paṇḍitānaṃ sevanā is the second maṅgala or blessing of the thirty-eight blessings.Here *paṇḍita* means the wise and *sevanā means* associating, so *paṇḍitānaṃ sevanā* means associating with the wise . Associating with the wise also means having wise person as one's leader.The wise person is the opposite of the fool.

A wise man is one who can discriminate what is true from what is flase, and to things which are for the good of the people. *Mahosadha* and *Vidhūra* are examples of the wise one.

Mahosadha did nothing for his own benefite; whtever he did was only for the benifite of the king and his countrymen. *Mahosadha* protected the in terests even of his enemies, *Sena, Devinda, Kāminda, Pakudha,* who were always making trouble for him.

In short, those leaders, who can discriminate between truth and untruth, and do things for the good of the people and for the good of the country are panditas. The panditas is one who can discriminate the truth from untruth, who is not self-seeking, and is willing to risk even his own life for the good of his countrymen and for the good of the whole world.

2.Blessing Concerning Action and Behavior

Patirūpadesavāsoca,
Pubbeca Katapuññatā,
Attasammā paṇidhi ca,
Etaṃ maṅgala muttamaṃ.

These *maṅgala* is a three in one constant *maṅgala* which is to abide by lay people. " *Patirupadesavasoca"* is also such a place that is dwelled by the wise who are capable of knowing good and bad will tell the ignorant of a certain place the words of wisdom a"*Attasammapanidhica*"-This line of *Pali* words means to set oneself on the right course i.e. to make serious effort. If the meritorious deeds in the past were inadequate for a lay person, another reliable discourse expounded by our lord Buddha is *attasammapanidhi ca.* In compliance with this discourse, a lay person can set himself on the right course.

3.Blessing Concerning Education

Bāhusaccañca Sippañca,
Vinayo ca susikkhito,
Subhāsitā ca yāvācā,
Etaṃ maṅgala muttamaṃ.

The *Pali* verse given above is one of numbers of auspiciousness concerning the aspect of education. According to the line *Bāhusaccañca*, one must have wide general knowledge. *Sippañca* signifies that having skill in technology is also auspiciousness because one can be successful in life if he knows technology. *Vinayoca* means to have discipline and good training.

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Any person who behaves and practices these four factors of auspiciousness can bring benefit to the social organizations. The significance of these four factors of auspiciousness is hereby submitted to the reader for the acknowledgement the welfare of human organizations.

From everyday learning at school, one can hear a lost about remarkable and wonderful events; sometimes one can see remarkable and wonderful events; sometimes one can see unbelievable happenings. These happenings and stories are actually not-worthy.

4.Blessing Concerning Obligation and Responsibilities

Mātāapitu upaṭṭhānaṃ
Puttadarassa saṅgaho,
Anakulā sa kammantā,
Etaṃ maṅgala muttamaṃ

Mātāapitu upattāna means supporting parents and ministering to their needs; looking after the family especially the offspring with tender love and care- *puttadarassa saṅgaho*; and *Anakulā sa kammantā*—living a blameless life are also the auspiciousness, regarding the obligations and responsibilities of the children or offspring of a family. If a certain family is established in accord with these rules, it will become a happy and peaceful that can live in an auspicious villa.

In accord with the rule of *Anakulā sa kammantā* one should not do a complicated job. But there are some business men who never accomplish their trade. Therefore, their assets and liabilities get confused and complicated. As a result, they will finally have a head ache job which is disadvantageous to him. They should appreciate such a proverb as - Jack of all trades but muster of none. If they abide by the rules of *Anakulā sa kammantā*, they will become successful in their jobs and get rich soon.

5.Blessing Concerning Obligation

Dānañca dhammacariyā ca,
Ñātakānañca saṅgaho,
anavajjāni kammāni,
Etaṃ maṅgala muttamaṃ

Dāna can be defined as charity. It also means almsgiving and donation, Buddhist traditional way of offering alms to the monks and donation in term of money, necessary things to the social organizations are also *Dāna* in Myanmar term. Giving away one's possession to the poor, to a community, contribution, small or large are also included in the action of *dāna* which is a *Pali* word.

Even though a person has made great donations he is required to practice austerity in conformity with the auspiciousness of *dhammacariyāca* so that such a person will become a real Buddhist of great merit. In this case the capability of making judgment for justice and injustice is important. The following are the justification for the acknowledgement of justice and injustice.

Having convinced of justice and injustice one should cooperate with those who are righteous and respect the justice by following the rule of *dhammacariyā ca maṅgal.* Such an act of cooperation with the circle of people who practice the lawful conduct also means *dhammacariyā ca.* One who performs good deeds and leads righteous life is practicing *dhammacriyā ca maṅgala.*

Ñātakānañca maṅgala means helping one's own relatives. Supporting one's own relatives is relevant to the good action of giving away the clothes to one's own relatives who are relying on him encouragement for those being depressed in their life and having an arguing with the person who is speaking disparagingly of one's own relatives. If possible one should practice *Ñātakānañca maṅgala* because such an action of supporting one's own relatives with what they need is very influential to needy families for their better life.

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*Anavajjāni kammāni*is blameless action mainly associated with welfare and activities. Hereby one should be able to identify what the blameless actions are. Observing eight precepts and keeping Sabbath, planting shady trees, building of a shed with a pot of clean and cool water for drinking beside the road, repairing roads, organizing to form social organizations, trading of commodities and bridge construction are the simple and blameless professions. Such professions for being blameless and simple can provide happiness peace and tranquility for a business person's life. These four kinds of auspiciousness are to be observed and practiced by Buddhist lay people.

6.Blessing Concerning Restraint

Āratīviratī pāpā,
Majjapāna ca saṃyamo,
Appamādo ca dhammesu,
Etaṃ maṅgala muttamaṃ

Āratīviratī pāpā, means to keep away and to abstain from evil, killing, stealing, sexual misconduct and falsehood that are all bad evils. It also means to refrain from evil, in thought words and deeds. One should avoid telling words of annoyance to others. Not to disturb others by bad actions and manners; because these actions and words are evils that are harmful and bad.

One should keep and safeguard the reputation of one's generation. One should be conscious of having duty and responsibility to preserve the nobility of one's generation. In this case, the conscious mind is important so that one will think of good - nature, honesty and nobility of his generation.

Then he can be proud of his generation for having noble mind and fine personal qualities. Such generation will abstain from killing, stealing, sexual misconduct, telling lies and ills of others having such good-nature of mind, his generation will be able to observe this *Āratīviratī maṅgala* ,

Majjapāna ca saṃyamo maṅgala - This suggested to abstain from alcoholic drink. Children are always endowed with this auspiciousness. It is required of the whole family to obtain from taking intoxicants. It happened to me once to read a story book. About bad consequences and disadvantages for taking alcoholic drink is written in that book. For the reader's acknowledgment it is hereby submitted.

Once upon a time there was a king who used to take alcoholic drink. He liked meat so much that he could not eat, well if any meat curry was not served him. One day he was embracing his beloved son while taking alcohol. The meat served to him did not include any of the meat dishes.

He was then so angry that he committed killing his own son, for his taste. He ordered his chief to cook it as quality as personable. How sorrow for of him to know that he had killed his own son due to the influence of alcoholic drink. He had to suffer great pain and sorrow only for the death of his son when he was no longer intoxicated. His son who had been killed for his good taste for alcoholic drink will never return to him.

If the king was not drunk, he would not have killed his own son because of his good nature and sympathetic nature of mind. He would protect his son at the risk of his life when anybody attempted to kill him if he well not under the influence of alcohol. Due to the influence of alcohol he had lost his sympathetic mind and became so nervous that he did not know it was his only son of his own blood he had killed for his taste. How sorrowful of this incident! Owing bad influence of alcoholic drink some drunkards bullied not only their beloved wives but also their respectable parents. An alcoholic sometimes dares enough to commit adultery. The auspiciousness of *Majjapāna ca saṃyamo* should be observed and practiced in order to avoid the bad nature of misconduct and evil.

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Appamādo ca dhammesu means not to be negligent in doing good deeds. According to this auspiciousness it is important for a person to be mindful and diligent. Good deeds in this present life should be done regularly and a righteous man should not forget it. Paying homage to our lord Buddha soon after getting up from bed, washing up one's face and combing hair is the obligation of a righteous man who is pious and appreciates the incomparable value of *Buddha, Dhamma* and *Saṃgha*.

Before going to bed one should first pay homage to Buddha and then should radiate his loving-kindness, parents' grandparents, relatives and teachers who have taught him by letting him hear and see because a person is naturally brought up and gradual grown up under the guardianship of his elders. Such action of good deeds is auspicious and conforms to the rule of *Appamādo ca dhammesu maṅgalā*.

7.Blessing Concerning Purification

Gāravo ca *nivāto ca,*
Santuṭṭhi ca kataññutā,
Kālena dhammassavanaṃ,
Etaṃ maṅgala muttamaṃ

Gāravo ca *maṅgala* is paying respect to those who are worthy of respect. In this case one should know the elders who are worthy of respect. Actually parents, grandparent, teachers, Buddhist monks and relatives, who are older in age and greater in dignity are all the people who deserve our respect and obeisance. A person's good and polite action of favoring the elders by allowing them to take his seat, passing by them with his body bowed down, not walking over the elders when they are a sleep are the good and meritorious deeds indicating his respect to them. Those who are not obedient and respectful to their parents and teachers are naturally neglect by their elder because the elders know that such young people will never listen to their words of advice. Those who show their respect to their elders and dignities will be uplifted and heard up.

The young people who are disobedient and disrespectful to the elders will never be successful in the life. The young people who are obedient and respectful to their elders can hear word of advice and wisdom from the elders. So that they will become prosperous in their life as they know the way and method of doing successful business. Moreover, their knowledge is greater and greater so it is auspicious to follow the rule of *Gāravo* ca *maṅgala.*

nivāto ca maṅgala can be defined as being humble or modest. *Nivāta* literally means without air so it is a place which is calm. In modern parlance the meaning of *nivāta* is to keep still, not to be full of pride or be presumptuous. A humble person who appreciates the auspiciousness of *nivāta* will be walking with the head a little bit bowed down.

He will never walk arrogantly. Such a person neither boasts of his qualification and personal possession nor bullies the people who are weak low and live in poverty even though he is wealthy and strikingly good looking. As he abides by the rule of *nivāta* he is naturally humble. Many people love him, cherish him for his modesty. Therefore, being humble in dealing with the people around is auspicious and such a suspiciousness can make his successful prosperous in life.

Santuṭṭhi ca maṅgala is generally translated as contentment. Contentment is the satisfaction of a righteous man who will adapt himself to his environmental situation.

Therefore, his life is peaceful because of contentment. In a person has no contentment and unpleasant. Parents love their children who are content with whatever they have. Being the children who are content, their parents never get annoyed with them. So the auspiciousness of *Santuṭṭhi ca maṅgala* can bring peace and happiness to a family provided that this *maṅgala* is followed and practiced.

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Kataññutā maṅgala is translated as gratitude. So good people are always grateful to their benefactors who are our give them money or help when they are in need of them. Parents are our first and foremost benefactors. They give us cloths to wear, food to eat. Moreover, they trained and admonished us to good and righteous men. They sent to good schools to learn education. Therefore, they should be always remembered in our mind as our benefactors.

They deserve our support and respect as they have been kind and good us. A person who knows the debt of gratitude he owed to his benefactors well one day be prosperous and successful in his life. Our lord Buddha had exhorted. His disciples and pious Buddhist people not forget the debt of gratitude to their benefactors. So we are to pay them off.

Kālena dhammassavanaṃ is translated as listening to the *dhamma* on the suitable occasions. One can get rid of his greed by the *dhamma*. Therefore, if a person is so angry that he willing to kill somebody his better controls himself and clam down his angry mind by listening to *dhamma*.

Only *dhamma* enables an angry person to come to know the consequences of good and bad mind of a person. So the angry person will realize to change his bad mind after deeply considering the intrinsic meaning of *Dhamma*. Gradually he will be conscious of the advantages of bad and good mind. The more he listens to *dhamma*, the better consciousness of mind is greater and greater. Therefore, *Kālena dhammassavanaṃ* is greater auspiciousness.

8.Blessing Concerning Forbearance

Khantī ca Sovacassatā, Khantī ca maṅgala is translated as patience or forbearance. No response to abusive and rude words whenever somebody said and no retort to a person's accusation and challenge are also virtue of patience. Here I would like to cite an example to support this auspiciousness of *Khantī ca*.

Patience is a mother of virtue. If all human beings follow and live in conformity to the *Khantī ca maṅgala*, the world will be a very peaceful global village.

If a person appreciates the value of *Khantī* and depends on the reliability and power of *Khantī ca maṅgala* he will one day become a righteous man and back him up for his brighter future. Therefore, the auspiciousness of *Khantī ca maṅgala* is to be followed and practiced for the welfare of the people living on the earth.

Sovacassatā maṅgala is translated as obedience, it means being amenable to advice given by one's elders. Some children are obedient to their parents, teachers and elders. Whatever they are told they obey it. So, they do not go to the places their parents do not like, they do not go to the places their parents do not like, they do not any work their parents dislike. So, there is no danger and hardship in their life. If is because they behave and act in accordance with the auspiciousness' of Sovacassatā *maṅgala*.

For being obedient and good nature, all the elders love and cherish them. Consequently, they are fed with what they like and are given what they want because of the obedience to parents and elders. In brief, the words of advice by the elders and words of wisdom by Lord Buddha have changed their life to become men of wisdom and reason who are capable of leading our country.

Benefits

Maṅgala sutta is important to develop social organization and Myanmar society. By practicing these doctrines, one can get peace, happiness and success.

Conclusion

The *maṅgala sutta* is now flourishing everywhere to be relied on for the development of social organization. It is clearly seen that whoever abides by and follows the thirty-eight blessings overcomes the difficulties and will gain success and prosperity in the present life as well as in the future life. Therefore, the Myanmar people should never give up their pursuit of *maṅgala*; it is a social, cultural and moral determinant as well as an important goal of life.

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Since man is a social animal, who lives in society, he is responsible for the development of his society as well as his family, friends and relatives, his country and the world. In the social organizations such as Myanmar Red Cross and other social welfare communities and the young people who are doing volunteer work in combating drug abuse, the spread of HIV/AIDS and in prevention of drugs trafficking in our country. With the mighty and strength of these young people, we can resolve social and moral problems in the present time. In resolving these problems *maṅgala a sutta* plays as the foundation for Myanmar society.

Buddha expounded the discourses of *maṅgala sutta* for many *Devas* and human being who are longing for the wellbeing. Today it is still practice and follows by Myanmar social organization. The practice of abiding by the rules of *maṅgala sutta* can bring to the rules of *maṅgala sutta*, the social organization good luck such as and many advantages necessary for the welfare and development.

So the concept of *maṅgala sutta* is important to social organization and Myanmar society. It should be considered and followed by not only the Myanmar society but also every cultural society.

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The Life Stories of Former Buddhas in This Kappa and Some Special Lives of Gotama Buddha who had Received Preordainment form Former Buddhas

Thin Thin Mon[1], San Shwe[2]

Abstract

In this kappa, there will be emergence of five Buddhas and the former four Buddhas, Kakusandha, konāgamana, Kassapa and Gotama Buddhas had already enlightened while the last Buddha, Arimetteyya still remain. The life span for the emergence of Metteyya Buddha will be eighty thousand years. The respective life span for each Buddhas who had already emerged in this kappa are forty thousand years for Kakusandha Buddha, thirty thousand years for Konāgamana Buddha, twenty thousand years for Kassapa Buddha and one hundred years for Gotama Buddha. After the passing away of Vessābū Buddha, through twenty-nine Suññā Kappas (the kappa which Buddhas do not emerge), the time of Bhadda Kappa had reached and the first Buddha, Kakusandha emerged in the life span of forty thousand years and gradually reduced to ten years interval. The reason behind this is the overwhelming of greed and ignorance around the world of beings. After ten years period, the people got regret or remorse and began to practice the moral conducts and to do merits and then the life span was also gradually in ascending trend till Asaṅkheyayya (countless amount). Among the numerous up and down of life span of humans, the emergence of Buddhas can be occurred only in the descending trend between one hundred and one hundred thousand years. In this way, the emergence of Konagamana, Kassapa, Gotama had existed. The Gotama Buddha had been

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preached Dhamma which can lead the beings to Nibbāna through enlightenment for His remaining life span since the great attainment of omniscience. In this study, the brief life stories of the former four Buddhas in this Kappa and some lives of Gotama Buddha who had definite preordainment of former Buddhas are described in order to get knowledge on the custom and affairs of Buddhas.

Keywords: Buddha, life story, lifespan, preordainment

Introduction

In this world in which we are living, there had been four Buddhas and only one Buddha had remained to emerge. The life span for the emergence of last Buddha, Arimetteya, will be eighty thousand years. The titles of Buddhas who had already emerged in this kappa are Kakusandha, Konāgamana, Kassapa and Gotama and the life spans of these Buddhas are forty thousand, thirteen thousand, twenty thousand and one hundred years respectively. Current occasion of Sāsanā of Gotama Buddha is short-lived and the reasons behind this are rareness of people who do charity works, morality and meditation and the overwhelming of greed, hatred and ignorance over the mind of people. The last of Gotama Buddha were preached at time of final passing away and are to be mindfulness on trying for enlightenment as the mental formations are impermanence. Those who want to good in Samsara should heed these precious words of Buddha.

The Buddhas who had enlightened in this kappa

Five types of Kappa (world)

According to descriptions in commentaries, the types of kappa in which Buddhas emerge are five in number and are as follow.

Sāra kappa in which only Buddha emerges
Maṇḍha Kappa in which two Buddhas emerge
Vara Kappa in which three Buddhas emerge
Sāramadha Kappa in which four Buddhas emerge
Bhadda kappa in which five Buddhas emerge.

Current one in which we live is Bhadda kappa and supreme of all types as five Buddhas emerge. The Buddhas who had already emerged in this kappa are Kakusandha Buddha, Konagamana Buddha, Kassapa Buddha, Gotama Buddha and the last Arimetteyya Buddha does not emerged yet. Among the emerged Buddhas, Kakusandha Buddha had emerged in the life span of forty thousand years, Konagamana Buddha in thirty thousand years, Kassapa Buddha in twenty thousand years and Gotama Buddha in one hundred years life spans respectively. These life spans and types of kappas are described in one poem which was written by Venerable Vicittasarabhivamsa who was recorded as the person of world's greatest memory and experts in Tipitakas. The number of Buddha who would be emerge in a kappa can be determined by the earliest sign in the formation processes of a Kappa that is emergence of lotus blossoms and the number indicates that of Buddhas. In this study, the life stories of past four Buddha who had already emerged in this Kappa will be discussed and the first will be the life story of Kakusandha Buddha. The discussion points are from Buddhavaṃsa Pali of Suttanta Piṭaka.

The Life story of Kakusandha Buddha

After passing away of Vessabhū Buddha and end of this kappa, the period of twenty-nine sunna kappas were passed. There was time of Bhadda Kappa in which five Buddha will emerge and the first Buddha in this kappa was Kakusandha. The brief life story of Kakusandha Buddha is as follow;

(1) title of Buddha - kakusandha
(2) Birthplace (capital) - Khemāvadī city
(3) The race or social class - Brahmin
(4) Father's name - Aggidatta Brahmin
(5) Mother's name - Visākhā Brahmin
(6) Bride's name - Rocinī Brahmin

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(7) Son's name - Uttara
(8) The royal buildings - the royal place of Kāma, Kāmavaṇṇa and Kāmasuddhi
(9) The period of practicing Dukkaracariyā - eight months
(10) The vehicle used in great departure - the chariot with eight horses
(11) Chief disciple (male monk) right side - Venerable Vidhura
(12) Chief disciple (male monk) left side - Venerable Sañjīva
(13) Closed disciple (monk) - Venerable Buddhija
(14) Chief disciple (female monk) right side - Sāmā Therī
(15) Chief disciple (female monk) left side - Campā Therī
(16) Layman (most charity works) - Accuta and Sumana
(17) Laywoman (most charity works) - Nandā and Sunandā
(18) Bodhi tree - Lebbeck tree
(19) Height - forty tauns (measurement unit= 18 inches)
(20) The life span of humans - forty thousand years
(21) The place of passing away - the compound of Khema

The Life Story of Koṇāgamana Buddha

After Parinibbana of Kakusandha Buddha, the life span of human beings gradually decreased till to the ten years rate. Again, they had practiced the merits and wholesome things, the life span increased till to countless numbers (Asaṅkhyeyya). The descending trend took place again and the rate of thirty thousand years occurred again. Konagamana Bhodhisatta had practiced ten Paramis (perfections) and had existed in Tusitā Heaven. Due to the apology of nats and Brahmas from ten thousand universes, He took great conception in the womb of Uttrā Brahmini. The brief life history of Konagamana Buddha is as follow.

(1) title of Buddha - Koṇāgamana
(2) Birthplace (capital) - Sobhavatī city
(3) The race or social class - Brahmin
(4) Father's name - Yaññadatta Brahmin
(5) Mother's name - Uttrā Brahmini
(6) Bride's name - Rucigattā Brahmini
(7) Son's name - satthavāha
(8) The royal buildings - Tusitā, Santusita and Santuṭṭha
(9) The period of practicing Dukkaracariya - six months
(10) The The vehicle used in great departure - elephant
(11) Chief disciple (male monk) right side - Venerable Bhiyyasa
(12) Chief disciple (male monk) left side - Venerable Uttra
(13) Closed disciple (monk) - Venerable Sotthija
(14) Chief disciple (female monk) right side - Samuddā Therī
(15) Chief disciple (female monk) left side - Uttarā Therī
(16) Layman (most charity works) - Ugga and Somadeva
(17) Laywoman (most charity works) - Sīvalā and Sāmā
(18) Bodhi tree - cluster fig tree
(19) Height - thirty tauns
(20) The life span of humans - thirty thousand years
(21) The place of passing away - the compound of Pabbata

The Life Story of Kassapa Buddha

After Parinibbana of Konagamana Buddha, the life span of human beings gradually decreased till to the ten years rate. Again, the people had practiced the merits and wholesome things, the life span increased till to countless numbers (Asaṅkhyeyya). The descending trend took place again and the rate of twenty thousand years occurred again. Kassapa Bhodhisatta had practiced ten Paramis (perfections) and had existed in Tusita Heaven. Due to the apology

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of nats and Brahmas from ten thousand universes, He took great conception in the womb of Dhanavadī Brahmini. The brief life history of Kassapa Buddha is as follow.

(1) title of Buddha - Kassapa
(2) Birthplace (capital) - Bārāṇasī city
(3) The race or social class - Brahmin
(4) Father's name - Brahmadatta Brahmin
(5) Mother's name - Dhanavatī Brahimini
(6) Bride's name - Sunanda Brahmini
(7) Son's name - Vijitasena
(8) The royal buildings - Haṃsa, Yasa and Sirinanda
(9) The period of practicing Dukkaracariya - seven days
(10) The vehicle used in great departure - royal palace
(11) Chief disciple (male monk) right side - Venerable Tissa
(12) Chief disciple (male monk) left side - Venerable Bhāradvāja
(13) Closed disciple (monk) - Venerable Sabbamitta
(14) Chief disciple (female monk) right side - Anuḷā devī
(15) Chief disciple (female monk) left side - Uruvelā Theri
(16) Layman (most charity works) - Sumaṅgala and Ghaṭikāra
(17) Laywoman (most charity works) - Vijitasenā and Bhaddā
(18) Bodhi tree - banyan Tree
(19) Height - twenty tauns
(20) The life span of humans - twenty thousand years
(21) The place of passing away - Setabya Garden near Setabya City

The Life Story of Gotama Buddha

After Parinibbana of Kassapa Buddha, the life span of human beings gradually decreased till to the hundred years rate. Gotama Bhodhisatta had practiced ten Paramis (perfections) and had existed in Tusita Heaven. Due to the apology of nats and Brahmas from ten thousand universes, He took great conception in the womb of Queen Mahāmāyā devī. The brief life history of Gotama Buddha is as follow.

(1) title of Buddha - Gotama
(2) the Buddha who gave definite preordainment - Dīpaṅkarā
(3) the life in which received definite preordainment - Hermit Sumedhā
(4) Native city - Kapilavatthu
(5) The last life before great conception - Setaketu in Tusitā heaven
(6) The day of great conception - Tuesday, Full moon day of Waso, 67 SE
(7) The day of great birth - Friday, Full Moon day of Kason, 68 SE
(8) The race or social class - royal family
(9) Father's name - King Suddhodhana
(10) Mother's name - Queen Mahāmāyā Devī
(11) Stepmother's name - Queen Mahāpajāpati Gotamī
(12) Name of layman life - Siddhattha
(13) Bride's name - Bhaddakañcanā
(14) Son's name - Rāhulā
(15) The royal buildings - Ramma, Subha, Suramma
(16) The four great signs - old man, sick man, dead man and monk
(17) The vehicle used in great departure - Royal Horse
(18) The day of great departure - Monday, Full Moon day of Waso, 97SE
(19) The period of practicing Dukkaracariya - six years
(20) The place of practicing Dukkaracariya - Uruvela forest
(21) The time of great enlightenment - dawn after midnight of full moon day of Kason

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(22) The day of delivering first sermon - forest of Isipatana Migadāvun, Bārānasi
(23) The place of delivering first sermon - Saturday, full moon day of Wasa, [illegible]
(24) Chief disciple (male monk) right side - Venerable Sariputtarā
(25) Chief disciple (male monk) left side - Venerable Mahā Moggallāna
(26) Closed disciple (monk) - Venerable Ānandā
(27) Chief disciple (female monk) right side - Khemā Therī
(28) Chief disciple (female monk) left side - Uppalwan Therī
(29) Layman (most charity works) - Citta and Atha
(30) Laywoman (most charity works) - Nandamātā and Uttārā
(31) Bodhi tree - Banyan tree
(32) Height - sixteen taans
(33) The life span of humans - hundred years
(34) The place of passing away - Kusinara Ingyin forest

The Life Stories of Gotama Buddha in term of receiving definite preordainment

Although brief life story of Gotama Buddha had already described, the Bhodhisatta had received definite preordainment since the time of Dipankarā Buddha to that of Kassapa Buddha. Under twenty-four Buddhas, Gotama Bhodhisatta was preordained and these lives are described in brief as follow.

Five Lives of Hermit

There are five life stories that Gotama Bhodhisatta had received preordainment in the life of hermit and are as follow;

(a) the receiving of preordainment under Dipankarā Buddha with the life of Sumedhā Hermit
(b) the receiving of preordainment under Nārada Buddha with the life of Jatila Hermit
(c) the receiving of preordainment under Atthadassi Buddha with the life of Susima Hermit
(d) the receiving of preordainment under Siddhattha Buddha with the life of Maṅgala Hermit
(e) the receiving of preordainment under Tissa Buddha with the life of Sujāta Hermit

Nine Lives of Monkhood

There are nine life stories that Gotama Bhodhisatta had received preordainment in the life of monkhood and are as follow;

(a) the receiving of preordainment under Kondhañña Buddha with the life of King Vijitāvī, universal monarch
(b) the receiving of preordainment under Maṅgala Buddha with the life of Suraci Brahmin
(c) the receiving of preordainment under Sumedhā Buddha with the life of Uttara Brahmin
(d) the receiving of preordainment under Sujāta Buddha with the life of universal monarch
(e) the receiving of preordainment under Phussa Buddha with the life of Vijitāvī universal monarch
(f) the receiving of preordainment under Vessabhū Buddha with the life of King Sudassana
(g) the receiving of preordainment under Kakusandha Buddha with the life of King Khema
(h) the receiving of preordainment under Konāgamana Buddha with the life of King Pabbata
(i) the receiving of preordainment under Kassapa Buddha with the life of Jotipāla Brahmin

Five Lives of Layman

There are five life stories that Gotama Bhodhisatta had received preordainment in the life of layman and are as follow;

(a) the receiving of preordainment under Revata Buddha with the life of Atideva Brahmin
(b) the receiving of preordainment under Sobhita Buddha with the life of Ajita Brahmin
(c) the receiving of preordainment under Padumuttara Buddha with the life of Jatila, the rich man
(d) the receiving of preordainment under Piyadassi Buddha with the life of Kassapa Brahmin
(e) the receiving of preordainment under Sikhi Buddha with the life of King Arindama

Two lives of Dragon

There are two life stories that Gotama Bhodhisatta had received preordainment in the life of dragon and are as follow;

(a) the receiving of preordainment under Sumana Buddha with the life of Atula Dragon King

(b) the receiving of preordainment under Vipassī Buddha with the life of Atula Dragon King

Separate lives

There are three separate lives that Bhodhisatta had received preordainment from respective Buddhas and are as follow;

(a) the receiving of preordainment under Dhammadassī Buddha with the life of Sakka, the celestial King

(b) the receiving of preordainment under Anomadassī Buddha with the life of Ogre commander

(c) the receiving of preordainment under Paduma Buddha with the life of Lion King.

The respective lives and their numbers are composed in some poems by ancient scholars and the total number of lives is twenty-three.

Discussion and Conclusion

The world in which we encounter is called as Bhadda Kappa and five Buddha would emerge in this type of world. The life span of emergence of Buddhas is between hundred thousand and one hundred years. There is only one Buddha to emerge and the last enlightened Buddha is Gotama whose life span is one hundred years. Due to the period of Buddha Sasana is 2564 years which is counted since the year of passing away of Gotama Buddha, the lifespan of humans is said to be in 75 years. Ignorance and greed influence the mind of global community for individual prosperity and benefits in terms of wealth and physical properties and therefore, the trend is moving towards the negative and descending pathway gradually. The natural disasters, pandemic diseases such as Covid-19 and world wars had been threatening most of the countries in this world and the life span of humans is reducing gradually. This might reach to the ten years trend. By getting the comprehensive knowledge on these situations through the study on life stories of Buddha can enhance the consideration on doing of merits, preserving moral conducts and attainment of insight.

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The *Shwe Kyaungdawkyi* in Mandalay that Captures Tourists' Attraction

Htwe Htwe Kyaw[1], Thin Thin Mon[2]

Abstract

The *Shwe Kyaungdawkyi* is located in Dawnabwa ward, Aungmyaythazan Township, Mandalay. It is a two-storeyed teak building that has been built since the Yadanabon Era. In this building, there are many sculptures depicted. It can be found that both the outside and inside of *Shwe Kyaungdawkyi* are delicately adorned with intricate wood carvings from wooden pillars under the building and the floors outside the building to its roof. This paper aims to find out the significant factors which attract most of the tourists who visit the Shwe Kyaungdawkyi in Mandalay. It contains why this is an important place and why tourists are very interested in the *Shwe Kyaungdawkyi*. Because the *Shwe Kyaungdawkyi* is inspired by the ancient culture, and Jātaka sculptures remain there, the *Shwe Kyaungdawkyi* becomes a tourist attraction nowadays. Moreover, ancient Myanmar's wonderful handicraft is famous not only among locals but also across the world. Therefore, tourists are coming to study the artful sculptures day by day. The *Shwe Kyaungdawkyi* can investigate from the point of view of Tourism in Buddhist Art and Architecture. Furthermore, it also describes the *Shwe Kyaungdawkyi* can be seen from historical, cultural, and religious points of view. In this research, the data were collected by using available information, library research, and field research. Moreover, historical and analytical methods were used to get data. This paper will provide a part of the cultural heritage in Myanmar to learn and promote the Buddhist Art and Architecture sectors, to help the improvement of the tourism industry. The more tourism develops, the higher the foreign currency will grow and the more local people will have opportunities for jobs and business.

Keywords: Buddhist Art and Architecture, ancient culture, artful sculptures, tourists' attraction, tourism industry.

Introduction

Mandalay is an economic, political, religious, and cultural center. There are many ancient and historical buildings and edifices around Mandalay. It is one of the cities where Myanmar culture is still thriving. It is located at the focal point of the economy in Upper Myanmar. Mandalay is also the last royal city of the ancient Myanmar kings. Just as it is a city that is at the strategic point of commerce, administration, and economy, it is also located at the focal point of land routes to communicate with foreign countries. As there are lots of traditional cultural works of art, ancient buildings, and famous pagodas, foreign visitors are visiting Myanmar to study them. This paper especially presents the *Shwe Kyaungdawkyi* as the ancient religious structures and sculptures that attract tourists.

Materials and Methods

For this research paper, most parts of the data were collected from the Chronicle texts, the records from the Archaeology Department in Mandalay, field studies and interviews of the Tourists and Tour guides, etc. and by using demonstrative and descriptive methods. The materials used in the paper are also taken from Internet data, and other works.

Location and Area of the *Shwe Kyaungdawkyi*

The *Shwe Kyaungdawkyi* is located in *Dawnabwa* ward, *Aung-myay-thazan* Township, Mandalay. To the east of the Shwe *Kyaungdawkyi* is 62nd street and the State *Pariyatti Sāsana* University, in the west lies the *Atumashi* Monastery, in the South, *Yaythwin Chaung* (creek) and in the North other monasteries.[3] This monastery has 10 feet from the ground to the first floor and 116 feet in length, 71 feet in breadth. The length of the enclosure wall of this monastery is 339-feet (from South to North), 190-feet (from East to West).[4]

History of the *Shwe Kyaungdawkyi*

Formerly the *Shwe Kyaungdawkyi* was used to be the *Shwe-nandaw* Chamber that stood in the North of *Mya Nan San Kyaw* Glass Palace. It was once one of the chambers in the

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[3] Myanmar Ancient Monasteries, p-141; The Record of Ancient Building, p-42.
[4] Survey, from (30.4.2016) to (21.5.2016).

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Mya Nan San Kyaw Palace. During his reign, he had separately built it and resided there. The vacant place to the west of the tea chamber in the *Mya Nan San Kyaw* Palace is the site on which the *Shwe Kyaung* once stood.[1] It has a three-tiered roof and was decorated in detail both inside and outside. Moreover, this was the place where the king's personal properties were kept and also served as the king's cloakroom and sleeping room. This was also the place when the king administered state affairs and religious affairs, consulting with the ministers. While the king was dwelling in this building, he passed away on the 6th waxing day of *Thadingyut*, 1240 (B.E), 1st October 1878 AD.[2]

King *Thibaw* had the building, *Shwe-nandaw*, dismantled and reconstructed near the eastern gate in the compound of the *Mahā Atula Vijayārāma* monastery.[3] Then he donated it to *Shwe-nandaw* which became a monastery. At that time the five monks resided there. Now, there is not any monk in this monastery. This is the only building that escape from the wrath of war[4]. Since 1995, it has been taken care by Department of Archaeology and as a National Museum, Ministry of Culture.

The Buildings of the *Shwe Kyaungdawkyi*

The *Shwe Kyaungdawkyi* is an epitome of *Yadanapon* in the later *Konbaung* Dynasty. Originally, it was a separate chamber where king *Mindon* used to reside and it was gilded all over; therefore, it earned the title the *Shwe-nandaw Kyaung* or the *Shwe Kyaung*.[5] It is a two-storeyed building; it is made of teak. There are three chambers upstairs: (1) *Zetawun Saung*[6], (2) *Sanu Saung*[7], and (3) *Saung-ma-gyi* (or) *Main Saung*[8]. But this monastery has not *Kyaunoo pyathad Saung* and *Bawga* Saung (storeroom). The monastery is made up of 15 pillars from east to west and 10 from south to north, 150 altogether.

Architectural Work Set of the *Shwe Kyaungdawkyi*

The *Shwe Kyaungdawkyi* is the place that comes in contact with the public and it is the center where social, educational and religious affairs involve. As it is a religious building, it assumes a unique and holy feature. There are 36 outer teak pillars with measurements of 3 feet and 7 inches in circumference and these pillars are decorated with *Naya* (a mythical animal) figures which are 5 feet and 4 inches in height and bat wings for those pillars to prop. Because of these *Naya* (a mythical animal) figures and bat wings, they are graceful and magnificent. Each of the 36 pillars is propped by a *Naya,* and the four pillars in four corners are propped by 2 or 3 *Naya* figures; thus, there are 42 *Naya* figures in the whole monastery. There are five flights of stairs with *Thayetkin* (mango buds).[9]

At the bottom of the pillars are marble plinths and on top of the rails are capped with bell-shaped marble to protect from the rainwater. Another slanting roof under the three-tiered roof is *Sapyin*. As it is floored far to the end of the stairway outside the walls under the *Sapyin*, there is a corridor around the monastery.

The entire floor is of teak that is 2 inches thick. On the verandah at the brick stairway is the water-outlet that was carved in the form of the head of a Makara (mythical sea monster). There are 38 doors that are not hinged, but on both sides of each door are the holes through which the rods may be put to serve as hinges.

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[1] King Mindon, p-53; Today Mandalay, p-45.
[2] 100 Years of Mandalay, p-104-5; U Mg Mg Tin (MA), 1892, p-201-2; The Great Chronicle of Kaung-baung(3rd Edit), p-406; King Mindon, p-114-6.
[3] The Latest Kong-baung Monasteries, p-141; Bithu, p-18-9; 150 Years of Mandalay Magazine, p-101.
[4] Myanmar Ancient Monasteries, p-289; The Record of Ancient Building, p-43.
[5] Bithu, p-18.
[6] Bithu, p-19.
[7] The Record of Ancient Buildings, p-43.
[8] Bithu, p-21.
[9] Bithu, p-19-20; The Record of Ancient Buildings, p-43.

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Despite the Golden Palace Monastery being built by King *Thibaw*, unlike other monasteries of the *Konbaung* Dynasty, neither *Pyathat Saung* nor *Bhoga Saung* was included. The palace chamber of King *Mindon* has cleared away and the main building was transformed into a monastery.[1]

The *Jātaka* Sculptures at *Shwe-nandaw Kyaung*

Kun-sin-ting (any of the six highest posts of the main part of a building erecting posts for constructing a building)[2], stands are situated and the sculptures of 10-great birth stories of the Buddha; (1) *Temiya Jātaka*[3], (2) *Mahājanaka Jātaka*[4], (3) *Suva¼¼asāma Jātaka*[5], (4) *Nemi Jātaka*[6], (5) *Mahosadha* (or) *Umaṅga Jātaka*[7], (6) *Bhūridatta Jātaka*[8], (7) *Candakumāra Jātaka*[9], (8) *Mahānāradakassapa Jātaka*[10], (9) *Vidhūra Jātaka*[11], (10) *Vessantarā Jātaka*[12], (11) *Mahāpaduma Jātaka*[13], (12) *Utena Jātaka*[14], and (13) renunciation of the Buddha[15] are depicted on these stands.

These sculptures have 6-feet and 4-inches in length, 3-inches in thickness, and floral designs are decorated on the background made of teak.

The Two Main Purposes of Decorating Buddhist Monasteries

There are two main purposes of decorating Buddhist monasteries, rest-houses, and other similar religious buildings with floral and sculptural art depicting varieties of *Jātaka* stories. The first purpose is to create a decoration for an attractive design. The second is to share Buddhist's teachings by the imagery of *Jātaka* stories not only for knowledge but also for inspiration.

Tourist Attractions in the *Shwe Kyaungdawkyi*

Many tourists visit the *Shwe Kyaungdawkyi* because this monastery is the finest example of ancient Myanmar art and architecture and sculptures. As it is the monastery donated by the king, the outer corridor is walled which is decorated in Myanmar style with floral motifs, embossed flowers, and frescos. The walls inside and outside are decorated with embossments, scenes from *Jātaka*, gilded pillars, fresco ceilings, bat wings, and four *Catulawkapāla Nats* flunked with fresco and stems of water lily, *nat* figures, *karaweik* bird, peacock, flying *naya, garuḍa* and *haµsa* birds. There are double sculptured figures on the flaps of doors at the end of the *thayatkin* stairs.

The outer walls of the monastery are systematically made squares on which there are decorated figures. The figures are winged human beings, dancers, *zawgyi* (necromancers), ogres, *nats*, ministers, pageboys, and monkeys. As these figures have been weathered and suffered from erosion, some parts of them are broken and missing. In the past they were gilded but now they have been dimmed. However, some frescos under the gutters and ceilings inside the monastery and pillars still have original golden glint.

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[1] Pyathard, p-27.
[2] Dictionary of Ancient Myanmar Historical Terms, p-21.
[3] No. 538, J. II, p-149-159; JA. VI, p-1-37; Sarinkye, p-113-114.
[4] No. 539, J. II, p-159-174; JA. VI, p-39-48; Sarinkye, p-179.
[5] No. 540, J. II, p-174-184; JA. VI, p-85-117; Sarinkye, p-264-265.
[6] No. 541, J. II, p-184-203; JA. VI, p-119-162; Sarinkye, p-138;
[7] No. 542, J. II, p-204-221; JA. VI, p-163-332; Sarinkye, p-174-177.
[8] No. 543, J. II, p-221-242; JA. VII, p-1-70; Sarinkye, p-162-163.
[9] No. 544, J. II, p-242-256; JA. VII, p-71-104; Sarinkye, p-88.
[10] No. 545, J. II, p-257-275; JA. VII, p-105-149; Sarinkye, p-135.
[11] No. 546, J. II, p-275-311; JA. VII, p-151-240; Sarinkye, p-217-219.
[12] No. 547, J. II, p-312-378; JA. VII, p-241-387; Sarinkye, p-224-226.
[13] No. 472, J. II, p-253-254; JA. IV, p-188-197; Sarinkye, p-180.
[14] DhA. I, p-103-147.
[15] BuA. p-7.

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Outer walls are decorated with 142 figures on the East, 147 figures on the West, 253 on the South, 148 on the West, 166 on the partition, 473 figures of dancing peacocks, 184 on the inner walls, 129 on the board band, 7 on the two-sided door of *Thayetkin* stairs and there are 1749 in total. Various figures of birds are sculptured in floral squares glittering on ceilings inside of the *Shwe Kyaungdawkyi*. An image of Buddha can be seen in *Bhūmiphassa Mudrā* sitting on the *Aparājita* throne surrounded by traditional decorations of the thrones such as *Nat-shrine, U Kin*-uppermost apart, *and Tanke* (backdrop). Emerald-colored posts with a round surface made in *Yadanabon* Mandalay Period can be found under protection. According to tourists, the purpose of their visit is to view ancient buildings and architecture.

Various decoration works of art in the *Shwe Kyaungdawkyi* were created by professional painters, sculptors, goldsmiths, blacksmiths, and stonemasons. It is entirely built of wood, and different floral and figurative wooden sculptures are found everywhere from the foundation posts to the roofs. It reveals Myanmar's traditional art and architecture.[1] Tourists are always amazed at the sight of the ancient architecture of the *Shwe Kyaungdawkyi*.

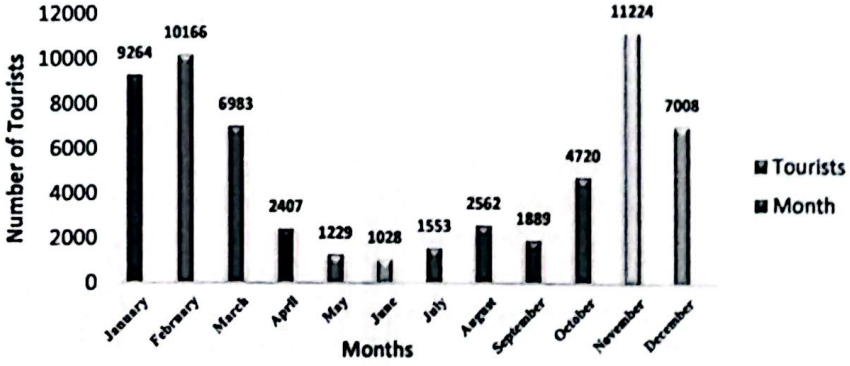


Figure (1) International Tourist Arrival at the *Shwe Kyaungdawkyi* in Mandalay During 2015
Source: Department of Archaeology at the *Shwe Kyaungdawkyi* in Mandalay (2015)

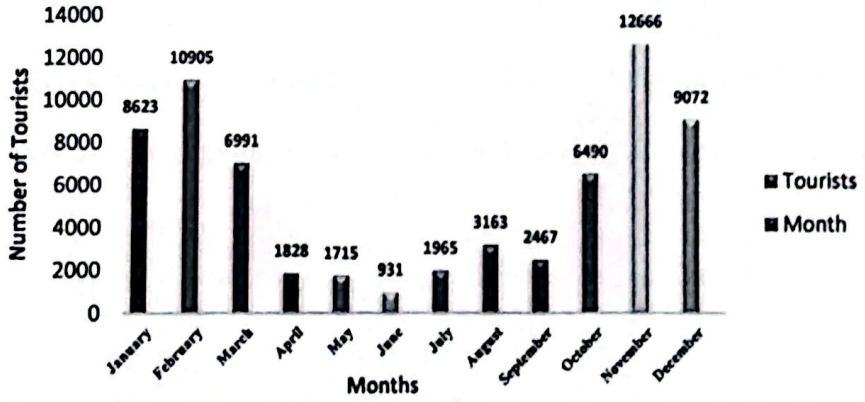


Figure (2): International Tourist Arrival at the *Shwe Kyaungdawkyi* in Mandalay During 2016
Source: Department of Archaeology at the Shwe Kyaungdawkyi in Mandalay (2016)

[1] Bithu, p-27; Survey, from 30.4.2016 and 21.5.2016.

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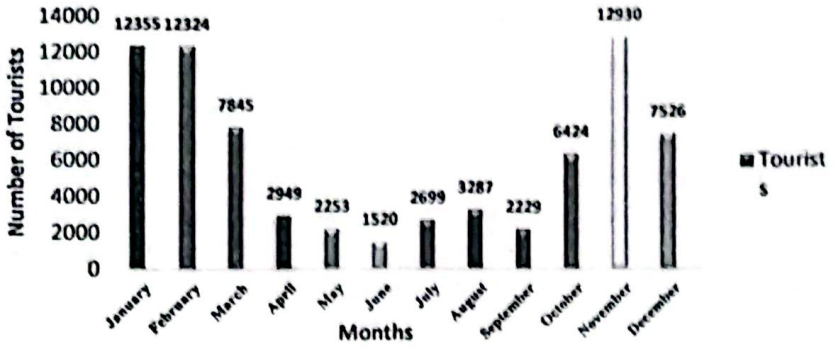


Figure (3): International Tourist Arrival at the *Shwe Kyaungdawkyi* in Mandalay During 2017
Source: Department of Archaeology at the Shwe Kyaungdawkyi in Mandalay (2017)

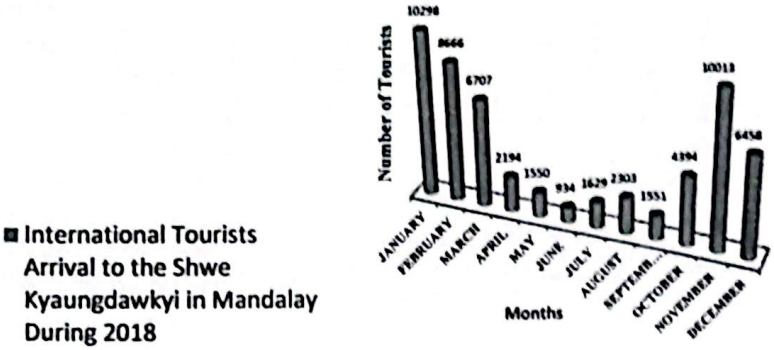


Figure (4): International Tourist Arrival at the *Shwe Kyaungdawkyi* in Mandalay During 2018
Source: Department of Archaeology at the Shwe Kyaungdawkyi in Mandalay (2018)



Figure (5): International Tourist Arrival at the *Shwe Kyaungdawkyi* in Mandalay During 2019
Source: Department of Archaeology at the Shwe Kyaungdawkyi in Mandalay (2019)

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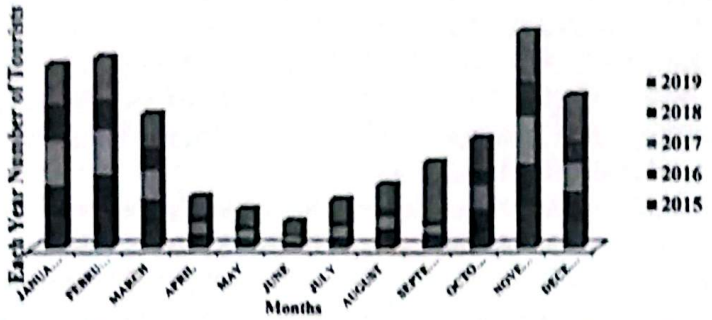


Figure (6) Comparison of International Tourists Arrival at the *Shwe Kyaungdawkyi* in Mandalay During 2015 to 2019
Source: Department of Archaeology at the Shwe Kyaungdawkyi in Mandalay (2019)

Finding and Discussion

The present research focuses on the seven famous religious buildings in Mandalay from the Buddhist Art and Architecture, and Tourism Points of View by using a framework of the International Tourist arrival at *Shwe Kyaungdawkyi* during 2015, 2016, 2017, 2018 to 2019. It was surveyed in the first week of every month in these periods. Based on the data analysis, the data of tourist arrival during twelve months (from January to December) was found at the *Shwe Kyaungdawkyi*. The overall data of description found in the *Shwe Kyaungdawkyi* can be seen in the table below and it was surveyed in the first week of every month in these periods.

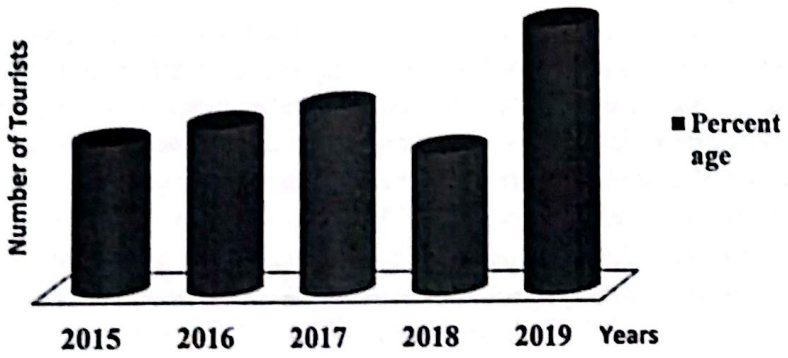


Figure (7): Comparison of the International Tourist arrival at the Shwe Kyaungdawkyi in Mandalay During 2015 to 2019
Source: Department of Archaeology at the Shwe Kyaungdawkyi in Mandalay (2019)

According to the table above, it can be seen that international tourists arrived at this Buddhist cultural building among the religious buildings. 2019 is the most frequent arrival of tourists at the *Shwe Kyaungdawkyi* with total 107580 tourists out of 365469 tourists. It can be observed that in 2019, 29.43% of total tourists visited the *Shwe*

Kyaungdawkyi. It was found that 11130 international tourists visited these places in January, 11657 tourists in February, 9138 tourists in March, 4971 tourists in April, 4085 tourists in May, 3192 tourists in June, 5748 tourists in July, 6506 tourists in August, 15969

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tourists in September, 8730 tourists in October, 13838 tourists in November and 12616 tourists in December respectively.

2017 is the second most frequent arrival of tourists at the *Shwe Kyaungdawkyi* with total 74343 tourists out of 365469 tourists. It can be observed that in 2017, 20.34% of total tourists visited the *Shwe Kyaungdawkyi*. It was found that 12355 international tourists visited these places in January, 12324 tourists in February, 7845 tourists in March, 2949 tourists in April, 2253 tourists in May, 1520 tourists in June, 2699 tourists in July, 3289 tourists in August, 2229 tourists in September, 6424 tourists in October, 12930 tourists in November and 7526 tourists in December respectively.

2016 is the third most frequent arrival time of tourists at the *Shwe Kyaungdawkyi* with total 66816 tourists out of 365469 tourists. It can be observed that in 2016, 18.30% of total tourists visited the *Shwe Kyaungdawkyi*. It was found that 8623 international tourists visited these places in January, 10905 tourists in February, 6991 tourists in March, 1828 tourists in April, 1715 tourists in May, 931 tourists in June, 1965 tourists in July, 3163 tourists in August, 2467 tourists in September, 6490 tourists in October, 12666 tourists in November and 9072 tourists in December respectively.

2015 is the fourth most frequent arrival time of tourists at the *Shwe Kyaungdawkyi* with total 60033 tourists out of 365469. It can be seen that in 2015, 16.43% of total tourists visited the *Shwe Kyaungdawkyi*. It was found that 9264 international tourists visited these places in January, 10166 tourists in February, 6983 tourists in March, 2407 tourists in April, 1229 tourists in May, 1028 tourists in June, 1553 tourists in July, 2562 tourists in August, 1889 tourists in September, 4720 tourists in October, 11224 tourists in November and 7008 tourists in December respectively.

According to the data, the international tourists visited the *Shwe Kyaungdawkyi* the least with 56697 tourists out of 365469. It can be seen that in 2018, 15.51% of total tourists visited the *Shwe Kyaungdawkyi*. It was found that 10298 international tourists visited these places in January, 8666 tourists in February, 6707 tourists in March, 2194 tourists in April, 1550 tourists in May, 934 tourists in June, 1629 tourists in July, 2303 tourists in August, 1551 tourists in September, 4394 tourists in October, 10013 tourists in November and 6458 tourists in December respectively.

From tourism point of view, it can be assumed that the majority of tours coming to Myanmar are to visit to the ancient Myanmar cultures or Buddhist cultures. According to the saying of tourist guides, almost 100 percent of foreigners who come to Mandalay, visit to *Mahāmuni* image. Especially, they visit there in the time of face washing ceremony, fanning by flowers fan and donating the *cetiya* of flowers. Besides, the sculptural and gold plate places are usually visited by many foreigners. They usually visit Royal Palace, Golden Palace Monastery, *Mahāatulawaiyan(Atumashi) Kyaung*, *Mahālokamārajin pagoda*, *Mahādhammikārāma Shwe-kyin* monastery, *Dutiya Shwe-In-Pin* monastery and Mandalay hill. The ancient statues and Buddhist cultural buildings can also be studied. The culture can also be assessed according to the history of images. As some of architecture designs of the pagodas are very ancient, especially, they attract people from different countries. The visitors study the decoration of the ancient arts and the significance things which have been used.

Therefore, the number of Tourists increased every year, with the aim of observing many Buddhist cultural arts, Myanmar cultural arts found at the Buddhist cultural buildings. Buddhist cultural tourism helps foreign currency to the country. It helps increase our country's GDP. Those foreign visitors come to study many Buddhist cultural arts in the famous Buddhist cultural buildings. It is the duty of every citizen to safeguard and protect the ancient buildings as our cultural heritage. These ancient buildings should be recognized as world heritage. In this way, Myanmar's country will be more and more developed.

These buildings are providing foreign incomes for the country since there are 4.5 million domestic travelers and foreign tourists who are studying the ancient buildings and

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pagodas. Therefore, the aims of this paper are to safeguard the ancient buildings as the country's treasures and regard them as world heritage, world monuments, and world memories.

Conclusion

The *Shwe Kyaungdawkyi* in Mandalay was built in *Kong-baung* Period. It is an ancient building, 150 years old. From the archaeological point of view, this paper presents a place of cultural heritage that is regarded as a world monument. From the Myanmar artist's point of view sculpture and many other handicrafts are found to have been developed. From the Buddha's cultural point of view, mudrā and āsana of the Buddha images, the structures of the spire, the inscriptions of the three Piṭakas, and paintings of ten stories of Buddha's previous lives are found there. So, this is a monument of cultural heritage.

In Architecture, there are two buildings with (*apyauk amhune*) namely, *nanpyauk* and *kyaungpyauk*. In a construction palace or royal house, only (thirty different floral and figurative wooden sculptures) can be made. And the sculpture of humans and animals are prohibited because the palace is glory.

The (*Kyaungpyauk*) which is found in the monastery is not only of the floral designs but also of the illustration of human, deity, *Sakka, kinnarī, kinnarā* and peacock, *haṃsa, garuḍa*, etc; and other suitable sculptures in the great ten birth stories of the Buddha, the illustrations come for five hundred and fifty *Jātaka*. Especially these are illustrated in (*Durins*), (*asaws*) and (*tawranaungs*). It may be regarded as decoration to be the glory.

According to a social point of view, there is a custom of human standard classification. The King's permission adds decoration to the building. And it may be regarded thus the differences of decoration depends on the finical cause and caste system. The decoration of the Golden Palace Monastery is more than that of Shwe-In-Pin Monastery. Therefore, it may be assumed; that ancient Myanmar artists were experienced artists.

Wooden sculptures are found at the *Shwe Kyaungdawkyi*. The sculptures of high standards, culture, and different periods can also be seen. Buddhist sculptures are the visual guidelines for the people to have good virtue and Buddha's teaching. Moreover, the moral lesson can be gained by looking at the Buddhist sculptures, especially for the illiterate and foreigners. This paper discusses Myanmar's cultural (Buddhist culture) heritage which should be world-famous.

The development of tourism brings the opportunity for jobs, the economy, and exchanging knowledge. Therefore, every citizen needs to protect these heritages of Buddhist cultural values. All should be careful not to destroy trees and forests, not to cut them, to throw rubbish into the dustbins systematically, and to travel with ease without destroying the natural resources and the beauties of nature. Moreover, Myanmar citizens should be careful about preventing civil war. The worse climate condition and the civil crisis may cause a decrease in tourists. So, all are responsible for safeguarding the historic works of arts in the *Shwe Kyaungdawkyi* where many tourists around the world are interested.

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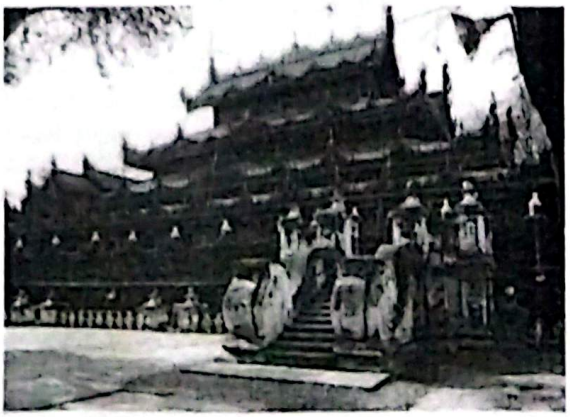
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The Wooden Sculptures, Floral Designs and Thayatkin Stair in the *Shwe Kyaungdawkyi*



The Wooden Sculptures, Floral Designs and Thayatkin Stair in the *Shwe Kyaungdawkyi*

Phytochemical Constituents, Nutritional Values, Vitamin-C Contents and Elemental Analysis from the Fruit of *Hylocereus undatus* Haworth

Nyan Htun[1]

Abstract

In this research, the fresh dragon fruits were collected from San Pya Quarter, Kyaukpadaung Township in Mandalay Region. Firstly, phytochemical screening of the dragon fruit showed the presence of alkaloid, carbohydrate, flavonoid, glycoside, phenolic compound, reducing sugar, saponin, steroid, tannin and terpene by usual method. Then, the nutritional values of *Hylocereus undatus* Haworth fruits were investigated. Moisture and ash contents were determined by using oven drying method and muffle furnace method. Fat content was investigated by Soxhlet extraction method. Protein and fibre contents were evaluated by using AOAC method. In addition, vitamin-C content of *Hylocereus undatus* Haworth fruits was examined by iodometric titration method. Furthermore, elemental composition of fruit sample was performed by Energy Dispersive X-ray Fluorescence Spectroscopy (EDXRF) method.

Keywords: *Hylocereus undatus* Haworth, phytochemicals, nutritional values, vitamin-C, elemental composition

Introduction

Herbal medicine has become an integral part of standard health care, as they are used both traditionally as well as in ongoing scientific research. Herbal medicines are riched in natural substances that can be promote health. The *Hylocereus undatus* is also known as dragon fruit belonging to family Cactaceae. Now, the fruit crops widely cultivated in Southeast Asian countries (Britton, *et al*., 1937). In Myanmar, dragon fruit plants grow well and become a promising crop. Growing areas of this fruit in Myanmar are found in Popa, Nyaung Oo, Kyaukpadaung, Pakokku, Meiktila, Heho, Naungcho, Aungban, Kyaukmae, Taunggyi, Nay Pyi Taw. It is commercially produced in other areas by private growers. So, the future, it could find its way to international market if the growing areas could be extended for production of quality produces (Nwe, 2014).

Hylocereus undatus Haworth is a perennial climbing cactus with green stems and it grows in tropical and subtropical countries. They are epiphytic or hemi epiphytic in nature (Barbeau, 1990). The fruits have delicate and sweet flesh with intense white color of the flesh and red-purple color of fruits extract. The fruits often consumed fresh or make into juices, jams and ice cream, sherbets, yogurt, candy and pastries (Nurul, *et al*., 2014). Commonly, nutrients are those substances which have health promoting as well as health protective activity. The nutrients can be divided into two types; macro nutrients and micro nutrients. Macro nutrient contains protein, carbohydrate, lipid or fat and crude fibre. Moreover, micro nutrient consist of different minerals, vitamins, antioxidants etc., (Halliwell, *et al*.,1999).

The fruit pulp is an edible part of dragon fruit. It is generally used in fruit salad and is a natural source of antioxidants. The flesh of dragon fruit is mildly sweet, low in calories and contain high amount of vitamin C and antioxidant. It has gained more attention due to its health benefits including prevention of memory losses, prevention of cancer, control of blood glucose level in diabetic patients, etc. In addition, it has the ability to promote the growth of probiotics in the intestinal tract (Zainoldin, *et al*., 2009).

Botanical Description of Plant

Botanical name : *Hylocereus undatus* Haworth
Family name : Cactaceae
English name : Dragon fruit (white)
Myanmar name : Nagamouk
Part used : Fruit

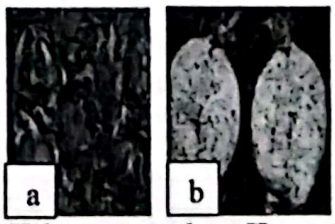


Figure 1. (a) The fruit of *Hylocereus undatus* Haworth
(b) Longitudinal section of fruit of *Hylocereus undatus* Haworth

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Materials and Methods

Materials

Chemically available reagent and solvents were used. They were purified by sample distillation before using in experiment. Common laboratory apparatus and equipment were used throughout the course of the research work.

Sample Collection

The fruit of *Hylocereus undatus* Haworth was selected for chemical analysis. The fresh dragon fruits were collected from San Pya Quarter, Kyaukpadaung Township in Mandalay Region. They were cleaned and stored in a fridge or other cool, dry place. Then the raw materials were ground with blender and used throughout the experiment.

Methods

Phytochemical Screening on the Fruit of *Hylocereus undatus* Haworth

The phytochemical tests were carried out at Department of Chemistry, to detect the different kinds of chemical constituents in the fruit sample. Phytochemical screening of the fruit sample was done by usual method (Harborne, 1973). The phytochemical tests were carried out on the sample extract with a view to investigate the presence or absence of alkaloid, carbohydrate, flavonoid, glycoside, phenolic compound, reducing sugar, saponin, steroid, tannin and terpene.

Determination of Nutritional Values of Fruit of *Hylocereus undatus* Haworth

The fruit of *Hylocereus undatus* Haworth were measured their nutritional values such as moisture, ash, protein, fat, fiber,carbohydrate and energy value at the Small Scale Industries Department, Ministry of Agriculture, Livestock and Irrigation, Yangon. The nutritional compositions of fruit sample such as moisture and ash contents were determined by using oven drying method and muffle furnace method. Fat content was investigated by Soxhlet extraction method. Protein and fiber contents were determined by using AOAC method.

Investigation of Vitamin-C Content of Fruit of *Hylocereus undatus* Haworth

The vitamin-C content of the fruit of *Hylocereus undatus* Haworth was examined by iodometric titration method. In this titration, potassium iodide, sulphuric acid, ascorbic acid, starch indicator and distilled water were used. Sample solution was absorbed by 25 mL of pipette and it was transferred into a 250 mL conical flask. And then 10 drops of starch indicator solution was added conical flask contain sample solution. This solution was titrated with iodine solution (0.001 N). The solution become deep green, process of analyzing vitamin-C content of the sample completed. This analysis was repeated three times for a sample. Finally, the vitamin-C content of the sample could be calculated.

Determination of Elemental Composition

The elemental composition of the fruit of *Hylocereus undatus* Haworth was determined by using Energy Dispersive X-ray Fluorescence Spectroscopy (EDXRF) method at Department of Chemistry, Monywa University.

Results and Discussion

Phytochemical Screening of the Fruit of *Hylocereus undatus* Haworth

The results of the phytochmical screening from the fruit of *Hylocereus undatus* Haworth was shown in Table 1.

Table 1. Results of Phytochemical Screening of the Fruit of *Hylocereus undatus* Haworth

Sr. No.	Test	Reagent used	Observation	Result
1	Alkaloid	(i) Mayer's reagents (ii)Wagner's reagents (iii) Dragendorff's	White ppt Brown ppt Orange color	+ + +
2.	Carbohydrate	10 % α-naphthol and conc: H_2SO_4	Red ring	+
3.	Flavonoid	Conc: HCl and Mg turnings	Brown colour	+

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4.	Glycoside	10 % NaOH solution and 10 % Lead acetate	Yellow ppt	+
5.	Phenolic compound	1 % $FeCl_3$ solution	Blue colour	+
6.	Reducing sugar	Benedict's solution	Red ppt	+
7.	Saponin	Shaken vigorously	Permanent froth	+
8.	Steroid	Acetic anhydride and conc: H_2SO_4	Brown colour	+
9.	Tannin	Lead acetate and 1 % $FeCl_3$solution	Bluish green ppt	+
10.	Terpene	Chloroform and conc: H_2SO_4	Yellowish green colour	+

(+) = Presence; (–) = Absence; (ppt) = precipitate

According to this table, the fruit of *Hylocereus undatus* Haworth contained alkaloid, carbohydrate, flavonoid, glycoside, phenolic compound, reducing sugar, saponin, steroid, tannin and terpene respectively. The phenolic compound, flavonoid and tannin are major contributors to antioxidant activity. Alkaloids, flavonoid, saponin, steroid, tannin and terpene play a major role as anti-inflammatory effects.

Hence, the fruit of *Hylocereus undatus* Haworth indicated that such bioactive compounds which have benefits to human health.

Nutritional Composition of Fruit of *Hylocereus undatus* Haworth

The nutritional values of *Hylocereus undatus* Haworth were described in Table 2 and shown in Fig. 2. The observed values of fruit sample contain nutritions which can be very effective to health.

Table 2. Results of Nutritional Composition of Fruit of *Hylocereus undatus* Haworth

Sr. No.	Parameter	Content
1.	Moisture	89.42 %
2.	Ash	0.73 %
3.	Protein	0.94 %
4.	Fat	0.04 %
5.	Fibre	1.24 %
6.	Carbohydrate	9.92 %
7.	Energy	43.71 kcal

According to results, the nutrients such as moisture, ash, fat, fibre, protein and carbohydrate were present in the fruit of *Hylocereus undatus* Haworth. The moisture content was high by measuring oven drying method. The amount of ash was also medium indicating total mineral elements in this sample. Moreover, the fruit sample contain fiber, this could be beneficial when consumed. In addition, the results show that the fruit samples are good sources of carbohydrate and protein. The main factor of nutritional values is energy. These may serve as source energy and nutrients for the body metabolic activity in addition to its medicinal properties.

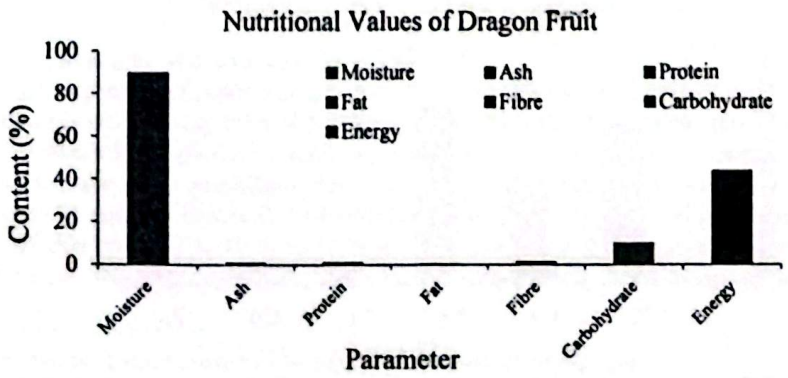


Figure 2. Histogram of the nutritional values in *Hylocereus undatus* Haworth

Vitamin-C Content in the Fruit of *Hylocereus undatus* Haworth

The dragon fresh fruit are good source of vitamin-C. The fresh juice sample vitamin-C content was determined by iodometric titration method. These resultant data is shown in Table 3.

Table 3. Result of Vitamin-C Content in Fruit of *Hylocereus undatus* Haworth

Test sample	Content (mg/100 g)
Fruit of *Hylocereus undatus* Haworth	11.23

According to Table 3, vitamin-C content of the fruit of *Hylocereus undatus* Haworth is found to be 11.23 mg/100 g. Vitamin-C is the most important mainly found in fruits and vegetables. Vitamin-C is an essential nutrient that plays a vital role in protecting the body from diseases. Vitamin-C is one of many antioxidants. Moreover, vitamin-C is also known as ascorbic acid and necessary for the growth, development and repair of all body tissues.

Elemental Analysis of *Hylocereus undatus* Haworth

The elemental composition of the fruit of *Hylocereus undatus* Haworth were determined by EDXRF spectrometer. The resultant data are presented in Table 4 and described in Fig. 3.

Table 4. Results of Elemental Composition in Fruit of *Hylocereus undatus* Haworth

Sr. No.	Element	Symbol	Relative abundance (%)
1.	Potassium	K	9.12
2.	Calcium	Ca	5.75
3.	Sodium	Na	10.42
4.	Iron	Fe	0.48
5.	Copper	Cu	0.003
6.	Zinc	Zn	0.001

From Table 4, the fruit of *Hylocereus undatus* Haworth was indicated that potassium, calcium, sodium, iron, copper and zinc were present in the fruit sample. Among these elements, potassium, calcium and sodium are the most abundance in the fruit sample. The health benefit of potassium is an essential mineral needed regulate water balance, levels of acidity and blood pressure. Potassium is important in controlling of the heart, muscles and nervous system. Moreover, calcium keeps the bones and teeth strong healthy. Calcium is important to normal kidney function and reduces blood cholesterol level. Furthermore, sodium is also needed for the body to function normally and help maintain fluid and blood volume in the body. In addition, iron is essential mineral for making haemoglobin in red blood cells, which carries oxygen around the body into muscles and tissues. The iron levels prevent anemia. According to elemental analysis, the fruit sample was found that these essential elements can be very effective to human health.

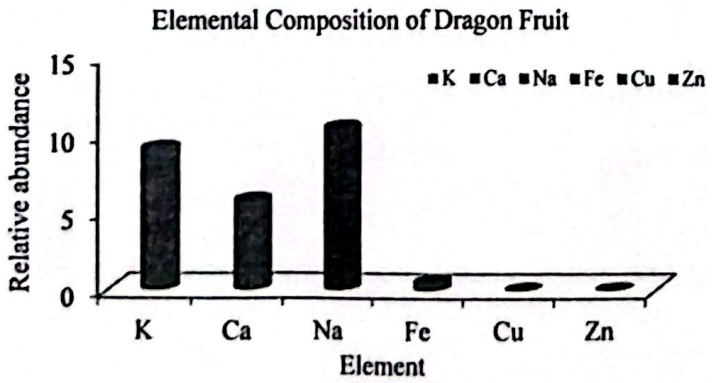


Figure 3. Histogram of the elemental contents in *Hylocereus undatus* Haworth

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Conclusion

In this research, the fruit of *Hylocereus undatus* Haworth was collected for chemical analysis. An attempt has been made to investigate the phytochemical constituents, nutritional values, vitamin-C content and elemental composition of the fruit sample. It indicated that alkaloid, carbohydrate, flavonoid, glycoside, phenolic compound, reducing sugar, saponin, steroid, tannin and terpene were present in dragon fruit sample. The nutritional values of *Hylocereus undatus* Haworth composed of moisture (89.42 %), ash (0.73 %), protein (0.94 %), fat (0.04 %), fibre (1.24 %), carbohydrate (9.92 %), and energy value was found 43.71 kcal. From the experimental point of view as their phytochemicals and nutrients values, the fruit samples are satisfactory and should be consumed for health supplements. The vitamin-C content of *Hylocereus undatus* Haworth sample was found to be 11.23 mg/100 g. The elemental compositions of *Hylocereus undatus* Haworth were found to be K (9.12 %) and Ca (5.75 %), Na (10.42 %), Fe (0.48 %), Cu (0.003 %) and Zn (0.001 %), respectively. From the results of elemental analysis, potassium, calcium and sodium were found to be contained relatively higher in this sample than other minerals that is necessary for health benefits. Therefore, the fruit of *Hylocereus undatus* Haworth could be considered as a source of valuable phytochemicals, nutritional values, vitamin-C and minerals for human health. The dragon fruit was a beneficial fruit for diabetics. Besides delicious eaten, *Hylocereus undatus* Haworth are also good for health and beauty care.

Acknowledgements

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Preparation and Characterization of Chitosan Nanoparticles Extracted from Waste Prawn Shells

Htay Htay Nwe[1], Yi Yi Myint[2]

Abstract

The primary objective of this study is to maintain the environmental pollution in terms of odor and aesthetic damage to the environment. The prawn shells bio-waste can be used to produce value-added products such as chitosan. Chitosan and chitosan derived nanoparticles are very promising due to their versatile properties and have found applications in various area such as biomedical, food packaging and personal care. The purpose of this research work is to prepare and characterize the chitosan nanoparticles extracted from waste prawn shells. The chitosan nanoparticles were prepared in three

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methods, using sonication, sodium tripolyphosphate (STPP) and sonication with STPP. The yield percents of chitosan nanoparticles were found to be 63.86 %, 64.73 % and 62.57 % respectively. The average molecular weights of chitosan nanoparticles were determined by using Ostwald's Viscometer. The prepared nanoparticles were characterized by modern techniques: X-ray diffraction (XRD), scanning electron microscope (SEM) and thermogravimetric/ differential thermal analysis (TG/DTA). It was found that the average crystalline sizes of prepared chitosan nanoparticles (CSNp-1, CSNp-2 and CSNp-3) were 3.02, 7.59 and 3.91 nm.

Keywords: chitosan nanoparticles, average molecular weights, modern techniques

Introduction

Nanotechnology can produce variety of new materials which may have wide functional purposes. The major advantage of nanoparticles is that it provides more surface area and enhanced functional properties. Chitosan and chitosan particles are used to make a wide variety of compositions containing chitosan nanomaterials, nanofibers, films, nanoclay, colloids, composites, gels and other products either alone, in combination with other natural chemical or biological or biochemical compounds. The physical properties of chitosan nanoparticles depend on concentration of chitosan used, amount of cross linking and molecular weight of the chitosan. Many methods have been used to prepare chitosan nanoparticles such as ionic gelation method using acetic acid and sodium tripolyphosphate (Radhakrishnan, *et al.*, 2015).

Ionic gelation technique is basically based on the ionic interaction between the positively charged amino groups of chitosan and the negatively charged groups of a polyanion. This polyanion is usually called a crosslinker. Different crosslinkers have been used, among which is sodium tripolyphosphate (TPP). TPP is the most extensively used crosslinker in preparing CSNPs because of its safety and multivalent properties. Polyphosphates including TPP are hydrolyzed into simpler phosphates, which are considered as nutritious (Nemrawi, *et al.*, 2018).

This is the source of today's most popular technology 'nano technology concept'; the present work also concentrates on synthesis of one of its derivative nanochitosan which has been used for blend formation. Nanochitosan can be prepared by ionic crosslinking method of chitosan with sodium tripolyphosphate which has excellent physicochemical properties, making it a superior environmentally friendly material.

The potential applications of nano-chitosan are well demonstrated in all the field such as adsorption of heavy metals, treatment of waste water and medical field, particularly in controlled drug delivery systems. The nanoderivative of chitosan has high mechanical and thermal stability than chitosan hence this work is more concentrated on preparation of nanochitosan and its blends (Rajeshwari, *et al.*, 2016).

The present study is aimed to prepare chitosan nanoparticles by using sonication, sodium tripolyphosphate (STPP) and sonication with STPP. The average molecular weights of chitosan nanoparticles were determined by using Ostwald's Viscometer. Chitosan nanoparticles was characterized by modern techniques: X-ray diffraction (XRD), scanning electron microscope (SEM) and thermogravimetric/ differential thermal analysis (TG/DTA).

Materials and Methods

Materials

Chitosan (degree of deacetylation 87.76 %) was extracted from prawn shells, penta sodium tri poly phosphate (STPP), sodium hydroxide (NaOH) and all chemical were used analytical grade.

Preparation of Chitosan Nanoparticles from Chitosan

In this research, chitosan nanoparticles were prepared by using stirring, sonication and centrifugation at different condition with 0.1 M NaOH and 2 g/L of sodium tripolyphosphate (STPP) (Qi, *et al.*, 2004; Du, *et al.*, 2009; Lu, *et al.*, 2009).

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Preparation of Chitosan Nanoparticles from Chitosan by Sonication with 0.1 M NaOH (CSNp-1)

The chitosan nanoparticles (CSNp-1) were prepared from chitosan by using stirring, sonication and centrifugation with 0.1 M NaOH solution.

One gram of chitosan powder was dissolved in 100 mL of 1 % (v/v) acetic acid and leaving it under magnetic stirring at room temperature for 1 hr until a clear homogeneous solution was obtained. Then the solution was placed ultrasonic bath for 30 mins. After 30 mins, the solution was titrated by addition of 0.1 M NaOH solution adjusts to pH 5.5 under magnetic stirring at room temperature. A milky dispersion with a pH of 5.5 was obtained. The mixture was stirred at room temperature for 1 hr. After that, the resulting suspension was placed ultrasonic bath for 1 hr. The mixture solution was placed into the ice-bath for 1 hr and followed by centrifuged. Finally, the residue was repeatedly washed with ethanol. Then the residue was transferred to the petri dish and dry at room temperature. The weight of the dry chitosan nanoparticles was determined.

Preparation of Chitosan Nanoparticles from Chitosan with Sodium Tripolyphosphate (STPP) after 0.1 M NaOH (CSNp-2)

The chitosan nanoparticles (CSNp-2) were prepared from chitosan by using stirring and centrifugation with use of 5 mL of STPP (2 g/L) after 0.1 M NaOH solution.

One gram of chitosan powder was dissolved in 100 mL of 1 % (v/v) acetic acid and leaving it under magnetic stirring at room temperature for 1 hr until a clear homogeneous solution was obtained. The resulting solution was titrated by addition of 0.1 M NaOH solution adjusts to pH 5.5 under magnetic stirring at room temperature. 2 g/L (w/v) concentration of sodium tripolyphosphate (STPP) was also prepared with distilled water. Then, 5 mL of 2 g/L STPP solution was added drop wise with a syringe to chitosan solution, while stirring for 1 hr at room temperature. A milky dispersion with a pH of 5.5 was obtained. The mixture solution was placed into the ice-bath for 1 hr and followed by centrifuged. Finally, the residue was repeatedly washed with ethanol. Then the residue was transferred to the petri dish and dry at room temperature. The weight of the dry chitosan nanoparticles was determined.

Preparation of Chitosan Nanoparticles from Chitosan by Sonication with STPP after 0.1 M NaOH (CSNp-3)

The chitosan nanoparticles (CSNp-3) were prepared from chitosan by using stirring, sonication and centrifugation with use of 5 mL of STPP (2 g/L) after 0.1 M NaOH solution.

One gram of chitosan powder was dissolved in 100 mL of 1 % (v/v) acetic acid and leaving it under magnetic stirring at room temperature for 1 hr until a clear homogeneous solution was obtained. Then the solution was placed ultrasonic bath for 30 mins. The resulting solution was titrated by addition of 0.1 M NaOH solution adjusts to pH 5.5 under magnetic stirring at room temperature. 2 g/L (w/v) concentration of sodium tripolyphosphate (STPP) was also prepared with distilled water. Then, 5 mL of 2 g/L STPP solution was added drop wise with a syringe to chitosan solution, while stirring for 1 hr at room temperature, followed by sonication for 1 hr. A milky dispersion with a pH of 5.5 was obtained. The mixture solution was placed into the ice-bath for 1 hr and followed by centrifuged. Finally, the residue was repeatedly washed with ethanol. Then the residue was transferred to the petri dish and dry at room temperature. The weight of the dry chitosan nanoparticles was determined.

Finally, dried chitosan nanoparticles were collected and weighted to determine the percent yield of chitosan nanoparticles from the following equation.

$$\text{Yield percent of nanoparticles} = \frac{\text{weight of chitosan nanoparticles}}{\text{weight of chitosan}} \times 100\ \%$$

Determination of Viscosity-Average Molecular Weight of Prepared Chitosan Nanoparticles (CSNp-1), (CSNp-2) and (CSNp-3), by using Ostwald's Viscometer

The viscosity of the chitosan solutions was measured at 25 °C using a Ostwald's viscometer based on a 1 g/L sample in 0.1 M acetic acid and 0.1 M NaCl solution.

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The mixture solution of 100 mL of 0.1 M acetic acid and 100 mL of 0.1 M NaCl solution were prepared to determine the viscosity-average molecular weight of the chitosan nanoparticles.

0.25 g of chitosan nanoparticles (CSNp-1) was dissolved in the 50 mL of mixture solution under magnetic stirring at room temperature. These solutions were filtered and 0.005 M chitosan nanoparticles (CSNp-1) solution was obtained. Moreover, various concentration (0.001 M, 0.002 M, 0.003 M and 0.004 M) of chitosan nanoparticles (CSNp-1) solution were prepared to determine the intrinsic viscosity by using an Oswald's Viscometer.

The intrinsic viscosity of the chitosan nanoparticles (CSNp-1) was determined by both Huggin's and Kraemer's plots. The average value of two intercepts obtained from the two linear plots was considered as intrinsic viscosity [η] of the sample. The intrinsic viscosity data was used to calculate viscosity-average molecular weight of the samples, M_v.

The viscosity-average molecular weight of the chitosan nanoparticles (CSNp-1) was calculated using the Mark-Houwink equation, (Zhao, *et al.*, 2003)

$$[\eta] = K\,[M_v]^{\alpha}$$

Where,

K = 1.81×10^{-3} cm^3/g

α = 0.93 (constant)

[η] = Intrinsic Viscosity (mL/g)

M_v = Viscosity-Average Molecular Weight (Da)

Similarly, the viscosity-average molecular weight of the chitosan nanoparticles CSNp-2 and CSNp-3 were also determined.

Characterization of the Extracted Chitosan and Chitosan Nanoparticles

The prepared chitosan nanoparticles CSNp-1, CSNp-2 and CSNp-3 were characterized by X-ray Diffraction (XRD), Scanning Electron Microscope (SEM) and Thermogravimetry /Differential Thermal Analysis (TG/DTA).

Results and Discussion

Yield Percents of Chitosan Nanoparticles from Chitosan

The chitosan nanoparticles (CSNp-1) was prepared from chitosan by stirring, sonication and centrifugation with 0.1 M NaOH solution. The yield percent of chitosan nanoparticles are described in Table 1.

The chitosan nanoparticles (CSNp-2) was prepared from chitosan by using stirring and centrifugation with STPP after 0.1 M NaOH solution. The yield percent of chitosan nanoparticles are described in Table 1.

The chitosan nanoparticles (CSNp-3) was prepared from chitosan by using stirring, sonication and centrifugation with STPP after 0.1 M NaOH solution. The yield percent of chitosan nanoparticles are described in Table 1.

Table 1. The Yield Percent of Chitosan Nanoparticles (CSNp-1, CSNp-2 and CSNp-3)

Sr. No.	Weight of Chitosan Sample (g)	Reagent	Weight of Chitosan Nanoparticles (g)	Yield of Chitosan Nanoparticles (%)
1	1.0000	0.1 M NaOH Sonication	0.6386	63.86
2	1.0000	0.1 M NaOH + (2 g/L) STPP	0.6473	64.73
3	1.0000	0.1 M NaOH + (2 g/L) STPP (sonication)	0.6257	62.57

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Intrinsic Viscosity [η] and Viscosity-Average Molecular Weight M_v of Prepared Chitosan Nanoparticles (CSNp) by Using Ostwald's Viscometer

The viscosity-average molecular weight of chitosan nanoparticles CSNp-1, CSNp-2 and CSNp-3 were calculated by using Mark-Houwink equation. These observations are described in Fig. 1 to Fig. 3 and Table 2 to Table 4.

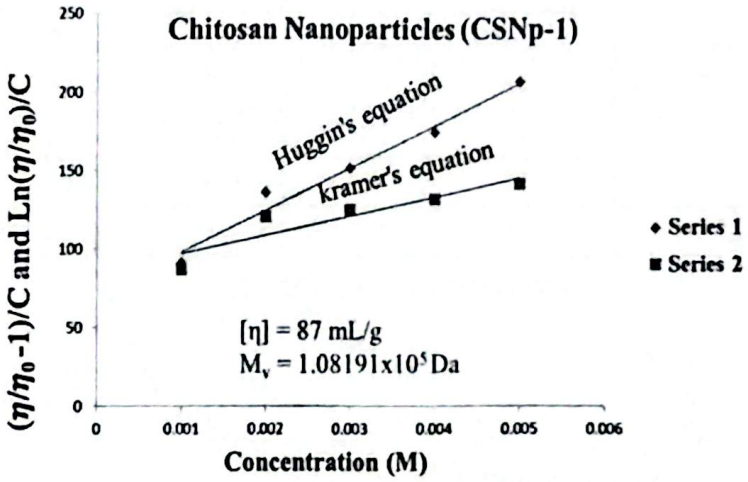


Figure 1. Huggin's and Kramer's plot of chitosan nanoparticles (CSNp-1)

Table 2. Viscosity-Average Molecular Weight of Chitosan Nanoparticles (CSNp-1)

Sr. No.	Concentration (M)	Average Flow Time (s)	$t/t_0 = \eta/\eta_0$	$\eta/\eta_0 - 1$	$(\eta/\eta_0 - 1)/C$	$Ln(\eta/\eta_0)/C$
1	Mixture solution	33	1	0	0	0
2	0.001	36	1.0909	0.0909	90.90	87.0030
3	0.002	42	1.2727	0.2727	136.36	120.5703
4	0.003	48	1.4545	0.4545	151.51	124.8874
4	0.004	56	1.6969	0.6969	174.24	132.2008
6	0.005	67	2.0303	1.0303	206.06	141.6367

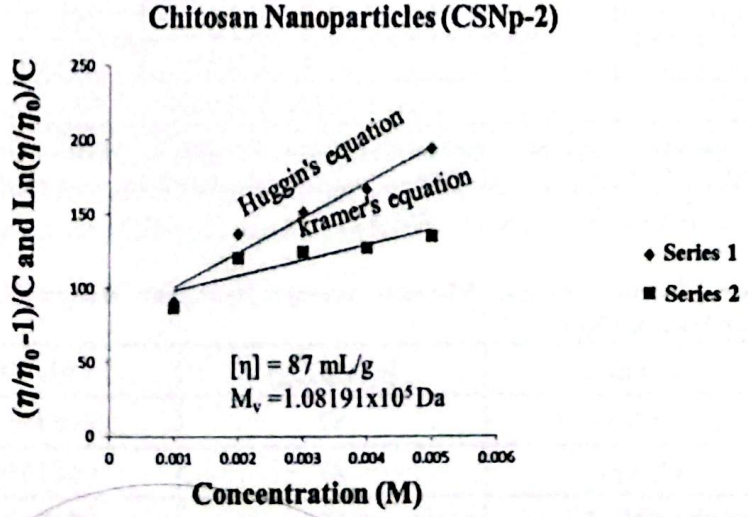


Figure 2. Huggin's and Kramer's plot of chitosan nanoparticles (CSNp-2)

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Table 3. Viscosity-Average Molecular Weight of Chitosan Nanoparticles (CSNp-2)

Sr. No.	Concentration (M)	Average Flow Time (s)	$t/t_0=\eta/\eta_0$	η/η_0 -1	$(\eta/\eta_0$ -1)/C	$Ln(\eta/\eta_0)/C$
1	Mixture solution	33	1	0	0	0
2	0.001	36	1.0909	0.0909	90.90	87.0030
3	0.002	42	1.2727	0.2727	136.36	120.5703
4	0.003	48	1.4545	0.4545	151.51	124.8874
4	0.004	55	1.6667	0.6667	166.67	127.7114
6	0.005	65	1.9696	0.9696	193.94	135.5661

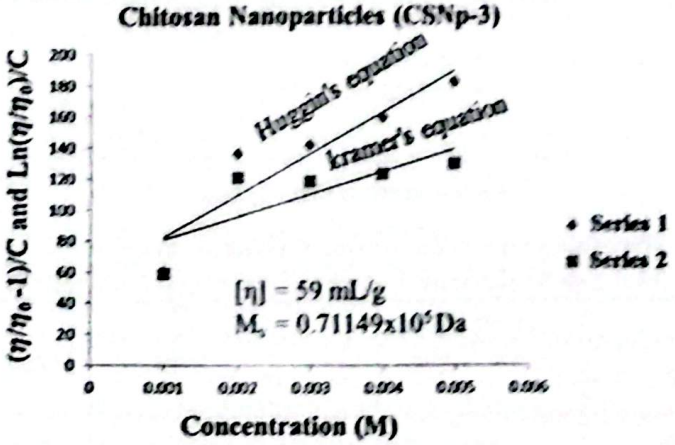


Figure 3. Huggin's and Kramer's plot of chitosan nanoparticles (CSNp-3)

Table 4. Viscosity-Average Molecular Weight of Chitosan Nanoparticles (CSNp-3)

Sr. No.	Concentration (M)	Average Flow Time (s)	$t/t_0 = \eta/\eta_0$	η/η_0 -1	$(\eta/\eta_0$ -1)/C	$Ln(\eta/\eta_0)/C$
1	Mixture solution	33	1	0	0	0
2	0.001	35	1.0606	0.0606	60.60	58.8348
3	0.002	42	1.2727	0.2727	136.36	120.5703
4	0.003	47	1.4242	0.4242	141.41	117.8701
4	0.004	54	1.6363	0.6363	159.09	123.1094
6	0.005	63	1.9090	0.9090	181.82	129.3159

Intrinsic viscosity [η] and viscosity-average molecular weight M_v of chitosan nanoparticles CSNp-1, CSNp-2 and CSNp-3 were calculated by using Mark-Houwink equation. These results are described in Table 5.

Table 5. Intrinsic Viscosity [η] and Viscosity-Average Molecular Weight M_v of Chitosan Nanoparticles (CSNp)

Sr. No.	Sample	[η] (mL/g)	M_v (Da)
1	CSNp-1	87	$1.08191x10^5$
2	CSNp-2	87	$1.08191x10^5$
3	CSNp-3	59	$0.71149x10^5$

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The average molecular weight of chitosan nanoparticles CSNp-1 and CSNp-2 were higher than the CSNp-3.

Characterization of the Prepared Chitosan Nanoparticles

The prepared chitosan nanoparticles CSNp-1, CSNp-2 and CSNp-3 were characterized by X-ray Diffraction (XRD), Scanning Electron Microscope (SEM) and Thermogravimetry /Differential Thermal Analysis (TG/DTA).

Characterization of the Extracted Chitosan Nanoparticles by XRD

The crystal nature of chitosan nanoparticles CSNp-1, CSNp-2 and CSNp-3 were characterized at Universities' Research Centre, Yangon. X-ray Diffraction (XRD) patterns and the crystallite size of each chitosan nanoparticles are presented in Fig. 4 to Fig. 6 and Table 6 to Table 8.

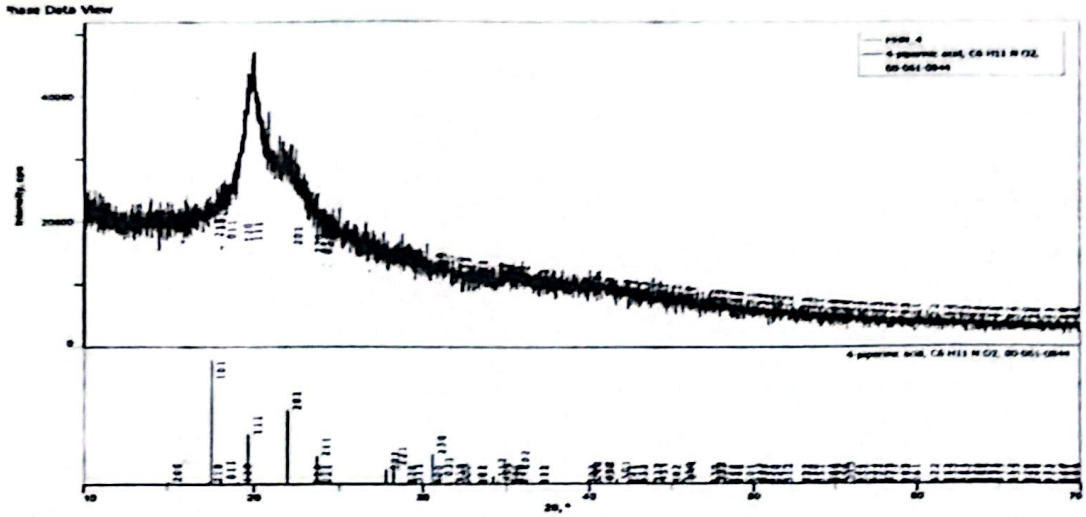


Figure 4. XRD spectrum of chitosan nanoparticles from chitosan (CSNp-1)

Table 6. Crystallite Size Data for Chitosan Nanoparticles from Chitosan (CSNp-1)

Wavelength (λ) (Å)	2θ (deg)	θ (deg)	Cos θ	FWHM (deg)	FWHM (rad)	Crystallite Size (D) (nm)
1.5406	19.76	9.880	0.9852	1.80	0.03141	4.4309
1.5406	22.29	11.145	0.9811	2.60	0.04537	3.0803
1.5406	29.10	14.55	0.9679	2.80	0.04886	2.8993
1.5406	36.24	18.12	0.9504	4.90	0.08551	1.6872
Average Crystallite Size of Chitosan Nanoparticles (CSNp-1)						3.0244

According to XRD results, the crystallite size of chitosan nanoparticles (CSNp-1) were found to be within the range of (1.6872 to 4.4309) nm. The average crystallite size of chitosan nanoparticles (CSNp-1) was 3.0244 nm.

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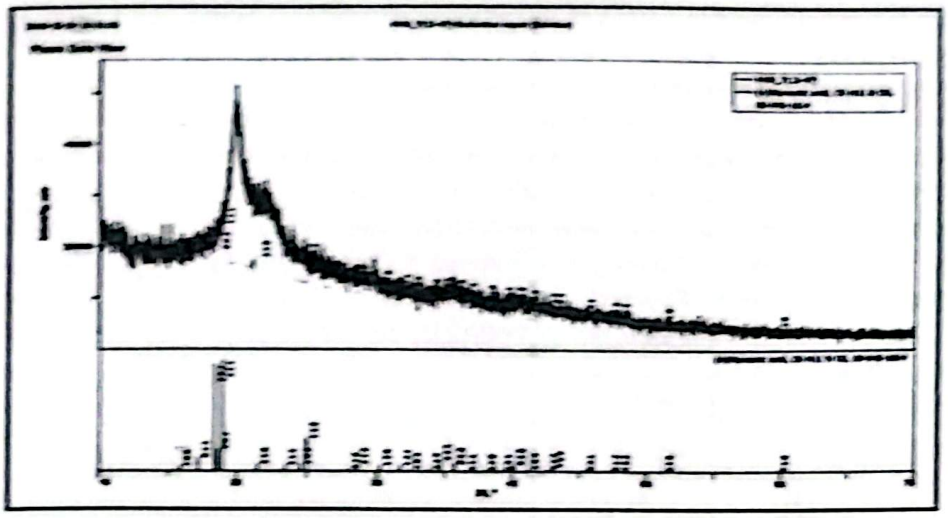


Figure 5. XRD spectrum of chitosan nanoparticles from chitosan (CSNp-2)

Table 7. Crystallite Size Data for Chitosan Nanoparticles from Chitosan (CSNp-2)

Wavelength (λ) (Å)	2θ (deg)	θ (deg)	Cos θ	FWHM (deg)	FWHM (rad)	Crystallite Size (D) (nm)
1.5406	19.77	9.885	0.9852	1.60	0.02792	4.9847
1.5406	35.57	17.785	0.9522	0.81	0.01413	10.1876
Average Crystallite Size of Chitosan Nanoparticles (CSNp-2)						7.5861

According to XRD results, the crystallite size of chitosan nanoparticles (CSNp-2) were found to be within the range of (4.9847 to 10.1876) nm. The average crystallite size of chitosan nanoparticles (CSNp-2) was 7.5861 nm.

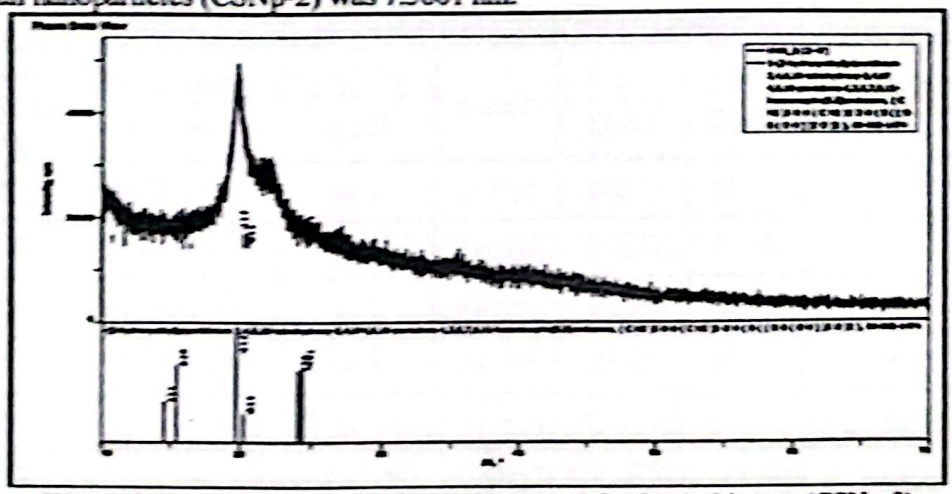


Figure 6. XRD spectrum of chitosan nanoparticles from chitosan (CSNp-3)

Table 8. Crystallite Size Data for Chitosan Nanoparticles from Chitosan (CSNp-3)

Wavelength (λ) (Å)	2θ (deg)	θ (deg)	Cos θ	FWHM (deg)	FWHM (rad)	Crystallite Size (D) (nm)
1.5406	17.40	8.700	0.9885	6.00	0.10470	1.3248
1.5406	19.77	9.885	0.9852	1.00	0.01745	7.9755
1.5406	22.08	11.040	0.9815	3.30	0.05758	2.4259
Average Crystallite Size of Chitosan Nanoparticles (CSNp-3)						3.9088

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According to XRD results, the crystallite size of chitosan nanoparticles (CSNp-3) were found to be within the range of (1.3248 to 7.9755) nm. The average crystallite size of chitosan nanoparticles (CSNp-3) was 3.9088 nm.

Characterization of the Extracted Chitosan Nanoparticles by SEM

The morphology of the prepared chitosan nanoparticles were characterized by Scanning Electron Microscope (SEM) and the images are shown in Fig. 7 to Fig. 9.



Figure 7. SEM image of chitosan nanoparticles synthesized from chitosan (CSNp-1)

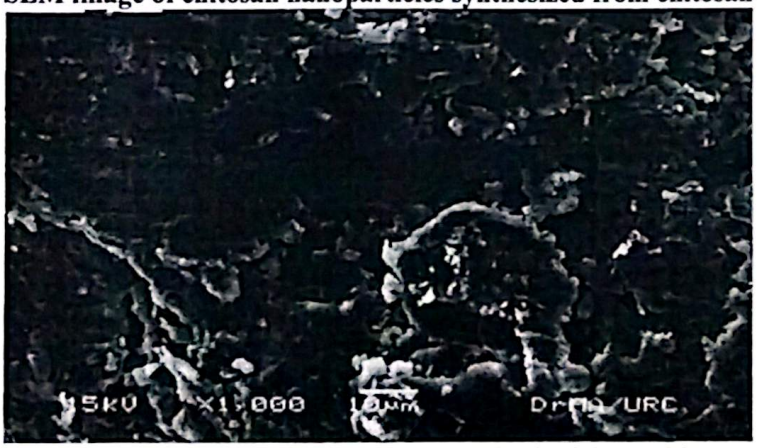


Figure 8. SEM image of chitosan nanoparticles synthesized from chitosan (CSNp-2)



Figure 9. SEM image of chitosan nanoparticles synthesized from chitosan (CSNp-3)

The SEM images of chitosan nanoparticles were observed that the good dispersion of the nanoparticles which are entangled one on the other with a larger exposed surface making the material very suitable for adsorption.

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Characterization of the Extracted Chitosan and Chitosan Nanoparticles by TG/DTA

To measure the thermal weight loss of the extracted chitosan and Chitosan nanoparticles by Thermogravimetric Analysis /Differential Thermal Analysis TG/DTA and the images are shown in Fig. 10 and Fig. 11. The results are shown in Table 9 and Table 10.

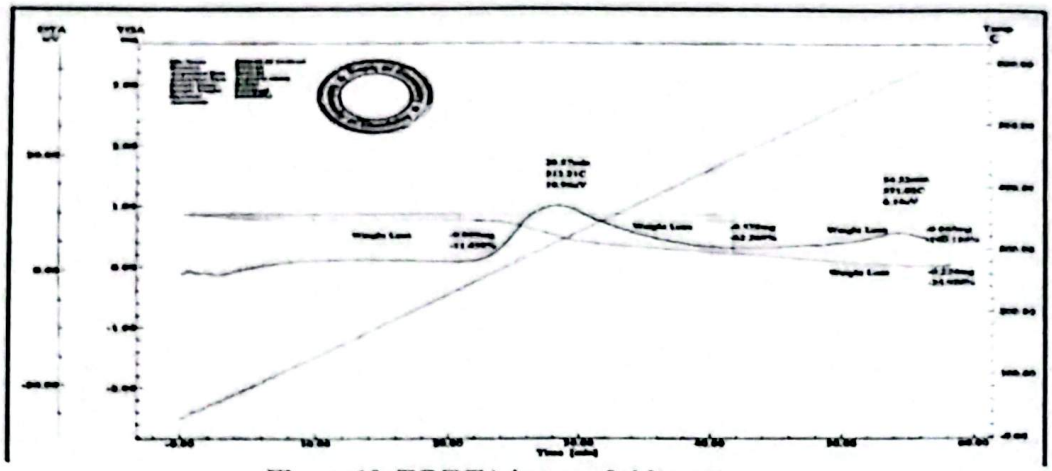


Figure 10. TG/DTA image of chitosan

Table 9. The Results of Thermogravimetry /Differential Thermal Analysis (TG/DTA) Data of Chitosan (CS)

Sample	Temperature (°C)	Weight loss (%)	Type of peak	Remark
Chitosan (CS)	313.21	62.269	Exothermic	Some extent in degradation occur
	571.02	100.000	Exothermic	Completely degradation occur

From the TG/DTA data, the chitosan (CS) started to degrade at 313.21 °C and the maximum degradation temperature was found to be at 571.02 °C.

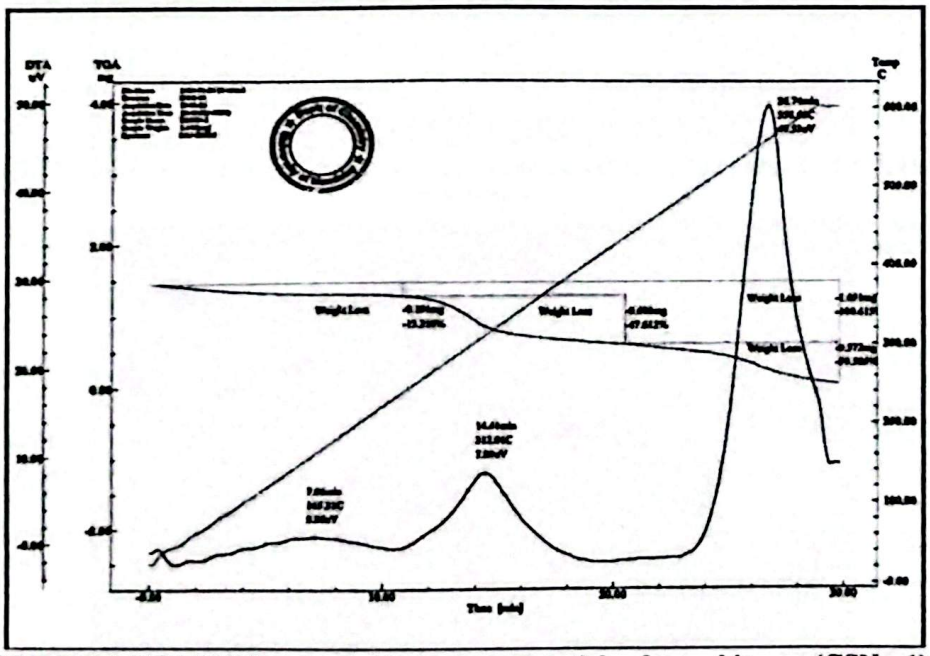


Figure 11. TG/DTA image of chitosan nanoparticles from chitosan (CSNp-1)

Table 10. The Results of Thermogravimetry /Differential Thermal Analysis (TG/DTA) Data of Chitosan Nanoparticles (CSNp-1)

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Sample	Temperature (°C)	Weight loss (%)	Type of peak	Remark
Chitosan Nanoparticles (CSNp-1)	165.33	13.218	Exothermic	Due to the loss of moisture
	312.01	47.612	Exothermic	Some extent in degradation occur
	558.68	100.000	Exothermic	Completely degradation occur

From the TG/DTA data, the chitosan nanoparticles (CSNp-1) started to degrade at 165.33 °C and the maximum degradation temperature was observed to be at 558.68 °C.

Conclusion

Chitosan nanoparticles were prepared by applying three methods such as stirring, sonication and centrifugation. The chitosan nanoparticles were extracted from chitosan powder samples by using 0.1 M sodium hydroxide solution and (2 g/L) of STPP solution. The yields of chitosan nanoparticles were found to be 63.86 % for (CSNp-1), 64.73 % for (CSNp-2) and 62.57 % for (CSNp-3), respectively.

The viscosity-average molecular weight of the chitosan nanoparticles were determined by using Ostwald's viscometer. The average molecular weight were found 1.08191×10^5 Da for (CSNp-1) and (CSNp-2), 0.71149×10^5 Da for (CSNp-3) respectively.

The prepared chitosan nanoparticles were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and thermogravimetric analysis/differential thermal analysis (TG/DTA). From the XRD data, the average crystallite size of chitosan nanoparticles showed 3.0244 nm for (CSNp-1), 7.5861 nm for (CSNp-2), and 3.9088 nm for (CSNp-3) respectively. According to the XRD results, the prepared chitosan nanoparticles were confirmed the formation of nanoparticles.

The SEM images of chitosan nanoparticles were observed that the good dispersion of the nanoparticles which are entangled one on the other with a larger exposed surface making the material very suitable for adsorption.

The thermal stability of chitosan and chitosan nanoparticles were examined using thermogravimetric/ differential thermal analysis (TG/DTA). From the TG/DTA data, the chitosan (CS) started to degrade at 313.21 °C and the maximum degradation temperature was found to be at 571.02 °C. In the chitosan nanoparticles (CSNp-1) started to degrade at 165.33 °C and the maximum degradation temperature was observed to be at 558.68 °C.

From this finding, the prepared chitosan nanoparticles may contribute to the treatment of waste water from food and textile industries.

Acknowledgements

I would like to express my deepest gratitude to Dr. Aung Win, Rector, Dr. Aye Aye Thant and Dr. Zin Mar Latt, Pro-rectors, University of Myitkyina for their interest encouragement on my research paper. Moreover, I would like to extend my acknowledge to Dr Than Than Nu (Professor and Head) and Dr Khin Swe Latt (Professor), Department of Chemistry, University of Myitkyina, for her guidance invaluable suggestions and comments offered in writing this research.

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Data Display System Based on PIC 16F628A

Aye Thandar Kyaw[1]

Abstract

The purpose of this research work is to construct a data display system for Physics Department of Myitkyina University. The whole system is constructed by using PIC16F628A microcontroller manufactured by Microchip Technology Inc., a four-line twenty-character liquid crystal display (LCD), a buzzer, other electronic components and two button switches, namely "TEACHER" and "STUDENT". The switch "STUDENT" is used to call student data and the switch "TEACHER" is also used to call the data of all teachers of Physics Department. In the constructed system, PIC16F628A microcontroller performs as the heart of the whole system and the LCD is used to display the corresponding data. The control program for PIC16F628A microcontroller is written by using Assembly language and built by using MPLAB IDE v8.50 software. A PIC KIT2 (v2.61) programmer board is also used to transform the machine code from the computer to PIC16F628A microcontroller. A 9 V battery is used as the built-in power source of the whole system.

Keywords: counting system, two switches, LCD display, PIC16F628A, programmer board

Introduction

The birth of signs and display can be said to be as old as the existence of man on the planet earth. From the beginning of the world, different types of displays have been in use. Signs are any kind of visual graphics created to display information to a particular audience. Electronic digital display system is perfect for this application. It can be used for both indoor and outdoor which makes it universal fit for any business or event. The use of electronic is now becoming very important. It is extensively applied in almost our day-to-day activities. Electronic digital display system is very efficient and cost-effective way to spread messages to the people. The data display systems are widely used today in microelectronic technology such as electronic dictionary, weather station, digital oscilloscope and so on. Their advantage is that it can operate independently of a computer and they are available in various shapes and sizes. The differences of various data display systems are based on the way that data is recorded and stored. In the data loggers, the on-board memory is large enough to hold data that is recorded over a longer period of time. In this thesis, the constructed data display system is composed of electronic hardware and software to display the data of Physics Department of Myitkyina University. The whole circuits are designed to implement the use of digital components such as PIC16F628A microcontroller, 4-line 20-character LCD and other components.

General Descriptions of Constructed Data Display System

The constructed data display system contains five main units and they are user interface unit, main control unit, display unit, alarm unit and regulated power supply unit. The user interface unit is to choose the data which is displayed on LCD. The main control unit are to receive the output signal of user interface unit, to control alarm unit, and also to interface with display unit. The main control unit sends the digital data for LCD by using 8-bit data bus. The function of display unit is to display the data of student numbers and the data of all teachers of Physics department. The alarm unit is to produce the sound signal when the switch

[1]Daw, Demonstrator, Department of Physics University of Myitkyina

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of user interface unit is pressed. The function of regulated power supply unit is to provide the regulated +5 V for the whole system.

Block Diagram of Data Display System

The block diagram of the constructed data display system is shown in Fig. 1 and its complete circuit is also shown in Fig. 8.

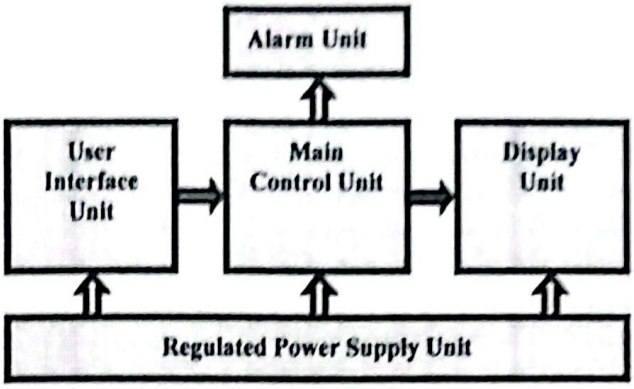


Figure .1 Block Diagram of the Constructed Data Display System

Alphanumeric Liquid Crystal Display

In this circuit, alphanumeric liquid crystal display is used as display unit. The alphanumeric LCD modules can display characters, numerals, symbols and some limited graphics. The LCD module used in this paper is 4-line 20- character and matrix modules with LED back-lighting. It has a Hitachi type HD 44780 controller IC. Features of the HD 44780 are built in character generator with 192 character modified ASCII character set, ability to program up to custom characters, bi-directional 8 or 4 bit bus interface, 80 characters RAM, auto reset on power up, and wide range of instruction functions including Display clear, Cursor positioning, Display or cursor shift. Most LCD modules conform to a standard interface specification. A 16-pin access having eight data lines, three control lines and five power lines are provided. The photograph the LCD module is illustrated in Fig. 2. LCD module has two registers: one is used for inputting instructions and another for reading or writing data. Instructions are used to tell the module how and where to put the data. Writing data to the LCD is done in several steps: set R/W bit to low, set RS bit to logic 0 or 1 (instruction or character), set data to data lines (if it is writing), set E line to high and set E line to low.



Figure. 2 Photograph of 4 × 20 LCD Module

PIC16F628A Microcontroller

PIC is the family of Reduces Instruction Set Computer (RISC) microcontrollers made by Microchip Technology. PIC16F628A microcontroller is used as the brain of the whole system. The PIC16F628A is 18-pin flash-based member, high performance, 8-bit microcontroller. All microcontrollers employ an advanced RISC architecture. A total of 35 instructions (reduced instruction set) are available, complemented by a large register set. PIC16F628A device has integrated features to reduce external components, thus reducing system cost, enhancing system reliability and reducing power consumption. The PIC16F628A

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has two ports, PORTA and PORTB. Some pins for these I/O ports are multiplexed with alternate functions for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin. The pin diagram and photograph of PIC16F628A microcontroller are shown in Fig. 3. The PIC16F628A can be operated in eight different oscillator options. The user can program three configuration bits (FOSC2 through FOSC0) to select one of these eight modes: LP Low Power Crystal, XT Crystal/Resonator, HS High Speed Crystal/Resonator, RC External Resistor/Capacitor (2 modes), INTOSC Internal Precision Oscillator (2 modes), EC External Clock In.

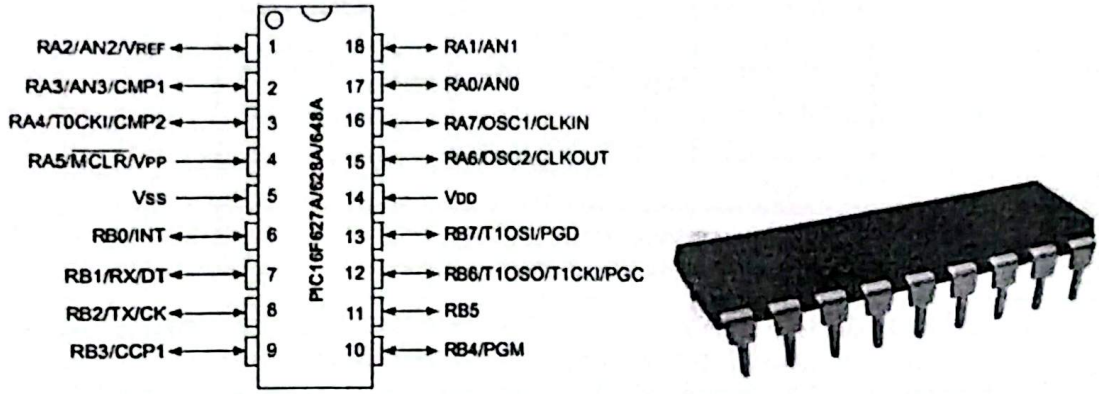


Figure. 3 Pin Diagram and Photograph of PIC16F628A Microcontroller

Buzzer

Buzzer is a sound producing device and there are two main types of buzzer, active and passive. One has active components inside the casing and only requires a DC supply to produce sound. The frequency of sound produced from this type of buzzer cannot be changed and they are fixed by the internal circuitry. This type of buzzer is active and is used in this system. This buzzer is used as alarm unit.

Assembling the System of Data Selector Circuit

In the data selector circuit, two button switches, namely "TEACHER" and "STUDENT" are used to call student data and the data of all teachers of Physics Department. The circuit is constructed by using two button switches and two 10 kΩ resistors. In circuit connection, the outputs are pulled up to +5 V through 10 kΩ resistors to obtain digital HIGH state initially. Then, one node of the two button switches are connected to RA2 and RA3 of PIC16F628A microcontroller. The remaining nodes of the two switches are directly grounded. If the switch "TEACHER" is pressed, RA2 of PIC16F628A microcontroller will change the digital HIGH to LOW state. If the switch "STUDENT" is pressed, RA3 of PIC16F628A microcontroller will change the digital HIGH to LOW state. The schematic diagram of data selector circuit is shown in Fig. 4.

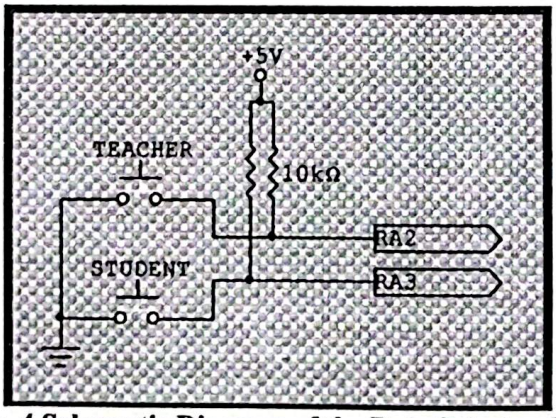


Figure. 4 Schematic Diagram of the Data Selector Circuit

Main Processing Circuit

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The main processing device of the whole system is PIC16F628A microcontroller manufactured by Microchip Company. The functions of main processing circuit are to receive the outputs of data selector circuit, to interface with 4 × 20 liquid crystal display (LCD), and also to control buzzer with the help of BC547 NPN transistor. In this thesis, the internal oscillator of 4 MHz frequency is used as the clock circuit for PIC16F628A microcontroller by configuring control program. It is performed to obtain the stable clock speed of 4 MHz for PIC16F628A microcontroller. By using internal oscillator, any other external oscillator is not required in this circuit. Additionally, the $\overline{MCLR}$ pin of microcontroller is applied +5 V via 10 kΩ resistor.

In microcontroller pin configuration, RA0 and RA1 of PIC16F628A microcontroller are used as digital outputs to control Register Select pin and Enable pin of LCD. RA2 and RA3 of microcontroller are used as digital inputs to receive the outputs of data selector circuit. RA4 of microcontroller is used as digital output to control buzzer alarm. Therefore, it must be required to configure as (TRISA = xxx01100) in which "x" may be configured as either logic 0 or 1. All of PORTB such as RB0 to RB7 of microcontroller are used as digital outputs to send LCD data and therefore, the configuration of TRISB is (TRISB = 00000000). The schematic diagram of main processing circuit is shown in Fig. 5.

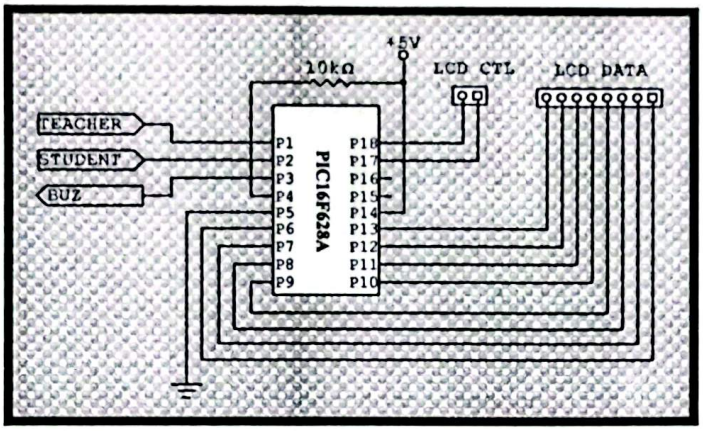


Figure. 5 Schematic Diagram of Main Processing

The display and alarm circuit is constructed by using a 4-line 20-character LCD, a buzzer and PIC16F628A microcontroller. In this circuit, LCD is used to display student data and the data of all teachers of Physics Department. PIC16F628A microcontroller is used as the control device of this circuit. The buzzer is used to produce the sound signal when the switches "TEACHER" and "STUDENT" are pressed.

In circuit connection, pin-1 and pin-5 of LCD are connected to ground. Pin2 of LCD is applied +5 V directly. A 5 kΩ variable resistor is performed as voltage divider. The output of voltage divider circuit is connected to pin-3 of LCD to control the contrast of LCD character. Register Select and Enable pins of LCD are connected to RA0 and RA1 of microcontroller respectively. For sending the digital data from PIC16F628A microcontroller to LCD, 8-bit data bus is used. Data bit-0 to bit-7 of LCD are connected to RB0 to RB7 of PIC16F628A microcontroller respectively. The back lighting pins of LCD are directly applied +5 V.

RA4 of PIC16F628A microcontroller is connected to the base of BC547 transistor via 1 kΩ resistor. The emitter of the transistor is connected to the ground line of power supply. The collector of BC547 transistor is connected to the negative terminal of buzzer. Positive terminal of buzzer is connected to +5V line of power supply. When RA4 of microcontroller is LOW, the transistor will cut off. In this condition, the buzzer will not produce the sound. When RA4 of PIC16F628A microcontroller is HIGH, the transistor will saturate and the

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buzzer will produce the sound signal. The schematic diagram of display and alarm circuit is shown in Fig. 6.

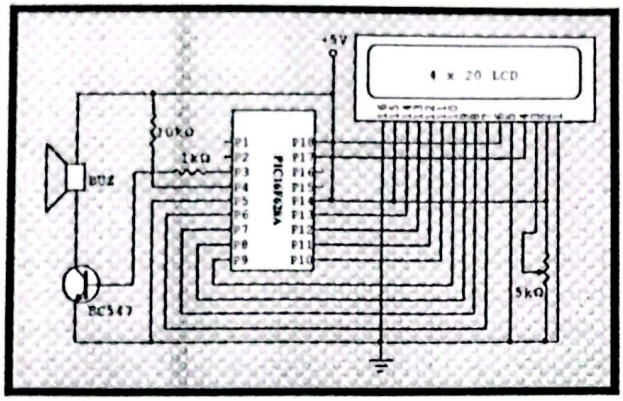


Figure .6 Schematic Diagram of Display and Alarm Circuit

The data selector circuit, main processing circuit, display and alarm circuit, and power supply circuit are wired together to obtain the complete circuit of data display system. In the whole circuit, both PORTA and PORTB of PIC16F628A microcontroller are used to complete this research. PORTA of microcontroller is used to select data and to control buzzer, and PORTB is used to interface with LCD. The internal oscillator of 4 MHz frequency is used for oscillating circuit of PIC16F628A microcontroller by configuring program software. The complete circuit is shown in Fig. 7 and photograph of constructed data display system and the photograph of internal circuit are also shown in Fig. 8.

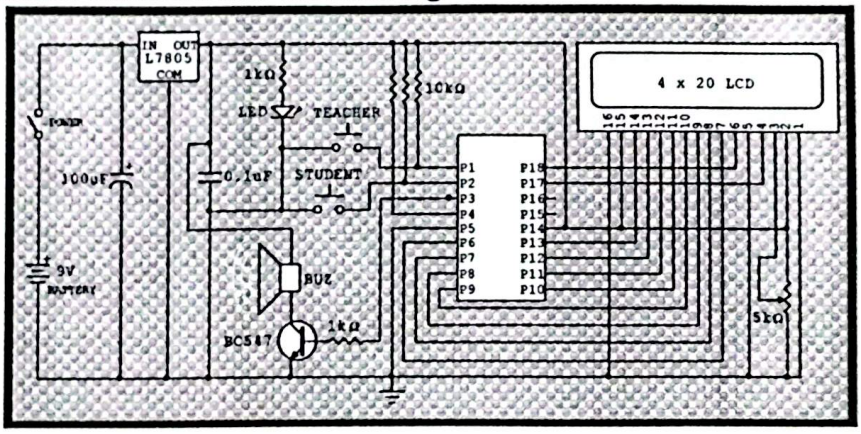


Figure. 7 Complete Circuit of Constructed Data Display System

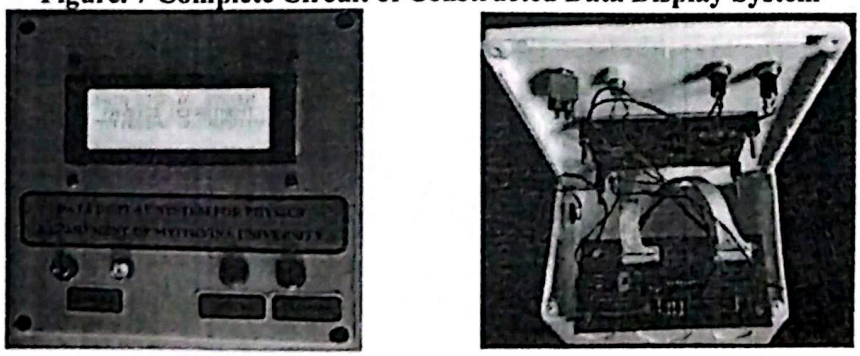


Figure. 8 Photograph of Constructed Data Display System and Photograph of Internal Circuit

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Software Development

The control program for PIC16F628A microcontroller is written by using Assembly language. Firstly, the desired Assembly code "Data_Display.asm" is written in the notepad. Then, the code is compiled by using MPLAB IDE v8.50 software which produces the machine code "Data_Display.hex". Next, the machine code "Data_Display.hex" is imported into the PICkit2 v2.61 programmer software. After finishing the imported process, the machine code "Data_Display.hex" file is retrieved from the USB port of the computer and writes into the PIC16F628A microcontroller by using PICKIT2 programmer board. The snapshot of MPLAB IDE v8.50 software screen is shown in Fig. 9. The photograph of PICKIT2 and the snapshot of PICkit2 v2.61 programmer software screen and programmer board are shown in Fig. 10 and Fig. 11 respectively.

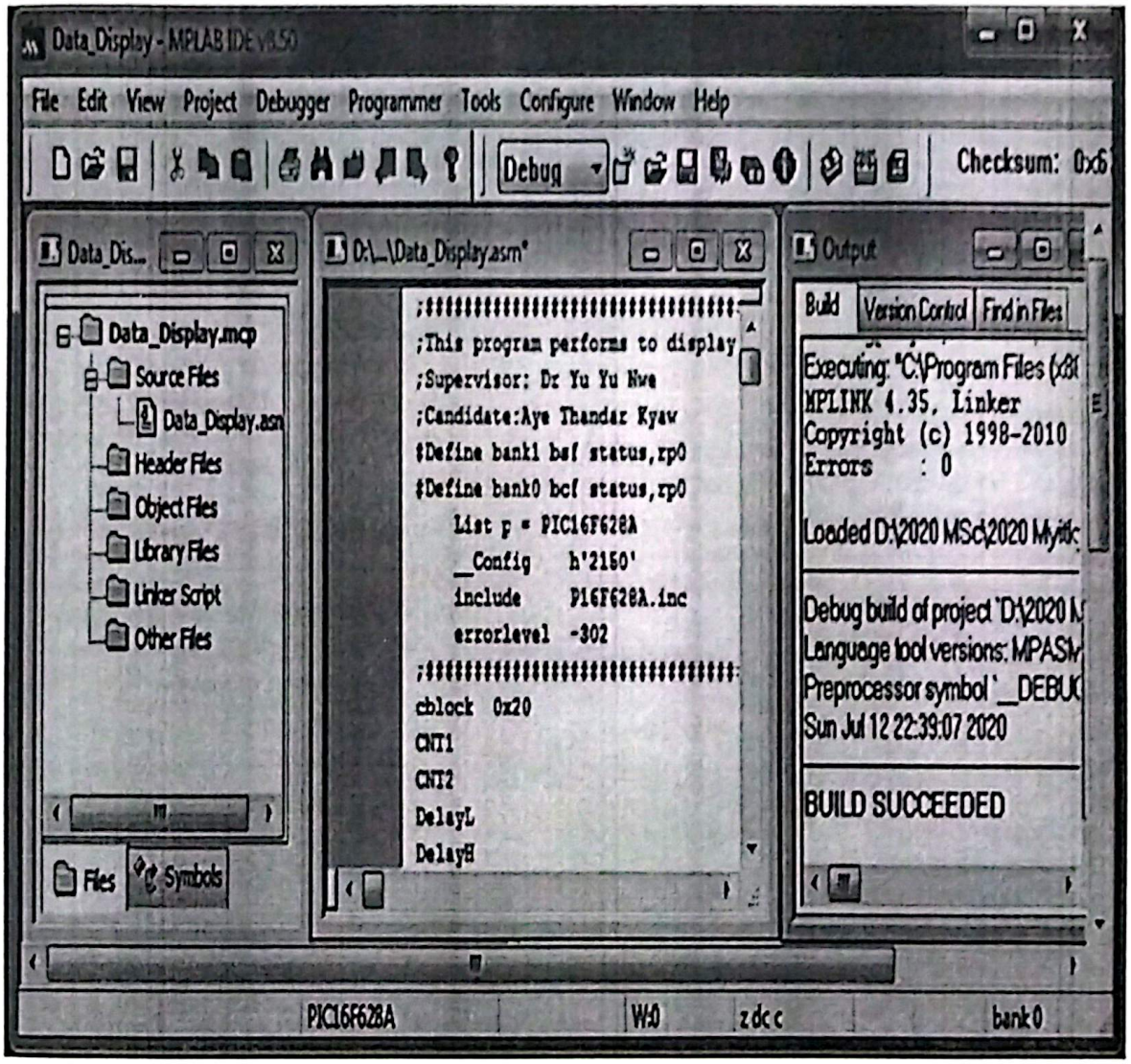


Figure. 9 Snapshot of MPLAB IDE v8.50 Software Screen

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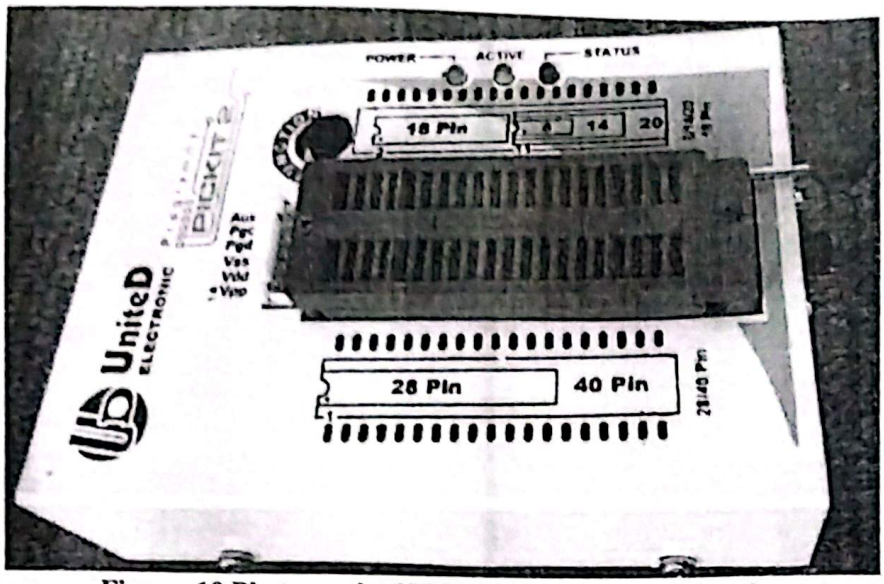


Figure. 10 Photograph of PICKIT2 Programmer Board

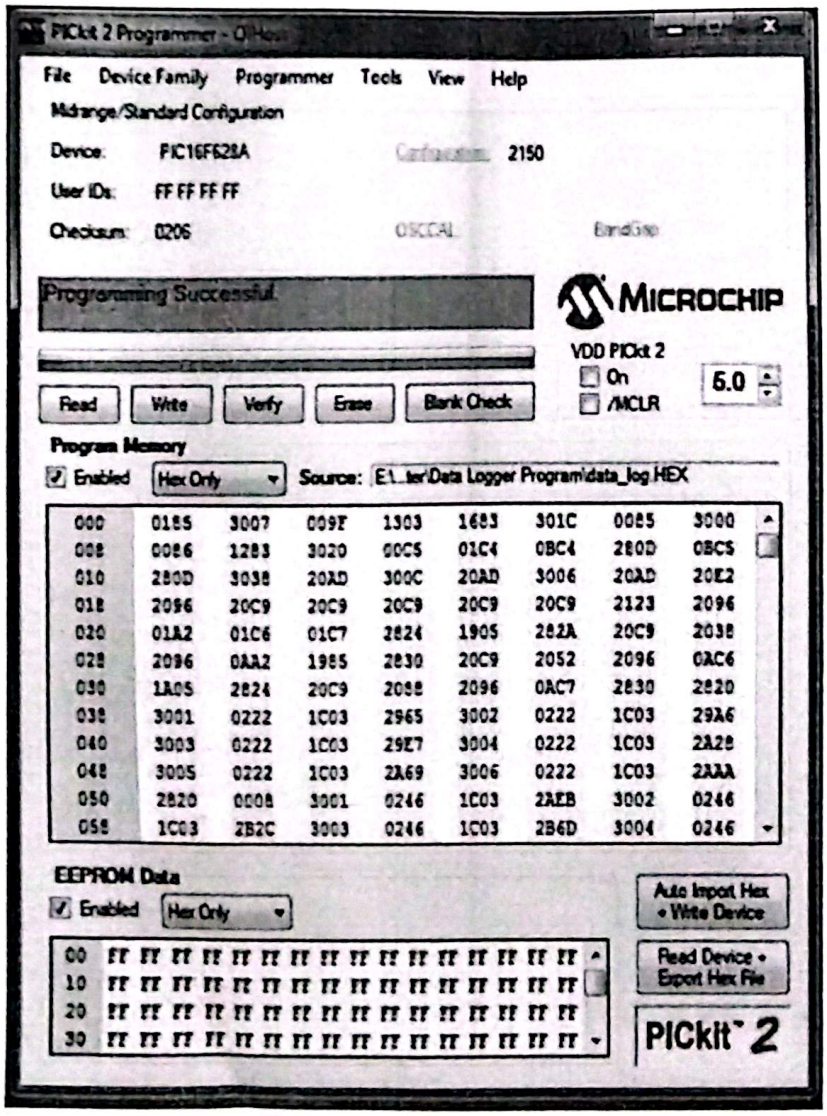


Figure. 11 Snapshot of PICkit2 v2.61 Programmer Software Screen

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Discussions

The use of electronic technology is now becoming very important. It is extensively applied in almost our day to day activities. The constructed data display system is one of the applications of interfacing between PIC16F628A microcontroller and 4-line 20-character liquid crystal display (LCD). The constructed system can display the total of 33 data on LCD. To do this performance, the data are stored in the program memory of PIC16F628A microcontroller. Two button switches "TEACHER" and "STUDENT" are used to call the data of all teachers of Physics Department and student data. In system operation, when the system power is switched-on, "DATA DISPLAY SYSTEM FOR PHYSICS DEPARTMENT" will be displayed on LCD. Then, the system is ready to enter the switches "TEACHER" and "STUDENT" to display the corresponding data. The data of all teachers of Physics Department can be seen on LCD by pressing the switch "TEACHER". The students data can also be also be seen on LCD by pressing the switch "STUDENT". The buzzer will produce the sound signal for pressing each switch.

Conclusion

The whole system is constructed based on microelectronic technology and it consists of both hardware and software development. In the hardware section, the whole system is constructed by using PIC16F628A microcontroller, 4 × 20 LCD and other electronic components. Therefore, the hardware connection of basic power supply circuit and microcontroller based circuit can be studied in the constructed system. In the software section, the control program for PIC16F628A microcontroller is written by using Assembly language and compiled by using MPLAB IDE v8.50 software. To write the machine code from the computer to PIC16F628A microcontroller, PICkit2 v2.61 programmer software and PICKIT2 programmer board are also used. Therefore, the university students and other researchers can study the facts how to use PIC16F628A microcontroller, how to develop a control program, and how to write machine into microcontroller.

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Investigation on Structural and Optical Properties of AL_2O_3 Doped TiO_2 Powder

Lei Lei Aung[1], Yu Yu Nwe[2], Nwe Nwe Khine[3]

Abstract

The preparation of Al_2O_3 doped TiO_2 powders were synthesized by solid-state reaction method. The Al_2TiO_5 powder contains 5, 10 and 15 mol% of Al_2O_3. The prepared powders were sintered at 400℃ for 4 hour. Crystalline phase formation and crystallite sizes of these powders were investigated by X-ray diffraction (XRD). The particle size was estimated by the full width at half maximum (FWHM) of the strongest X-ray diffraction (XRD) peak. Scanning electron microscope (SEM) was used to find out the particle size, morphology and microstructure of sintered powder. Optical properties of Al_2TiO_5 were investigated by using UV–Vis spectroscopy. The UV–Visible spectroscopy of prepare powder shows that the band gap energy in the range of semiconductor materials. The objective of the present work was to be studied the effect of Al_2O_3 substitution on TiO_2.

Keywords: XRD, UV–Vis, SEM, Al_2O_3, TiO_2

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Introduction

Composites of alumina and titania are known for their high toughness, low thermal expansion, and low thermal conductivity. These properties make alumina-titania composites desirable materials of construction and coatings for high performance applications where thermal barriers are required. Al_2O_3 is an oxide of aluminum a group III element. It is known to be a very stable and robustmaterial. It possesses strong ionic interatomic bonding giving rise to it is desirable material characteristics. Alumina is well known for its high strength and stiffness. Three different crystallographic structures of TiO_2 (titania) occur in nature: Rutile - tetragonal, Anatase-tetragonal, Brookite–orthorhombic. Out of these three polymorphs of TiO_2, only rutile is the thermodynamically most stable phase where as anatase and brookite is metastable, transforming to rutile when they are heated. Brookite transforms into rutile at quite low temperatures. Only the rutile and anatase play a significant role in industrial applications. Applications of brookite are limited due to its rareness and difficult preparation.

Al_2TiO_5 is a synthetic ceramic material, it is considered as a candidate for many structural applications because of its high melting point, low thermal conductivity, almost zero thermal expansion and excellent thermal shock resistance.

Materials and Methods

Sample Preparation

The raw materials of TiO_2 and Al_2O_3 were chosen as starting materials. Firstly, these materials were analyzed by XRD at Universities' Research Centre (URC). Then, these powders were weighted and mixed to get Al_2TiO_5. This desired compound was calculated by stoichiometric ratio. The mixture of (x) Al_2O_3 and ($1 - x$) TiO_2 is prepared from high purity of Al_2O_3 (99.9%) and TiO_2 (99.9%) powder according to the stoichiometric composition of $x = 5$mol%, $x = 10$ mol% and $x = 15$ mol% respectively. The first step in process was to weight and powder – batching the starting materials at Al_2O_3 and TiO_2 by the stoichiometric formula of the powder with desirable compositions. We placed Al_2O_3 and TiO_2 in the agate motor and stirred to get a homogeneous mixture in about 2 hours time. The heat treatment schedule in this research work was 400°C for 4 hour. Then Al_2O_3 doped TiO_2 sample was formed. Al_2TiO_5 powders were obtained. These powders were fabricated by solid-state reaction method and then characterized by X-ray diffraction (XRD) again. X-ray diffraction analysis was carried out to examine the crystalline phase assignment and lattice parameters of these powders. Optical properties of Al_2TiO_5 were investigated by using UV–Vis spectroscopy in this research. The morphologies of the samples were observed by the scanning electron microscopy (SEM).

Results and Discussion

Structural Characterization Analysis

Structural analysis of Al_2O_3 doped TiO_2 powder was examined by XRD technique. It was performed using monochromatic CuK_α radiation (λ=1.54056 Å) operated at 40 kV (tube voltage) and 40 mA (tube current). Sample was scanned from 10 ° to 70 ° in diffraction angle, 2θ with a step-size of 0.02. The upper side of XRD profile was represented the observed profile while the lower side indicated the standard/reference JCPDS (Joint Committee on Powder Diffraction Standard) library file. Figure 1 (a-d) showed the XRD spectrum of Al_2O_3 (0%)-TiO_2 (100%), Al_2O_3 (5%)-TiO_2 (95%), Al_2O_3 (10%)-TiO_2 (90%) and Al_2O_3 (15%)-TiO_2 (85%) powders respectively. From XRD results, the crystallite sizes of Al_2TiO_5 powder were 84.1 nm for Al_2O_3 (0%), 88.3 nm for Al_2O_3 (5%), 98.0 nm for Al_2O_3 (10%) and 81.7 nm for Al_2O_3 (15%) respectively. Table 1 showed the lattice parameters (a, b, c), diffraction angles (2θ) and FWHM of Al_2TiO_5 powder with various Al_2O_3 contents. Table 2 showed the most dominant peak, crystal structure and crystallite size of Al_2TiO_5 powder with various Al_2O_3contents. The crystallite size was calculated using a well-known Debye Scherrer's formula:

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$$G = \frac{0.899 \times \lambda}{FWHM \times \cos\theta}$$

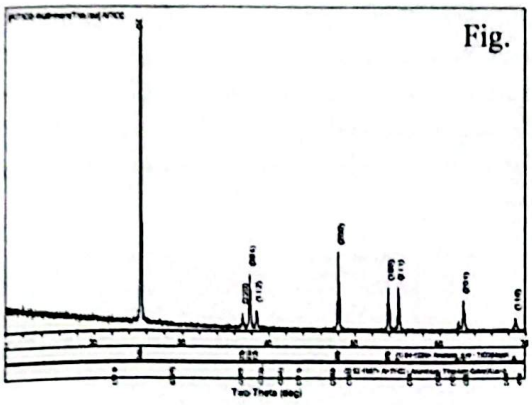
G = crystallite size (nm)

λ = 1.54056 Å for Cu K_α

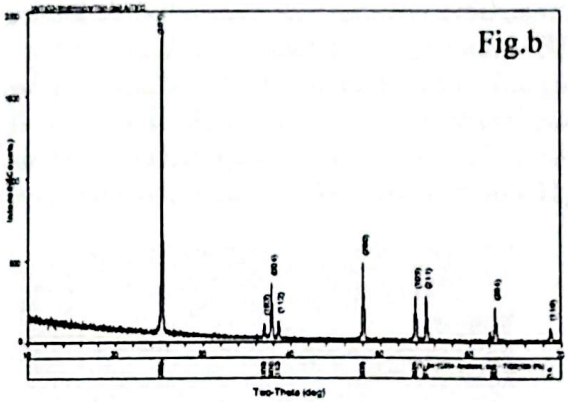
FWHM = full width at half maximum at dominant peak(rad),

θ = Bragg angle(°).

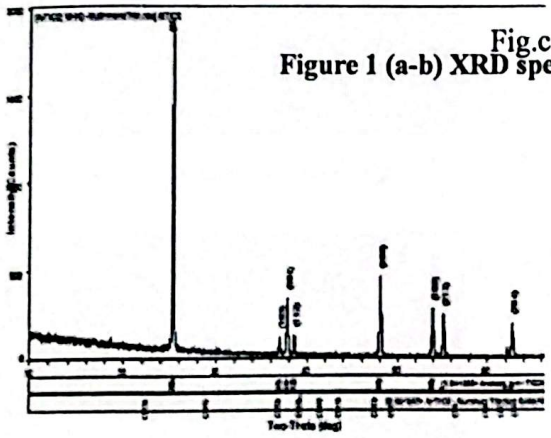
From the XRD curves of TiO_2 raw powder, the maximum intensity was caused by 2θ of 25.308°. The interplaner spacing d was determined by 3.5163 Å. Lattice parameter a = b = 3.7843 Å and c = 9.5123 Å . From the XRD curves, it was seemed that all profiles were remarkably difference. Agreement at lattice constant value (a=b≠c) proved that TiO_2 has tetragonal structure.



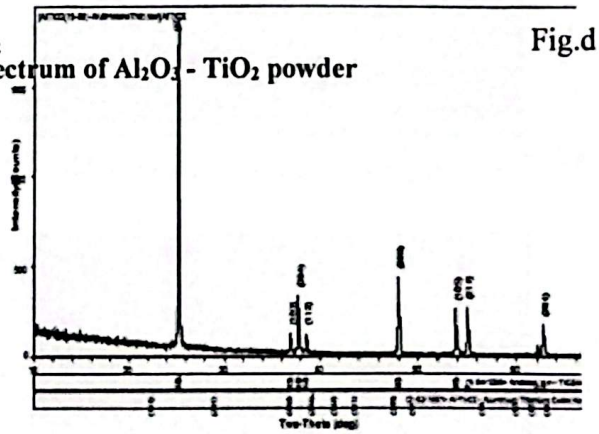
Al_2O_3 0%



Al_2O_3 5%



Al_2O_3 10%



Al_2O_3 15%

Figure 1 (a-b) XRD spectrum of Al_2O_3 - TiO_2 powder

Figure. 1 (c-d) XRD spectrum of Al_2O_3- TiO_2 powder

Table 1. Lattice parameters (a, b, c), diffraction angles (2θ) and FWHM of Al_2TiO_5 powder withvarious Al_2O_3 contents

Al_2O_3 Content (%)	Lattice parameter (Å)			2θ(°)	FWHM(rad)
	a	b	c		
0	3.7843	3.7843	9.5128	25.308	0.139
5	7.0263	7.0263	4.8644	25.300	0.136
10	7.0233	7.0233	4.8597	25.320	0.130
15	7.0238	7.0238	4.8626	25.309	0.141

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Table 2. Crystallized size and crystal structure of Al_2TiO_5 powder with various Al_2O_3 contents

Dominant peak	Al_2O_3 Content (%)	Crystallite size (nm)	Type of Structure
(101)	0	84.1	Tetragonal
(101)	5	88.3	Tetragonal
(101)	10	98.0	Tetragonal
(101)	15	81.7	Tetragonal

Morphology Analysis

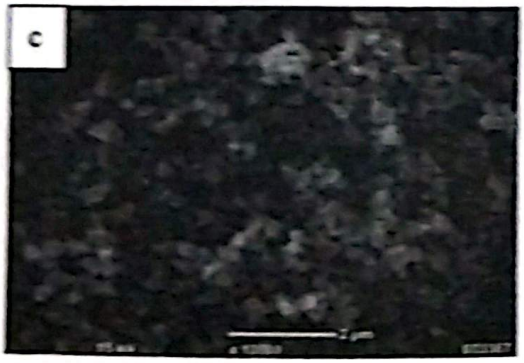
The microstructural properties of Al_2TiO_5 powder were observed by using Scanning Electron Microscopy (SEM). Materials evolutions were obtained grain size, surface roughness and pore distribution. Figure 2 (a-d) showed the SEM photographs of Al_2TiO_5 crystalline powder with various Al_2O_3 contents (0%, 5%, 10%, 15%). As detail analysis of SEM micrograph, it looked crack-free and little dense. Porosity and grain growth pattern were significantly observed on SEM images. These images were smooth and the grain distribution was uniform but some of grain sizes were slightly larger. According to SEM results, these Al_2TiO_5 powders were composed of regular and sphere grains with average sizes ranging from (164.66 nm - 214.74 nm) for various Al_2O_3 contents.



(a) SEM image of Al_2O_3 0%



(b) SEM image of Al_2O_3 5%



(c) SEM image of Al_2O_3 10%



(d) SEM image of Al_2O_3 15%

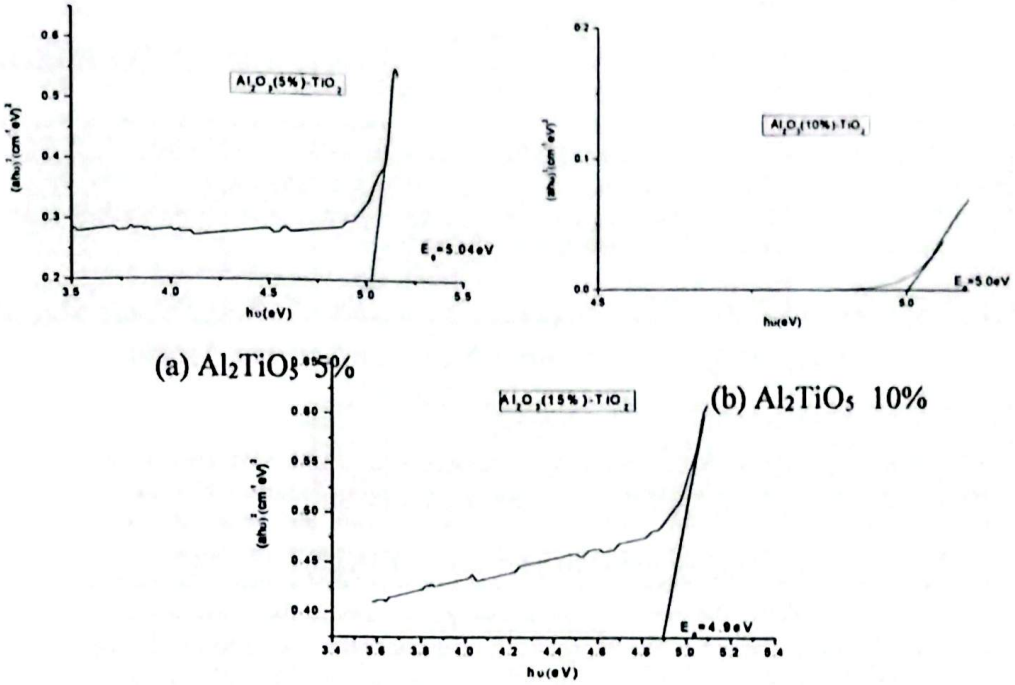
Figure 2 (a-d) SEM image of Al_2O_3 -TiO_2 powder

Optical Band Gap Analysis

The energy band gap of the material was determined by using UV-visible spectra according to Tauc relation $\alpha h\nu = A(h\nu - E_g)^n$, where E_g is the energy band gap, constant A is different for different transitions, ($h\nu$) is the energy of the photon and n is an index which assumes the value 1/2, 3/2, 2 and 3 depending on the nature of the electronic transition responsible for the reflection. The value of n is 1/2 for allowed and 2 for forbidden direct energy gap. Further, the value of α has been calculated by the following relation, $\alpha = 4\pi k/\lambda$,

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where λ is wavelength in nm and k is absorption index. Figure 3 a-c illustrated the energy band gap of the Al_2O_3 substituted TiO_2 powder. The value of optical energy band gap E_g has been calculated for the all samples by $(\alpha h\nu)^2$ vs $h\nu$ plots. The values of E_g for different samples were found by extrapolating the linear portion to the *hv* determine the energy band gap E_g to be from 4.9 to 5.04 eV. The energy band gap and maximum absorption wavelength values were shown in Table 3.



(a) Al_2TiO_5 5%

(b) Al_2TiO_5 10%

(c) Al_2TiO_5 15%

Figure. 3 The energy band gap of Al_2TiO_5 -Al_2O_3 content

Table 3. The energy band gap and maximum absorption wavelength values for Al_2TiO_5 powder with various Al_2O_3 contents

Sample	Wavelength (nm)	Energy band gap (eV)
Al_2O_3 (5%)-TiO_2	245	5.04
Al_2O_3 (10%)- TiO_2	247	5.00
Al_2O_3 (15%)- TiO_2	252	4.90

Conclusion

Fabrication of Al_2O_3 doped TiO_2 powder (x = 5 mol%, 10mol% and 15mol%) was performed by conventional solid-state mixed-oxide route. XRD investigation was carried out for identifying crystal structure and phase assignment. Although all XRD profiles were remarkably difference, lattice parameters were found to be composition dependence. From XRD results, the crystallite sizes of Al_2TiO_5 powders were 84.1 nm for Al_2O_3 (0%), 88.3 nm for Al_2O_3 (5%), 98.0 nm for Al_2O_3 (10%) and 81.7 nm for Al_2O_3 (15%) respectively.

Porosity and grain growth pattern were significantly observed on SEM images. These images were smooth and the grain distribution was uniform but some of grain sizes were slightly larger. According to SEM results, these Al_2TiO_5 powders were composed of regular and sphere grains with average sizes ranging from (164.66 nm-214.74 nm) for various Al_2O_3 contents.

The maximum absorption wavelength of Al_2O_3 (5%)-TiO_2 (95%), Al_2O_3 (10%)- TiO_2 (90%) and Al_2O_3 (15%)- TiO_2 (85%) were 245 nm, 247 nm and 252 nm respectively. The Al_2TiO_5 powders were successfully fabricated by ceramic method. The optical energy band

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gap of the resulted Al_2TiO_5 powers are in the range of 4.9 eV to 5.04 eV. These could be considered that it can be suitable to use as sensitized in DSSC by adding dyes.

Acknowledgements

We would like to express appreciation to Rector Dr Aung Win, University of Myitkyina, for his encouragement and kind permission to undertake the present research. We would like to thank Pro-rector Dr Aye Aye Ko, East Yangon University, for her kind permission to carry out our research work. We would like to express my profound thanks to Professor Dr Mya Mya (Ret.), Head of Department of Physics, University of Myitkyina, for her kind permission to carry out this research work.

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Global System for Mobile Communication and Motion Sensor Based Security System with Short Message Service Alerts

Yu Yu Nwe[1], Lei Lei Aung[2]

Abstract

The purpose of this research is to construct a security system with SMS alert. In this research, the whole system is developed by using GSM module, Arduino UNO module, motion sensor, PIC16F628A microcontroller, electric bell and other electronic components. The GSM module is used to send the SMS message to the predefined phone number. The Arduino UNO module is used to interface with GSM module. The motion sensor is used to detect the motion of the human and to provide the output signal to PIC16F628A microcontroller. The PIC16F628A microcontroller is used to apply the trigger signal to Arduino UNO module based on the output signal of motion sensor. The source code for PIC16F628A microcontroller is written by using Assembly language with the help of MPLAB IDE software. The electric bell is also used to produce alarm sound when the motion is detected. In the system operation, when a motion is detected inside the range of motion sensor, the electric bell will ring and the GSM module will also send the SMS alerts to specified mobile number.

Keywords: GSM, SMS, Arduino, PIC16F628A microcontroller, Motion sensor

Introduction

Nowadays, the need of security system is very essential due to increasing number of crime and burglary. The security system becomes the best solution to overcome house intrusion problem when user is not in house. We have lots of security systems in the market for both indoor and outdoor applications such as ultrasonic detectors, CCTV, microwave detectors, photoelectric detectors, infrared detectors etc.

The developed system is concerned with the Global System for Mobile Communication (GSM) and motion sensor based security system with Short Message Service (SMS) alerts. The developed system is designed with three main parts: the motion sensing, main processing and SMS sending. The motion sensing is the perception section that is done via motion sensor mounted at the building. The main processing is performed by the PIC16F628A microcontroller. The SMS sending is done through the use of interfacing between the GSM module and Arduino Uno module. An electronic motion detector is a device used to detect any physical movement in a given area and transforms motion into an electric signal. It consists of sensor that electrically connected to other devices such as security system, lighting, automatic door opener, and other applications.

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General Descriptions of Constructed Security System

The constructed security system contains six main units and they are motion sensor, main control unit (MCU), Arduino UNO module, GSM module, AC bell and power supply unit. The functions of motion sensor are to detect the motion of the human and to send the digital signal output to the main control unit. The functions of main control unit are to receive the output of motion sensor, to control the alarm unit and to trigger the Arduino UNO module. The function of the Arduino UNO module is to interface with GSM module. The function of GSM module is to send the SMS to the specified phone number. The function of AC bell is to produce alarm sound. The functions of power supply unit are to provide +4.5 V, +5 V and +12 V for other sections. The block diagram of the constructed security system is shown in Fig. 1.

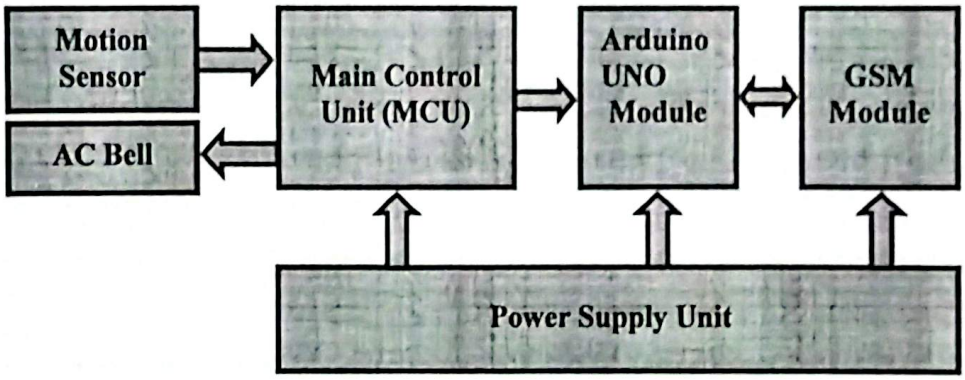
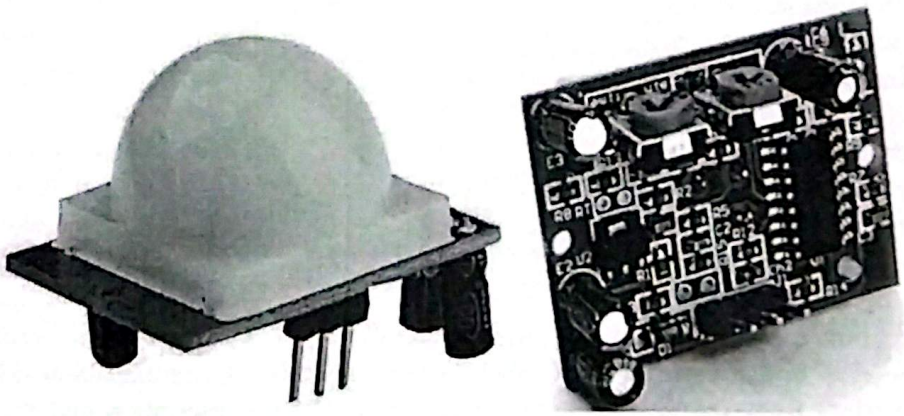


Figure. 1 Block diagram of constructed security system

Motion Sensor

The human body radiates heat in the form of infrared radiation. The presence of human body creates a sudden change in the infrared profile of the surrounding that is sensed by the motion sensor. The motion sensor module has an instrumentation circuit on board that amplifies this signal to appropriate voltage level to indicate the detection of motion. The motion sensor used in this research requires an initial stabilization time of about 10 to 60 seconds in order to function properly. The motion sensor modules usually have a 3-pin connection: V_{cc}, Output, and Ground. The pin out may vary and the photograph of motion sensor used in this research work is shown in Fig. 2. The output goes high when the motion is sensed.



(a) Front view **(b) Back view**

Figure. 2 Photograph of motion sensor

PIC16F628A Microcontroller

The PIC16F628A is 18-pin flash-based member of low cost, high performance, 8-bit microcontroller. The PIC16F628A have enhanced core features, eight-level deep stack, and multiple internal and external interrupt sources. PIC16F628A device have integrated features to reduce external components, thus reducing system cost, enhancing system reliability and reducing power consumption. The PIC16F628A has two ports, PORTA and PORTB. Some pins for these I/O ports are multiplexed with alternate functions for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin. The PIC16F628A can be operated in eight different oscillator options. The pin diagram and photograph of PIC16F628A microcontroller are shown in Fig. 3.



Figure. 3 Pin diagram and photograph of PIC16F628A microcontroller

Arduino UNO Module

Arduino is a small microcontroller board with a USB plug to connect to the computer. There are a number of connection sockets that can be wired up to external electronics, such as motors, relays, light sensors, laser diodes, loudspeakers, microphones, etc. They can either be powered through the USB connection from the computer or from a 9 V battery. They can be controlled from the computer or programmed by the computer and then disconnected and allowed to work independently. The top row of the Arduino has 14 digital pins, labeled 0-13. On the bottom left row, it has 3.3 V or 5 V supply and GND. On the bottom right row, it also contains the analog input pins, labeled A0-A5. The photograph of Arduino UNO module is shown in Fig. 4.

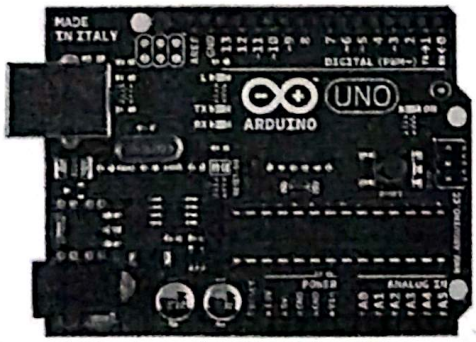


Figure. 4 Photograph of Arduino UNO module

GSM Module

GSM is an acronym for the Global System for Mobile Communication. The GSM network differs from the analog mobile network such that subscription and mobile are separated. The GSM module has many uses in many applications, including transfer of data between two machines in different places and remote control of a device. In this research, a SIM900A GSM module is used to send the SMS (short message service) from the constructed system to specified phone number. The supply voltage range of SIM900A GSM module is 3.2 V to 4.8 V. The module consumes around 300 mA current while under normal operating

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conditions, and around 2 A current during transmit bursts. The photograph of GSM module used in this research is shown in Fig. 5.

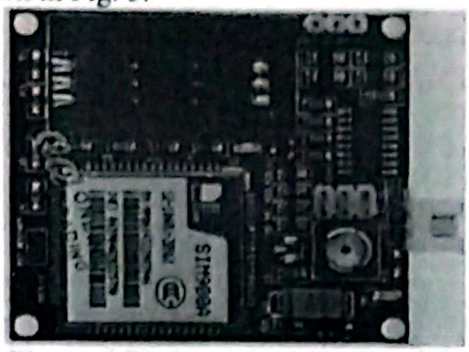


Figure. 5 Photograph of GSM module

Circuit Construction of GSM and Motion Sensor Based Security System

In this research work, the GSM and motion sensor based security system is designed and constructed with SMS alerts. The main control device of the whole system is PIC16F628A microcontroller. The internal oscillator of 4 MHz frequency is used as oscillating circuit of the microcontroller. In the microcontroller configuration, RB0 of microcontroller is used as digital input to monitor the output of motion sensor. RB4 of microcontroller is used as digital output to control the electric bell with the help of transistor. RA2 of microcontroller is used as digital output to provide the trigger signal to the Arduino UNO module. In circuit connection, the output of motion sensor is connected to the RB0 of PIC16F628A. RB4 of microcontroller is connected to the base of C9013 transistor via 1 kΩ resistor. The emitter of transistor is connected to the ground. The collector drives the relay.

In this work, three digital pins of Arduino UNO module are used and the analog pins are not used. Two digital pins (D2 and D3) of Arduino UNO module are used to perform serial communication with SIM900A GSM module and the remaining digital pin (D7) is used to receive the trigger signal of PIC16F628A microcontroller. In circuit connection, Vcc pin of Arduino UNO module and IN+ pin of LM2596 module are connected to +12 V power supply. Gnd pin of Arduino UNO module and IN- pin of LM2596 module are connected to the ground. The output of LM2596 module produces 4.5 V. OUT+ and OUT- of LM2596 module are wired to Vcc and Gnd of SIM900A GSM module respectively. D2 of Arduino is used as Rx pin and D3 of Arduino is used as Tx pin. Therefore, D2 pin of Arduino is connected to the Tx pin of GSM module and D3 pin of Arduino is connected to the Rx pin of GSM module. The communication between Arduino and GSM module is used as serial method.

In the regulated power supply circuit, AC 220 V main line is connected to the primary input of the step-down transformer. The secondary output of transformer is converted into DC voltage by using full wave bridge rectifier. The output of rectifier is filtered with 1000 µF capacitor. The filtered voltage is applied to the input of L7805 and L7812 voltage regulators. The common terminals of regulators are grounded and the output terminals produce +5 V and +12 V respectively. The output of +5 V line is filtered by using 0.1 µF capacitor and an LED is also provided at the output of L7805 to give the status of regulated power supply circuit. The output of +12 V line is filtered by using 100 µF capacitor. The complete circuit diagram of the whole system is shown in Figure. 6. The photograph of constructed security system is also shown in Fig. 7.

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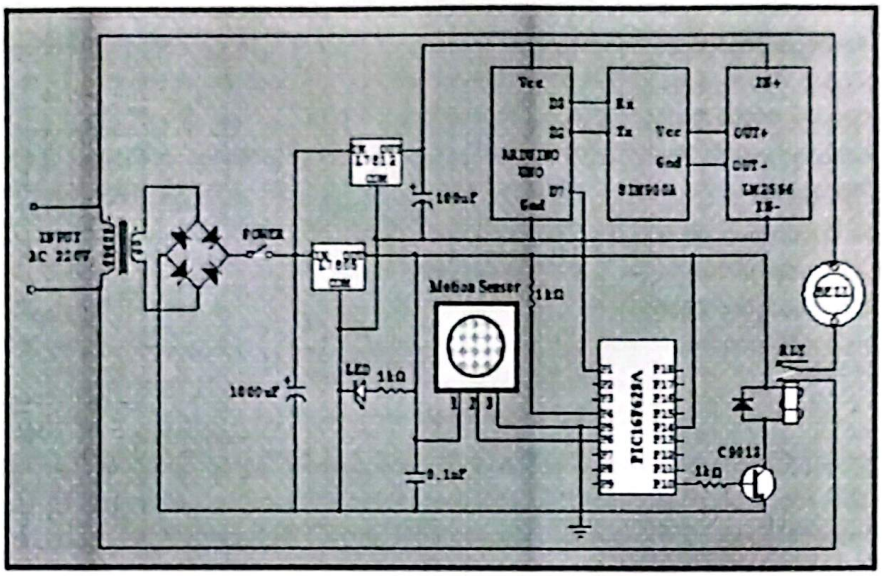


Figure. 6 Complete circuit diagram of the whole system

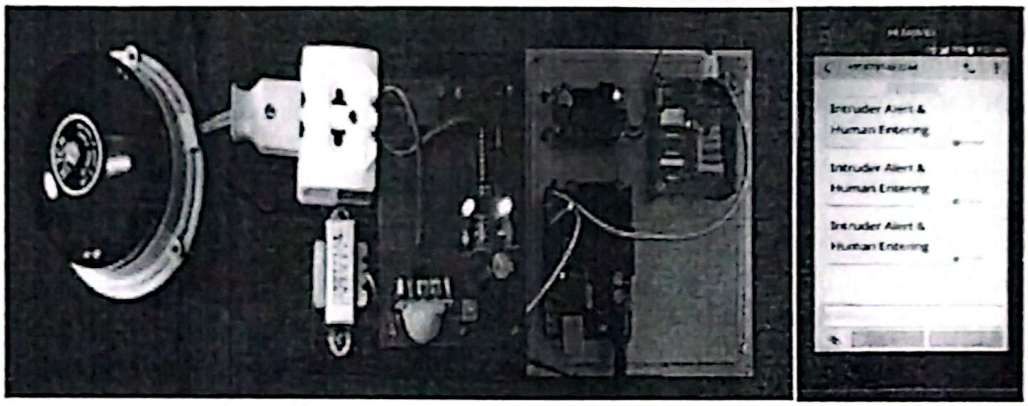


Figure. 7 Photograph of the constructed security system

Discussion

A GSM and motion sensor based security system is designed and constructed to perform sending SMS from the constructed system to specified phone number when the motion is detected. The main control device of the whole system is PIC16F628A microcontroller. An electric bell is provided in the constructed system to produce alarm sound. A SIM900A GSM module is also used to send the SMS message. The communication between Arduino UNO and SIM900A GSM module is performed by using serial method. The control program for the PIC16F628A is written by using Assembly language and converted to machine code by using MPLAB IDE v8.50 software. A PICKIT 2 programmer board is used to download the machine code from the personal computer into the PIC16F628A microcontroller.

When the motion sensor does not detect the motion, the output of sensor is logic "0" and PIC16F628A does not perform to activate the electric bell. When the motion sensor detects the motion, the output of sensor is logic "1" and PIC16F628A microcontroller performs to activate the electric bell. At this time, a message "*Intruder Alert & Human Entering*" is sent to the specified phone number via GSM module.

Conclusion

In this research work, a modern security system has been successfully designed, developed and tested. The motion sensor used in this research can detect the movement within the range of 20 feet well. The detection range of the motion sensor can be varied by using built-in potentiometer. The sensing capability of the motion sensor used in this research is reliable. The constructed system can be used for homes, universities, banks, hotels and other

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buildings to monitor the 24 hours security. By using the developed system, quick and reliable alert response is possible to prevent intruder.

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I would like to express our gratitude to Rector Dr Aung Win, University of Myitkyina, Pro and Pro-rector Dr Aye Aye Ko, East Yangon University, for their permission to perform this research. I am very deeply grateful to Professor Dr Mya Mya (Ret:), Head of Department of Physics, University of Myitkyina for her valuable guidance, helpful advice and technical suggestions to complete this research.

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Approximating Population Growth by the Logistic Model

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Abstract

In this paper, the Logistic model is discussed in order to predict the population growth in the real world. Firstly, the basic concepts of modeling are introduced and some basic definitions of differential equations are described as well. Next, some examples of first order differential equations are presented. Finally, the general solution of the Logistic model and its applications are studied, which helps us to explain population growth effectively in the real world.

Keywords: differential equations, modeling, population, logistic, application

Introduction

Many laws in Mathematics, Physics, Chemistry, Engineering and many other sciences appear in the form of differential equations. Differential equations are essential for a mathematical description of nature because they are the central part of many physical theories. Differential equations can describe how population changes, how heat moves, how spring vibrates, how radioactive material decays and much more. They are mutual ways to describe many things in the universe. The aim of this paper is a study of constructing a mathematical model from a physical problem and solving this model to interpret the situation of the physical problem.

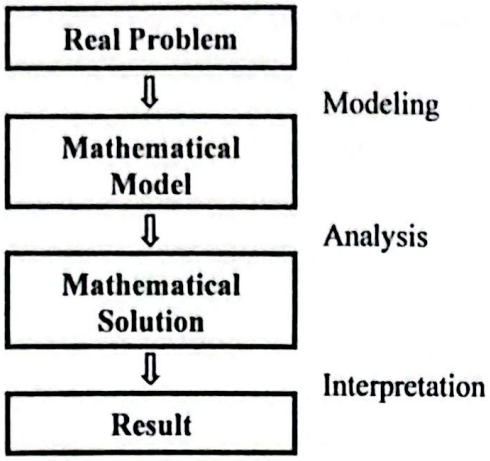
1. The Basic Concepts of Modeling

The translation from physical problem to a corresponding "mathematical model" is called modeling. There are five steps for solving problem. They are

(i) understanding the concepts in the application area,
(ii) comprehending the mathematical concepts,
(iii) using laws to develop the mathematical model,
(iv) solving the mathematical model and
(v) interpreting the result in physical problem.

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2. Basic Definitions and Examples of Differential Equations

In this section, we first state some definitions and examples of differential equations. They are needed to construct and solve the mathematical models.

2.1 Definitions

The process of finding the rate of change of given function is called **differentiation** and the function is said to be **differentiated**. If y is a function of the independent variable x, we say that y is differentiated with respect to x.

2.2 Definition

A differential equation is an equation contains one or several derivatives of an unknown function.

2.3 Definitions

An ordinary differential equation is an equation that contains one independent variable and one or several derivatives of an unknown function.

A partial differential equation is an equation that contains two or more independent variables and one or several derivatives of an unknown function.

The number of the highest derivative term in the equation is called the **order of the differential equation.**

The **degree of a differential equation** is the power of the highest ordered derivative involved in the equation.

We express some examples of differential equations as follows:

$$\frac{d^2y}{dx^2}+3\frac{dy}{dx}+7y=0. \tag{1}$$

$$\left[\frac{d^2y}{dx^2}+\left(\frac{dy}{dx}\right)^2\right]^4=\kappa^2\left(\frac{d^3y}{dx^3}\right)^2. \tag{2}$$

$$\frac{\partial u}{\partial t}=\kappa\frac{\partial^2 u}{\partial x^2}. \tag{3}$$

In the above examples, equation (1) is a second order ordinary differential equation with degree 1, equation (2) is a third order ordinary differential equation with degree 2, and equation (3) is a second order partial differential equation with degree 1.

2.4 Definition

An **initial value problem** is a differential equation along with an appropriate number of the initial conditions.

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2.5 The Example of An Initial Value Problem

We will solve the initial value problem $\frac{dy}{dx} = -6xy,\ y(0) = 7.$

We consider that

$$\frac{dy}{dx} = -6xy.$$

By using the method of separation of variables, we get

$$\frac{dy}{y} = -6x\,dx.$$

$$\int\frac{dy}{y} = -\int 6x\,dx + C, \text{ where C is an arbitrary constant}$$

$$\ln|y| = -3x^2 + C$$

$$y = e^{-3x^2 + C}$$

$$y = Ae^{-3x^2}, \text{ where } A = e^C.$$

When $y(0) = 7$, we obtain $A = 7$.

Therefore the general solution for this initial value problem is $y = 7e^{-3x^2}$.

3. The Mathematical Models for Population Growth

Population growth is defined as an increase in the size of a population over a specific time period. The growth rate is calculated using two factors known as the number of population and the unit of time. This rate is influenced by the birth rate and the death rate. The size of the population does not rise indefinitely because of the limitation of certain factors. These factors are water and nutrients, space and light as well as the existence of competitors. The explanation for population growth can be done using two growth models. These two models are called the exponential growth and the logistic growth. In this section we will mainly discuss the logistic growth model.

3.1 Definition of Population Growth

The rate of change of the population at a certain time is proportional to the total current population at that time.

Proof

Let P = the size of a population over a specific time period,
t = time and
κ = a population's per individual growth rate.

If P is the size of a population over a specific time period t and κ is a population's per individual growth rate, then we can describe the general differential equation for population growth rate as follows:

$$\frac{dP}{dt} = \kappa P.$$

When the individual growth rate κ is the constant of proportionality, we can get the exponential growth.

The exponential growth is $\frac{dP}{dt} = \kappa P.$

By using the method of separation of variables, we obtain

$$\frac{dP}{P} = \kappa\,dt.$$

By integrating to both sides, we get

$$\ln P = \kappa t + C, \text{ where C is an arbitrary constant}$$

$$P = e^{\kappa t + C}$$

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$$P = Ae^{\kappa t}, \text{where } A = e^{C}.$$

This $P = Ae^{\kappa t}$ is called the general solution for the exponential growth.

3.2 The Example of Exponential Growth

A culture of bacteria doubles in number every hour. If there were originally 1000 bacteria in the culture with an unlimited supply of nutrients, we can know how many bacteria will there be after 3 hours and when the population will reach 64000 bacteria, by exponential growth.

Let P be the size of population and κ be the individual rate at time t.

By population growth,

$$\frac{dP}{dt} = \kappa P.$$

For exponential growth,

$$P = Ae^{\kappa t}.$$

Then $P = 1000$ at $t = 0$.

The solution of the initial value problem is $P = 1000\, e^{\kappa t}$.

After one hour, $P = 2000$.

Then we get the value of $\kappa = 0.69315$.

Hence $P = 1000\, e^{0.69315t}$.

After 3 hours, we obtain

$$P = 1000\, e^{0.69315 \times 3}$$

$$P = 8000.$$

When $P = 64000$,

$$64000 = 1000\, e^{0.69315t}$$

$$64 = e^{0.69315t}$$

$$4.15888 = 0.69315\, t$$

$$t = 5.99.$$

The population will reach 64000 bacteria after 5 hours.

3.3 The Logistic Model and Its Applications

There are many assumptions of this exponential model. In particular, it is assumed that there are unlimited resources and there is no competition within the population. Exponential growth is not a very sustainable state of affairs since it depends on infinite amounts of resources which tend not to exist in the real world. This may happen for a while, if there are few individuals gets large enough, resources start to get used up, the growth rate will decrease. So we will discuss the more accurate mathematical model for population growth, called the logistic growth in the rest of this paper.

For this logistic growth, the rate of change of the population is proportional to the product of the current population P and $\frac{K-P}{K}$, where K is the maximum amount in the population that can be supported in an surrounding area, called the carrying capacity.

Then we can write the logistic differential equation

$$\frac{dP}{dt} = \kappa P \frac{K-P}{K}.$$

This equation can be rewritten in the form

$$\frac{dP}{dt} = \kappa P\left(1 - \frac{P}{K}\right).$$

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We can solve this differential equation by the method of separation of variables. First, we separate the variables and then integrate to get

$$\frac{1}{P\left(1-\frac{P}{K}\right)}\,dP = \kappa\,dt$$

$$\int\frac{1}{P\left(1-\frac{P}{K}\right)}\,dP = \int\kappa\,dt. \qquad (4)$$

In order to evaluate the left hand side, we can write it by the method of partial fractions as follows:

$\frac{1}{P\left(1-\frac{P}{K}\right)} = \frac{A}{P} + \frac{B}{1-\frac{P}{K}}$, where A and B are coefficients yet to be determined.

Then $1 = A\left(1-\frac{P}{K}\right) + B\,P.$

Hence A=1 and $B = \frac{1}{K}$.

Therefore $\frac{1}{P\left(1-\frac{P}{K}\right)} = \frac{1}{P} + \frac{\frac{1}{K}}{1-\frac{P}{K}}$

$$= \frac{1}{P} + \frac{1}{K-P}.$$

From equation (4), we have

$$\int\left(\frac{1}{P} + \frac{1}{K-P}\right)dP = \int\kappa dt$$

$$\int\frac{1}{P}dP + \int\frac{1}{K-P}dP = \int\kappa dt$$

$$\ln|P| - \ln|K-P| = \kappa\,t + C$$

$$\ln|K-P| - \ln|P| = -\kappa\,t - C$$

$$\ln\left|\frac{K-P}{P}\right| = -\kappa\,t - C$$

$$\left|\frac{K-P}{P}\right| = e^{-\kappa t - C}$$

$$\frac{K-P}{P} = Ae^{-\kappa t}, \text{ where } A = \pm e^{-C}$$

$$K-P = APe^{-\kappa t}$$

$$P + APe^{-\kappa t} = K$$

$$P\left(1+Ae^{-\kappa t}\right) = K$$

$$P = \frac{K}{\left(1+Ae^{-\kappa t}\right)}.$$

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Thus $P = \frac{K}{(1 + Ae^{-kt})}$ is called the general solution of the Logistic growth.

When $t = 0$, the initial population is $P_0 = \frac{K}{1 + A}$.

Then $P_0 + AP_0 = K$ and hence $A = \frac{K - P_0}{P_0}$.

Therefore we obtain $$P = \frac{K}{1 + \left(\frac{K - P_0}{P_0}\right)e^{-kt}}$$

$$= \frac{K}{\frac{P_0 + (K - P_0)e^{-kt}}{P_0}}$$

$$= \frac{P_0 K}{P_0 + (K - P_0)e^{-kt}}.$$

This is the general solution of the initial value problem for the Logistic model.

At any given point in time during a population's growth, the expression $K - P$ tells us how many more individuals can be added to the population before it reaches the carrying capacity. The more carrying capacity that has been used up, the more the $\frac{K - P}{K}$ term will reduce the growth rate. When the population is very tiny, P is very small compared to K. So the $\frac{K - P}{K}$ term becomes approximately $\frac{K}{K}$ or 1, giving us back the exponential equation.

3.4 The Example of Logistic Growth

Suppose a student carrying a flu virus returns to an isolated college campus of 1000 students. If it is determined that the rate at which the virus spreads is proportional not only to the number P of students infected but also to the number of students not infected. By using the Logistic growth, we can determine the number of infected students after 6 days given that the number of infected students after 4 days is 50.

By the Logistic growth,

$$\frac{dP}{dt} = 1000\kappa\left(1 - \frac{P}{1000}\right)P.$$

Then the general solution of the initial value problem for the Logistic growth is

$$P = \frac{K P_0}{P_0 + (K - P_0)e^{-\kappa t}}.$$

When $t = 0, P_0 = 1, K = 1000$, we get the solution of the initial value problem is

$$P = \frac{1000}{1 + 999e^{-1000\kappa t}}.$$

After 4 days, the population is $P = 50$.

Then $$50 = \frac{1000}{1 + 999e^{-4000\kappa}}.$$

Hence $\kappa = 0.0009906$.

Thus we get the general solution for this problem, $P = \frac{1000}{1 + 999e^{-0.9906t}}$.

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After 6 days, we have $P = \frac{1000}{1+999\,e^{-0.9906\times 6}} = 276.$

Finally, we can approximate the numbers of infected students are 276 students after 6 days.

3.5 Approximating the World's Population

In 1990, the world's population was around 5.3 billion. The birth rates at that time was approximately 40 million per year and death rates approximately 20 million per year. We can estimate the world's population in the year 2000 and predict the world population in the year 2050 by using the logistic growth. Assume that the carrying capacity for the world's population is 100 billion.

By the Logistic growth, we have the differential equation such as

$$\frac{dP}{dt} = \kappa P\left(1-\frac{P}{K}\right).$$

Then the general solution of the above equation is $P = \frac{K}{1+A\,e^{-\kappa t}}$.

When we set the year 1990 is time $t = 0$ and the population $P = 5.3\times 10^9$, we obtain the value of A is 17.87 approximately. At that time, the growth rate κ is about 0.0038.

After 10 years, we estimate the world's population is

$$P = \frac{100}{1+17.87e^{-0.0038\times 10}}$$
$$= 5.51967.$$

Thus the world's population is approximately 5.5 billion in the year 2000.

When we continually predict the world's population for the year 2050, the population is

$$P = \frac{100}{1+17.87e^{-0.0038\times 60}}$$
$$= 6.59844.$$

Finally, we can predict the world's population in 2050 is 6.6 billion.

3.6 Estimation of Myanmar's Population

In 2020, the population in Myanmar was around 54.41 million. The birth rates and the death rates at that time was 17.2 per 1000 people and 8.3 per 1000 people respectively. We can estimate the Myanmar's population in the year 2022 and predict the Myanmar population in the year 2050 by using the logistic growth. Assume that the carrying capacity for the Myanmar's population is one billion.

By the Logistic growth, we have the differential equation

$$\frac{dP}{dt} = \kappa P\left(1-\frac{P}{K}\right).$$

Then the general solution of the above equation is $P = \frac{K}{1+A\,e^{-\kappa t}}$.

When we set the year 2020 is time $t = 0$ and the population $P = 54.41\times 10^6$, we obtain the value of A is 17.379 approximately. At that time, the growth rate κ is about 0.000164.

After 2 years, we estimate the Myanmar's population is

$$P = \frac{10^9}{1+17.379\,e^{-0.000164\times 2}}$$
$$= 54426802.28.$$

Thus the Myanmar's population is approximately 54.43 million in the year 2022.

When we continually predict the Myanmar's population for the year 2050, the population is

$$P = \frac{10^9}{1+17.379\,e^{-0.000164\times 30}}$$

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$$= 54663611.47.$$

Thus we can approximate the Myanmar's population in 2050 will be 54.66 million.

4. Conclusion

We have observed that there is a slight discrepancy between Myanmar's population in theory and the data from daily webpage in early 2022. By using mathematical models, we can find the approximated solutions for real problems. We solve the mathematical model by using the methods of first order differential equations in Calculus to give the solutions of the real problems. The mathematical models make us easily to get the required information on reality.

Acknowledgements

First of all I would like to express my gratitude to Dr Aung Win, Rector, University of Myitkyina, whose permission to conduct this research paper. I wish to express to Dr Aye Aye Thant and Dr Zin Mar Latt, Pro-Rectors, University of Myitkyina, whose permission and encourage me to carry out my present research. It is my utmost desire to express my words of thanks to Professor Dr Daw Win Sein, Head of Department of Mathematics, University of Myitkyina, for encouragement to do this research paper.

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Some Applications of Newton's Cooling and Heating Laws

[1]Khaw Duq Lone Mawq

Abstract

In this paper, the mathematical models are constructed to interpret the solutions of the real problems by using Newton's cooling and heating laws. Firstly, the basic concepts of modeling are presented and some basic definitions of differential equations are also stated. Next, some examples of first order differential equations are described. Finally, Newton's cooling and heating laws with their applications are studied.

Keywords: mathematical modeling, differential equations, Newton's cooling and heating laws, applications

Introduction

Many laws in Mathematics, Physics, Chemistry, Engineering and many other sciences appear in the form of differential equations. Differential equations are essential for a mathematical description of nature because they are the central part of many physical theories. Differential equations can describe how population changes, how heat moves, how spring vibrates, how radioactive material decays and much more. They are mutual ways to describe many things in the universe. The aim of this paper is a study of constructing a mathematical model and solving this model to get a solution.

1. The Basic Concepts of Modeling

The translation from a physical problem to a corresponding "mathematical model" is called modeling. There are five steps for solving problem. They are

(i) understanding the concepts in the application area,
(ii) comprehending the mathematical concepts needed,
(iii) using laws to develop the mathematical model,
(iv) solving the mathematical model and
(v) interpreting the result in physical problem.

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2. Basic Definitions and Examples of Differential Equations

In this section, we first state some definitions and examples of differential equations. They are needed to construct and solve the mathematical models.

2.1 Definitions

The process of finding the rate of change of given function is called **differentiation** and the function is said to be **differentiated**. If y is a function of the independent variable x, we say that y is differentiated with respect to x.

2.2 Definition

A differential equation is an equation contains one or several derivatives of an unknown function.

2.3 Definitions

An ordinary differential equation is an equation that contains one independent variable and one or several derivatives of an unknown function.

A partial differential equation is an equation that contains two or more independent variables and one or several derivatives of an unknown function.

The number of the highest derivative term in the equation is called the **order of the differential equation.**

The **degree of a differential equation** is the power of the highest ordered derivative involved in the equation.

We express some examples of differential equations as follows:

$$\frac{d^2y}{dx^2}+3\frac{dy}{dx}+7y=0. \tag{1}$$

$$\left[\frac{d^2y}{dx^2}+\left(\frac{dy}{dx}\right)^2\right]^4=\kappa^2\left(\frac{d^3y}{dx^3}\right)^2. \tag{2}$$

$$\frac{\partial u}{\partial t}=\kappa\frac{\partial^2 u}{\partial x^2}. \tag{3}$$

In the above examples, equation (1) is a second order ordinary differential equation with degree 1, equation (2) is a third order ordinary differential equation with degree 2, and equation (3) is a second order partial differential equation with degree 1.

2.4 Definition

An **initial value problem** is a differential equation along with an appropriate number of the initial conditions.

2.5 Example of Solving an Initial Value Problem

We will solve the initial value problem $\frac{dy}{dx}=-6xy,\ y(0)=7.$

We consider that

$$\frac{dy}{dx}=-6xy$$

$$\frac{dy}{y}=-6x\,dx$$

$$\int\frac{dy}{y}=-\int 6x\,dx+C \quad \text{,where C is an arbitrary constant.}$$

$$\ln|y|=-3x^2+C$$

$$y=e^{-3x^2+C}$$

$$y=Ae^{-3x^2}, \text{ where } A=e^C.$$

When $y(0)=7,\ A=7.$

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Therefore $y = 7e^{-3x^2}$.

3. Newton's Cooling and Heating Laws with Applications

If we put a hot cup of coffee sit out in order to let it cool, then we are taking advantage of a phenomenon called heat transfer. Heat transfer takes place when any two objects of different temperatures are in contact with each other. In the case, the two objects are the coffee and the cooler air in the room around it. So we will conduct an experiment that is modeled by Newton's Law and we will calculate the time it should take for warm to cool down to room temperature.

3.1 Derivations of Newton's Cooling and Heating Laws

The rate of change of the temperature of a warming or cooling body is directly proportional to the difference between the temperature of the body and the surrounding temperature.

Proof

Let T = temperature of an object,
M = temperature of its surrounding and
t = time.

If T is the temperature of the body at time t and M is its surrounding temperature, then we can describe the following differential equation by Newton's Law;

$$\frac{dT}{dt} = \kappa\,(M - T), \kappa > 0.$$

Then we get $$\frac{dT}{M-T} = \kappa\, dt$$

$$-\ln|M-T| = \kappa t + C \text{ ,where C is an arbitrary constant.}$$

$$|M-T| = e^{-\kappa t - C}.$$

Here we need to consider whether $|M-T|$ is positive or negative. This depends on whether the object is cooling down to the surrounding temperature or is warming up to the surrounding temperature.

For cooling, we have $T > M$ and hence $M-T$ is negative, $|M-T| = -(M-T)$.

Thus we get

$$-(M-T) = e^{-\kappa t - C}$$

$$M-T = -e^{-\kappa t - C}$$

$$T = M + Ae^{-\kappa t}, \text{ where } A = e^{-C}.$$

Since the object is cooling down to the surrounding temperature, T will always be greater than M. So A will be a positive value. This agrees with the fact that $A = e^{-C}$ must be a positive value.

For heating, we obtain $T < M$ and hence $M-T$ is positive, $|M-T| = M-T$.

Then we have $$M-T = e^{-\kappa t - C}$$

$$T = M - Ae^{-\kappa t}, \text{ where } A = e^{-C}.$$

This time, as the object is warming up to the surrounding temperature, T is always less than M. So A is again a positive value.

3.2 Example

A thermometer is taken from a room that is $20^\circ C$ to the outdoors where the temperature is $5^\circ C$. After one minute, the thermometer reads $12^\circ C$. By Newton's Law of

Cooling, we can know what will the reading on the thermometer after one more minute and when the thermometer will read $6^{\circ}C$.

Let T be the temperature of thermometer and M be its surrounding temperature at time t. By Newton's Law, we have the differential equation such as

$$\frac{dT}{dt} = \kappa\,(M - T), \kappa > 0.$$

For cooling, we obtain

$$T = M + Ae^{-\kappa t}$$

$$T(0) = 20^{\circ}C.$$

The solution of the initial value problem is $T = 5 + 15\,e^{-\kappa t}$.

After one minute, $T(1) = 12^{\circ}C$.

Then we get the value of $\kappa = 0.76214$.

Hence $T = 5 + 15e^{-0.76214t}$.

After two minutes,

$$T = 5 + 15e^{-0.76214 \times 2}$$

$$T = 8.3^{\circ}C.$$

Thus the thermometer will read about $8.3^{\circ}C$ after two minutes being taken outside.

When $T = 6^{\circ}C$,

$$6 = 5 + 15e^{-0.76214t}$$

$$t = 3.55321$$

$$t = 3.5.$$

The thermometer will read $6^{\circ}C$ after being outside for about 3.5 minutes.

3.3 Example

At midnight, with the temperature inside at $70^{\circ}F$ and the temperature outside at $20^{\circ}F$, our furnace breaks down. Two hours later, the temperature in our house has fallen to $50^{\circ}F$. we assume that the outside temperature remains constant at $20^{\circ}F$. We can estimate at what time the inside temperature of our house will reach $40^{\circ}F$.

Let T be the temperature inside the room and M be temperature outside the room at time t.

By Newton's Law, we have

$$\frac{dT}{dt} = \kappa\,(M - T), \kappa > 0.$$

For cooling, we get

$$T = M + Ae^{-\kappa t}.$$

Assume $t = 0$ at midnight, $T(0) = 70^{\circ}F, M = 20^{\circ}F$.

The solution of the initial value problem is $T = 20 + 50\,e^{-\kappa t}$.

After two hours,

$$T(2) = 50^{\circ}F.$$

Then we get the value of $\kappa = 0.25541$.

Hence $T = 20 + 50\,e^{-0.25541t}$.

When the inside temperature of the house reach $40^{\circ}F$,

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$$40 = 20 + 50\,e^{-0.25541t}$$
$$t = 3.58753$$
$$t = 3.6.$$

Thus the temperature in the house will reach $40^{\circ} F$ after 3:30 a.m.

3.4 Application of Newton's Cooling Law in a Murder Investigation

In a murder investigation, a corpse was found by a detective at exactly 8 p.m. Being alert, the detective also measured the body temperature and found it to be $70^{\circ} F$. Two hours later, the detective measured the body temperature again and found it to be $60^{\circ} F$. If the room temperature is $50^{\circ} F$, and assuming that the body temperature of the person before death was $98.6^{\circ} F$, we can guess at what time the murder occurred.

Let T be the temperature of the person and M be the room temperature at time t.
By Newton's Law,

$$\frac{dT}{dt} = \kappa\,(M - T), \kappa > 0.$$

For cooling, we have

$$T = M + Ae^{-\kappa t}.$$

By taking time $t = 0$ at 8 p.m., $T(0) = 70^{\circ} F$ and $M = 50^{\circ} F$.
The solution of the initial value problem is $T = 50 + 20\,e^{-\kappa t}$.
After two hours,

$$T(2) = 60^{\circ} F.$$

Then we get the value of $\kappa = 0.34657$.
Hence $T = 50 + 20\,e^{-0.34657t}$.
By assuming that the body temperature of the person before death was $98.6^{\circ} F$.
Then we obtain

$$T = 50 + 20\,e^{-0.34657t}$$
$$98.6 = 50 + 20\,e^{-0.34657t}$$
$$t = -2.56.$$

Therefore it appears that this person was murdered at about 5:30 p.m.

3.5 Application of Newton's Heating Law in Heat Conducting Process

We can find the temperature inside our refrigerator without putting a thermometer inside. If we take a can of soda from the refrigerator and let it warm for half an hour, then record its temperature. We let it warm for another half an hour and record its temperature again. Suppose that the readings are $T\left(\frac{1}{2}\right) = 45^{\circ} F$ and $T(1) = 55^{\circ} F$. By assuming that the room temperature is $70^{\circ} F$, we can estimate what the temperature is inside the refrigerator.

Let T be the temperature inside the refrigerator and M be the outside temperature at time t.
By Newton's Law,

$$\frac{dT}{dt} = \kappa\,(M - T), \kappa > 0.$$

For heating, we have $T = M - Ae^{-\kappa t}$.

We consider that the time one half hour after the soda was removed from the refrigerator is the "zero time."

At $t=0$, $T(0)=45^{\circ}F$.

Thus the solution of the initial value problem is $T=70-25e^{kt}$.

After half an hour, $T\left(\frac{1}{2}\right)=55^{\circ}F$.

Then we get the value of $k=1.02165$.

Hence $T=70-25e^{1.02165t}$.

If the temperature of the refrigerator is the temperature of the can of soda at time $t=-\frac{1}{2}$,

then we get $T\left(-\frac{1}{2}\right)=70-25e^{1.02165\left(-\frac{1}{2}\right)}$.

Thus $T=28.3^{\circ}F$.

Therefore the temperature of the refrigerator is $28.3^{\circ}F$.

4. Conclusion

By using mathematical models, we can find the approximated solutions for real problems. We solve the mathematical model by using the methods of first order differential equations in Calculus to give the solutions of the real problems. The mathematical models make us easily to get the required information on reality.

Acknowledgements

First of all I would like to express my gratitude to Dr Aung Win, Rector, University of Myitkyina, for his encouragement and permission to conduct this research paper. I wish to express to Dr Aye Aye Kyi, Pro-Rector, East Yangon University, whose permission to me to carry out my present research. It is my utmost desire to express my words of thanks to Professor Dr Daw Win Yein, Head of Department of Mathematics, University of Myitkyina, for encouragement to do this research paper. I am deeply grateful to Dr Nang Bawk, Professor(Retd.), Department of Mathematics, University of Myitkyina, for her various piece of advices and invaluable encouragement on my research.

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The Collision of Elastic Bodies Based on the Newton's Experimental Law

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Abstract

This research paper focused on the collision of elastic bodies. Today, Newton's experimental law with momentum conservation is used to predict each body's velocity after a collision. An experiment with multiple body one-dimensional collisions is presented, aiming to measure the time at which they collide and velocities after the collision by tracking the motion of the system of bodies during the collision. To solve problems involving elastic collisions, collision, elasticity, the law of impacts such as the law of conservation of momentum and Newton's experimental law are defined. Besides the direct and oblique impact, the loss of kinetic energy that will form by the impact is also discussed together with some examples. Moreover, the whole distance described before the particle has finished rebounding and the whole time taken is presented with an example.

Keywords: momentum, collision, Newton's experimental law, coefficient of restitution, kinetic energy

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Introduction

Collision is a phenomenon that appears when one moving object is contacting violently with the other object. In this process, there are two different questions of collision. Whether it is elastic or inelastic? If two or more hard spheres collide, it may be nearly elastic. An elastic collision occurs when both the kinetic energy and momentum are conserved. An inelastic collision is one in which objects stick together after impact, and kinetic energy is not conserved. The large force acts directly on two bodies, such as, for example, two billiard balls, a golf club and a ball, blow of a hummer, a shot from a gun and a pile driver. When a ball made up of glass on a marble floor is dropped, it rebounds almost to its original height, but when the same ball is dropped on a wooden floor, it rebounds to a much smaller height. Further, the heights to which a wooden ball and an ivory ball rebound when they are dropped from the same height on a hard floor will be seen to be quite different. Although the balls from the same height are dropped, therefore their velocities are the same on reaching the floor, they rebound to different heights. It means that their initial rebounding velocities must be different.

1. Impact

Impact occurs when two bodies collide against each other during a very short time period and causing large impulsive forces to be exerted. There are two kinds of impact such as direct and oblique impact.

1.1 Direct impact: When the direction of motion of each body is along the common normal at the point where they meet, the impact between two bodies is said to be direct.

1.2 Oblique impact: When the direction of motion of one or both, is not along the common normal at the point when they meet, the impact between two bodies is said to be oblique.

2. Kinetic Energy

Kinetic energy of a body is its capacity to do work by its motion and is measured by the amount of work which this body will do in coming to rest.

A moving bullet has kinetic energy because it strikes a wall of sand, it penetrates it before coming to rest, thus doing work against the force of resistance offered by the sand. Hence it follows that before the bullet struck the wall it possessed kinetic energy.

The kinetic energy of a body of mass m moving with velocity v is $\frac{1}{2}mv^2$.

When the body of mass m is moving along a straight line under the action of a force F and v is its velocity at a distance x from a fixed point O on the line.

Then

$$F = m\frac{dv}{dt}.$$

Hence

the work done in bringing the body to rest $= -\int F\,dx$

$$= -m\int_{v}^{0}\frac{dv}{dt}dx$$

$$= -m\int_{v}^{0} v\,dv$$

$$= \frac{1}{2}mv^2.$$

3. Elasticity

When two balls of any hard material collide, they are slightly compressed, and, in many cases, when they are moving in opposite directions before impact, the velocity of one of them is reversed.When they generally tend to return to their original shape, they rebound. The property of solid bodies which causes these differences in velocities and causes they rebound after the collision is called **elasticity**. In an elastic collision, both the momentum and kinetic energy of the bodies are conserved.

The bodies are said to be **inelastic or plastic** when they do not tend to return to their original shape after compression and do not rebound after the collision. In inelastic collision, the momentum of the bodies is conserved, but kinetic energy is not conserved. Hence, the longer time the two objects are together, the larger the loss of energy will be. Two objects of masses m_1 and m_2 moving with velocities u_1 and u_2 impinge directly. After impact, v_1 and v_2 are velocities of two objects. The difference between elastic collisions and inelastic collisions is illustrated in the following Figures.

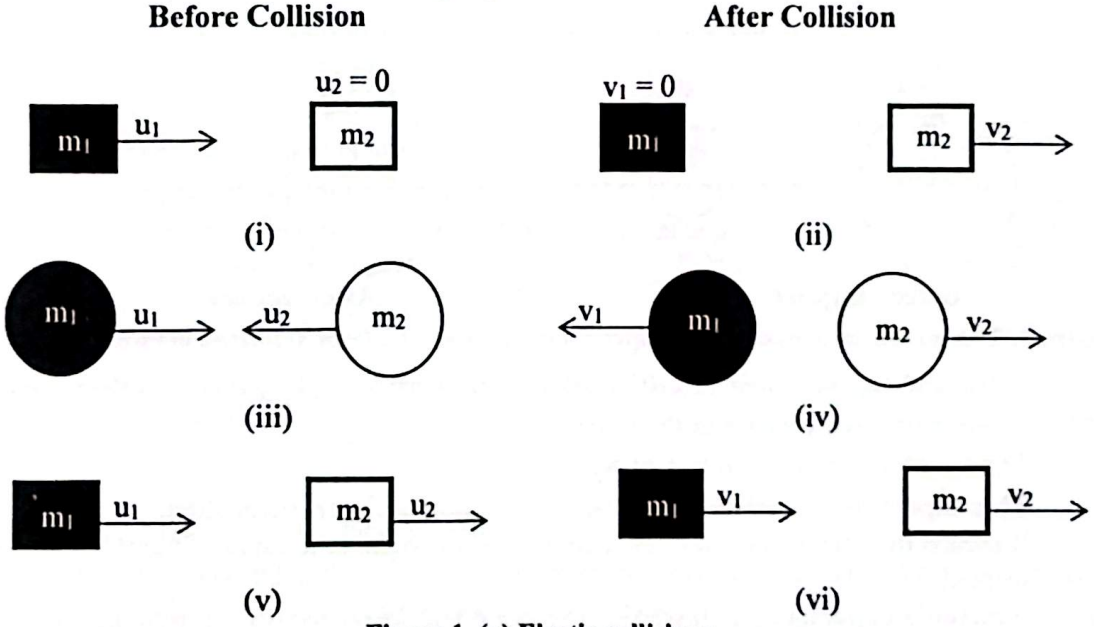


Figure 1. (a) Elastic collisions

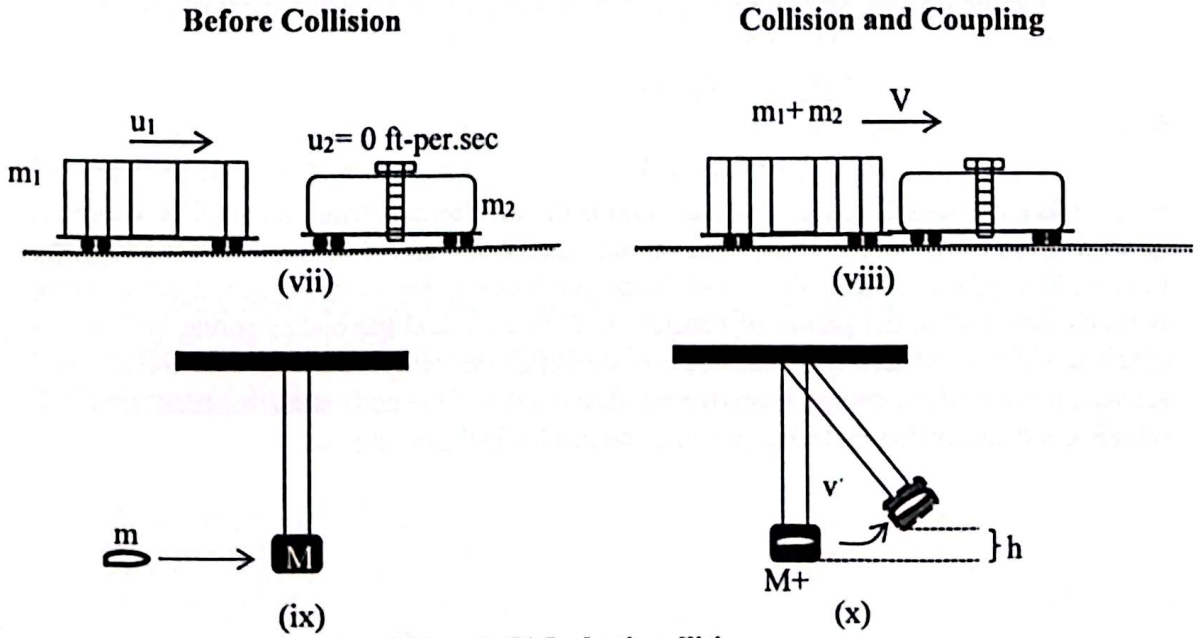


Figure 1. (b) Inelastic collisions

4. Compression and restitution

When two bodies collide, they remain in touch with each other for a very short interval of time before they separate. This short interval of time during which the impact lasts is divided into two parts:

(i) **The period of compression:** The time taken by the two bodies in compression, after the instant of collision, is called the period of compression.

(ii) **The period of restitution:** The time for which restitution takes place is called the period of restitution.

5. Law of Impacts

There are two laws of impact.

(i) **Law of conservation of linear momentum:** When two bodies A and B impinge on each other, by Newton's third law of motion, the action of A on B is different from B on A in that their actions are equal and opposite. When the time of contact for both the bodies is the same, the impulse of the action of A on B is equal and opposite to that of B on A.

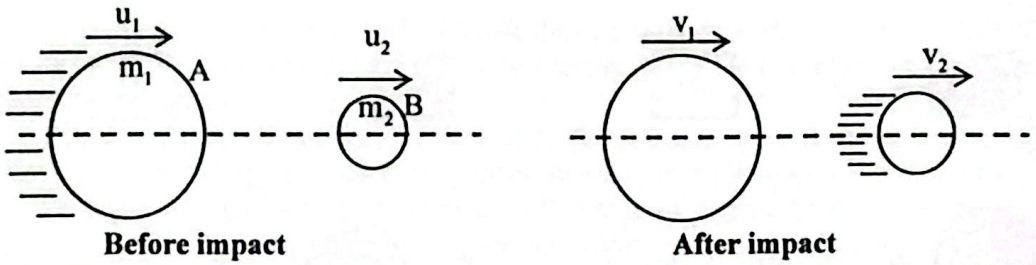


Figure 2. The masses of A and B are respectively m_1 and m_2, their velocities before impact are u_1 and u_2, and their velocities before impact are v_1 and v_2 such that the velocities are measured positive in the same direction

Then $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$. (1)

This expression is called the law of conservation of linear momentum.

It means that the sum of momenta after impact is equal to the sum of momenta before impact.

(ii) **Newton's experimental law:** Newton found that when two bodies impinge, the relative velocity of the bodies component along the line of centres after impact is $-e$ time the relative velocity immediately before impact. This statement can be written as

$$v_1 - v_2 = -e(u_1 - u_2)$$

(or)

$$v_2 - v_1 = e(u_1 - u_2), \quad (2)$$

where e is a constant for given materials and $0 \le e \le 1$. This constant e is called the coefficient of restitution or elasticity. It depends on the shape and material properties of the impacting bodies. When two bodies collide and deform each other, they store energy. If all the energy is recovered during the period of restitution, then $e = 1$ and the bodies spring back to their original shapes. Bodies for which $e = 1$ are called perfectly elastic bodies for an elastic impact. If none of the energy is recovered, then $e = 0$ and the body sticks together. Bodies for which $e = 0$ are called inelastic or plastic bodies for inelastic impact.

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6. Direct Impact of Two Spheres

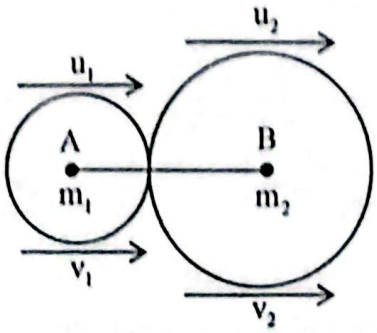


Figure 3. Two elastic spheres of masses m_1 and m_2 moving with velocities u_1 and u_2 impinge directly

After impact, two spheres move with velocities v_1 and v_2 along the line of centres AB in Figure 3. The momentum in the line of motion is unaltered by the impact. Then, by the law of conservation of linear momentum,

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

and, by Newton's experimental law,

$$v_1 - v_2 = -e(u_1 - u_2).$$

These equations determine the velocities after impact, namely

$$v_1 = \frac{(m_1 - em_2)u_1 + m_2u_2(1+e)}{m_1 + m_2} \tag{3}$$

and

$$v_2 = \frac{m_1u_1(1+e) + (m_2 - em_1)u_2}{m_1 + m_2}. \tag{4}$$

If $m_1 = m_2$ and $e = 1$, then $v_1 = u_2$ and $v_2 = u_1$.

Thus if two equal and perfectly elastic spheres moving in the same direction impinge directly, they will interchange their velocities after impact.

6.1 Impulse of the blow

The impulse of the blow on the blow of mass m = change of momentum of m

$$= m(u - v)$$

$$= \frac{m_1m_2(1+e)(u-v)}{m_1 - m_2}$$

by using the equation (3).

The impulse of the blow on the other ball m_2 is equal and opposite to that of m_1.

Example 6.2

A sphere weighing 5 lbs. traveling at $20\,fts^{-1}$ collides with another sphere weighing 10 lbs. traveling at $10\,fts^{-1}$ in the opposite direction. If $e = 0.8$, we can find the final velocity of each sphere as follow.

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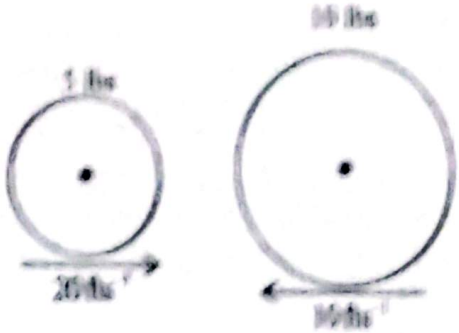


Figure 4. Before impact

Let u_1 and u_2 be initial velocities, and v_1 and v_2 be final velocities.

u_2 is in the opposite direction to u_1.

From the law of conservation of linear momentum,

$$v_1 + 2v_2 = 0,$$

and then from Newton's experimental law,

$$-v_1 + v_2 = 24.$$

From these two equations, final velocities $v_1 = 16\,\text{ft s}^{-1}$ and $v_2 = 8\,\text{ft s}^{-1}$ are obtained respectively. Therefore the second sphere slows down to $8\,\text{ft s}^{-1}$ while the first sphere now moves at $16\,\text{ft s}^{-1}$ in the opposite direction.

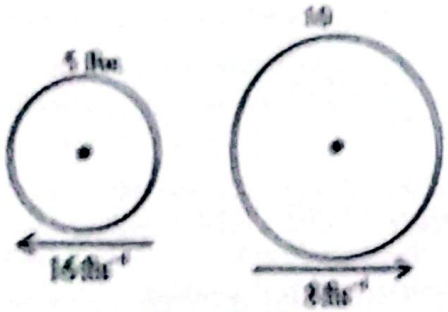


Figure 5. After impact

7. Loss of Kinetic Energy due to Direct Impact

When two elastic spheres of masses m_1 and m_2 moving with velocities u_1 and u_2, and coefficient of restitution e, impinge directly, the spheres move with velocities v_1 and v_2 after impact.

To find the loss of kinetic energy, m_1m_2 times the square of the equation (1) to the square of the equation (2) are added together,

$$(m_1v_1 + m_2v_2)^2 + m_1m_2(v_1 + v_2)^2 = (m_1u_1 + m_2u_2)^2 + m_1m_2e^2(u_1 - u_2)^2.$$

Now by adding and subtracting $m_1m_2(u_1 - u_2)^2$ in the right- hand side of the above equation,

$$(m_1^2 + m_1m_2)v_1^2 + (m_2^2 + m_1m_2)v_2^2 = \left[(m_1u_1 + m_2u_2)^2 + m_1m_2(u_1 - u_2)^2\right] + \left[m_1m_2e^2(u_1 - u_2)^2 - m_1m_2(u_1 - u_2)^2\right]$$

or

$$m_1(m_1 + m_2)v_1^2 + m_2(m_1 + m_2)v_2^2 = m_1(m_1 + m_2)u_1^2 + m_2(m_1 + m_2)u_2^2 - m_1m_2(u_1 - u_2)^2(1 - e^2).$$

Dividing both sides by $2(m_1 + m_2)$.

$$\frac{1}{2}m_1v_1^2+\frac{1}{2}m_2v_2^2=\frac{1}{2}m_1u_1^2+\frac{1}{2}m_2u_2^2-\frac{m_1m_2}{2(m_1+m_2)}(u_1-u_2)^2(1-e^2)$$

or

$$\left(\frac{1}{2}m_1u_1^2+\frac{1}{2}m_2u_2^2\right)-\left(\frac{1}{2}m_1v_1^2+\frac{1}{2}m_2v_2^2\right)=\frac{1}{2}\frac{m_1m_2}{2(m_1+m_2)}(u_1-u_2)^2(1-e^2).$$

Now kinetic energy before impact $=\frac{1}{2}m_1u_1^2+\frac{1}{2}m_2u_2^2$ (5)

and kinetic energy after impact $=\frac{1}{2}m_1v_1^2+\frac{1}{2}m_2v_2^2$. (6)

Therefore loss of kinetic energy $=\frac{1}{2}\frac{m_1m_2}{m_1+m_2}(u_1-u_2)^2$. (7)

Example 7.1

A smooth sphere P of mass m is moving with speed u on a smooth horizontal table when it collides directly with another smooth sphere Q of mass 3m, which is at rest on the table. The coefficient of restitution is e. The spheres have the same radius and are modeled as the particles. We can find the velocities after the collision. Immediately after the collision, total kinetic energy of the spheres is $\frac{1}{6}mu^2$. Then we can also find the volume of e and hence we can observe P is at rest after the collision.

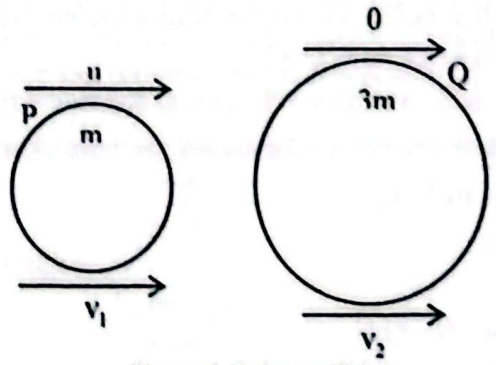


Figure 6. Before collision

If v_1 and v_2 are velocities of two smooth spheres after impact, by the laws of impact,

$$mu = mv_1 + 3mv_2$$

$$u = v_1 + 3v_2 \quad (8)$$

and

$$eu = -v_1 + v_2. \quad (9)$$

From the equations (8) and (9),

$$v_1 = \frac{u}{4}(1-3e) \text{ and } v_2 = \frac{u}{4}(1+e). \quad (10)$$

Since the total kinetic energy of the spheres is $\frac{1}{6}mu^2$,

$$\frac{1}{2}m\frac{u^2}{16}(1-3e)^2+\frac{1}{2}3m\frac{u^2}{16}(1+e)^2=\frac{1}{6}mu^2$$

$$e^2=\frac{1}{9}$$

$$e = \frac{1}{3}.$$

Substituting $e = \frac{1}{3}$ in the equation (10), the velocity of the smooth sphere P after the collision is not moving. It means $v_1 = 0$.

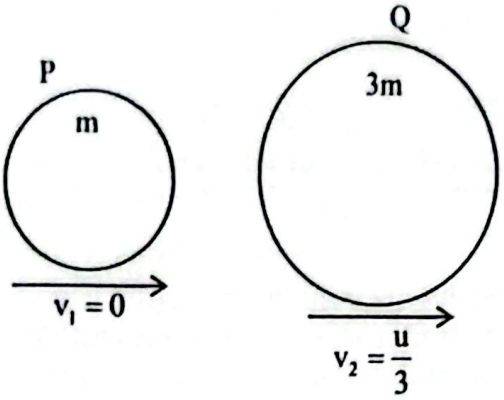


Figure 7. After collision

Example 7.2

Two bodies of equal masses impinge directly. If e is the coefficient of restitution, then we can show that the amount of kinetic energy gained by one body will be e times the amount lost by the other provided that before impact the bodies are moving in opposite directions with speeds proportional to $(3+e)$ and $(1-e)$.

The mass m of each body and their velocities in opposite directions are $(3+e)u$ and $(1-e)u$. If v_1 and v_2 are their velocities after impact, the laws of impact will give

$$m_1v_1 + m_2v_2 = m(3+e)u - m(1-e)u$$

or

$$v_1 + v_2 = 2(1-e)u \qquad (11)$$

and $$v_1 - v_2 = -e\left[(3+e)u + (1-e)u\right]$$

or

$$v_2 - v_1 = 4eu. \qquad (12)$$

By solving the equations (11) and (12),

$$v_1 = (1-e)u \text{ and } v_2 = (1+3e)u.$$

Loss of kinetic energy in the first body $= \frac{1}{2}m\left[(3+e)^2u^2 - (1-e)^2u^2\right]$

$= 4m(1+e)u^2.$

Gain in kinetic energy in the second body $= \frac{1}{2}m\left[(1+3e)^2u^2 - (1-e)^2u^2\right]$

$= 4me(1+e)u^2$

$=$ e (loss of kinetic energy in the first body).

Example 7.3

If two masses, m and n, are moving in the same straight line, then we can show that their kinetic energy is $\frac{1}{2}(m+n)V^2 + \frac{1}{2}\frac{mn}{m+n}v^2$, where V is the velocity of their center of mass, and v is their relative velocity. If there is a direct impact between the masses, then we

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can also show that their loss of kinetic energy is $\frac{1}{2}\frac{mn}{m+n}(1-e^2)v^2$, where e is their coefficient of restitution.

If u_1 and u_2 are the velocities of m and n, the velocity V of their center of mass is given by $V = \frac{mu_1 + nu_2}{m+n}$ and their relative velocity $v = u_1 - u_2$.

If E is their kinetic energy,

$$E = \frac{1}{2}mu_1^2 + \frac{1}{2}nu_2^2.$$

Multiplying both sides by $(m+n)$,

$$\begin{aligned}(m+n)E &= \frac{1}{2}m^2u_1^2 + \frac{1}{2}n^2u_2^2 + \frac{1}{2}mn(u_1^2 + u_2^2)\\ &= \frac{1}{2}(mu_1 + nu_2)^2 + \frac{1}{2}mn(u_1^2 + u_2^2) - mnu_1u_2\\ &= \frac{1}{2}(mu_1 + nu_2)^2 + \frac{1}{2}mn(u_1 - u_2)^2\\ &= \frac{1}{2}(m+n)^2V^2 + \frac{1}{2}mnv^2.\end{aligned}$$

Therefore $$E = \frac{1}{2}(m+n)V^2 + \frac{1}{2}\frac{mn}{m+n}v^2.$$

Now the velocity of the center of mass is unaffected by impact between the masses, and hence the first term remains unaltered. By Newton's experimental Law, the relative velocity v is multiplied by e and reversed, that is, it becomes – ev.

Hence the second term becomes, after the impact,

$$\frac{1}{2}\frac{mn}{m+n}e^2v^2$$

and the loss of kinetic energy is

$$\frac{1}{2}\frac{mn}{m+n}v^2(1-e^2).$$

8. Oblique Impact of a Smooth Sphere on a Fixed Smooth Plane

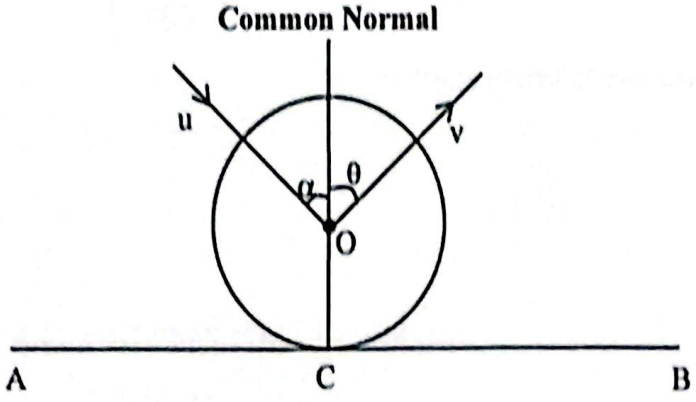


Figure 8. A smooth sphere of mass m strikes a fixed smooth plane AB at the point C with a velocity u making an angle α with the normal to the plane at C

If O is the centre of the smooth sphere, CO is the common normal. v is the velocity of the sphere after impact making an angle θ with the normal to the plane at C.

Since the plane and sphere are smooth, there is no force acting on the sphere in the direction perpendicular to the common normal at C, the impulse of the blow being perpendicular to the plane. Hence the velocity of the sphere remains unchanged in the direction perpendicular to the common normal.

Therefore

$$v \sin\theta = u \sin\alpha. \tag{13}$$

By Newton's experimental law along CO,

$$v \cos\theta = eu \cos\alpha. \tag{14}$$

By squaring and adding the equations (13) and (14),

$$v^2 = u^2(e^2 \cos^2\alpha + \sin^2\alpha). \tag{15}$$

The equation (15) gives the magnitude of the velocity of the sphere after impact.

By dividing the equations (13) and (14),

$$\cot\theta = e \cot\alpha. \tag{16}$$

The equation (16) gives the direction of motion of the sphere after impact.

Therefore loss of kinetic energy =kinetic energy before impact −kinetic energy after impact

$$= \frac{1}{2}mu^2 - \frac{1}{2}mv^2.$$

By using the equation (15),

$$\text{loss of kinetic energy} = \frac{1}{2}mu^2 - \frac{1}{2}mu^2(e^2\cos^2\alpha + \sin^2\alpha)$$

$$= \frac{1}{2}mu^2(1 - e^2\cos^2\alpha - \sin^2\alpha)$$

$$= \frac{1}{2}mu^2(1 - e^2)\cos^2\alpha.$$

If a sphere with velocity u impinges directly on a smooth fixed plane, it rebounds in the reverse direction with velocity eu. If a perfectly elastic sphere impinges on a smooth fixed plane, the sphere after impact rebounds so that the angle of reflection is equal to the angle of incidence. If a perfectly inelastic sphere impinges on a smooth fixed plane, it does not have the reverse direction, and its unaltered velocity parallel to the plane.

Example 8.1

If e is the coefficient of elasticity, the total time taken and the range can be found. Then it will keep rebounding from the plane for a time $\frac{2u\sin\alpha}{g(1-e)}$ and will have a range $\frac{u^2 \sin 2\alpha}{g(1-e)}$, e being the coefficient of elasticity.

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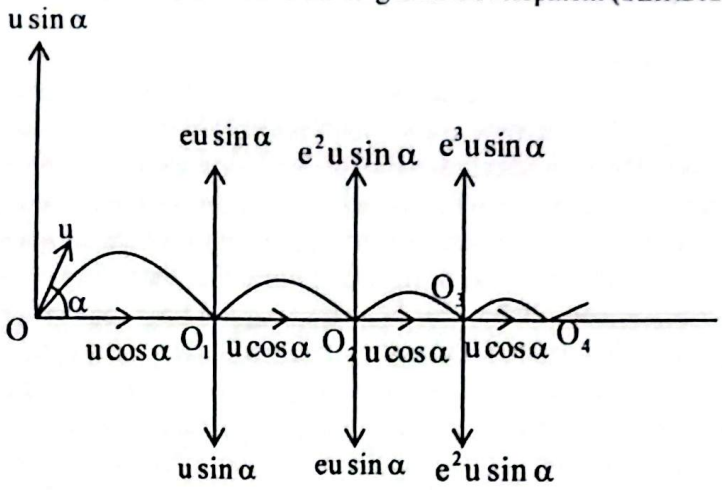


Figure 9. From a point in a smooth horizontal plane, a ball is projected with velocity u at an angle α to the horizon

The ball is projected from the point O with velocity u at an angle α to the horizon. After describing a parabolic path, it will strike the horizontal plane at the point O_1 with the same velocity u at the same angle α. The vertical and horizontal components of this velocity u are $u\sin\alpha$ and $u\cos\alpha$, respectively. The vertical component of velocity $u\sin\alpha$ becomes $eu\sin\alpha$ after the first rebound and the horizontal component of velocity $u\cos\alpha$ remains unaltered, since there is no horizontal force acting on the ball during the period of impact. At each continuous rebound, the vertical velocity will become e times the velocity before impact. In contrast, the horizontal velocity will remain constant.

Time of describing each parabolic path = Time of flight

$$= \frac{2(\text{vertical velocity})}{g}.$$

Hence the times of describing the first, second, third and so on parabolic paths are

$$\frac{2u\sin\alpha}{g}, \frac{2eu\sin\alpha}{g}, \frac{2e^2u\sin\alpha}{g}, \text{ etc.}$$

Therefore

$$\text{total time taken in describing all the parabolic paths} = \frac{2u\sin\alpha}{g} + \frac{2eu\sin\alpha}{g} + \frac{2e^2u\sin\alpha}{g} + \ldots$$

$$= \frac{2u\sin\alpha}{g}(1 + e + e^2 + \ldots)$$

$$= \frac{2u\sin\alpha}{g}.\frac{1}{1-e}$$

$$= \frac{2u\sin\alpha}{g(1-e)}.$$

Also

$$\text{the range} = \text{horizontal velocity} \times \text{total time}$$

$$= (u\cos\alpha)\frac{2u\sin\alpha}{g(1-e)}$$

$$= \frac{u^2\sin 2\alpha}{g(1-e)}.$$

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9. Conclusion

The collision time affects the amount of force that an object experiences during a collision. The greater the time over which the collision occurs, the smaller the force acting upon the object. Thus, to maximize the force experienced by an object during a collision, the collision time must be decreased. Likewise, to minimize the force, the collision time must be increased. There are several real-world applications of these phenomena. The airbags in automobiles increase the collapse time and minimize the effect of force on objects during a collision. Airbag accomplishes this by extending the time required to stop the momentum of the passenger and the driver. Other safety features such as seatbelts, crash mats, bike helmets, cushioned surface, etc., can reduce from dangerous conditions. Overall, the momentum of an object is conserved in elastic and inelastic collisions and kinetic energy is not conversed during in elastic collision. This is because some kinetic energy is transferred to some other form of energy, such as sound and thermal energy, during the collision.

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Methods of Solving Integer Linear Programming Problem

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Abstract

In this paper, the integer linear programming problem is calculated by using Branch and Bound Method, Gomory's Cutting Plane Method, MATLAB Programming Language and Excel Solver software to get the integer optimal solution. Firstly, we describe mathematical model of Integer Linear Programming Problem. Furthermore, we illustrate the Kachin Weaving Workshop problem for the integer linear programming problem. Then, we solve this problem by using Branch and Bound Method and Gomory's Cutting Plane Method. Finally, we use MATLAB Programming Language and Excel Solver software in computer to solve this problem.

Keywords: Integer linear programming problem; optimal solution; maximum; MATLAB; Excel

Introduction

Linear programming uses a mathematical model to solve the linear problems. The linear programming problem is a problem that is concerned with finding the optimal value of the linear problem. The integer linear programming problem is the linear programming problem with integer values. The integer linear programming is a natural extension of linear programming when the decision variables are integers. Three types of integer linear programming problems are mixed-integer problems if $x_j \geq 0$ and $x_j \in \not\in$ for some j, pure-integer problems if $x_j \geq 0$ and $x_j \in \not\in$ for every j and 0-1 integer problems if $x_j \in \{0,1\}$ for every j. The integer linear programming problem (ILPP) contains an objective function

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(maximum profit or minimum costs), decision variables and different constraints. We use the integer program to mean a linear optimization problem when some or all variables are required to be integers. The integer linear programming problem is solved by using linear programming to get the integer results. The general form of integer linear programming problem is

$$\begin{aligned} &\text{maximize } c^T x \\ &\text{subject to; } Ax \le b \\ &x \ge 0, x \in \not\in . \end{aligned} \tag{1}$$

Several variations to the above problem are possible. For example, instead of maximizing, we can minimize and the constraints may be in the form of equality and inequality, such as $Ax = b$ or $Ax \le b$.

1. Mathematical Model of Integer Linear Programming Problem

Linear programming is a mathematical modeling program in which a linear function is maximized or minimized with linear equality constraints and linear inequality constraints. If the objective function is the total profit, the constraints are some limited resources.

The technique of linear programming problem is maximum linear objective function,

$$f(x_1, \ldots, x_n) = \sum_{i=1}^{n} c_i x_i \text{, where } x_1, \ldots, x_n \text{ are n decision variables.} \tag{2}$$

A set of m linear constraints for maximum linear objective function are as follows.
Subject to;

$$\left.\begin{aligned} a_{11}x_1 + \ldots + a_{1n}x_n &= \sum_{i=1}^{n} a_{1i}x_i \le b_1 \\ a_{21}x_1 + \ldots + a_{2n}x_n &= \sum_{i=1}^{n} a_{2i}x_i \le b_2 \\ &\vdots \\ a_{m1}x_1 + \ldots + a_{mn}x_n &= \sum_{i=1}^{n} a_{mi}x_i \le b_m \end{aligned}\right\} \tag{3}$$

where $x_i \ge 0$ $(i = 1, 2, \ldots, n)$.

For integer linear programming problem, $x_i \ge 0$ and are all integers with m linear constraints. The formulation of the linear programming problem can also be written in matrix form as follows.

$$x = \begin{bmatrix} x_1 \\ M \\ x_n \end{bmatrix}_{n\times 1}, c = \begin{bmatrix} c_1 \\ M \\ c_n \end{bmatrix}_{n\times 1}, b = \begin{bmatrix} b_1 \\ M \\ b_m \end{bmatrix}_{m\times 1}, A = \begin{bmatrix} a_{11} & L & a_{1n} \\ M & O & M \\ a_{m1} & L & a_{mn} \end{bmatrix}_{m\times n} \tag{4}$$

Then the integer linear programming problem can be written as

$$\text{Maximize } c^T x \tag{5}$$

$$\text{Subject to; } \begin{cases} Ax \le b \\ x \ge 0, x \in \not\in \end{cases} \text{, where } \not\in \text{ is the set of integers.} \tag{6}$$

Here, the m linear inequality constraints and the n non-negative and integer constraints are described in matrix form as $Ax \le b$ and $x \ge 0, x \in \not\in$ .When the n decision variables are all integers, this linear programming problem is called the integer linear programming problem. This problem is also called pure-integer linear programming problem.

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2. Methods for Solving Integer Linear Programming Problem

The optimal solution of integer linear programming problem is the maximum total profit. The integer linear programming problem is solved by using Branch and Bound Method and Gomory's Cutting Plane Method.

2.1 Illustrative Example

The Northern Myanmar Weaving workshop is a small workshop with only three employees which makes Kachin longyi and Kachin oneset. They earn 20000 kyats profit for Kachin longyi and 30000 kyats profit for Kachin oneset per unit respectively. Sandar weaves Kachin longyi for 4 days per unit and can weave 26 days per month. Nandar weaves Kachin oneset for 8 days per unit and can weave 28 days per month. Muyar designs cottons on the weaving loom for Kachin longyi and Kachin oneset. She designs Kachin longyi and Kachin oneset for 1day per unit respectively and can work 9 days per month. The workshop would like to get maximum profit per month. So this workshop wishes to determine how many units of Kachin longyi and Kachin oneset to produce per month to maximize total profit.

Table 1. Data for Northern Myanmar Weaving workshop problem

Person	Production days per unit		Total work days per unit
	Kachin longyi	Kachin oneset	
Sandar	4		26
Nandar		8	28
Muyar	1	1	9
Profit per unit(kyat)	20000	30000	

The data in Table 1 can be written by linear programming model (LP model). Let x_i be the number of units for Kachin longyi and Kachin oneset to produce per month (i = 1,2).

By using (2), the objective function is Maximize $f(x_i) = \sum_{i=1}^{2} c_i x_i \quad (i = 1,2).$ (7)

Let $f(x_i) = Z$

$$Z = 2x_1 + 3x_2. \tag{8}$$

By using (3), the constraints are

$$\left.\begin{aligned} 4x_1 &\le 26 \\ 8x_2 &\le 28 \\ x_1 + x_2 &\le 9 \\ x_1,\ x_2 &\ge 0 \text{ and are integers.} \end{aligned}\right\} \quad \text{Subject to;} \tag{9}$$

So this linear programming problem is the integer linear programming problem because x_1 and x_2 are integers. The results of the problem are $x_1 = 6$, $x_2 = 3$ and the maximum profit that is 210,000 kyats. This problem can be solved by using Branch and Bound Method and Gomory's Cutting Plane Method to get this maximum profit.

2.1.1 Branch and Bound Method

Branch and Bound Method is based on Graphical Method but this method calculates to get integer decision variables.

The constraints are used to draw the straight lines with equation forms.

$4x_1 = 26$

$x_1 = 6.5$

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The line cuts at the point (6.5, 0).

$8x_2 = 28$

$x_2 = 3.5$

The line cuts at the point (0, 3.5).

$x_1 + x_2 = 9$

x_1	0	9
x_2	9	0

The line cuts at the points (0,9) and (9,0).

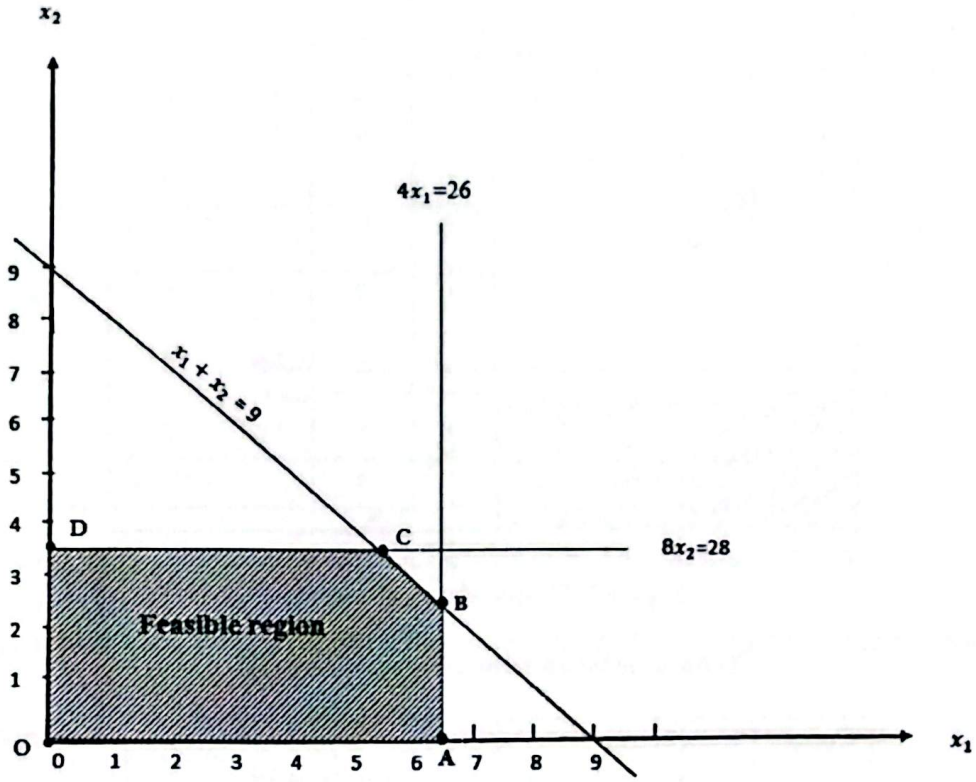
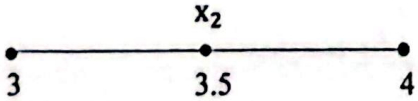


Figure 1. Graph of the feasible region

Table 2. Solution table of problem

Corner	Coordinate (x_1, x_2)	Value of objective function $Z = 2x_1 + 3x_2$
O	(0,0)	0
A	(6.5,0)	13
B	(6.5,2.5)	20.5
C	(5.5,3.5)	21.5
D	(0,3.5)	10.5

The optimal solution is $x_1 = 5.5$, $x_2 = 3.5$, $Z = 21.5$ and then the results of variables are not integers. So this problem is divided into sub-problems with x_2 to get integer results.



Sub-problem (1)

Maximize: $Z = 2x_1 + 3x_2$

Sub-problem (2)

Maximize: $Z = 2x_1 + 3x_2$

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Subject to; $4x_1 \le 26$
$8x_2 \le 28$
$x_1 + x_2 \le 9$
$x_2 \le 3$

Subject to; $4x_1 \le 26$
$8x_2 \le 28$
$x_1 + x_2 \le 9$
$x_2 \le 4$

The sub-problem (2) is infeasible.

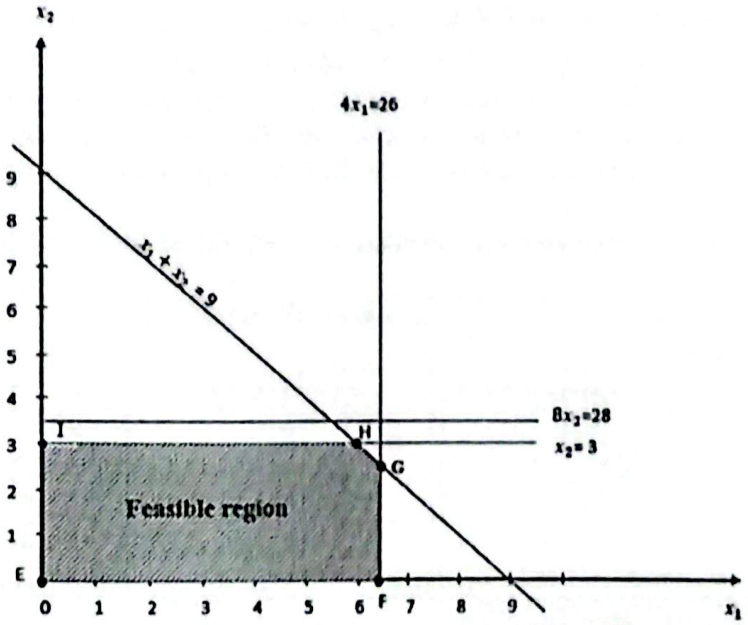


Figure 2. Graph of the sub-problem (1)

Table 3. Solution table of sub-problem (1)

Corner	Coordinate (x_1, x_2)	Value of objective function $Z = 2x_1 + 3x_2$
E	(0,0)	0
F	(6.5,0)	13
G	(6.5,2.5)	20.5
H	(6,3)	21
I	(0,3)	9

The optimal integer solution is x_1=6, $x_2 = 3$ and Z=21.Therefore, the maximum total profit is 210,000 kyats.

2.1.2 Gomory's Cutting Plane Method

Gomory's Cutting Plane Method is based on simplex method. This method uses simplex method and dual simplex method. First this problem is reformulated into the standard form in which all constraints are expressed as equalities.

Any constraints in inequality form by (3) are

$$a_{i1}x_1 + L + a_{in}x_n \le b_i \quad (i=1, 2,\ldots, m). \tag{10}$$

We convert to an equality form,

$$a_{i1}x_1 + L + a_{in}x_n + s_i = b_i \text{ , where } s_i \ge 0 \text{ is a slack variable.} \tag{11}$$

Then, this problem is converted equality forms.

Maximize Z, $Z = 2x_1 + 3x_2 + 0s_1 + 0s_2 + 0s_3$

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$6x_1 + s_1 = 26$

$8x_1 + s_2 = 28$

$x_1 + x_2 + s_3 = 9$ and $x_1, x_2, s_1, s_2, s_3 \geq 0$, then they are integers

Table 4. Solution table of Simplex method (step 1)

		c_j	2	3	0	0	0	
Basic variable	c_B	x_B	x_1	x_2	s_1	s_2	s_3	x_B/x_2
s_1	0	26	6	0	1	0	0	
s_2	0	28	0	8	0	1	0	3.5
s_3	0	9	1	1	0	0	1	9
	$Z = 0$		-2	-3	0	0	0	$\Delta_j = c_B x_2 - c_j$
s_1	0	26	6	0	1	0	0	6.5
x_2	3	3.5	0	1	0	1/8	0	
s_3	0	5.5	1	0	0	-1/8	1	5.5
	$Z = 10.5$		-2	0	0	3/8	0	$\Delta_j = c_B x_2 - c_j$
s_1	0	4	0	0	1	1/2	-6	
x_2	3	3.5	0	1	0	1/8	0	
x_1	2	5.5	1	0	0	-1/8	1	
	$Z = 21.5$		0	0	0	1/8	2	$\Delta_j = c_B x_2 - c_j$

The optimal solution is $x_1 = 5.5$, $x_2 = 3.5$ and $Z = 21.5$. This solution is not integer results. So we go to next step.

Step 2. To obtain the integer-valued solution, we proceed to construct Gomory's fractional cut.

The values of variables are $x_1 = 5 + \frac{1}{2}$ = Integer + fractional value of x_1 and

$x_2 = 3 + \frac{1}{2}$ = Integer + fractional value of x_2.

Maximize (fractional value of x_1, fractional value of x_2) = Max $(\frac{1}{2}, \frac{1}{2}) = \frac{1}{2}$ = fractional value of x_2

We construct the Gomorian constraint for equation (2) from the bottom of step 1 table that is x_2,

$$3\frac{1}{2} = x_2 + \frac{1}{8}s_2$$

$$\frac{1}{2} + (3 - x_2) = \frac{1}{8}s_2$$

$$\frac{1}{2} \leq \frac{1}{8}s_2$$

$$-\frac{1}{8}s_2 \leq -\frac{1}{2}.$$

This inequality form is converted the equality form by adding Gomory's slack variable g_1,

$$-\frac{1}{8}s_2 + g_1 = -\frac{1}{2}.$$

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Step 3. We add this additional constraint to the bottom of the step 1 table.

Table 5. The bottom of step 1 table with Gomorian constraint

	c_j		2	3	0	0	0	0
Basic variable	c_B	x_B	x_1	x_2	s_1	s_2	s_3	g_1
s_1	0	4	0	0	1	$1/2$	-4	0
x_2	3		0	1	0	$1/8$	0	0
x_1	3.5		1	0	0	$-1/8$	1	0
g_1	2	5.5	0	0	0	$-1/8$	0	1
	0	-0.5						
	Δ_j		0	0	0	$1/8$	2	0

$Z = 21.5, x_1 = 5.5, x_2 = 3.5, g_1 = -0.5$

Step 4. We apply dual simplex method to find leaving variable and entering variable.

Leaving variable: $\min(x_B) = \min(4, 3.5, 5.5, -0.5) = -0.5 = g_1$

Entering variable: $\max\left(\frac{\Delta_j}{x_{ij}}\right) = \frac{\Delta_4}{x_{44}} = \frac{1/8}{-1/8} = -1$ where $x_{ij} < 0$ and x_{ij} is from the row of leaving variable (g_1), that is s_2. Therefore, the entering vector is s_2.

Step 5. We remove g_1 and insert s_2 by using dual simplex method.

Table 6. The dual simplex table

	c_j		2	3	0	0	0	0
Basic variable	c_B	x_B	x_1	x_2	s_1	s_2	s_3	g_1
s_1	0	2	0	0	1	0	-4	
x_2	3	3	4		0	1	0	0
x_1	2	6	0	1				
s_2	0	4	1	0	0	0	1	-
			1					
			0	0	0	1	0	-
			8					
		Δ_j	0	0	0	0	2	
			1					

$Z = 21$

The optimal integer solution is $x_1 = 6$ and $x_2 = 3$. The maximum total profit is 210,000 kyats.

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3. Using MATLAB Programming Language to Solve the Integer Linear Programming Problem

Let c be a column vector of length n, b be a column vector of length m and A be a $m \times n$ matrix. A linear program associated with c, A, and b is

the minimum problem $\quad$ minimize $c^T x$

or

the maximum problem $\quad$ maximize $c^T x$.

The constraints are $\quad Ax \le b$

$$A_{eq}x = b_{eq}$$

$$lb \le x \le ub$$

Where c = linear objective function vector c,
A = matrix for linear inequality constraints,
b = vector for linear inequality constraints,
lb = vector of lower bounds,
ub = vector of upper bounds,
A_{eq} = matrix for linear equality constraints,
b_{eq} = vector for linear equality constraints.

We note that x is a column vector of length n.

Integer linear programming problem is $\quad$ Maximize $Z = 2x_1 + 3x_2$

Subject to; $4x_1 \le 26$

$8x_2 \le 28$

$x_1 + x_2 \le 9$

and $x_1 \ge 0,\ x_2 \ge 0$, they are integers.

In MATLAB, the default operation mode of solvers is minimization. So, we need to transfer this problem to a minimization integer linear programming problem because this problem is a maximization problem. This problem must be changed to the negative signs of objective function. This problem is performed by changing of maximize $Z = 2x_1 + 3x_2$ to minimize $Z = -2x_1 - 3x_2$.

In this problem, the objective function and constraints are formed by the vectors and matrix.

$$c = \begin{bmatrix} -2 \\ -3 \end{bmatrix}, x = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}, A = \begin{bmatrix} 4 & 0 \\ 0 & 8 \\ 1 & 1 \end{bmatrix}, b = \begin{bmatrix} 26 \\ 28 \\ 9 \end{bmatrix}, lb = \begin{bmatrix} 0 \\ 0 \end{bmatrix}, ub = [\,], A_{eq} = [\,], b_{eq} = [\,]$$

In this case, after running this optimization problem, we should change the sign of the output value of the objective function in order to match the ordinary objective function.

Step 1.

(1) First, click on "New Script" to write MATLAB code and then save with file name.

(2) MATLAB code of this problem can be written as [x z] =linprog (c^T,A,b,A_{eq},b_{eq},lb,ub).

(3) After writing the following MATLAB code, click on "Run" at MATLAB.

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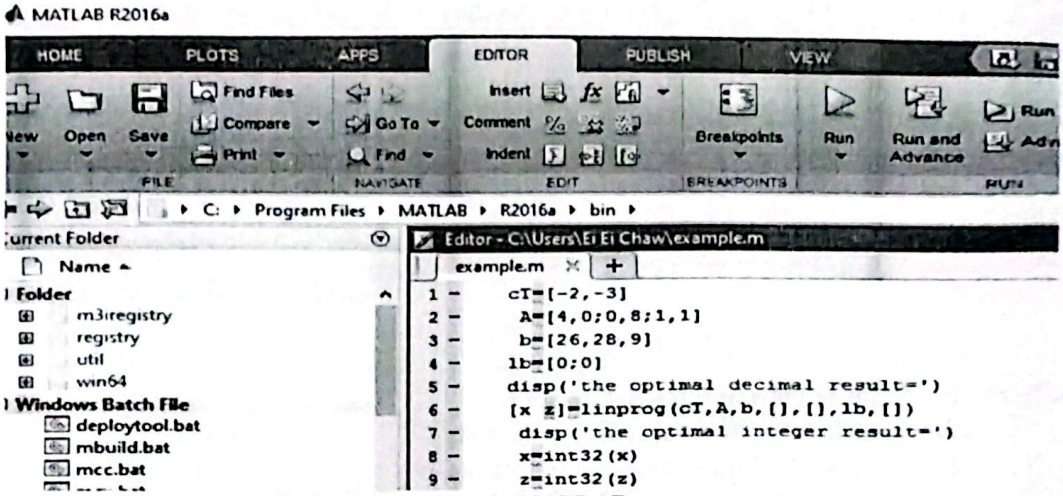


Figure 3. The step 1 in MATLAB

Step 2. After clicking on "Run" at MATLAB, this problem gets the optimal decimal result fast.

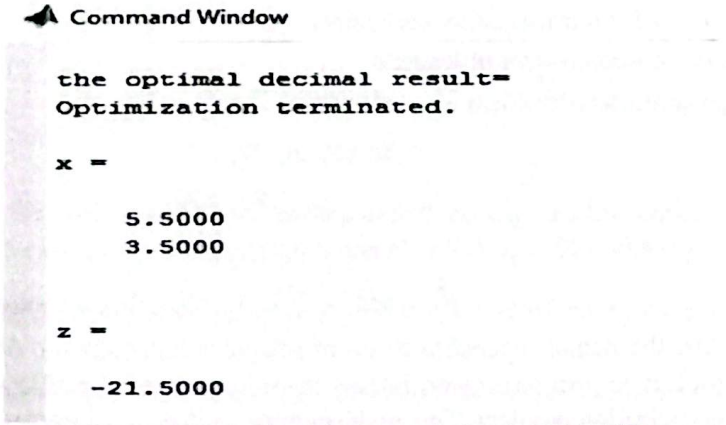


Figure 4. The optimal decimal solution in MATLAB

Step 3. Finally, this problem gets the optimal integer result.

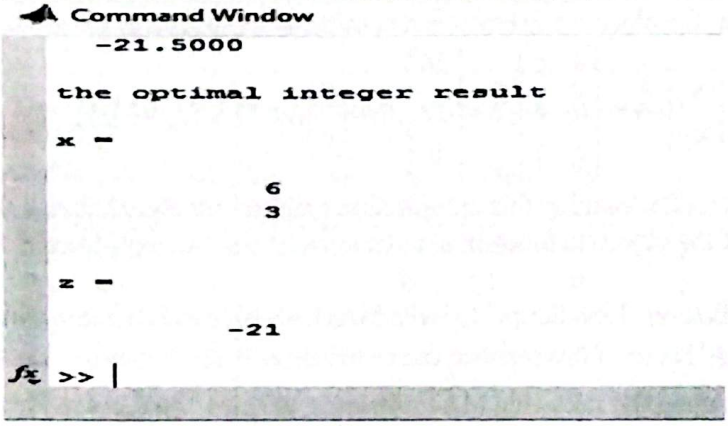


Figure 5. The optimal integer solution in MATLAB

The result of the integer linear programming problem is Z= -21 at minimization. We return this result at maximization by multiplying with negative. So the optimal integer solution is $x_1 = 6, x_2 = 3$, $Z = 21$. Therefore, the total profit per month is 210000 kyats.

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4. Using the Excel Solver to Solve the Integer Linear Programming Problem

The Excel solver can quickly apply the simplex method to find an optimal solution for the model. Firstly, we includes a tool called "Solver" in DATA tap before the problem is solved in the Excel.

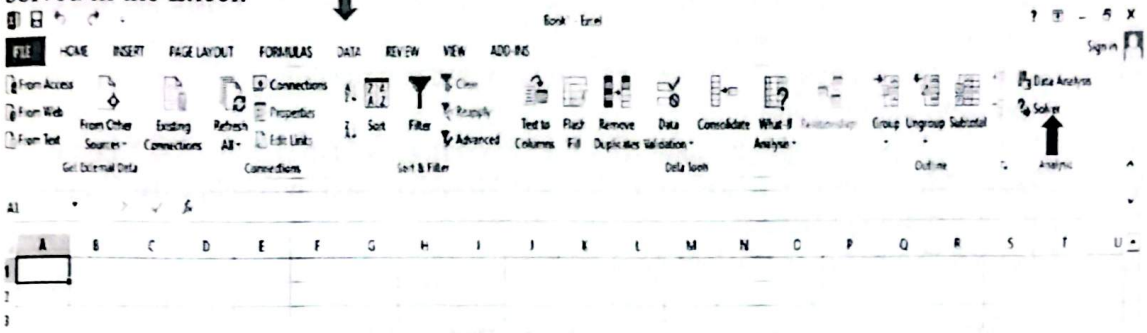
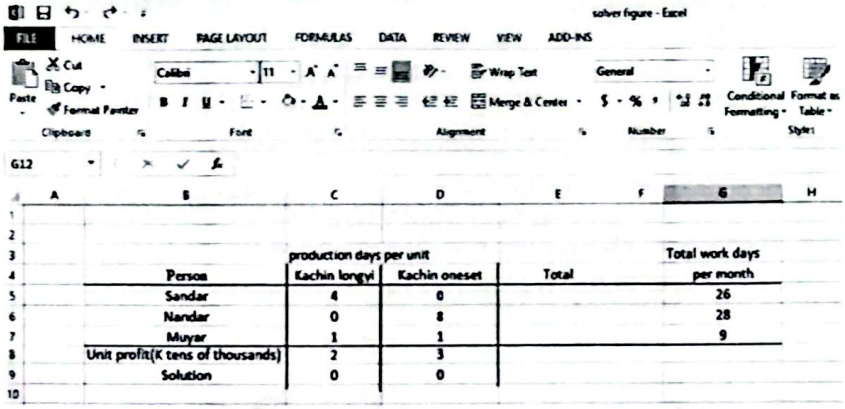


Figure 6. The "Solver" in DATA tap

Step 1.

(1) Insert all of the data cells for the problem on the spreadsheet according to the figure.
(2) Add a "Solution" cell in row 9 to store the value of decision variables.
(3) Insert 0 in C9 and D9 because this problem doesn't have any particular initial values.
(4) Insert a "Total" cell in column E.

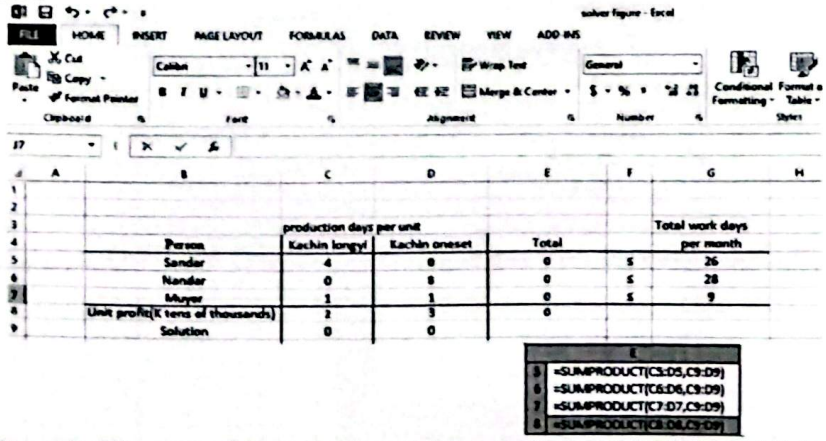


	Person	production days per unit: Kachin longyi	Kachin oneset	Total	Total work days per month
5	Sandar	4	0		26
6	Nandar	0	8		28
7	Muyar	1	1		9
8	Unit profit(K tens of thousands)	2	3		
9	Solution	0	0		

Figure 7. The spreadsheet for the data cells of the problem

Step 2.

(1) Insert ≤ signs in F5, F6 and F7 cells for the constraints.
(2) Insert [=SUMPRODUCT(C5:D5,C9:D9)] in cell E5 for the first constraint, [=SUMPRODUCT(C6:D6,C9:D9)] in cell E6 for the second constraint and [=SUMPRODUCT(C7:D7,C9:D9)] in cell E7 for the third constraint.
(3) Insert [=SUMPRODUCT(C8:D8,C9:D9)] in cell E8 for the total profit.
(4) The "Total" in column E and the total profit in cell E8 become 0 in the initial trial solution.



	Person	production days per unit: Kachin longyi	Kachin oneset	Total		Total work days per month
5	Sandar	4	0	0	≤	26
6	Nandar	0	8	0	≤	28
7	Muyar	1	1	0	≤	9
8	Unit profit(K tens of thousands)	2	3	0		
9	Solution	0	0			

	E
5	=SUMPRODUCT(C5:D5,C9:D9)
6	=SUMPRODUCT(C6:D6,C9:D9)
7	=SUMPRODUCT(C7:D7,C9:D9)
8	=SUMPRODUCT(C8:D8,C9:D9)

Figure 8. The spreadsheet for the problem before using the Excel Solver

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Step 3.

(1) Use the "Solver" from the Data tab to solve the problem.
(2) Select the cell E8 in the "Set Objective" window to calculate the total profit.
(3) Choose "Max" and then insert the cells C9 and D9 in the "By Changing Variable Cells" to get decision variables.
(4) Click "Add" and insert the column E, column F and column G in the "Add Constraint" window to put the constraints.
(5) Click the "Options" button, then click the "Evolutionary" tab and the "OK" button.
(6) Check "Make Unconstrained variables Non-Negative" and then select the "Simplex LP" in a Solving Method.
(7) Click on "Solve" in the Solver dialogue box.

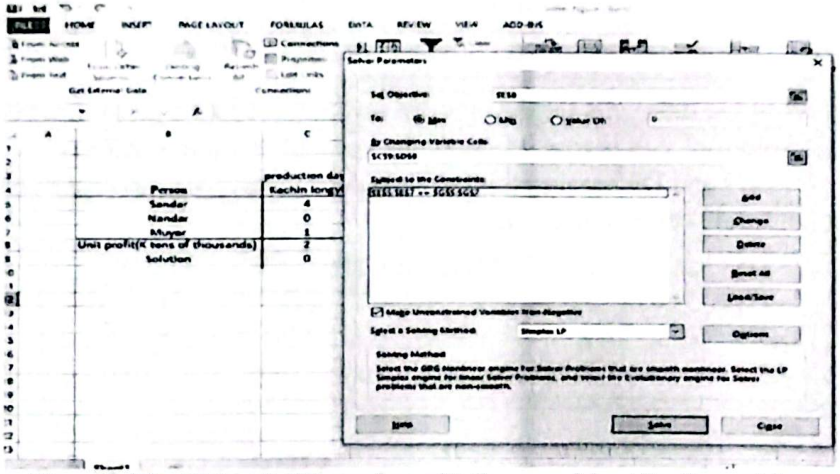


Figure 9. The "Solver" dialogue box with the spreadsheet for the problem

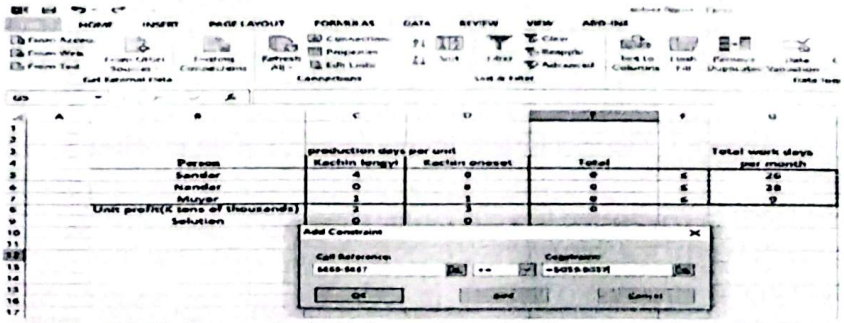


Figure 10. The "Add Constraint" dialogue box with the spreadsheet for the problem

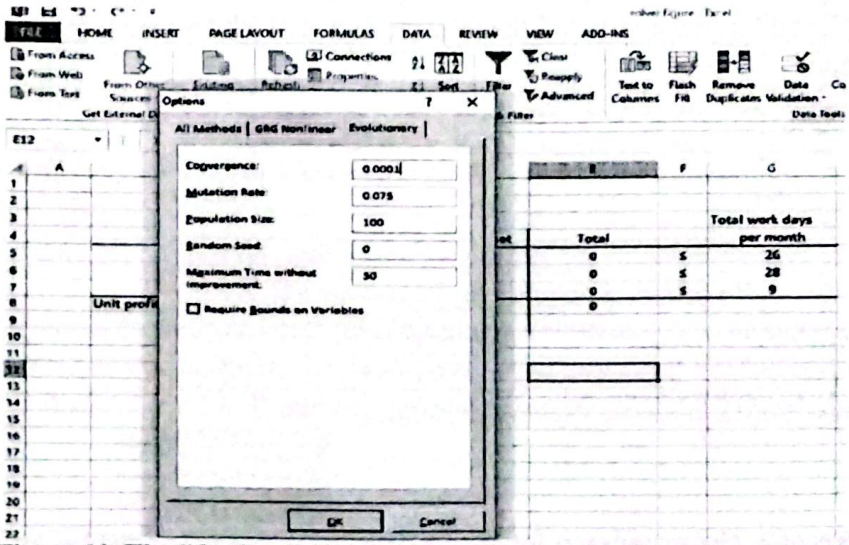


Figure 11. The "Options" dialogue box with the spreadsheet for the problem

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Step 4.

The Solver will indicate the decimal result with the "Solver Results" dialogue box. Then click the "OK". But this result is the decimal result. The integer linear programming problem must get the integer result. So we go to next step.

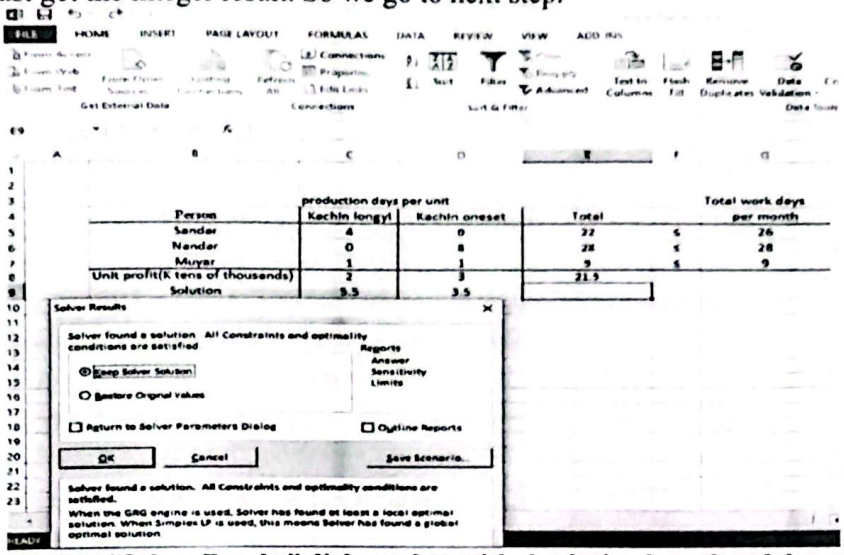


Figure 12. The "Solver Results" dialogue box with the decimal results of the problem

Step 5.

(1) Next, go to the Solver with the including data to put the integer sign.

(2) Then, click "Add", insert the row 9 with the decimal results in "Cell Reference" and choose "int" sign in the "Add Constraint" window.

(3) Click "OK".

(4) Next, click "Solve" button in the Solver dialogue box to get the integer results.

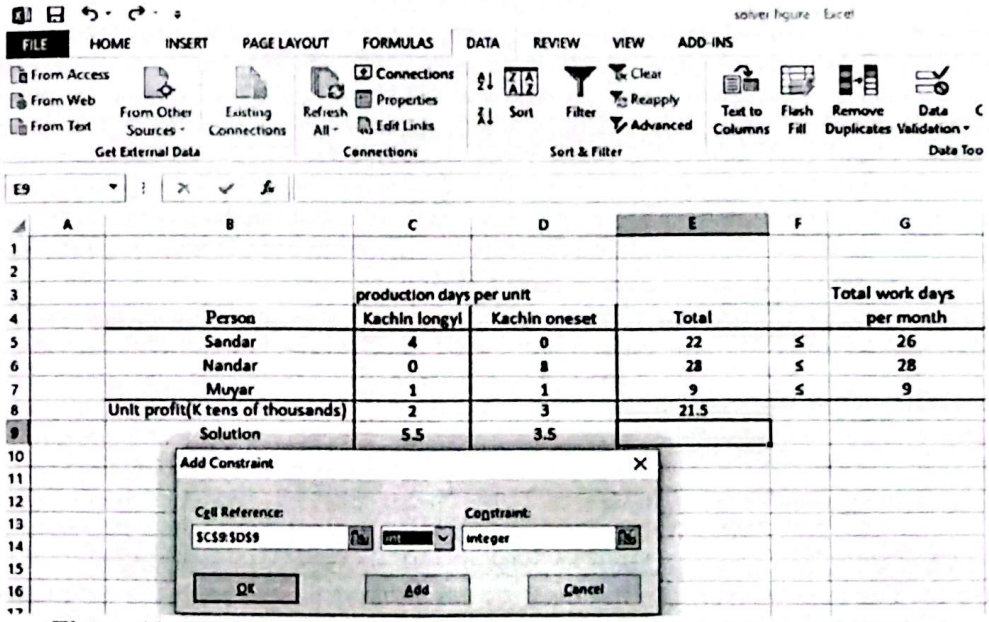


Figure 13. The "Add Constraint" dialogue box with the choosing "int" sign

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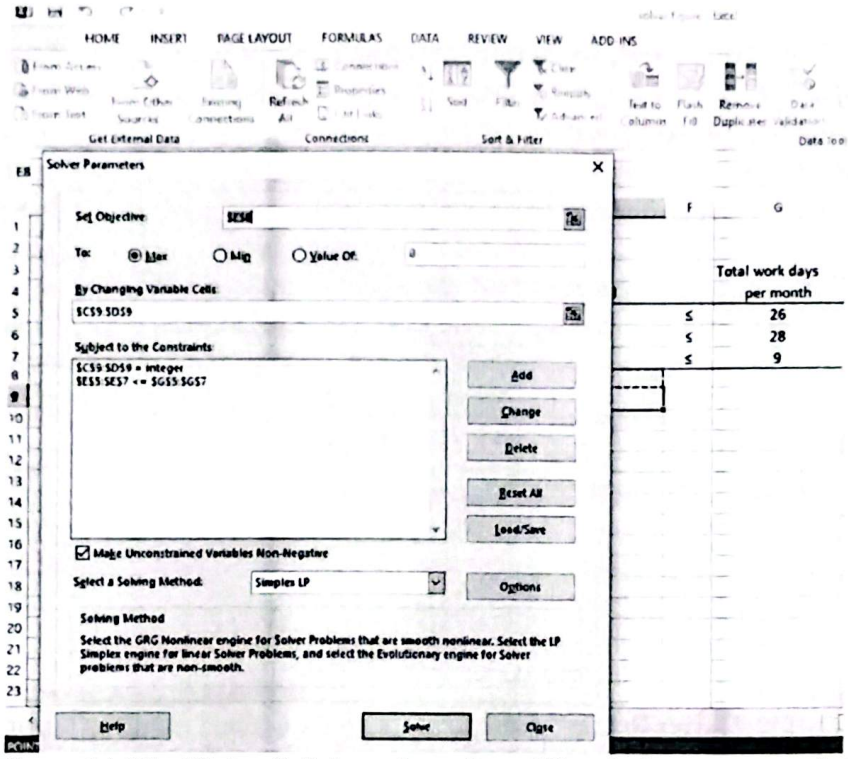


Figure 14. The "Solver" dialogue box after adding the integer constraint

Step 6.

(1) Finally, this problem get the integer results with the "Solver Results" dialogue box.

(2) Then, click on "OK" button.

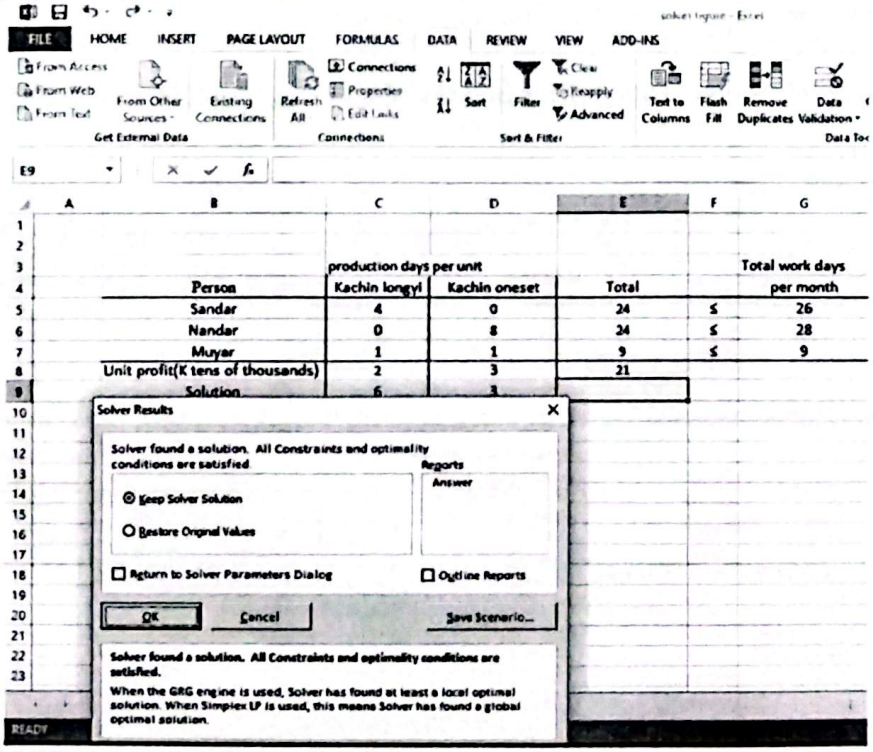
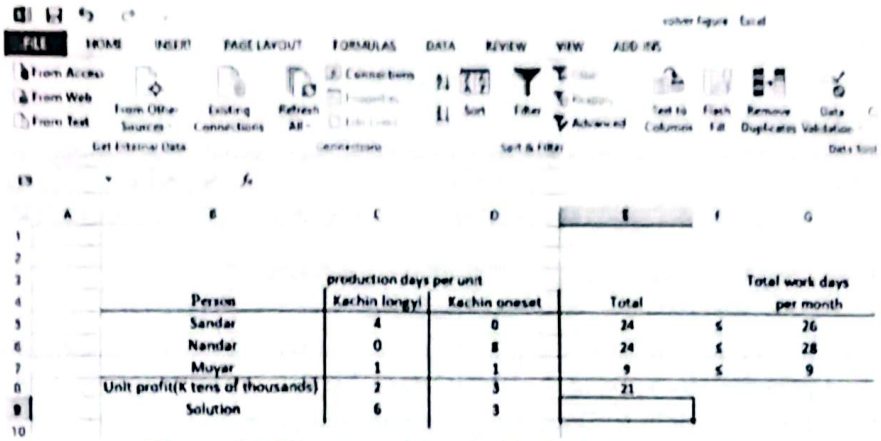


Figure 15. The next "Solver Results" dialogue box with the integer results of the problem

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	Person	production days per unit: Kachin longyi	Kachin oneset	Total		Total work days per month
5	Sandar	4	0	24	≤	26
6	Nandar	0	8	24	≤	28
7	Muyar	1	1	9	≤	9
8	Unit profit(K tens of thousands)	2	3	21		
9	Solution	6	3			

Figure 16. The spreadsheet with the integer results

The optimal integer solution is $x_1 = 6, x_2 = 3$ and $Z = 210000$.

5. Conclusion

The above methods calculated the integer linear programming problem (ILPP) to get the optimal integer results from the decimal results. The optimal integer solution of this ILPP is $x_1 = 6, x_2 = 3$ and $Z=210000$. The maximum total profit per month is 210,000 kyats. Gomory's Cutting Plane Method is based on the Simplex Method. This method solved the integer programming problem to get the integer solution by adding Gomorian constraint. Branch and Bound Method is based on the Graphical Method. This method also calculated the ILPP to get integer results by drawing graphs. By using MATLAB programming language in computer, this problem can be solved to get the integer results. Finally, this ILPP can also be calculated by using Excel Solver in computer to get the maximum profit. So, these four methods are used to calculate the integer results with the maximum total profit for this problem. Therefore, I would like to advise these four methods for solving many integer linear programming problems.

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The Study of Monotonic Functions in Mathematical Practices

Khin Thidar Oo[1]

Abstract

In this paper, we study the basic concept of monotonic functions. Firstly, the definitions, examples, and first derivative test are studied. Secondly, strictly monotone and maximal monotone are discussed. Finally, monotone operator are studied on Banach space and Hilbert space.

Keywords: maximum, minimum, increasing, decreasing, monotone

Introduction

In mathematics, a monotonic function (or) monotone function is a function between ordered set that preserves or reverse the given order. To examine the highest and the lowest point of the monotonic function. Once we can do this, we can solve a varity of problem in which we find the optimal (best) way to do something in a given situation.

1. Some Definitions and Examples of Monotonic Functions

1.1 Definitions

Let f be a function with domain D. Then f has an **absolute maximum** value on D at a point c is $f(x) \le f(c)$ for all x in D and an **absolute minimum** value on D at c is if $f(x) \ge f(c)$ for all x in D.

1.2 Definition

An interior point of the domain of a function f where f' is zero or undefined is a **critical point** of f.

1.3 Definition

A function that is increasing or decreasing on an interval is said to be **monotonic** on the interval.

1.4 Definitions

Suppose that f is continuous on $[a,b]$ and differentiable on (a,b). If $f'(x) > 0$ at each point $x \in (a,b)$, then f is **increasing** on $[a,b]$. If $f'(x) < 0$ at each point $x \in (a,b)$, then f is **decreasing** on $[a,b]$.

1.5 Example

The function $f(x) = (x^2 - 3)e^x$ is continuous and differentiable for all real numbers, so the critical points occur only at the zeros of f'.

We find the derivative $f'(x) = (x^2 - 3)\frac{d}{dx}e^x + \frac{d}{dx}(x^2 - 3)e^x$

$$= (x^2 - 3)e^x + 2xe^x$$

$$= (x^2 + 2x - 3)e^x.$$

$$x^2 + 2x - 3 = 0$$

$$(x+3)(x-1) = 0.$$

The zero $x = -3$ and $x = 1$ partition the x-axis into intervals as follows:

Interval	$x < -3$	$-3 < x < 1$	$1 < x$
Sign of f'	+	−	+
Behavior of f	increasing	decreasing	incresing

The function increases on $(-\infty, -3)$ and $(1, \infty)$ and decrease on $(-3, 1)$.

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[1] Dr, Assistant Lecturer, Department of Mathematics, University of Myitkyina Since is never zero, the first derivative is zero if and only if

1.6 Definition

Let $y = f(x)$ be a differentiable function on an interval (a,b). If for any two points $x_1, x_2 \in (a,b)$ interval such that $x_1 < x_2$, there holds the inequality $f(x_1) \le f(x_2)$, the function is called **increasing** (or non decreasing) in the interval.

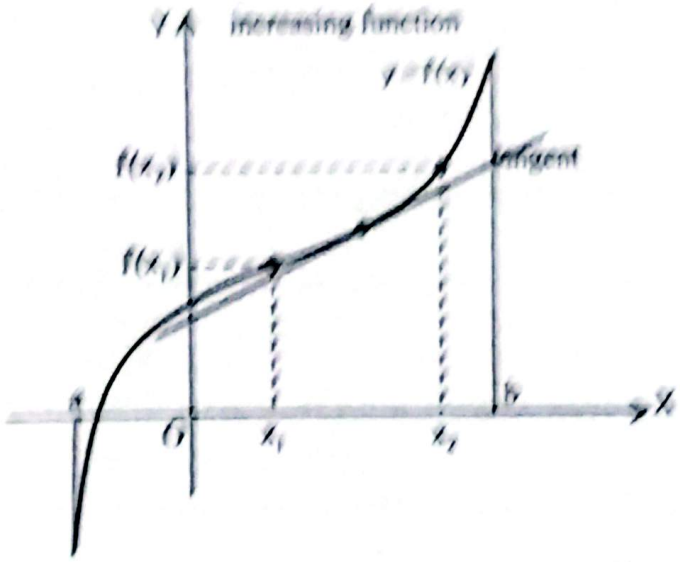


Figure 1.

1.7 Definition

Let $y = f(x)$ be a differentiable function on an interval (a,b). If for any two points $x_1, x_2 \in (a,b)$ interval such that $x_1 < x_2$, there holds the inequality $f(x_1) \ge f(x_2)$, the function is called **decreasing** in this interval.

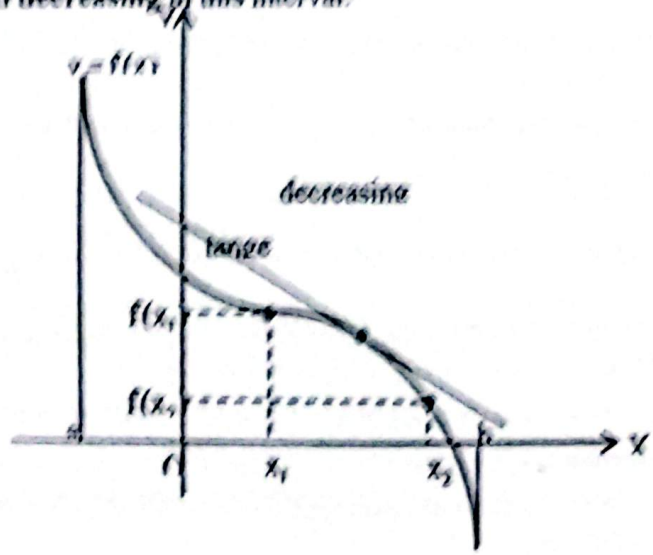


Figure 2.

1.8 Definition

If f is a monotonic function defined on an interval I, then f is differentiable almost everywhere on I.

1.9 Some basic applications and results

The following properties are true for a monotonic function $f : ¡ \to ¡$;

(i) f has limits from the right and from the left at every point of its domains
(ii) f has a limit at positive or negative infinity ($\pm\infty$) of either a real number
(iii) f can only have jump discontinuities.
(iv) f can only have countably many discontinuities in its domain.

1.10 Remarks

Suppose that f'' is continuous near $x = 0$.

(i) If $f'(c) = 0$ and $f''(c) < 0$ then f has local maximum at $x = c$.
(ii) If $f'(c) = 0$ and $f''(c) > 0$ then f has a local minimum at $x = c$.
(iii) If $f'(c) = 0$ and $f''(c) = 0$, then the test fails.

1.11 Definition

A function f is called **strictly increasing** if whenever $x > y$, then $f(x) > f(y)$.

1.12 Example

Using the definition of monotonicity prove that the function $f(x) = x^2 + 1$ is strictly increasing for $x \geq 0$.

1.13 Example

What is the length L of the interval on which the function $f(x) = x^4 e^{-x}$ is increasing?

Solution

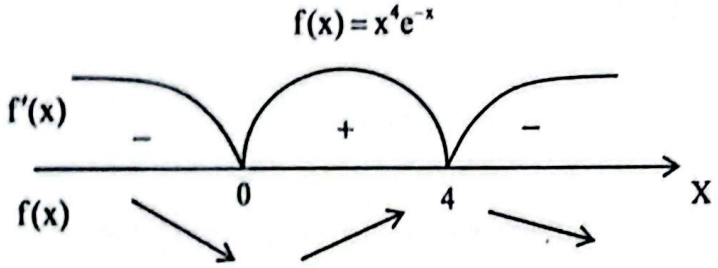


Figure 3.

1.14 Definition

A function f is called **strictly decreasing** if whenever $x < y$, then $f(x) < f(y)$.

1.15 Example

Using the definition of monotonicity prove that the function $f(x) = \cos x$ is strictly decreasing on the interval $[0, \pi]$.

1.16 Definition

If f is a strictly monotonic function, then f is **injective** on its domain.

1.17 Definition

A segment joining two given elements x and y of a vector space X is defined to be the set of all $z \in X$ of the form $z = \alpha x + (1-\alpha)y$ $(\alpha \in R, 0 \leq \alpha \leq 1)$.

The subset M of X is said to be **convex** if for every $x, y \in M$. $z = \alpha x + (1-\alpha)y \in M$.

1.18 Mean Value Theorem

Let $f : [a, b] \to ¡$ be continuous on $[a, b]$ and differentiable on (a, b), then there exists a c, $a < c < b$ such that $\frac{f(b) - f(a)}{b - a} = f'(c)$.

1.19 Definition

A non-empty set X is called a **vector space** or **liner space** over the field K if there exist two algebraic operations such that

(i) $(x + y) + z = x + (y + z)$ for all $x, y, z \in X$,
(ii) $x + y = x + y$, for all $x, y \in X$,
(iii) there exists $0 \in X$ such that $x + 0 = x$, for all $x \in X$,

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(iv) for each $x \in X$, there exists $y \in X$ such that $x + y = 0$,

(v) $\lambda(x+y) = \lambda x + \lambda y$, for all $x, y \in X$, for all $\lambda \in K$,

(vi) $(\lambda+\mu)x = \lambda x + \mu x$, for all $x \in X$, for all $\lambda, \mu \in K$,

(vii) $(\lambda\mu)x = \lambda(\mu x)$, for all $x \in X$, for all $\lambda, \mu \in K$,

(viii) $1 \cdot x = x$, for all $x \in X$.

1.20 Definitions

Let X be a nonempty set. A class τ of subsets of X is called a **topology** on X if it satisfies the following two conditions:

(i) the union of every class of sets in τ is a set in τ,

(ii) the intersection of every finite class of sets in τ is a set in τ.

The pair (X, τ) is called a **topological space**.

2. Monotonic Transformation

2.1 Definitions

Let X, Y, Z be three topological vector spaces over the field. Then the mapping $(\cdot,\cdot): Y \times X \to Z$ such that $(y, x) \to (y, x)$ is called a **bilinear mapping** if

(i) for each $y_0 \in Y$, the mapping $y_0 \to (y_0, x)$ is linear,

(ii) for each $x_0 \in X$, the mapping $y_0 \to (y_0, x)$ is linear.

It said to be **separately continuous** if the mapping (i) and (ii) are continuous for each y_0, x_0.

2.2 Definitions

Let V be a vector space over the field K. A function $\|\cdot\|: X \to K$ is called a **norm** if it satisfies the following axioms for all $v, w \in V$.

(N_1) $\|v\| \geq 0$ and $\|v\| = 0$ if and only if $v = 0$.

(N_2) $\|v + w\| \leq \|v\| + \|w\|$.

(N_3) $\|kv\| \leq |k| + \|v\|, \forall k \in K$.

A vector space (linear space) V together with a norm is called a **normed vector space** or **simply a normed space.**

2.3 Definition

We have stated that a norm linear space is a metric space. It is also complete, then the norm linear space is called **Banach space.**

2.4 Definition

We have stated that an inner product space is a norm linear space. If it is also complete, then the inner product space is called a **Hilbert space.**

2.5 Definition

An operator $T: X \to Y$ is said to be **monotone operator** if $(Tu - Tv, u - v) \geq 0$ for all $u, v \in X$, where X and Y are topological vector spaces.

2.6 Definition

A subset G of $X \times Y$ is said to be a **monotone subset** if for every pair $[u_1, w_1]$ and $[u_2, w_2]$ in G, $(w_1 - w_2, u_1 - u_2) \geq 0$.

2.7 Definition

A subset G of $X \times Y$ is said to be **maximal monotone subset** of $X \times Y$ if it is a monotone set and maximal among the monotone subset of $X \times Y$.

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2.8 Definition

A mapping $T: X \to 2^Y$ is said to be **monotone** if its graph $G(T) = \{[x, y] | x \in X, y \in Tx\}$ is a monotone subset of $X \times Y$.

2.9 Theorem

Let T be a monotone and $\lambda > 0$. Then λT is monotone.

Proof

Let $x_1, x_2 \in X$.

$$[(\lambda T)(x_1) - (\lambda T)(x_2), x_1 - x_2]$$
$$= [\lambda T(x_1) - \lambda T(x_2), x_1 - x_2]$$
$$= [\lambda(T(x_1) - T(x_2)), x_1 - x_2]$$
$$= \lambda[T(x_1) - T(x_2), x_1 - x_2].$$

Since T is monotone, $[T(x_1) - T(x_2), x_1 - x_2] \geq 0, \forall x_1, x_2$.

$$\lambda[T(x_1) - T(x_2), x_1 - x_2] \geq 0, \lambda > 0.$$

That is $[(\lambda T)(x_1) - (\lambda T)(x_2), x_1 - x_2] \geq 0, \forall x_1, x_2$.

Therefore λT is monotone.

2.10 Theorem

Let H be a Hilbert space over ¡ . Then

(i) the identity mapping I is monotone,

(ii) $T = I + \lambda K$ is monotone, where $K: H \to H$ is linear and continuous with $|\lambda| \|K\| < 1$.

Proof

(i) We define $I: H \to H$ such that $I(x) = x$.

We will show that $(I(x_1) - I(x_2), x_1 - x_2) \geq 0$.

$$(I(x_1) - I(x_2), x_1 - x_2) = (x_1 - x_2, x_1 - x_2)$$
$$= \|x_1 - x_2\|^2$$
$$\geq 0.$$

Therefore the identity mapping I is monotone.

(ii) Suppose that $K: H \to H$ such that $K(x)$ is linear and continuous.

We define $I + \lambda K: H \to H$ such that $(I + \lambda K)(x) = x + \lambda K(x)$.

That is, $T(x) = x + \lambda K(x)$

We have to show that T is monotone. That is $(T(x), x) \geq 0, \forall x \in H$.

$$(T(x), x) = (x + \lambda K(x), x)$$
$$= (x, x) + (\lambda K(x), x)$$
$$= \|x\|^2 + \lambda(K(x), x)$$
$$\geq \|x\|^2 - |\lambda||(K(x), x)|.$$

By Cauchy-Schwarz Inequality, linearity and continuity of K,

$$|(K(x), x)| \leq \|K\| \|x\| \|x\|$$
$$= \|K\| \|x\|^2.$$
$$(T(x), x) \geq \|x\|^2 - |\lambda| \|K\| \|x\|^2$$
$$(T(x), x) = \|x\|^2 (1 - |\lambda| \|K\|)$$

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$\geq 0.$

Hence $T = I + \lambda K$ is monotone.

2.11 Theorem

Let $f : ¡ \to ¡$ such that x a $f(x)$ be convex and differentiable. Then $f' : ¡ \to ¡$ such that x a $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ is monotone.

Proof

We consider $(f'(x) - f'(y), x - y) = (f'(x) - f'(y))(x - y)$.

We have to show that $f(y) - f(x) \geq (y - x)f'(x), \forall y \in ¡$.

Firstly, we can show that

$$\lim_{\substack{h \to 0 \\ 0<\lambda<1}} \frac{f(x+\lambda y) - f(x)}{\lambda} = yf'(x).$$

If we put $\lambda y = h$. Then

$$\lim_{\lambda \to 0} \frac{f(x+\lambda y) - f(x)}{\lambda} = \lim_{h \to 0} \frac{f(x+h) - f(x)}{\frac{h}{y}}$$

$$= y \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$= yf'(x)$$

$$(y - x)f'(x) = \lim_{\substack{\lambda \to 0 \\ 0<\lambda<1}} \frac{f(x + \lambda(y - x)) - f(x)}{\lambda}$$

$$= \lim_{\substack{\lambda \to 0 \\ 0<\lambda<1}} \frac{f(\lambda y + (1 - \lambda)x) - f(x)}{\lambda}$$

$$\leq \lim_{\substack{\lambda \to 0 \\ 0<\lambda<1}} \frac{\lambda f(y) + (1 - \lambda)f(x) - f(x)}{\lambda}, \text{ since f is convex.}$$

$$= f(y) - f(x).$$

$(y - x)f'(x) \leq f(y) - f(x), \forall y, x \in ¡$

$(x - y)f'(x) \leq f(x) - f(y).$

Similarly, $(y - x)f'(y) \leq f(y) - f(x).$

$$(f'(x) - f'(y))(x - y) = (x - y)f'(x) - (x - y)f'(y)$$

$$= (x - y)f'(x) + (y - x)f'(y)$$

$$\geq f(x) - f(y) + f(y) - f(x)$$

$$= 0.$$

Therefore f' is monotone.

3. Conclusion

In this paper the ability to find the functions from their rates of charge is one of the very powerful tools of calculus. The duality mappings are related to monotonicity conditions. In functional analysis, existence theorem of monotone operator is studied on Banach space and Hilbert space.

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The Relation between New Types of Graphs and Topological Spaces

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Abstract

In this paper, a technique to construct a new type of topological structures by graphs called topological graphs is introduced. The concept of a homeomorphism between topological graphs as a topological property to prove the isomorphic between graphs is used. Many topological properties such as continuity, connectedness, compactness and separation axioms on graphs are studied. Moreover, some examples of different types of graphs and their topological graphs are presented. Finally, some of their topological and algebraic properties are studied.

Keywords: graphs, topological graph, topological structure, homeomorphic, isomorphic

Introduction

Topology is a branch of geometry called rubber sheet geometry. If X is a nonempty set, a collection τ of subsets of X is said to be a topology on X if the following condition holds X and $\varnothing$ belongs to τ, the finite intersection of any two sets in τ belongs to τ and the union of any member of sets in τ belongs to τ.

A graph $G=(V,E)$, is an ordered pair of disjoint sets (V,E), where V is a nonempty set and E is a subset of unordered pair of V. The vertices and edges of a graph G are the elements $V=V(G)$ and $E=E(G)$, respectively. The degree of a vertex $u \in V(G)$ is the number of edges containing u. If there is no edge in a graph G contains a vertex u, then u is called an isolated point, and so the degree of u is zero. An edge which has the same vertex to ends is called a loop. A graph is simple if it has no loop. A simple graph is called complete graph, if any two distinct vertices are joined by an edge. If v_i and v_j are vertices of a graph G, and A and B are the sets representing v_i and v_j respectively, we are denoted by $N(v_i, v_j)$ the cardinal number of the set $A \cap B$. The aim of the present paper is devoted to establish some new types of graphs in terms of its topological graphs or topological structures. We study the isomorphic between graphs in the view point of topology. The model of topological structures helps also to apply graphs in biology, medicine and many real life problems.

1. Basic Definitions

Definition 1.1 If $G(V,E)$ **is a directed graph and** $u, v \in V$, then

(i) u is invertex of v if $\overrightarrow{uv} \in E(G)$.

(ii) u is outvertex of v if $\overrightarrow{vu} \in E(G)$.

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(iii) The indegree of a vertex v is the number of vertices u such that $\overrightarrow{uv} \in E(G)$.

(iv) The outdegree of a vertex v is the number of vertices u such that $\overrightarrow{vu} \in E(G)$.

Definition 1.2 Let $X = \{1,2,3,...,n\}$ be a set, a transformation S_n on X can be defined as a **bijective function** from X to X that is $f: X \to X$, the number of transformations of $S_n = n!$.

Definition 1.3 Two graphs G_1 and G_2 are **homomorphic** if there exists a function $F: G_1 \to G_2$, such that for each $v_1, v_2 \in V(G_1)$, and $(v_1, v_2) \in E(G_1)$, then $\{F(v_1), F(v_2)\} \in E(G_2)$.

Definition 1.4 Two graphs G and H are **isomorphic** if there exists a bijective function $F: V(G) \to V(H)$, such that for each two adjacent vertices u and v in G, then F(u) and F(v) are also adjacent in H.

Definition 1.5 A graph G is said to be **a topological graph** if there exists a topology τ generated by G.

2. The Graphic of a Class of Sets

Definition 2.1. Let $C_1 \subseteq P(X)$, $C_2 \subseteq P(Y)$, C_1 is **parallel** to C_2(say $X : Y$), if there exists a bijective function $F: X \to Y$ such that for each $c_1 \in C_1$, there exists $c_2 \in C_2$ and $F(c_1) = c_2$. Let $X = Y$. Then C_1 and C_2 are parallel if there exists a transformation $F: X \to X$, such that $F(C_1) = C_2$.

Example 2.2. Let $X = \{1,2,3\}$. Assume that $C_1 = \{\{3\},\{1,2\},\{3,1\}\}$, $C_2 = \{\{1\},\{2,3\},\{1,2\}\}$. Then C_1 and C_2 are parallel. Because of, there exists a bijective function $F: X \to X$, such that $F(\{3\}) = \{1\}$, $F(\{1,2\}) = \{2,3\}$, $F(\{3,1\}) = \{1,2\}$.

In the following, every class of sets can be represented to a general graph. Any graph G with only one edge can be represented by a class $\{A,B\}$ such that $A \cap B$ is a singleton $|A \cap B| = 1$. If G contains r-edges, then $|E(G)| = |A \cap B| = r$, where $|A|$ refers to the cardinality of a set A. So, every graph can be illustrated by different classes as shown in Example 2.3.

Example 2.3. The classes $C_1 = \{\{1\},\{2\},\{1,2\}\}$, $C_2 = \{\{1,2,3\},\{4,5\},\{3,4\}\}$, $C_3 = \{\{3,7\},\{8,9,10\},\{3,10,12\}\}$ of a set $X = \{1,2,3,4,5,6,7,8,9,10,11,12\}$ represent the same graphs as shown in Figure 1.

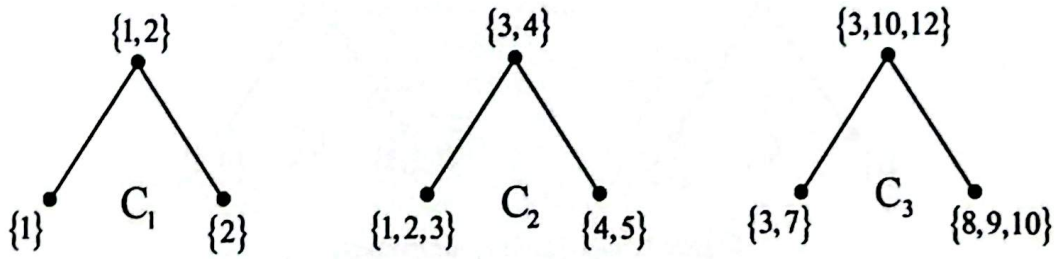


Figure 1. Three classes with only one graph

Definition 2.4. If $C = \{C_i : i \in I\}$ is the set of all classes of a set X, then C_i can be represented by the same graph G. The graph number of a graph G equals $\min\{|\cup C_i| : i \in I\}$. In other words,

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if G is a graph, then the graph number of $G = m$, that means, there is no number $r < m$ such that $\left|\bigcup_{i=1} C_i\right| = r$.

Example 2.5. From example 2.3, $\cup C_1 = \{1,2\}$, $\cup C_2 = \{1,2,3,4,5\}$ and $\cup C_3 = \{3,7,8,9,10,12\}$. Then $|\cup C_1| = 2$, $|\cup C_2| = 5$, $|\cup C_3| = 6$. This means that the number of graph on C_1 equals 2, C_2 equals 5 and C_3 equals 6.

Definition 2.6. Let G be a graph and $v_i, v_j \in V(G)$. If the vertices v_i is represented by a set A and v_j is represented by a set B in a set graph G, then $N(v_i, v_j)$ is defined by $|A \cap B|$. It is clear that $N(v_i, U) = |A|$ and $N(v_j, U) = |B|$, where U is the universal set of vertices.

Example 2.7. From example 2.3, if $A = \{1\}$ and $B = \{1,2\}$, then $N(A,B) = 1$, for $A \cap B = \{1\}$ and $|A \cap B| = 1$.

Theorem 2.8. If G_1 and G_2 are two graphs which represented by two parallel classes C_1 and C_2, respectively, then G_1 and G_2 are isomorphic.

Proof.
If C_1 and C_2 are two parallel classes, then there exists a bijective a function F from C_1 to C_2 that is $F: C_1 \to C_2$, such that $F(C_1) = C_2$, where $C_1 = \{A_i : i \in I\}$ and $C_2 = \{F(A_i) : i \in I\}$. Then every vertex v_{A_i} in G_1, the graph generated by C_1, have a corresponding vertex $v_{F(A_i)}$ in G_2, the graph generated by C_2. So

$$N(v_{Ai}, v_{Aj}) = |A_i \cap A_j| = |F(A_i \cap A_j)| = |F(A_i) \cap F(A_j)| = N(v_{F(A_i)}, v_{F(A_j)}).$$

Example 2.9. In Figure 2, the two graphs of classes C_1 and C_2 are isomorphic. But the set graphs can not be represented by two parallel classes.

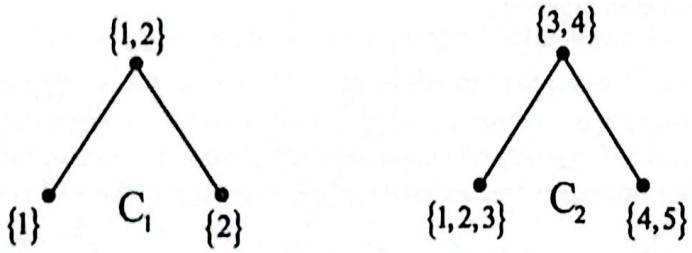


Figure 2. Two isomorphic graphs

In the following, we describe a new class from any simple graph G.

Definition 2.10. In a graph G, any isolated point can be represented by an empty set $\varnothing$ in a new definite class C.

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Definition 2.11. In a graph G, the **universal set** U can be represented by a subset of natural numbers N. The class of a universal set vertex U is adjacent with each set vertex in its set graph.

Let A and B are two nonempty sets and $|A| = m$, $|B| = n$. The graphs represented by a class $\{A, B, A \cap B, A \cup B\}$ will be given as in the following figures:

If $A \cap B = \emptyset$, then the graph G is shown in Figure 3.

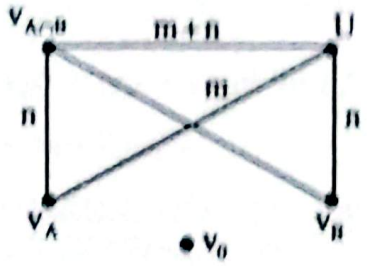


Figure 3. Disjoint graph sets

If $A \subset B$, then $|A \cap B| = |A|$ and $|A \cup B| = |B|$. The graph G is shown in Figure 4.

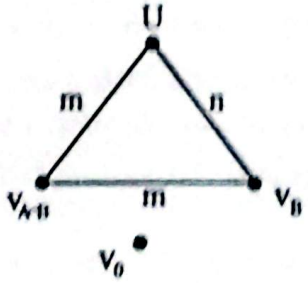


Figure 4. Inclusion graph sets

If $A \cap B \neq \emptyset$, $|A| \neq |B|$ and $|A \cap B| = r$, where $r \in N$, then the graph G is shown in Figure 5.

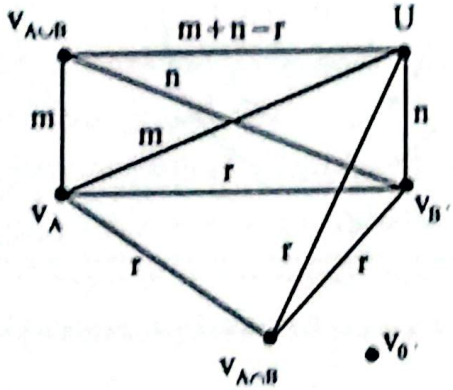


Figure 5. Intersection graph sets

Remark 2.12. Every graph set for a subgraph H of G is a subset from the graph set of G. Each graph set can also be represented by the class P(N), where P(N) denotes to the power set of N.

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3. Some Operations on Topological Graphs

In this section, we use a set graph to generate a topological space, we say also, a topological graph or a topological structure. The set graph will be represented by $P(N)$. Some algebraic operations such as, a union, an intersection and a subset, between vertices are defined by:

(i) $v_\alpha \cup v_\beta = v_{\alpha \cup \beta}$

(ii) $v_\alpha \cap v_\beta = v_{\alpha \cap \beta}$

(iii) $v_\alpha \subset v_\beta$ if and only if $\alpha \subset \beta$

Definition 3.1. A pseudograph P, with degree n, can be represented by a topology for a set $X = \{1, 2, 3, ..., n\}$.

Example 3.2. The topological graph on a discrete graphs D will be constructed if we delete only the loops in a pseudograph P. In simple graphs, we draw only one edge between each adjacent vertices in a discrete graph D.

Theorem 3.3.

(i) The number of edges $E_p(G)$ of a pseudograph G of the set $X = \{1, 2, ..., n\}$ equals $n.2^{n-1}(2^{n-1} - 1) + n.2^{n-1}$.

(ii) The number of edges $E_d(G)$ of a discrete graph arising from a pseudograph that is by deleting loops in P equals $n.2^{n-1}(2^{n-1} - 1)$.

(iii) The number of edges $E_s(G)$ of a simple graph arising from the discrete graph that is by drawing only one edge joint two adjacent vertices in D equals $\frac{1}{2}(n.2^{2n-2} - 2^{n-1} - 5^{n-1} + 1)$.

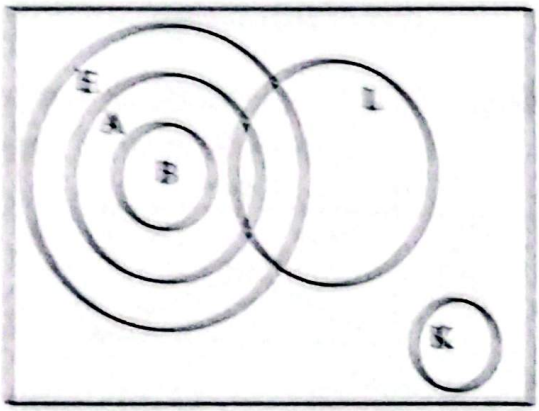


Figure 1. Relationship between sets.

Proof.
The relation between sets can be shown in Figure 6.
We apply Theorem 3.3 in example 3.4.

Example 3.4. The number of edges of pseudographs G, discrete graphs and simple graphs of a set $X=\{1,2,3\}$ is given by:

$$|E_P(G)| = 3*2^{3-2}\left(2^{3-1}-1\right)+3*2^{3-1}$$
$$= 3*2*3+12 = 18+12 = 30,$$
$$|E_D(G)| = 3*2^{3-2}\left(2^{3-1}-1\right) = 3*2*3 = 18,$$
$$|E_S(G)| = \frac{1}{2}\left(2^6-2^3-3^3+1\right) = 15,$$

respectively, where S denotes to simple graphs

Theorem 3.5. Let G be a graph satisfies the following conditions:
(i) G contains only one isolated vertex
(ii) G contains a vertex v adjacent with each vertex in $G\setminus\{v_0\}$ and
$N(v_i,v)\le N(v_i,U)\le N(v,U)$, for every $v_i\in G\setminus\{v_0\}$.
(iii) For every two distinct vertices $v_i,v_j\in V(G)$, then $v_i\cup v_j\in V(G)$ and $v_i\cap v_j\in V(G)$.
Then the class τ of vertices is a topological graph.

Proof.
Let G be a graph. To complete the proof, it is sufficient to prove three conditions of topology on τ.
(i) By definition 2.4, G can be represented by different classes. Suppose that the graph number of G is m. Then three exists a class, say τ, such that $\tau\subseteq P\left(\{1,2,3,...,m\}\right)=2^{\{1,2,3,...,m\}}$ and presents G. Each $A_i\in\tau$ represents v_i and $X\in\tau$ represents the set of vertices V(G). So, by definition 2.6, $N(v_i,V(G))=N(v_i,U)$. If $N=\{1,2,3,...,m\}$, then $|A\cap X|=|A\cap N|=|A|$. This means that each $A\in\tau$ satisfies that $A\subseteq X$. Since every vertex in G is a graph subset of V(G), that is for every $v_i\in V(G)$ the singleton $\{v_i\}\subseteq V(G)$ and each element in τ is a subset from $X\in\tau$, then $X=\{1,2,...,m\}$. Also, the isolated vertex v_0 can be represented by $\varnothing\in\tau$.
(ii) Let $v_1,v_2,...$ be an arbitrary different vertices in V(G) represents by $A_{v_1},A_{v_2},...$. Since $v_1\cup v_2\cup...=v_{(A_{v_1}\cup A_{v_2}\cup...)}$, then $A_{v_1}\cup A_{v_2}\cup...\in\tau$.
(iii) If v_i and v_j are two different vertices in V(G) and represented by A_i and A_j, respectively. Since $v_i\cap v_j=v_{A_i\cap A_j}$, then $A_i\cap A_j\in\tau$. Therefore τ is a topology.

Theorem 3.6. The number of edges of a topological graph represented by a topology $\tau=\{\varnothing,\{1\},\{1,2\},...,\{1,2,...,n\}\}$ is given by $\frac{1}{6}n\left(n^2-1\right)$.

Proof.
Let $A_m=\{1,2,3,...,m\}$, $1<m<n$,

$$\deg V_{A_m} = m(n-m)+\sum_{r=1}^{m-1} r$$
$$= m(n-m)+\frac{1}{2}m(m-1)$$

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$$\deg V_{A_m} = mn - m^2 + \frac{1}{2}m^2 - \frac{1}{2}m = mn - \frac{1}{2}m^2 - \frac{1}{2}m.$$

The number of edges is

$$\begin{aligned}
|Edges| &= \frac{1}{2}\sum_{m=1}^{n} \deg V_{A_m} \\
&= \frac{1}{2}\sum_{m=1}^{n}\left(mn - \frac{1}{2}m^2 - \frac{1}{2}m\right) \\
&= \frac{1}{2}n\sum_{m=1}^{n} m - \frac{1}{4}\sum_{m=1}^{n} m^2 - \frac{1}{4}\sum_{m=1}^{n} m \\
&= n^2(n+1) - \frac{1}{24}n(n+1)(2n+1) - \frac{1}{8}n(n+1) \\
&= \frac{1}{24}n(n+1)(6n-3-2n-1) \\
&= \frac{1}{24}n(n+1)(4n-4) \\
&= \frac{1}{6}n(n^2-1)\$ \\
&= {}^{n+1}C_3.
\end{aligned}$$

Example 3.7. Let $X = \{1,2,3\}$ with a topological graph $\tau = \{\emptyset, \{1\}, \{1,2\}, X\}$. The number of edges equals 4.

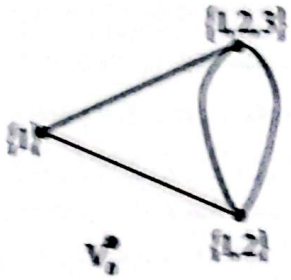


Figure 7. A topological graph for 3 points

Example 3.8. Let $Y = \{1,2,3,4\}$ with a topological graph $\tau = \{\emptyset, \{1\}, \{1,2\}, \{1,2,3\}, Y\}$. The number of edges equals 10.

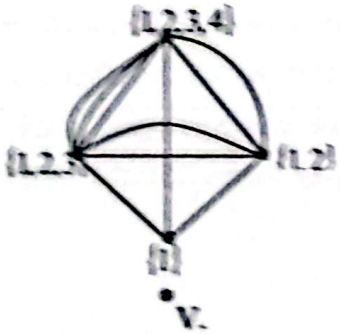


Figure 8. A topological graph for 4 points.

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Example 3.9. Let G be a graph and its topological graph τ be shown in Figure 9. We construct τ by the following procedures:

An isolated vertex v_f represented by $\varnothing$, the vertex v_a and v_b or one of them can be considered as a vertex adjacent with all vertices except v_f. Take v_a is a vertex V represented by a set X. Since $N(v_e, V(G)) = 1$, then v_e represented by $\{1\}$. At $N(v_d, V(G)) = 2$, then v_d represented by $\{1,2\}$. Also, at $N(v_c, V(G)) = 2$, then v_c represented by $\{1,3\}$. In the same manner, v_b represented by $\{1,2,3\}$ and v_a represented by $\{1,2,3,4\}$, for $N(v_b, V(G)) < N(v, U)$, for all v in G.

Therefore $\tau = \{\varnothing, \{1\}, \{1,2\}, \{1,3\}, \{1,2,3\}, X\}$ is a topology on X. τ is said to be a topological graph of G.

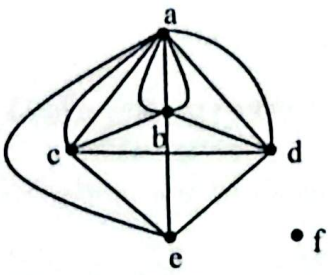


Figure 9. A graph which is a topological graph

Example 3.10. The structure in Figure 10 is not a topological graph of any graph G, this means that, the class τ of G does not satisfies conditions of topology. Because of $\deg(v_a) = 4$ (where deg denotes to the degree of vertex), $\deg(v_b) = 3 = \deg(v_c)$. Now, v_a represented by $X = \{1,2,3,4\}$, v_b represented by a set, say $\{2\}$, and v_c represented by a set, say $\{3\}$. Although $N(v_b, v_c) = 1$, we have $\{2\} \cap \{3\} = \varnothing$.

Therefore $\tau = \{\varnothing, X, \{2\}, \{3\}\}$ is not a topology, for $\{2\} \cup \{3\} = \{2,3\} \notin \tau$.

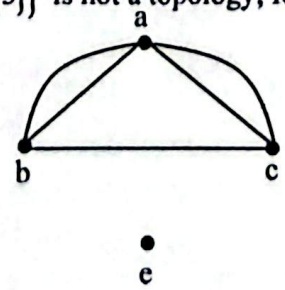


Figure 10. A graph which is not a topological graph.

4. An Isomorphic between Topological Graphs

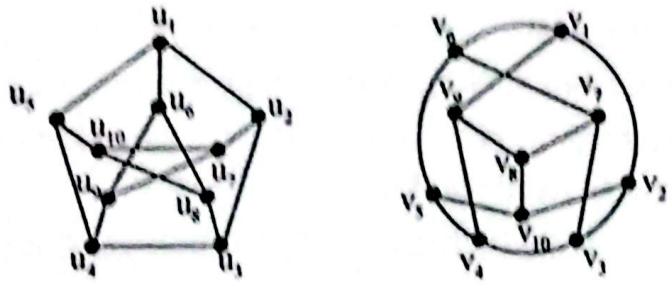
In this section, we study the isomorphic between graphs, which is an important property in graph theory, through the homeomorphic between its topological graphs which is a topological property. In our study, we use the topological graph stated in section 3. The following examples discuss special types of graphs such as a Peterson graph in Figure 11 and some other graphs in Figure 12.

Example 4.1. The isomorphism by topological graphs is shown in Figure 11. From Table 1, we have a class

$$C = \{\{1,2,3\}, \{1,4,5\}, \{4,6,7\}, \{6,8,9\}, \{3,9,10\}, \{2,12,13\}, \{5,14,15\}, \{7,11,12\}, \{8,13,14\}, \{10,11,15\}\},$$

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which represents a graph G_1. By the same manner, we have the same class by Table 2, which represents a graph G_2. Table 3 proves the homeomorphic between topological graphs of G_1 and G_2.



G_1 G_2

Figure 11. Two isomorphic graphs G_1 and G_2

Since there are a homeomorphic between topological graphs in Table 3, then G_1 and G_2 are isomorphic in Figure 11.

Table 1. A topological graph of G_1

Step/Vertex	1	2	3	4	5	6	7	8
u_1	{1,2,3}							
u_2	{1,	{1,4,5}						
u_3		{4,	{4,6,7}					
u_4			{6,	{6,8,9}				
u_5	{3,			{3,9,		{3,9,10}		
u_6	{2,					{2,12,13}		
u_7		{5,					{4,14,15}	
u_8			{7,			{7,12,		{7,11,12}
u_9				{8,		{8,13,	{8,13,14}	
u_{10}					{10,		{10,15,	{10,11,15}

Table 2. A topological graph of G_1

Step/Vertex	1	2	3	4	5	6	7	8
v_1	{1,2,3}							
v_2	{1,	{1,4,5}						
v_3		{4,	{4,6,7}					
v_4			{7,	{7,11,12}				
v_5				{11,	{10,11,15}			
v_6	{3,				{3,10,	{3,9,10}		
v_7			{6,			{6,9,	{6,8,9}	
v_8							{8,	{8,13,14}
v_9	{2,			{2,12,				{2,12,13}
v_{10}		{5,			{5,15,			{5,14,15}

Table 3. Homeomorphic between topological graph of G_1 and G_2

Sets	G_1	G_2
{1,2,3}	u_1	v_1
{1,4,5}	u_2	v_2
{4,6,7}	u_3	v_3
{6,8,9}	u_4	v_7
{3,9,10}	u_5	v_6
{2,12,13}	u_6	v_9
{5,14,15}	u_7	v_{10}
{7,11,12}	u_8	v_4
{8,13,14}	u_9	v_8
{10,11,15}	u_{10}	v_5

Example 4.2. Let G_1 and G_2 be two graphs which is shown in Figure 12. From Tables 4 and 5, we have the same topological graph $\tau = \{\varnothing, \{1\}, \{2\}, \{3\}, \{1,2\}, \{1,3\}, \{2,3\}, \{1,2,3\}\}$, for graphs G_1 and G_2. We proves that G_1 is an isomorphic with G_2, in Table 6.

Since there are a homeomorphic between topological graphs in Table 6, then G_1 and G_2 are isomorphic in Figure 12.

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Table 4. A topological graph of G_1

Step/Vertex	1	2	3	4
u_0	∅			
u_1		{1}		
u_2			{2}	
u_3				{3}
u_4		{1,	{1,2}	
u_5		{1,		{1,3}
u_6			{2,	{2,3}
u_7		{1,	{1,2,	{1,2,3}

Table 5. A topological graph of G_2

Step/Vertex	1	2	3	4
v_0	∅			
v_1		{1}		
v_2			{2}	
v_3				{3}
v_4			{2,	{2,3}
v_5		{1,		{1,3}
v_6		{1,	{1,2}	
v_7		{1,	{1,2,	{1,2,3}

Table 6. Homeomorphic between two topological graphs of G_1 and G_2

Sets	G_1	G_2
∅	u_0	v_0
{1}	u_1	v_1
{2}	u_2	v_2
{3}	u_3	v_3
{1,2}	u_4	v_6
{1,3}	u_5	v_5
{2,3}	u_6	v_4
{1,2,3}	u_7	v_7

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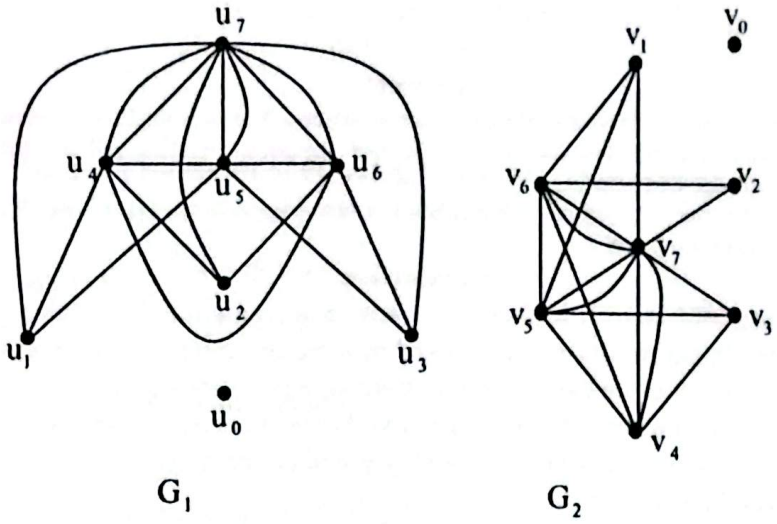


Figure 12. Two isomorphic graphs G_1 and G_2

5. Conclusion

The field of mathematical science which goes under the name of the topology is concerned with all questions directly or indirectly related to topological graphs. Therefore, the theory of graphs and topological spaces become the most important subjects in mathematics. Topology plays a significant rule in quantum physics, high energy physics and superstring theory. Moreover, the concepts proposed in this paper can be extended in fuzzy topological structures and thus one can get a more affirmative solution in decision making problems in real life solutions.

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Applications of Fourier Transform

[1]Khin Wah Wah

Abstract

The basic definitions of the Fourier transform are introduced. And then, the Fourier transform of some special functions are computed. After that, the basic theorems and some of its applications are also discussed.

Keywords: Fourier transform, convolution, self-convolution, cross correlation, autocorrelation

Introduction

Fourier transform is well known as a providing technique for solving problems in linear systems. This transformation can be used as a mathematical tool to alter the problem into one that can be solved more easily. Fourier transform plays an important part in the theory of many branches of science. Many scientists know Fourier theory not in terms of Mathematics, but as a set of propositions about physical phenomena.

1. The Fourier Transform

Let $f : R \to C$ be a real or possibly complex-valued function. The Fourier transform of f(x) is defined as

$$\mathcal{F}[f(x)] = \int_{-\infty}^{\infty} f(x)e^{-i2\pi xs}\,dx.$$

This integral, which is a function of s, may be written as F(s).

Let F(s) be the Fourier transform of f(x) . Then the integral

$$\int_{-\infty}^{\infty} F(s)e^{i2\pi xs}\,ds = \int_{-\infty}^{\infty}\left[\int_{-\infty}^{\infty} f(x)e^{-i2\pi xs}dx\right]e^{i2\pi xs}\,ds$$

is equal to f(x), where $f(x)$ is continuous, or to $\frac{1}{2}(f(x^+)+f(x^-))$, where f(x) is discontinuous, provided that $\int_{-\infty}^{\infty}|f(x)|dx$ exists and any discontinuities in f(x) are finite.

Thus the inverse Fourier transform of F(s) is defined by

$$\mathcal{F}^{-1}[F(s)] = \int_{-\infty}^{\infty} F(s)e^{i2\pi xs}\,ds = f(x).$$

1.1 The Fourier Transform of Rectangle Function of Unit Height and Base

We consider rectangle function of unit height and base

$$\Pi(x) = \begin{cases} 1 & \text{if } |x| \le \frac{1}{2}, \\ 0 & \text{if } |x| > \frac{1}{2}. \end{cases}$$

$$\mathcal{F}[\Pi(x)] = \int_{-\frac{1}{2}}^{\frac{1}{2}} 1.e^{-i2\pi xs}\,dx$$

$$= \left[\frac{e^{-i2\pi xs}}{-i2\pi xs}\right]_{-\frac{1}{2}}^{\frac{1}{2}}$$

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$$= -\frac{1}{i2\pi s}\left[e^{-i\pi s} - e^{-i\pi s}\right]$$

$$= \frac{\sin \pi s}{\pi s}.$$

1.2 The Fourier Transform of Filtering Function

We obtain the Fourier transform of filtering function

$$\operatorname{sinc}(x) = \begin{cases} \dfrac{\sin \pi x}{\pi x} & \text{if } x \neq 0, \\ 1 & \text{if } x = 0. \end{cases}$$

Now, we have, for $a \neq 0$, $\int_{-\infty}^{\infty} \operatorname{sinc}(ax)\,dx = \dfrac{1}{|a|}$.

$$\mathcal{F}[\operatorname{sinc}(x)] = \int_{-\infty}^{\infty} \operatorname{sinc}(ax) e^{-i2\pi xs}\,dx$$

$$= \int_{-\infty}^{\infty} \operatorname{sinc}(x)(\cos 2\pi xs - i \sin 2\pi xs)\,dx$$

$$= \int_{-\infty}^{\infty} \operatorname{sinc}(x)\cos 2\pi xs\,dx - i\int_{-\infty}^{\infty} \operatorname{sinc}(x)\sin 2\pi xs)\,dx$$

$$= \int_{-\infty}^{\infty} \frac{\sin \pi x}{\pi x}\cos 2\pi xs\,dx - i\int_{-\infty}^{\infty} \frac{\sin \pi x}{\pi x}\sin 2\pi xs\,dx$$

$$= \int_{-\infty}^{\infty} \left(\frac{\sin \pi(1+2s)x}{2\pi x} + \frac{\sin \pi(1-2s)x}{2\pi x}\right)dx - 0$$

$$= \int_{-\infty}^{\infty} \left(\frac{1+2s}{2}\,\frac{\sin \pi(1+2s)x}{\pi(1+2s)x} + \frac{1-2s}{2}\,\frac{\sin \pi(1-2s)x}{\pi(1-2s)x}\right)dx$$

$$\mathcal{F}[\operatorname{sinc}(x)] = \int_{-\infty}^{\infty} \left(\frac{1+2s}{2}\operatorname{sinc}(1+2s)x + \frac{1-2s}{2}\operatorname{sinc}(1-2s)x\right)dx$$

$$= \frac{1+2s}{2}\,\frac{1}{|1+2s|} + \frac{1+2s}{2}\,\frac{1}{|1-2s|}.$$

If $s < \dfrac{1}{2}$, $\mathcal{F}[\operatorname{sinc}(x)] = \dfrac{1+2s}{2(1+2s)} + \dfrac{1-2s}{2(1-2s)} = \dfrac{1}{2} + \dfrac{1}{2} = 1.$

If $s < -\dfrac{1}{2}$, $\mathcal{F}[\operatorname{sinc}(x)] = \dfrac{1+2s}{2(-(1+2s))} + \dfrac{1-2s}{2(1-2s)} = -\dfrac{1}{2} + \dfrac{1}{2} = 0.$

If $s > \dfrac{1}{2}$, $\mathcal{F}[\operatorname{sinc}(x)] = \dfrac{1+2s}{2(1+2s)} + \dfrac{1-2s}{2(-(1-2s))} = \dfrac{1}{2} - \dfrac{1}{2} = 0.$

Thus $\mathcal{F}[\operatorname{sinc}(x)] = \prod(s)$.

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1.3 The Fourier Transform of Triangle Function of Unit Height and Area

We define triangle function of unit height and area

$$\Lambda(x) = \begin{cases} 1-|x| & \text{if } |x| \le 1, \\ 0 & \text{if } |x| > 1. \end{cases}$$

$$\mathcal{F}[\Lambda(x)] = \int_{-\infty}^{\infty} \Lambda(x) e^{-i2\pi xs}\, dx$$

$$= \int_{-1}^{1} (1-|x|)(\cos 2\pi xs - i \sin 2\pi xs)\, dx$$

$$= \int_{-1}^{1} (1-|x|)\cos 2\pi xs\, dx - i \int_{-1}^{1} (1-|x|)\sin 2\pi xs\, dx$$

$$= 2\int_{0}^{1} (1-x)\cos 2\pi xs\, dx$$

$$= 2\left\{ \left[(1-x)\frac{\sin 2\pi xs}{2\pi s} \right]_0^1 + \int_0^1 \frac{\sin 2\pi xs}{2\pi s}\, dx \right\}$$

$$= \frac{2}{2\pi s}\left[-\frac{\cos 2\pi xs}{2\pi s} \right]_0^1$$

$$= \frac{1}{2\pi^2 s^2}(-\cos 2\pi s + 1)$$

$$\mathcal{F}[\Lambda(x)] = \frac{\sin^2 \pi s}{\pi^2 s^2}$$

$$= \left(\frac{\sin \pi s}{\pi s} \right)^2$$

$$= \operatorname{sinc}^2(s).$$

1.4 The Fourier Transform of Truncated Exponential Function

We can solve the Fourier transform of truncated exponential function

$$e(x) = \begin{cases} e^{-x} & \text{if } x > 0, \\ 0 & \text{if } x < 0. \end{cases}$$

$$\mathcal{F}[e(x)] = \int_{-\infty}^{\infty} e(x) e^{-i2\pi xs}\, dx$$

$$= \int_{0}^{\infty} e^{-x} e^{-i2\pi xs}\, dx$$

$$= \int_0^\infty e^{-x(1+i2\pi s)}\,dx$$

$$= \left[\frac{e^{-x(1+i2\pi s)}}{-(1+i2\pi s)}\right]_0^\infty$$

$$= -\frac{1}{1+i2\pi s}[0-1]$$

$$= \frac{1}{1+i2\pi s}\cdot\frac{1-i2\pi s}{1-i2\pi s}$$

$$= \frac{1-i2\pi s}{1-i^2 2^2\pi^2 s^2}$$

$$= \frac{1-i2\pi s}{1+4\pi^2 s^2}.$$

1.5 Theorem (Fourier Transform of Complex Conjugate)

If the Fourier transform of $f(x)$ is $F(s)$, then the Fourier transform of $\overline{f(x)}$ is $\overline{F(-s)}$.

If the Fourier transform of a real-valued function $f(x)$ is $F(s)$, then $\overline{F(s)} = F(-s)$.

2. Convolution

The convolution of two functions f and g is a function defined by

$$(f * g)(x) = \int_{-\infty}^{\infty} f(u)g(x-u)du.$$

We write $(f * g)(x)$ also as $f(x) * g(x)$.

2.1 Self-convolution

The self-convolution of a function $f(x)$ is defined by

$$(f * f)(x) = \int_{-\infty}^{\infty} f(u)f(x-u)du.$$

2.2 Cross Correlation

The cross correlation of two real or possibly complex-valued functions f and g is a function defined by

$$(f \star g)(x) = \int_{-\infty}^{\infty} \overline{f(u-x)}g(u)du = \int_{-\infty}^{\infty} \overline{f(u)}g(u+x)du.$$

$f \star g$ is read as "f pentagram g". We write $(f \star g)(x)$ also as $f(x) \star g(x)$

2.3 Autocorrelation

The autocorrelation of a function $f(x)$ is defined by

$$(f \star f)(x) = \int_{-\infty}^{\infty} \overline{f(u-x)}f(u)du = \int_{-\infty}^{\infty} \overline{f(u)}f(u+x)du.$$

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3. Basic Theorems on the Fourier Transform

3.1 Linearity Theorem

If f(x) and g(x) have the Fourier transforms F(s) and G(s) respectively, then af(x) + bg(x), where a and b are constants, has the Fourier transform aF(s) + bG(s).

That is, $\mathcal{F}\left[af(x)+bg(x)\right] = aF(s)+bG(s)$.

Similarly, if f(x) and g(x) are the inverse Fourier transforms of F(s) and G(s) respectively, then

$$\mathcal{F}^{-1}\left[aF(s)+bG(s)\right] = af(x)+bg(x),$$

where a and b are constants.

3.2 Shift Theorem

If f(x) has the Fourier transform F(s), then f(x − a) has the Fourier transform $e^{-2\pi as}F(s)$.

That is, $\mathcal{F}\left[f(x-a)\right] = e^{-2\pi as}F(s)$.

3.3 Similarity Theorem

If f(x) has the Fourier transform F(s), then f(ax) has the Fourier transform $\frac{1}{|a|}F\left(\frac{s}{a}\right)$, where $a \neq 0$.

That is, $\mathcal{F}\left[f(ax)\right] = \frac{1}{|a|}F\left(\frac{s}{a}\right)$.

3.4 Corollary

If $\mathcal{F}\left[f(x)\right] = F(s)$, then

(i) $\mathcal{F}\left[f(-x)\right] = F(-s)$.

(ii) $\mathcal{F}\left[\overline{f(-x)}\right] = \overline{F(s)}$.

3.5 Modulation Theorem

If f(x) has the Fourier transform F(s), then

(a) f(x)cosωx has the Fourier transform $\frac{1}{2}F\left(s-\frac{\omega}{2\pi}\right)+\frac{1}{2}F\left(s+\frac{\omega}{2\pi}\right)$.

(b) f(x)sinωx has the Fourier transform $\frac{1}{2i}F\left(s-\frac{\omega}{2\pi}\right)-\frac{1}{2i}F\left(s+\frac{\omega}{2\pi}\right)$.

3.6 Convolution Theorem

If f(x) and g(x) have the Fourier transforms F(s) and G(s) respectively, then (f * g)(x) has the Fourier transform F(s)G(s), that is, the Fourier transform of convolution of two functions is multiplication of their transforms.

That is, $\mathcal{F}\left[(f*g)(x)\right] = F(s)G(s)$.

3.7 Corollary

(i) $\mathcal{F}\left[f(x)*g(-x)\right] = F(s)\overline{G(-s)}$.

(ii) $\mathcal{F}\left[f(x)*\overline{g(x)}\right] = F(s)\overline{G(-s)}$.

(iii) $\mathcal{F}\left[f(x)*\overline{g(-x)}\right] = F(s)\overline{G(s)}$.

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3.8 Multiplication Theorem

If f(x) and g(x) have the Fourier transforms F(s) and G(s) respectively, f(x) g(x) has the Fourier transform F(s)*G(s), that is, the Fourier transform of f(x) g(x) multiplication of two functions has convolution of their transforms.

That is, $\mathcal{F}[f(x)\,g(x)] = (F*G)(s)$.

3.9 Cross Correlation Theorem

If the Fourier transforms of two complex-vlaued functions f(x) and g(x) are F(s) and G(s) respectively, then $(f\bar{K}g)(x)$ has the Fourier transform $\overline{F(s)}\,G(s)$.

That is, $\mathcal{F}\,(f\bar{K}g)(x) = \overline{F(s)}\,G(s)$.

3.10 Corollary

If the Fourier transform of a complex-valued function f(x) is F(s), then its autocorrelation function $(f\bar{K}f)(x)$ has the Fourier transform $|F(s)|^2$.

That is, $\mathcal{F}[(f\bar{K}f)(x)] = |F(s)|^2$.

4. Applications

4.1 Example

Let $f(x) = e^{-|x|}$, for all x.

$$\mathcal{F}[f(x)] = \int_{-\infty}^{\infty} f(x)e^{-i2\pi xs}\,dx$$

$$= \int_{0}^{\infty} e^{-x}\,e^{-i2\pi xs}\,dx + \int_{-\infty}^{0} e^{x}\,e^{-i2\pi xs}\,dx$$

$$= \int_{0}^{\infty} e^{-x(i2\pi s+1)}\,dx + \int_{-\infty}^{0} e^{-x(i2\pi s-1)}\,dx$$

$$= \left[\frac{e^{-x(i2\pi s+1)}}{-(i2\pi s+1)}\right]_0^{\infty} + \left[\frac{e^{-x(i2\pi s-1)}}{-(i2\pi s-1)}\right]_{-\infty}^{0}$$

$$= \frac{1}{i2\pi s+1} - \frac{1}{i2\pi s-1}$$

$$= \frac{2}{1+4\pi^2 s^2}$$

$$= F(s).$$

If $g(x) = f(2x) = e^{-2|x|}$, then by theorem 3.3,

$$G(s) = \frac{1}{|2|}F\left(\frac{s}{2}\right)$$

$$= \frac{1}{2}\,\frac{2}{1+4\pi^2\frac{s^2}{4}}$$

$$= \frac{1}{1+\pi^2 s^2}.$$

If $g(x) = e^{-|x|}\cos\pi x$, then by theorem 3.5,

$$G(s) = \mathcal{F}[g(x)]$$

$$= \frac{1}{2}F\left(s-\frac{\pi}{2\pi}\right) + \frac{1}{2}F\left(s+\frac{\pi}{2\pi}\right)$$

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$$= \frac{1}{2}F\left(s-\frac{1}{2}\right)+\frac{1}{2}F\left(s+\frac{1}{2}\right)$$

$$= \frac{1}{2}\cdot\frac{2}{1+4\pi^2\left(s-\frac{1}{2}\right)^2}+\frac{1}{2}\cdot\frac{2}{1+4\pi^2\left(s+\frac{1}{2}\right)^2}$$

$$= \frac{1}{1+4\pi^2\left(s^2-s+\frac{1}{4}\right)}+\frac{1}{1+4\pi^2\left(s^2+s+\frac{1}{4}\right)}$$

$$= \frac{1}{1+\pi^2\left(4s^2-4s+1\right)}+\frac{1}{1+\pi^2\left(4s^2+4s+1\right)}$$

$$= \frac{1}{1+\pi^2(2s-1)^2}+\frac{1}{1+\pi^2(2s+1)^2}.$$

4.2 Example

(i) $\mathcal{F}[\Pi(x)] = \dfrac{\sin \pi s}{\pi s} = \operatorname{sinc}(s)$

$$\mathcal{F}[\Pi(x)*\Pi(x)] = \mathcal{F}[\Pi(x)]\,\mathcal{F}[\Pi(x)]$$
$$= \operatorname{sinc}(s)\,.\,\operatorname{sinc}(s)$$
$$= \operatorname{sinc}^2(s).$$

(ii) $$\mathcal{F}[\Lambda(x)] = \frac{\sin^2 \pi s}{\pi^2 s^2} = \operatorname{sinc}^2(s)$$

$$\mathcal{F}[\Lambda(x)*\Pi(x)] = \mathcal{F}[\Lambda(x)]\mathcal{F}[\Pi(x)]$$
$$= \operatorname{sinc}^2(s)\,.\,\operatorname{sinc}(s)$$
$$= \operatorname{sinc}^3(s).$$

(iii) $$\mathcal{F}[\operatorname{sinc}(x)] = \Pi(s)$$

$$\mathcal{F}[\,e(x)\,] = \frac{1}{1+i2\pi s}$$

$$\mathcal{F}[\,e(x)*\operatorname{sinc}(x)\,] = \mathcal{F}[e(x)]\,\mathcal{F}[\operatorname{sinc}(x)]$$

$$\mathcal{F}[\,e(x)*\operatorname{sinc}(x)\,] = \frac{1}{1+i2\pi s}\cdot\Pi(s)$$
$$= \frac{\Pi(s)}{1+i2\pi s}.$$

4.3 Example

Let $$f(x) = \begin{cases} ie^{-x} & \text{if } x > 0, \\ 0 & \text{if } x < 0, \end{cases}$$

and $$g(x) = \begin{cases} xe^{-x} & \text{if } x > 0, \\ 0 & \text{if } x < 0. \end{cases}$$

$$\mathcal{F}[f(x)] = i\,\frac{1-i2\pi s}{1+4\pi^2 s^2} = \frac{2\pi s+i}{1+4\pi^2 s^2} = F(s).$$

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$$\mathcal{F}[g(x)] = \frac{(1-i2\pi s)^2}{\left(1+4\pi^2 s^2\right)^2} = G(s).$$

$$\mathcal{F}[(f\text{K}g)(x)] = \overline{F(s)}\,G(s)$$

$$= \frac{2\pi s - i}{1+4\pi^2 s^2} \cdot \frac{(1-i2\pi s)^2}{(1+4\pi^2 s^2)^2}$$

$$= \frac{(2\pi s - i)(1-i2\pi s)^2}{(1+4\pi^2 s^2)^3}.$$

5. Conclusion

Fourier transform is thoroughly defined in this paper. Properties of Fourier transform are investigated in detail. Convolution is used a lot here. It is a fairly tricky concept. But it becomes easy when the Fourier transform of convolution of two functions are derived.

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Application of Dijkstra's Shortest Path Algorithm in Kachin State

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Abstract

This research paper is concerned with the application of Dijkstra's algorithm in graph theory for the estimation of the shortest road map to eight destinations in Kachin State. This algorithm can be used to find the shortest paths with a positive weight graph from a single source node to a single destination node by denoting permanent if it has been determined. In this paper, Myitkyina is used as a source node and the other seven towns in Kachin State are used as destination nodes. The goal of this paper is to find the shortest paths from Myitkyina to other towns by comparing the weighted values between any two different paths with their edge lengths that are assigned by actual values. The actual distances between the two towns are taken from Google map.

Keywords: map of Kachin State, weighted graph, Dijkstra's shortest path algorithm, permanent, temporary

Introduction

Kachin State is the northernmost state of Myanmar. The area of Kachin State is 89.041 km^2 (34.379 sq mile). The capital of the state is Myitkyina. Other important towns include Bhamo, Mohnyin and Putao. Kachin State has Myanmar's highest mountain, (Hkakabo Razi 5889 meters (19321ft)) and a Large inland Lake, Indawgyi Lake. In many fields of applications, graph theory plays vital role for various modelling problems in real world such as travelling, transportation, traffic control, communications and various computer applications and so on. This paper provides the shortest paths from one place to another by using Dijkstra's Algorithm in graph theory. Firstly, the descriptions of the algorithm are expressed. Then the steps of the algorithm are explained. Finally, the algorithm is illustrated

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to find the optimal paths for travelling to the seven towns and one city in Kachin State with shortest distances.

1. Definitions and Notation

A graph G consists of two finite sets, a set V of points, called **vertices** and a set E of connecting lines, called **edges,** such that each edge connects two vertices, called the **endpoints** of the edge. Two vertices which are incident with a common edge are **adjacent,** as are two edges which are **incident** with a common vertex. A graph will real number on the edges is called a **weighted graph** of a transportation network. A graph with no cycle is an **acyclic graph.** A tree is a connected acyclic graph. A tree T is called a **spanning tree** of a connected graph G if T is a subgraph of G and if T contains all vertices of G.

1.1 Problem Definitions

The problem of finding the shortest path between two intersections on a road map may be modeled as a special case of the shortest path problem in graphs. One such is the shortest path problems, given a roadway network connecting various towns, determine a shortest path between two specified towns in the network. For a traveller, who wants to visit all interesting and famous places in a region, it is important to know the effective way. When we plan a journey, there are different factors we might consider such as the shortest distance, the minimum time and the lowest cost for effective travelling. In this research paper, we consider to optimize distance only.

1.2 Dijkstra's Shortest Path Algorithm

Dijkstra's algorithm, published in 1959 and named after its creator Dutch computer scientist Edsger Dijkstra, can be applied on a weighted graph. The graph can either be directed or undirected. The following are the simple steps of the Dijkstra's algorithm.

Step 1. Initialization

(1) Label the start vertex as 0.
(2) Box this number (permanent label).
(3) Label each vertex that is connected to the start vertex with its distance (temporary label).

Step 2. Box the minimum number

(1) From this vertex, consider the distance to each connected vertex.
(2) If a distance is less than a distance already at this vertex, cross out this distance and write in the new distance. If there was no distance at the vertex, write down the new distance.

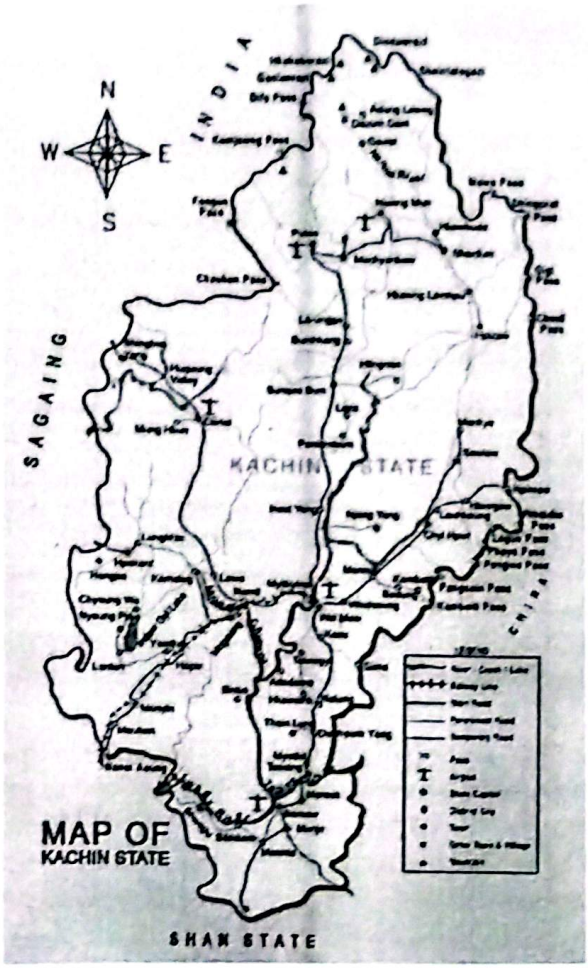
Step 3. Repeat from step 2 until the destination vertex is boxed.

When a vertex is boxed you do not reconsider it. You need to show all temporary labels together with their crossing out.

2. Result and Discussion

The application of Dijkstra's algorithm to effective travelling from Myitkyina to other seven towns in that region has been illustrated. We collect the data from Google map. Now, we convert from road map of Kachin State to a weighted graph. Then we find out the shortest distance between Myitkyina and other seven towns by using Dijkstra's algorithm. We consider the following a weighted graph such that the weights are positive number as kilometers between Myitkyina and other seven towns in Kachin State.

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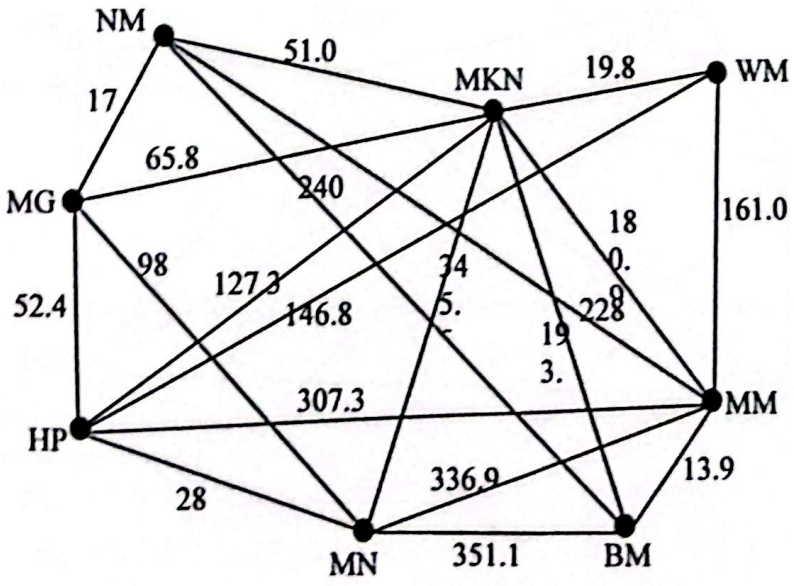


Figure 1. Presentation of towns in Kachin State by weighted connected graph

2.1 Explanation of the Algorithm

The explanation steps of the Dijkstra's shortest path algorithm are presented as follows:

Step 1. Define the initial (start) town and label that point as number zero and box it named as permanent or current.

Step 2. Search the towns that can be reached from permanent or current and select the nearest town by using the formula;

$$\text{new } d_j = \min\{d_j, d_i + d_{ij}\},$$

where d_j is the distance of adjacent town j, d_i is the distance value for the index of the current town, d_{ij} is the distance values between i^{th} town and j^{th} town.

Step 3. Repeat the step 2 until all destinations towns are permanent by changing the updated town with shortest distance to permanent list and box it. If we cannot reach any temporary labelled node from the current node, then all the temporary labels become permanent.

Step 4. Construct a minimum spanning tree to describe the shortest distances from start town to other destination towns in given network.

In this paper, we illustrate to find the optimal path (minimum spanning tree for shortest paths) from Myitkyina to other destination towns in Kachin State as follows:

Step 1.

Myitkyina (MKN) is designed as the current town and the state of the MKN is (0, p). Every other town has state (∞, t).

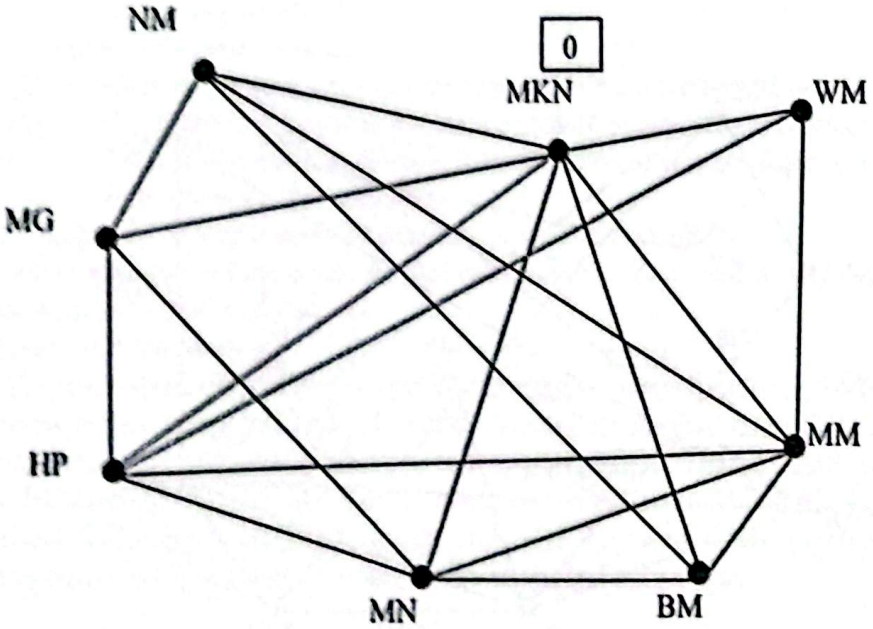


Figure 2. The states of current town Myitkyina (MKN) as permanent

Step 2.

The towns named Namati (NM), Waimaw (WN), Momauk (MM), Bhamo (BM), Mohnyin (MN), Hopin (HP) and Mogaung (MG) can be reached from the current town MKN. Update distance values for these cities:

$$d_{NM} = \min\{\infty, 0+51\} = 51$$
$$d_{WM} = \min\{\infty, 0+19.8\} = \boxed{19.8}$$
$$d_{MM} = \min\{\infty, 0+180.9\} = 180.9$$
$$d_{BM} = \min\{\infty, 0+193.6\} = 193.6$$
$$d_{MN} = \min\{\infty, 0+345.5\} = 345.5$$
$$d_{HP} = \min\{\infty, 0+127.3\} = 127.3$$
$$d_{MG} = \min\{\infty, 0+65.8\} = 65.8$$

Hence the shortest distance is 19.8 at Waimaw (WM). Box number 19.8 at Waimaw and the state label at WM changes to permanent so its state (19.8, p) while the states of Namati (NM), Momauk (MM), Bhamo (BM), Mohnyin (MN), Hopin (HP) and Mogaung (MG) remain temporary.

WM becomes the permanent town as shown in Figure 3.

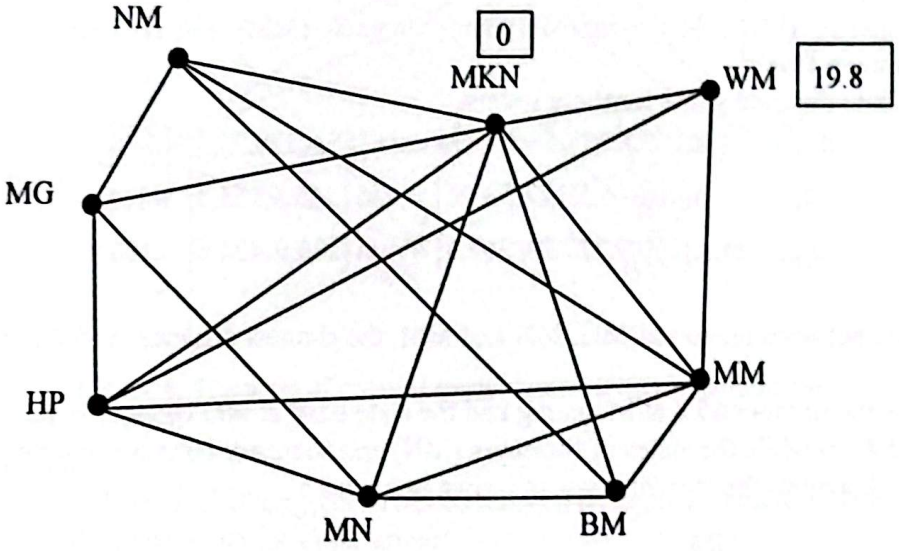


Figure 3. The state of current town Waimaw (WM) as permanent

Continue step 2.

Momauk (MM) and Hopin (HP) can be reached from the permanent town Waimaw. Update distance value for these towns:

$$d_{MM} = \min\{180.9, 19.8+161\} = \min\{180.9, 180.8\} = 180.8$$
$$d_{HP} = \min\{127.3, 19.8+146.8\} = \min\{127.3, 166.6\} = \boxed{127.3}$$

Hence the shortest distance is 127.3 at Hopin (HP).

Box the number 127.3 at Hopin and the state label at HP changes to permanent so its state (127.3, p) while the states of MM remain temporary.

Hopin becomes the permanent town as shown in Figure 4.

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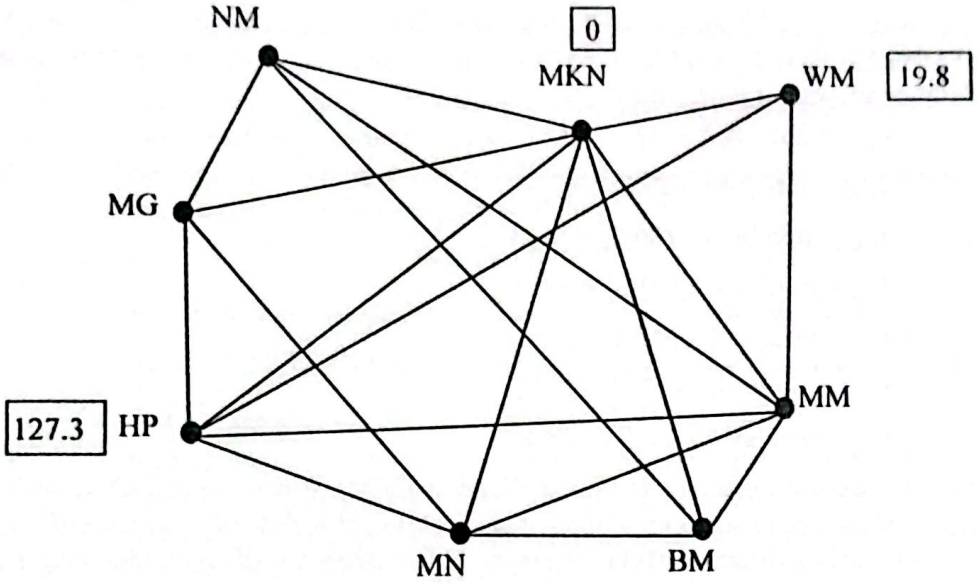


Figure 4. The state of current town Hopin (HP) as permanent

Continue step 2.

Mogaung (MG), Mohnyin (MN) and Momauk (MM) can be reached from the permanent town Hopin.

Update distance value for these towns:

$$d_{MG} = \min\{65.8, 127.3+52.4\} = \min\{65.8, 179.7\} = \boxed{65.8}$$

$$d_{MN} = \min\{345.5, 127.3+28\} = \min\{345.5, 155.3\} = 155.3$$

$$d_{MM} = \min\{180.9, 127.3+307.3\} = \min\{180.9, 434.6\} = 180.9$$

Now between the towns MG, MN and MM, the shortest distance is 65.8 at Mogaung (MG).

Box the number 65.8 at Mogaung and the state label at MG changes to permanent so its state (65.8, p) while the states of Mohnyin (MN) and Momauk remain temporary.

MG becomes the current town as shown in Figure 5.

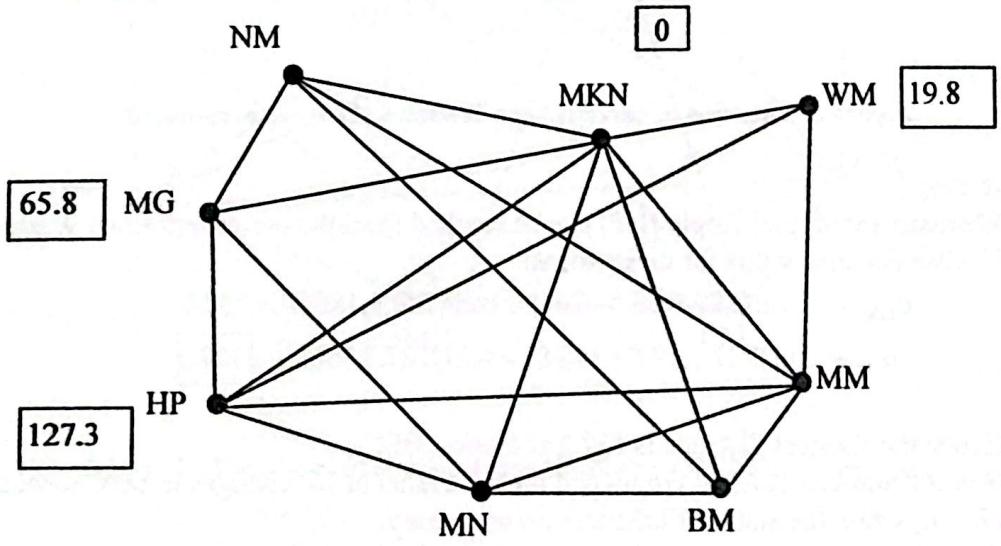


Figure 5. The state of current town Mogaung (MG) as permanent

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Continue step 2.

Namati (NM) and Mohnyin (MN) can be reached from the current town Mogaung (MG).

Update distance value for these towns:

$$d_{NM} = \min\{51.0, 65.8+17\} = \min\{51.0, 82.8\} = \boxed{51.0}$$

$$d_{MN} = \min\{345.5, 65.8+98\} = \min\{345.5, 163.8\} = 163.8$$

Hence the shortest distance is 51.0 at Namati (NM).

Box the number 51.0 at Namati and the state label at NM changes to permanent so its state (51.0, p) while the state of MN remain temporary.

Namati becomes the current town as shown in Figure 6.

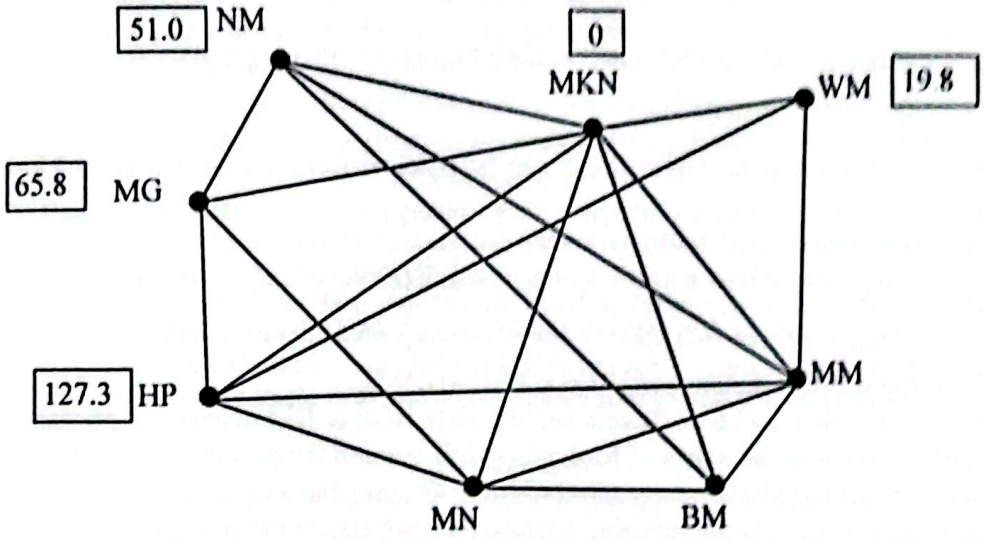


Figure 6. The state of current town Namati (NM) as permanent

Continue step 2.

Momauk (MM) and Bhamo (BM) can be reached from the current town Namati (NM).

Update distance value for these towns:

$$d_{MM} = \min\{180.9, 51.0+228\} = \min\{180.9, 279.0\} = \boxed{180.9}$$

$$d_{BM} = \min\{193.6, 51.0+240\} = \min\{193.6, 291.0\} = 193.6$$

The shortest distance is 180.9 at Momauk (MM).

Box the number 180.9 at Momauk and the state label at MM changes to permanent so its state (180.9, p) while the states of BM remain temporary.

Momauk becomes the current town as shown in Figure 7.

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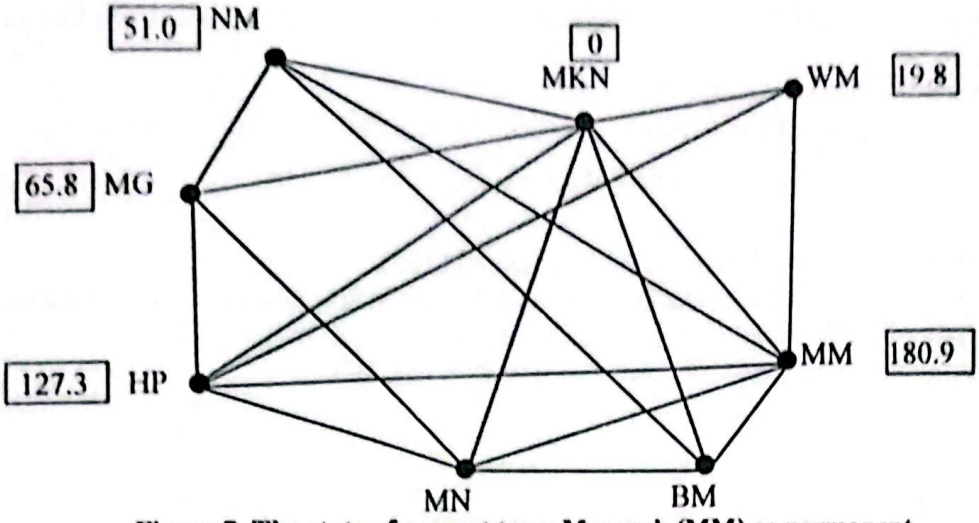


Figure 7. The state of current town Momauk (MM) as permanent

Continue step 2.

Bhamo (BM) and Mohnyin (MN) can be reached from the current town Momauk (MM).

Update distance value for these towns:

$$d_{BM} = \min\{193.6, 180.9 + 13.9\} = \min\{193.6, 194.8\} = \boxed{193.6}$$

$$d_{MN} = \min\{345.5, 180.9 + 336.9\} = \min\{345.5, 517.8\} = 345.5$$

Now the shortest distance is 193.6 at Bhamo (BM).

Box the number 193.6 at Bhamo and the state label at BM changes to permanent so its state (193.6, p) while the states of Mohnyin (MN) remain temporary. But Mohnyin is an end town of the network because its adjacent town, Bhamo and Hopin, are already selected as permanent towns. So it is automatically selected as permanent by implementation step 3.

The final graph showing the minimum spanning tree of distances from start city Myitkyina to other towns can be seen as follows:

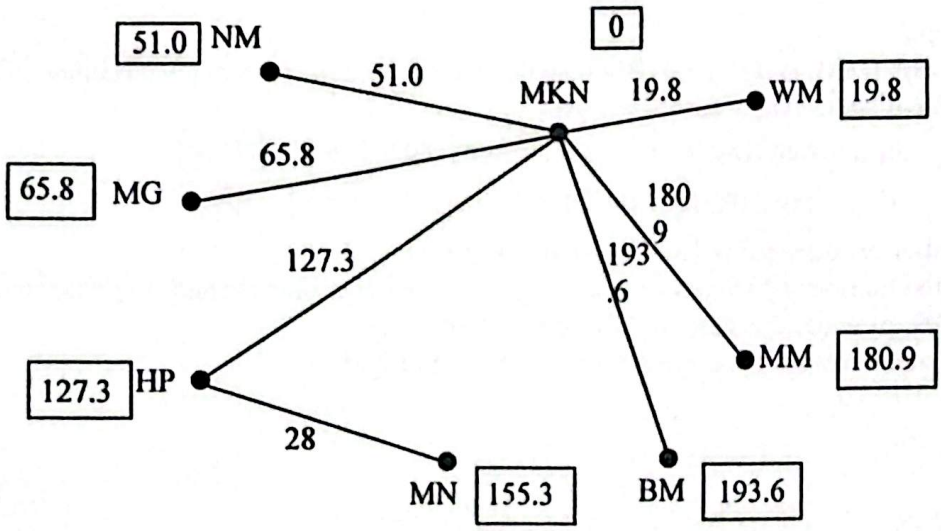


Figure 8. The minimum spanning tree of shortest paths (km) from Myitkyina to other towns in Kachin State

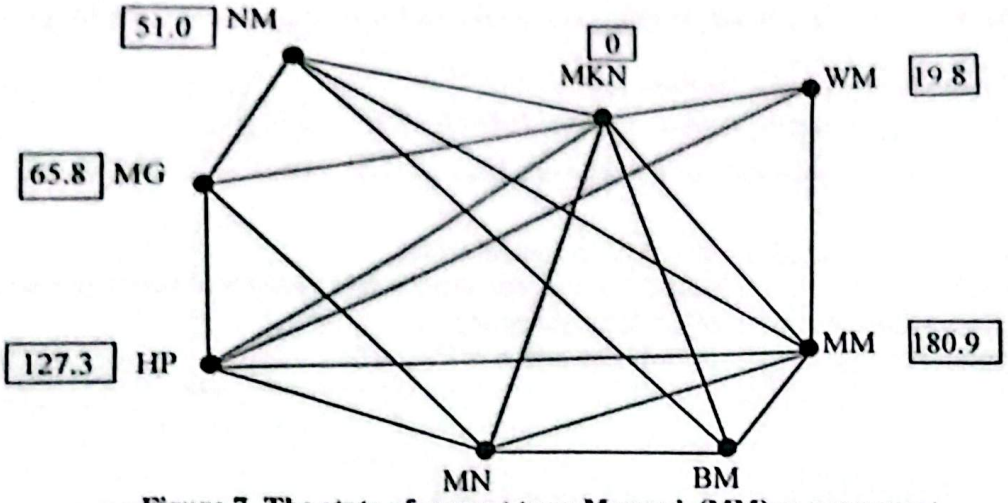


Figure 7. The state of current town Momauk (MM) as permanent

Continue step 2.

Bhamo (BM) and Mohnyin (MN) can be reached from the current town Momauk (MM).

Update distance value for these towns:

$$d_{BM} = \min\{193.6, 180.9 + 13.9\} = \min\{193.6, 194.8\} = \boxed{193.6}$$

$$d_{MN} = \min\{345.5, 180.9 + 336.9\} = \min\{345.5, 517.8\} = 345.5$$

Now the shortest distance is 193.6 at Bhamo (BM).

Box the number 193.6 at Bhamo and the state label at BM changes to permanent so its state (193.6, p) while the states of Mohnyin (MN) remain temporary. But Mohnyin is an end town of the network because its adjacent town, Bhamo and Hopin, are already selected as permanent towns. So it is automatically selected as permanent by implementation step 3.

The final graph showing the minimum spanning tree of distances from start city Myitkyina to other towns can be seen as follows:

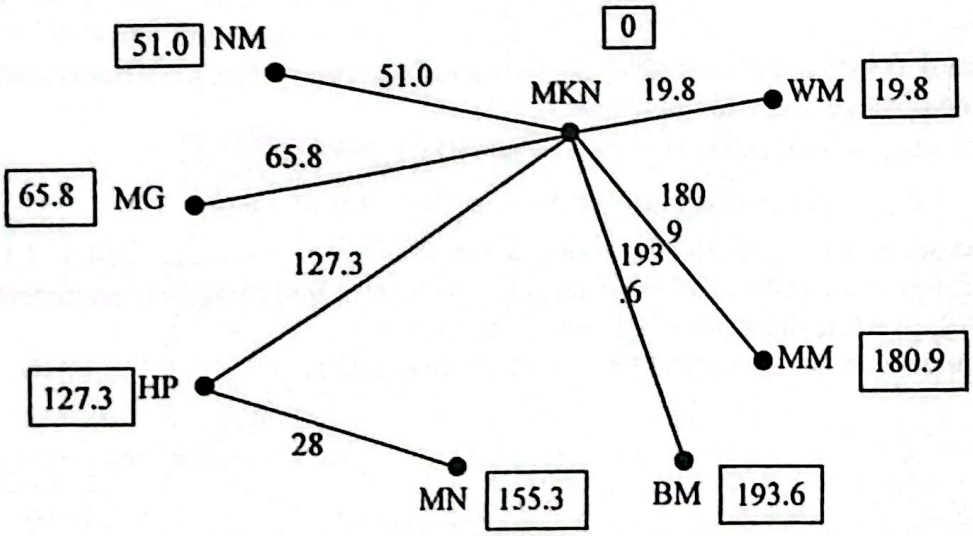


Figure 8. The minimum spanning tree of shortest paths (km) from Myitkyina to other towns in Kachin State

Now we get the minimum spanning tree of shortest paths from MKN-WM, MKN-MM, MKN-BM, MKN-NM, MKN-MG, MKN-HP and MKN-HP-MN in Figure 8.

Table 1. Comparing with the results from research and google map

Paths	Results from research	Google map
MKN-WM	19.8	19.8
MKN-MM	180.9	180.9
MKN-BM	193.6	193.6
MKN-NM	51.0	51.0
MKN-MG	65.8	65.8
MKN-HP	127.3	127.3
MKN-MN	155.3	345.5

3. Conclusion and Future works

By using Dijkstra's algorithm, the shortest path of a graph can be found. To travel from city to city, city to town, town to town, for example, the shortest path between these cities (or) towns can be achieved by using this algorithm. For further studies, this algorithm can also be applied to find the optimal results for traffic control, path finding in social networks, computer games, transportation systems and operations research etc.

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Study on Catch weight and Commercial Profit of Some Fish Species in Shan Ywar Myitkyo Inn, Laymyethna Township, Ayeyarwady Region

Sa Soe Shwe[1]

Abstract

Fishing from Shan Ywar Myitkyo Inn is important contribution to the national economies and trade in Myanmar. In addition, it provides livelihood to local communities and important and relatively cheap source of protein for the countries population. The study was observed on species composition, catch weight, mean values, prices and commercial profit on some fish species and conducted from December, 2018 to May, 2019. A total of 28 fish species belonging to 20 genera, 12 families under six orders was recorded during the study period. Fish species composition in order Cypriniformes (39.29 %), Siluriformes (25 %), Perciformes (21.43 %), Osteoglossiformes (7.14 %), Clupeiformes (3.57 %) and Cyprinodontiformes (3.57 %) was recorded respectively. Therefore, the highest catch weights were found in December and the lowest in May. The species of *Labeo rohita* and *Cirrhinus mrigala* were exported fish species categories for local and gained the profit for auctioneer. The monthly catch weight and income

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(345.578 kg, 690253 kyats) in December and followed by (292.302 kg, 501530 kyats) in January, (148.87 kg, 300305 kyats) in February, (148.437 kg, 314660 kyats) in March, (148.60 kg, 270570 kyats) in April and finally (97.959 kg, 171267.32 kyats) in May. The total catch weights were observed as the highest in *Labeo rohita* (211.77 kg) and followed by *Cirrhinus mrigala* (113.80 kg) and the lowest (8.173 kg) in species *Aorichthys aor*. Among the studied species, the species of *Notopterus chitala* and *Notopterus notopterus* (4500 kyats/kg) were the highest and the lowest in *Colisa fasciatus* (1000 kyats/kg) at local market price. The total incomes in *Labeo rohita* (453670 kyats) and *Cirrhinus mrigala* (243880 kyats) were recorded as the highest while the lowest in *Amblypharyngodon mola* (14000 kyats) and followed by *Osteobrama cotio cunma* (10575 kyats) throughout the study period. Concluding on the profits from December to May, the auctioneer gains (775138.32 Kyats) and followed by losses (99302.68 kyats) and net profits (675835.84 kyats) during the study period.

Keywords: species composition, catch weight, income, prices, commercial profit

Introduction

The Myanmar fisheries sector is vital for national food security, income generation and export earnings. Inland capture fisheries are a major contributor of the fisheries sector, and have generated 1, 2 million tones in 2012, i.e. 29% of the total fish production including aquaculture (Soe *et al*., 2003-2013). In Myanmar, fishery is an important sector for the socio-economic development. The increasing demand in local market as well as its large potential in the export markets has boosted more investment in aquaculture. Freshwater is one of the important natural resources and there is no substitute for it. River and floodplain resources are exploited largely by people living along the river (Johnson, 1993, Kristensen, 2003). Myanmar supports a highly productive fisheries sector, which is vital for national food security, income generation and export revenue. Inland fishery resources and aquaculture make an important generation and export revenue. Inland fishery resources and aquaculture make an important and expanding contribution to the sector (Soe *et al*., 2015). A survey of 180 leasable fisheries in the Ayeyarwady and Yangon region found that 96% of leases were associated with large rivers, river channels, or combination of rivers and wetlands; 43% contained seasonal wetlands; 40% were within, or encompassed, protected areas subject to fishing restrictions; and 32% contained known fish breeding areas (Wah *et al*., 2016). "Inn" leasable fisheries, the peak season involves capturing fishes migrating off the floodplain at the beginning of river drawdown lease enjoy exclusive rights to fish the lease area including preventing access by others and a certain degree of environmental management and control. This is referred to locally as the "Inn" fishery. The duration of an auctioned lease is one year; depending on the region this can be extended in three-year cycles for up to 10 years.

Leaseholders have exclusive rights to the fishing ground and some control over management of the resource (FAO and NACA, 2003). Commercial aquaculture, in particular, is concentrated within 50 km of Yangon to benefit from trade and transport infrastructure. Rohu carp is estimated to account for 70% of all farmed fish in Myanmar (Belton *et al*., 2015). Income from fishing is particularly important to developing economies, which often depend heavily on revenues from natural resources such as timber, mining, oil, and fish. Fisheries are a major foreign exchange earner for developing countries, which produce more than half of all internationally traded seafood (Sabatini, 2001). Fishing is also a crucial source of livelihoods in developing nations, particularly for low-income families in rural areas where job options are limited. Over 95 percent of them live in developing countries, and the majority are small-scale fishers (WRI *et al*., 2003).

Myanmar's fisheries are among the most important globally but remain some of the least documented. Fishes provide at least 60% of Myanmar's animal protein consumption. The fisheries sector occupies an important place in Myanmar's economy and culture, and is set to change rapidly as the country enters a period of unprecedented political and economic transition (Soe *et al*., 2000). A commercial fishery is any fishery that sells its catch in the marketplace, either for export or for local consumption. With the exception of subsistence fishers, all modern fisheries are commercial, including most small-scale or artisanal fisheries

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(FAO Fisheries Glossary, 2003). Shan Ywar Myitkyo Inn is situated at the south part of Laymyethna Township. The people living around the environs of Laymyethna Township depend on productivity of those Inn for this livelihood. The economic important of indigenous fishes of Shan Ywar Myitkyo Inn was not conducted in previous workers. The present study was conducted with the following objective such as to record and identify of some fish species and to investigate the catch weight and prices of each species and to record commercial profit of some fish species.

Materials and Methods

Study Site and Study Period

Shan Ywar Myitkyo Inn is one of the leasable fisheries at Shan Ywar Village of Laymyethna Township in Hinthada District, Ayeyarwady Region. It is located between 17°30′ 33.78″ N and 95°8′ 4.12″ E which is situated in the south part of Laymyethna Township, Ayeyarwady Region. The area is approximately 7. 54 sq.km which is a maximum depth 10.5 meters during monsoon period. The water level was reduced to minimum two meters in March to May. The study period was conducted from December, 2018 to May, 2019.

Specimen Collection, Identification and Recording data

Fish specimens were collected twice in a month with the help of the local fishermen. After soon catch, fresh specimens were taken photograph to obtain the natural size and color. The total weight of the caught fish was recorded. Identification of fish species was followed after Day (1978) and Talwar and Jhingran (1991). The data obtained from research work were presented by histogram and tabulation.

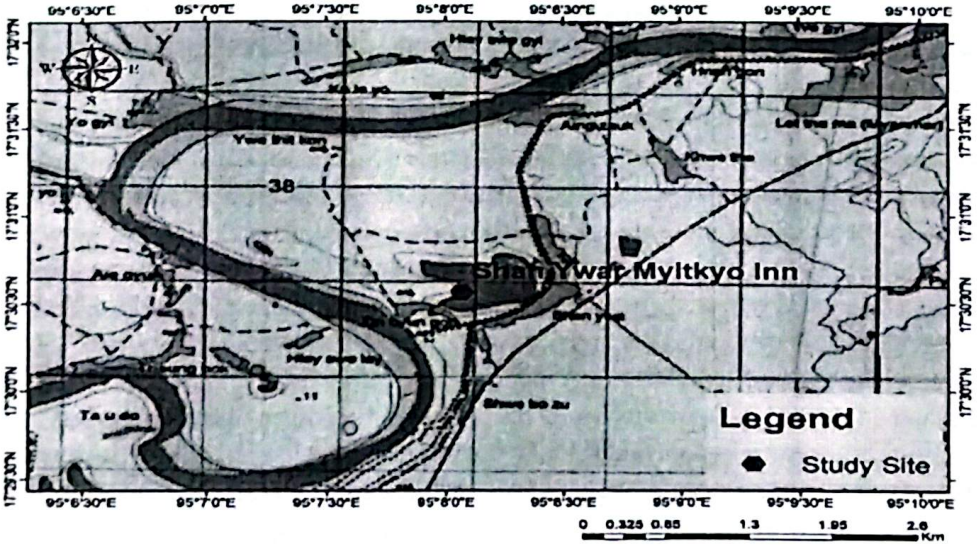


Figure (1) Map of the study site (Source: Google Search 2018)
Department of Geology, Hinthada University



A. Study site B. Specimen collection C. Weighing of the specimens by digital balance D. Weighing of each specimen by weigh balance

Plate (1) Study site, Specimen collection and Weighing of the collected fish species by digital and weigh balance

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Results

Over the Shan Ywar Myitkyo Inn, a total of 28 species belonging to 20 genera under 12 families of 6 orders was recorded during the study period (Table 1).

S. No.	Order	Family	Species	Local Name
1	Cypriniformes	Cyprinidae	Puntius sophore	Nga Ka Mala
			Puntius conchonius	Nga pha
			Puntius sarana	Nga phyo ka
			Puntius terio	Nga thone ginyaung
			Puntius gonionotus	Nga gyi
			Puntius sp.	Kyauk nga zin
			Cirrhinus mrigala	Nga mon gyi
			Cirrhinus reba	Nga mon chin
			Labeo rohita	Nga ngo ma ale
			Labeo boga	Nga phe thay
			Labeo bata	Nga ka dawn
			Labeo calbasu	Nga phe ma
			Labeo gonius	Nga Khon ma
			Labeo dyocheilus	Nga Khon ma mot kwe
			Labeo fimbriatus	Nga kok phyo
			Osteobrama cotio	Nga mote wet
2	Siluriformes	Bagridae	Mystus cavasius	Nga ye ping
			Mystus vittatus	Nga ma kyee
			Mystus aor	Nga thy
			Mystus tengara	Nga ma yae kwaing
		Siluridae	Ompok bimaculatus	Nga ne dan
			Ompok pabda	Nga Na
		Schilbeidae	Neotropius atherinoides	Nga thin gyee pa
3	Osteoglossiformes	Notopteridae	Notopterus notopterus	Nga phaung ma
4	Perciformes	Nandidae	Nandus nandus	Nga ein nge
		Channidae	Channa punctatus	Nga ka kwe
			Channa striatus	Nga phyo thale
		Badidae	Badis badis	Nga yan
		Ambassidae	Parambassis ranga	Nga nwar ga gaw
			Parambassis lala	Nga nwar ga kyin ni

Table (1) Systematic position of recorded fish species in Shan Ywar Myitkyo Inn

Fish Species Composition and Species Numbers in Shan Ywar Myitkyo Inn

The total species (28), genera (20), family (12) and order (6) of freshwater fish species were recorded from study site. The percentages of fish occurrence in order Cypriniformes (39.29 %), Siluriformes (25 %), Perciformes (21.43 %), Osteoglossiformes (7.14 %), Clupeiformes (3.57 %), and Cyprinodontiformes (3.57 %) were recorded during the study period. Among these, the order Cypriniformes (39.29 %) was found to be the highest and order Clupeiformes and Cyprinodontiformes (3.57 % each) were found to be the lowest. The species numbers in order Cypriniformes (11), Siluriformes (7), Perciformes (6), Osteoglossiformes (2), Clupeiformes (1) and Cyprinodontiformes (1) were recorded during the study period. Among them, the highest species number in order Cypriniformes (11) was found but lowest in order Clupeiformes and Cyprinodontiformes (1in each) (Fig. 2).

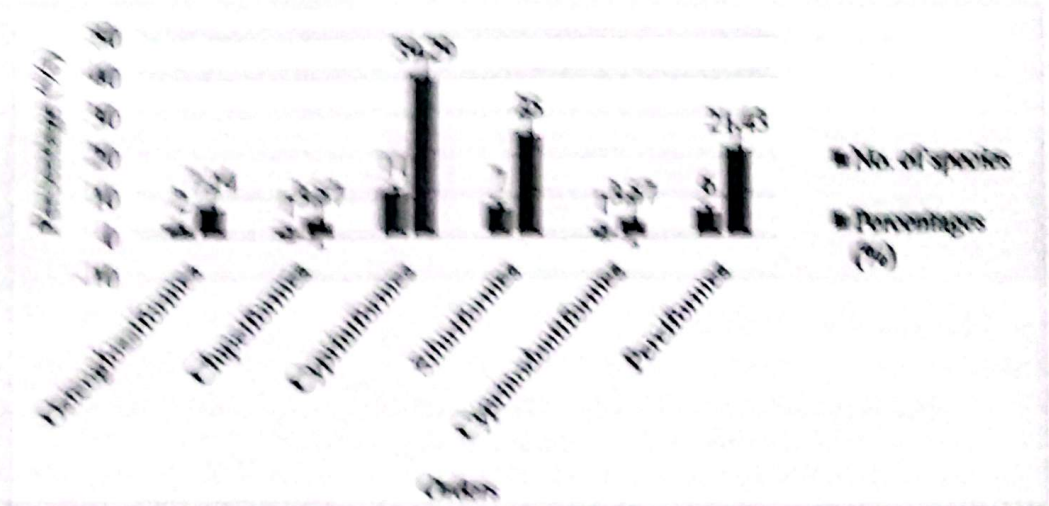


Figure (2) Species composition of recorded fish species in different families

Monthly Catch Weight (kg), Total Weight (kg) of Recorded Fish Species

Monthly total catch weight (57.143 kg) of fish species *Notopterus chitala* was found in five months (6.523 kg, 14.70 kg, 21.23 kg, 8.97 kg, 5.72 kg) except in January. The total weight (66.11 kg) which included the six months study period of *Notopterus notopterus* (8.16 kg, 21.23 kg, 9.78 kg, 14.70 kg, 8.97 kg, 3. 27 kg) was observed. During the six months study period, the total weight (51.416 kg) of *Stolephorus indicus* belonging to (16.33 kg, 19.58 kg, 1.633 kg, 1.633 kg, 8.16 kg, 4. 08 kg) was recorded. The total weight (94.53 kg) of *Catla catla* which included (65.32 kg, 9.72 kg, 3.27 kg, 7.28 kg, 8.94 kg) was recorded but not found in January. The total weight (113.80 kg) of *Cirrhinus mrigala* which included (37.56 kg, 29.40 kg, 32.66 kg, 8.16 kg, 2.45 kg, 3. 57 kg) was observed throughout the study period. During the study period, the total weight (16.523 kg) in the species of *Labeo boga* which included (1.713 kg, 5.71 kg, 6.53 kg, 2.57 kg) was recorded but not found in February and March.

The total weight (9.803 kg) of *Labeo calbasu* which included catch weight (0.82 kg, 1.633 kg, 3.27 kg, 4.08 kg) was observed except in January and February. During the six month study period, the total catch weight of (211.77 kg) of *Labeo rohita* which included (120.85 kg, 35.92 kg, 23.23 kg, 13.06 kg, 11.36 kg, 7.35 kg) was recorded. The total weight (60.256 kg) in the species of *Osteobrama belangeri* which included (11.44 kg, 21.23 kg, 6.523 kg, 11.42 kg, 4.89 kg, 4.753 kg) was found throughout the study period. In the present study, the total weight (11.519 kg) of *Osteobrama cotio cunma* which included 1.713 kg, 3.27 kg, 1.633 kg, 1.633 kg, 3.27 kg) was observed but not found in May. The total weight (53.89 kg) in the species of *Puntius chola* which included (8.17 kg, 26.12 kg, 8.16 kg, 3.27 kg, 5.72 kg, 2.45 kg) was observed throughout the study period. During the six months study period, the total weight (27.643 kg) of *Puntius sophore* belonging to (3.27 kg, 8.17 kg, 4.89 kg, 4.903 kg, 2.45 kg, 3.96 kg) was observed throughout the study period. The total weight (11.443 kg) in the species of *Amblypharyngodon mola* which included (1.633 kg, 3.27 kg, 2.45 kg, 4.09 kg) but not found in March and May during the study period.

The total weight (68.67 kg) of *Esomus altus* which included (24.57 kg, 37.56 kg,3.27 kg, 3.27 kg) but not found in March and May during the six months study period. During the study period, the total weight (8.173 kg) in the species of *Aorichthys aor* which included (1.64 kg, 2.45 kg, 1.633 kg, 2.45 kg) was observed but not found in January and May. The total weight (20.643 kg) of *Mystus cavasius* which included (0.82 kg, 2.453 kg, 4.89 kg, 4.08 kg, 8.40 kg) was found but not found in December throughout the study period. During the six months study period, the total weight (9.963kg) of *Mystus microphthalmus* belonging to (0.16 kg, 2.45 kg, 3.27 kg, 2.45 kg, 1.633 kg) was recorded but not found in January. The total weight (14.703 kg) of *Mystus pulcher* which included (4.08 kg, 3.27 kg, 5.72 kg, 1.633 kg) but not found in December and January during the study period. During the six months study period, the total weight (27.562 kg) of *Ompok bimaculatus* belonging to (1.963 kg, 8.16 kg, 3.266 kg, 4.903 kg, 0.82 kg, 8.45 kg) was observed. The total weight (57.96 kg) of *Wallago attu* belonging to (24.50 kg, 17.96 kg, 4.89 kg, 3.27 kg, 7.34 kg) was found but not observed in May. Monthly total catch weight (32.936 kg) of fish species *Pseudeutropius acutirostris* was found in five months (0.82 kg, 13.063 kg, 1.633 kg, 8.97 kg, 8.45 kg) except in February. The total weight (13.08 kg) of *Xenentodon cancila* belonging to (0.57 kg, 4.903 kg, 1.15 kg, 4.09 kg, 2.37 kg) was recorded in five months but not found in March.

In the present study, the total weight (21.239 kg) of *Pseudambassis ranga* belonging to (2.453 kg, 4.903 kg, 2.453 kg, 3.27 kg, 8.16 kg) was observed except in May. The total weight (21.133 kg) of *Glossogobius giuris* belonging to (0.41 kg, 3.27 kg, 1.633 kg, 0.82 kg, 6.53 kg, 8.47 kg) was found throughout the study period. During the six months study period, the total weight (10.76 kg) of *Colisa faciatus* belonging to (0.90 kg, 4.09 kg, 1.31 kg, 1.15 kg, 0.82 kg, 2.49 kg) was observed throughout the study period. The total weight (61.233 kg) of *Channa striatus* which included (4.09 kg, 21.22 kg, 1.633 kg, 26.12 kg, 5.72 kg, 2.45 kg) was

[illegible]

Table 12 - Local market prices of Dry Fish (₹/kg) recorded during the study period in 2019-20 year at Ghat, Dwar, Kyrdiep Int.

Sl. No.	Fish Species	Dry Fish (₹/kg)	Local Market Prices (₹/kg)
1	[illegible]	Dry Fish (₹/kg)	4500
2	[illegible]	Dry Fish (₹/kg)	4500
3	[illegible]	Dry Fish (₹/kg)	3500
4	[illegible]	Dry Fish (₹/kg)	3500
5	[illegible]	Dry Fish (₹/kg)	3500
6	[illegible]	Dry Fish (₹/kg)	3500
7	[illegible]	Dry Fish (₹/kg)	3500
8	[illegible]	Dry Fish (₹/kg)	3500
9	[illegible]	Dry Fish (₹/kg)	2000
10	[illegible]	Dry Fish (₹/kg)	3500
11	[illegible]	Dry Fish (₹/kg)	2000
12	[illegible]	Dry Fish (₹/kg)	2000

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13	*Amblypharyngodon mola*	One Viss (1.633 kg)	2000
14	*Esomus altus*	One Viss (1.633 kg)	1200
15	*Aorichthys aor*	One Viss (1.633 kg)	3500
16	*Mystus cavasius*	One Viss (1.633 kg)	2000
17	*Mystus microphthalmus*	One Viss (1.633 kg)	4000
18	*Mystus pulcher*	One Viss (1.633 kg)	2000
19	*Ompok bimaculatus*	One Viss (1.633 kg)	2500
20	*Wallago attu*	One Viss (1.633 kg)	4000
21	*Pseudeutropius acutirostris*	One Viss (1.633 kg)	2000
22	*Xenentodon cancila*	One Viss (1.633 kg)	3000
23	*Pseudambassis ranga*	One Viss (1.633 kg)	1500
24	*Glossogobius giuris*	One Viss (1.633 kg)	3000
25	*Colisa fasciatus*	One Viss (1.633 kg)	1000
26	*Channa striatus*	One Viss (1.633 kg)	4000
27	*Macrognathus aral*	One Viss (1.633 kg)	4000
28	*Macrognathus zebrinus*	One Viss (1.633 kg)	4000

Table (3) continued

Table (3) Monthly value changes of catch weight (kg), income (kyats), total catch weight (kg)and total income (kyats) of recorded fish species

Sr No	Species	December		January		February		March		April		May		Total catch weight (kg)	Total income (kyats)
		Catch weight (kg)	Income (kyats)	Catch weight (kg)	Income (kyats)	Catch weight (kg)	Income (kyats)	Catch weight (kg)	Income (kyats)	Catch weight (kg)	Income (kyats)	Catch weight (kg)	Income (kyats)		
1	*Notopterus chitala*	6.523	17955	-	-	14.70	40455	21.23	58455	8.97	24660	5.72	15750	57.143	157275
2	*Notopterus notopterus*	8.16	22455	21.23	58500	9.78	26910	14.70	40455	8.97	24660	3.27	9000	66.11	181980
3	*Setipinna indicus*	16.33	35000	19.58	41930	1.633	3500	1.633	3500	8.16	17465	4.08	8715	51.416	110110
4	*Catla catla*	65.32	140000	-	-	9.72	20825	3.27	7000	7.28	15610	8.94	15610	94.53	199045
5	*Cirrhinus mrigala*	37.56	80500	29.40	63000	32.66	70000	8.16	17465	2.45	5250	3.57	7665.00	113.8	243880
6	*Labeo boga*	1.713	1575	5.71	5235	-	-	-	-	6.53	5985	2.57	2355	16.523	15150
7	*Labeo calbasu*	0.82	1750	-	-	-	-	1.633	3500	3.27	7000	4.08	8715.00	9.803	20965
8	*Labeo rohita*	120.85	258965	35.92	76930	23.23	49770	13.06	27965	11.36	24325	7.35	15715	211.77	453670
9	*Osteobrama belangeri*	11.44	14000	21.23	25980	6.523	7980	11.42	13960	4.89	5980	4.753	5820	60.256	73720
10	*Osteobrama cotio cunma*	1.713	1575	3.27	3000	1.633	1500	1.633	1500	3.27	3000	-	-	11.519	10575
11	*Puntius chola*	8.17	10000	26.12	31980	8.16	9980	3.27	4000	5.72	7000	2.45	3000	53.89	65960
12	*Puntius sophore*	3.27	4000	8.17	10000	4.89	5980	4.903	6000.00	2.45	3000	3.96	4840	27.643	33820
13	*Amblypharyngodon mola*	1.633	2000	3.27	4000	2.45	3000	-	-	4.09	5000	-	-	11.443	14000
14	*Esomus altus*	24.57	18048	37.56	27600	3.27	2400	-	-	3.27	2400	-	-	68.67	50448
15	*Aorichthys aor*	1.64	3500	-	-	2.45	5250	1.633	3500	2.45	5250	-	-	8.173	17500
16	*Mystus cavasius*	-	-	0.82	1000	2.453	3000	4.89	5980	4.08	4980	8.40	10292.32	20.643	25252.32
17	*Mystus microphthalmus*	0.16	360	-	-	2.45	6000	3.27	8000	2.45	6000	1.633	4000	9.963	24360
18	*Mystus pulcher*	-	-	-	-	4.08	4980	3.27	4000	5.72	7000	1.633	2000.00	14.703	17980
19	*Ompok bimaculatus*	1.963	3000	8.16	12475	3.266	8165	4.903	7500.00	0.82	1250	8.45	12950	27.562	45340
20	*Wallago attu*	24.50	6000.00	17.96	43960	4.89	11960	3.27	8000	7.34	17960	-	-	57.96	141880
21	*Pseudeutropius acutirostris*	0.82	1000.00	13.063	15980	-	-	1.633	2000	8.97	9020	8.45	10360.00	32.936	38360.00
22	*Xenentodon cancila*	0.57	1020	4.903	9000	1.15	2600	-	-	4.09	7500	2.37	4350	13.08	24470
23	*Pseudambassis ranga*	2.453	2250	4.903	4500	2.453	2250	3.27	3000	8.16	7485	-	-	21.239	19485
24	*Glossogobius giuris*	0.41	750	3.27	6000	1.633	3000	0.82	1500	6.53	11970	8.47	15570	21.133	38790
25	*Colisa fasciatus*	0.90	550.00	4.09	2500	1.31	800	1.15	700	0.82	500	2.49	1520.00	10.76	6570.00
26	*Channa striatus*	4.09	10000	21.22	51960	1.633	4000	26.12	63960	5.72	14000	2.45	6000	61.233	149920
27	*Macrognathus aral*	-	-	0.82	2000	-	-	6.523	15960	7.35	17960	-	-	14.693	35920
28	*Macrognathus zebrinus*	-	-	1.633	4000	2.453	6000	2.773	6760	3.42	8360	2.87	7040	13.149	32160
	Total	345.578	690253	292.302	501530	148.87	300305	148.44	314660	148.60	270570	97.959	171267.32	1181.746	2248585.32

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Table (4) Monthly values of profits (kyats) and costs of recorded fish species in study site

Sr. No.	Types	December	January	February	March	April	May	Total
1	Total sale kilogram (kg)	345.758	292.302	148.87	148.44	148.60	97.959	1181.746
2	Total sales (kyats)	690253	501530	300305	314660	270570	171267.32	2248585.32
3	Total costs (kyats)	257111.12	257111.12	257111.12	257111.12	257111.12	257111.12	1542666.72
4	Profit (kyats)	433141.88	244418.88	40028.88	57548.88	-	-	775138.52
5	Loss (kyats)	-	-	-	-	13458.88	85843.80	99302.68

Table (5) Net profit of recorded fish species in study site

Sr. No.	Profit (kyats) from December to May	Loss (kyats) from December to May	Net profit (kyats) from December to May
1	775138.52	99302.68	675835.84

Table (6) Auctioned costs of leasable fisheries for the whole year from Department of Fisheries

Sr. No.	Auctioned costs (kyats) in the whole year	Costs for Twelve labours and auctioned costs in one day
1	14500000	128555.56

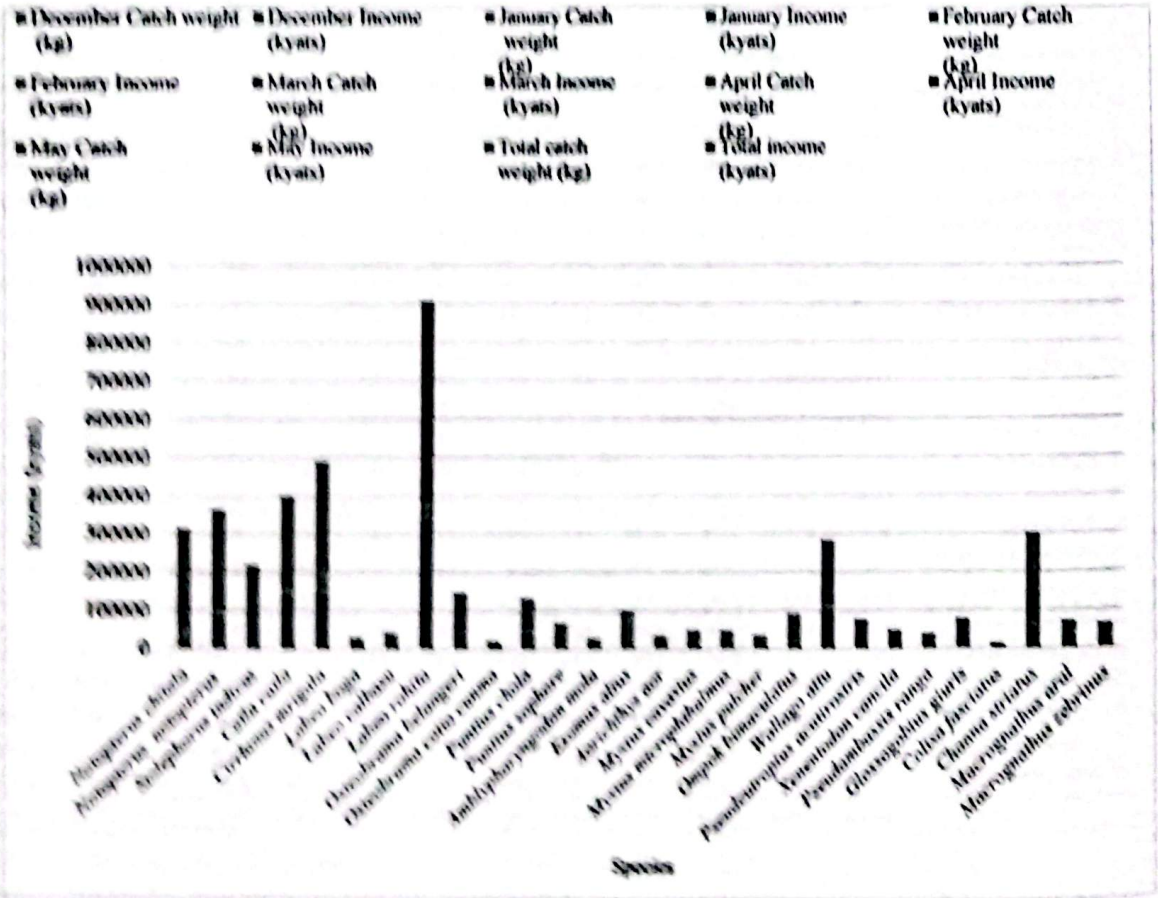


Figure (3) Monthly value changes of catch weight (kg), income (kyats), total catch weight (kg) and total income (kyats) of recorded fish species

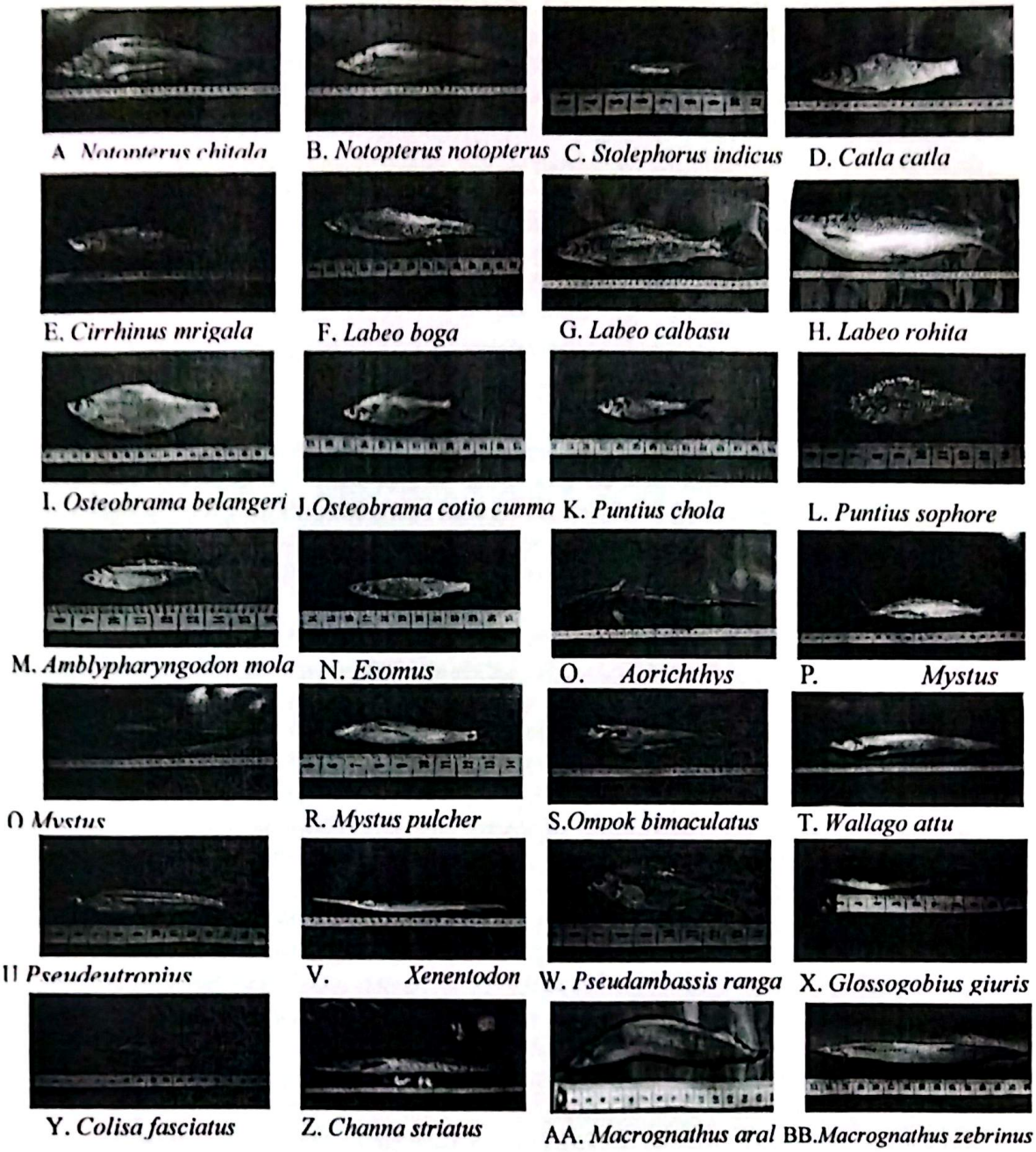


Plate (3) The recorded fish species in the study site

Discussion

A total of 28 species belonging to 20 genera under 12 families of six orders was recorded from the Shan Ywar Myitkyo Inn during the study period. In the present study, the collected species were recorded from order Osteoglossiformes, Clupeiformes, Cypriniformes, Siluriformes, Cyprinodontiformes and Perciformes. Regarding to species composition, the order of Cypriniformes (39.29 %) and Siluriformes (25 %) and Perciformes (21.43 %) was the highest while the order of Osteoglossiformes (7.14 %), Clupeiformes (3.57 %) and Cyprinodontiformes (3.57 %) was the lowest throughout the study period. Zin Mar Wai (2014) recorded that order Cypriniformes, Siluriformes and Perciformes were most abundant in Hinthada area along the Ayeyarwady River.

Ei Ei Khaine (2015) mentioned that order Cypriniformes was found the most abundant in Shar Khe Inn, Kyonpyaw Township, Ayeyarwady Region. Htet Htet Aung (2018) stated that order Cypriniformes was abundant and followed by order Siluriformes and Perciformes in

Inn-yegyi Lake, Kyonpyaw Township, Ayeyarwady Region. Myat Myat Thinn (2018) mentioned that order Cypriniformes was abundant and followed by Perciformes and Siluriformes in Eitpyet Inn, Hinthada Township, Ayeyarwady Region. Therefore, the present study was the same with the previous authors. According to the result of total catch weight of fish species, the species *Cirrhinus mrigala* and *Labeo rohita* were found to be the largest throughout the study period.

On the aspect of productive quantities, the production of *Labeo rohita* (211.77 kg) was the highest productive species and followed by *Cirrhinus mrigala* (113.80 kg) and *Catla catla* (94.53 kg). Kathy Myint (2012) stated that *Labeo rohita* (3562.9 kg) was the highest productive weight from Inma Inn. Ei Ei khaine (2015) reported that the highest productive weight was the species of *Labeo rohita* (17530.88 kg) from Shar Khe Inn, Kyonpyaw Township. Htet Htet Aung (2018) mentioned that the species of *Labeo rohita* (2769.24 kg), *Cirrhinus mrigala* (2769.24 kg) and *Catla catla* (2769.24 kg) were the highest productive catch weight from Inn-yegyi Lake, kyonpyaw Township. Therefore, the present study was the same with the study of previous authors. In the present study, the species of the total catch weight of *Aorichthys aor* (8.173 kg) was observed as the lowest throughout the study period. Sa Soe Shwe (2019) mentioned that the species of total catch weight of *Wallago attu* (16.93 kg) was found as the lowest in his study from Inn-yegyi Lake. Therefore, the present study of Sa Soe Shwe (2018-19) in Shan Ywar Myitkyo Inn was not the same with the study of Inn-yegyi Lake. Aung Kyaing (2010) stated that the Department of Fisheries (Hinthada and Zalun Townships) released fish seed (induced breed) in the Ayeyarwady River from 2001 to 2010. Thus the released fishes (*Labeo rohita* and *Catla catla*) are found in Hinthada and Zalun Townships (segments of Ayeyarwady River).

The catch weights of *Labeo rohita* (120.85 kg), *Esomus altus* (37.56 kg) and *Cirrhinus mrigala* (32.66 kg) were found to be the highest in December, January and February however *Mystus cavasius*, *Mystus pulcher*, *Macrognathus aral*, *Macrognathus zebrinus* were not found in December and *Notopterus chitala*, *Catla catla*, *Labeo calbasu*, *Aorichthys aor*, *Mystus microphthalmus* and *Mystus pulcher* in January and also *Labeo boga*, *Labeo calbasu*, *Pseudeutropius acutirostis* and *Macrognathus aral* in February were not observed respectively. The fish species of *Channa striatus* (26.12 kg), *Labeo rohita* (11.36 kg) and *Catla catla* (8.94 kg) were recorded as the highest catch weight in March, April and May while *Labeo boga*, *Amblypharyngodon mola*, *Esomus altus*, *Xenentodon cancila* in March and *Osteobrama cotio cunma*, *Amblypharyngodon mola*, *Esomus altus*, *Aorichthys aor*, *Wallago attu*, *Pseudambassis ranga* and *Macrognathus aral* in May were not observed respectively. The catch weight of recorded fish species was found as the total weight (345.578 kg) in December and followed by (292.302 kg) in January, (148.87 kg) in February, (148.44 kg) in March, (148.60 kg) in April and (97.959 kg) in May respectively. The total weight (1181.746 kg) which included as the highest in the species of *Labeo rohita* (211.74 kg) and the lowest in the species of *Aorichthys aor* (8.173 kg) was recorded during the study period.

Among the studied species, the species of *Notopterus chitala* and *Notopterus notopterus* were the highest prices than the other fish species and also the species of *Colisa fasciatus* was the lowest price than the other fish species. The highest income for fishermen was *Cirrhinus mrigala* and *Labeo rohita* because the production is higher than the other species. Htet Htet Aung (2018) stated that the species of *Labeo rohita*, *Cirrhinus mrigala* and *Catla catla* were the highest income for local fishermen in Inn-yegyi Lake, Kyonpyaw Township. Therefore, the present study was found nearly to be the same with the study of her finding. Hence, it was suggested that fishermen should be culture these fishes for their daily income. As the aspect of monthly catch weight and income, total catch weight (345.578 kg) and income (690253 kyats) were recorded the highest catch weight and income in December and followed by (292.302 kg, 501530 kyats) in January, (148.88 kg, 300305 kyats) in February, (148.44 kg,

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314660 kyats) in March, (148.60 kg, 270570 kyats) in April and finally (97. 959 kg, 171267.32 kyats) in May throughout the study period.

Moreover, a total income 2248585.32 kyats of 28 fish species which included income (690253 kyats) in December, (501530 kyats) in January, (300305 kyats) in February, (314660 kyats) in March, (270570 Kyats) in April and finally (171267.32 kyats) in May was recorded respectively during the study period. The total costs in December, January, February, March and April were recorded as (257111.12 kyats) respectively. The profit in December (433141.88 kyats), 244418.88 kyats in January, 40028.88 kyats in February, 57548.88 kyats in March and loss in April 13458.88 kyats and 85843.80 kyats in May were recorded respectively during the study period. The total sale kilogram and costs (1181.746 kg, 1542666.72 kyats), profit (775138.52 kyats) and loss (99302.68 kyats) throughout the study period. Moreover, the total income in the species of *Labeo rohita* (453670 kyats) and *Cirrhinus mrigala* (243880 kyats) was observed throughout the study period. In the profits from December to May, the auctioneer gains (775138.32 Kyats) and followed by losses (99302.68 kyats) and net profits (675835.84 kyats) during the study period. The highest catch weights were observed in December and the lowest in May. The species of *Labeo rohita* and *Cirrhinus mrigala* were exported fish species categories for local. Because this species are gained the profit for auctioneer.

Conclusion

Fishing from Shan Ywar Myitkyo Inn is important contribution to the national economies and trade in Myanmar. In addition, it provides livelihood to local communities and important and relatively cheap source of protein for the countries population. Unlike in many parts of the world, which are experiencing stable or decline fish production, capture fisheries production in most countries to rise. However, given the rate of expansively production in freshwater fishes observed in Myanmar, a big part of fish supply for Shan Ywar Myitkyo Inn in the future will likely come from this source. And also the fundamental concern for policy development should be placed on a sustainable basis with respect to resource utilization, generation of resource rent, commercial profitability and sustainable livelihoods for fishing communities. The policies in place for the sector of fisheries should provide a regulatory environment that encouraged a sustainable fishery sector. Excess fishing effort which had been managed by government strategines for fishers and minimum controls on fishing effort from Shan Ywar Myitkyo Inn.

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Assessment of Water Quality with Physico-Chemical Parameters in Taungthaman Lake, Amarapura Township, Mandalay Region

Nyunt Lwin[1], Thandar Saw[2], Thant Zin[3]

Abstract

Assessment of water quality with physico-chemical parameters was examined from Taungthaman Lake, Amarapura Township during July 2019 to June 2020. Water samples were carried at 8:30 am with clean plastic bottles and brought to laboratory for analysis. Water quality index (WQI) is calculated by using the measurement of some important phisico-chemical parameters' data. The values of WQI are varied from 116.12 to 144.16. The highest WQI value 144.16 was examined at Site A in the rainy season and the lowest value 116.12 was at Site B in the hot and cold seasons. Thus, the water quality of the sample sites clearly showed that the status of water body in Taungthaman Lake was degraded and unsuitable for human used by WHO standard and guidelines for drinking. The surface water quality became degraded by discharging of domestic and industrial wastewater and others activities. Therefore, water quality monitoring program is necessary for health of Taungthaman Lake. This research work will partially help to de the case the quality degrade of lake.

Keywords: Taungthaman Lake, water quality index

Introduction

Life on the earth is never possible without water (Sargaonkar and Deshpande 2003) and the most essential supporting element for the survival of human life gives full support in the movement, circulation and cycling of nutrients (Singh, 2010). Water sources may be mainly in the types of streams, glaciers, rivers, rain water, ground water etc (Tyagi *et al.*, 2013; Imneisi and Aydin, 2016). Water is one of the most essential constituents of the environments (Sargaonkar and Deshpande 2003). Water resources play a vital role in various

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sectors of economy such as agriculture, forestry, industrial activities, livestock production, hydropower generation, fisheries and other creative activities (Tyagi *et al.*, 2013).

Water quality is defined as all information of biological, chemical, and physical elements of water and their interaction to decide the suitable usage for water (Taner, *et al.*, 2011). Water quality in an aquatic ecosystem is determined by many physical, chemical and biological factors (Sargaonkar and Deshpande, 2003). There are varieties of pollutants being disposed into the nonpoint sources (i.e. runoff) and point sources (like industrial wastes, agricultural and sewage) (Ahuja, 2003).

Water quality of any specific area or specific source can be assessed using physical, chemical and biological parameters. The values of these parameters are harmful for human health if they occurred more than defined limits (WHO, 2012). Water quality index (WQI) utilizes the water quality data and helps in the modification of the policies, which are formulated by various environmental monitoring agencies. It has been realized that the use of individual water quality variable in order to describe the water quality for common public is not easily understandable (Bharti and Katyal, 2011; Akoteyon *et al.*, 2011).

However, because of rapid urbanization, industrialization, old agricultural practice, over uses of chemicals, etc., Taungthaman Lake are still at high risk. Thus, Taungthaman Lake was selected as the study area and the objectives with to examine and evaluate the water quality of Taungthaman Lake base on the physiochemical characteristics and to conserve the health of Taungthaman Lake.

Materials and Methods

Study Area and Study Sites

Taungthaman Lake is situated in Amarapura Township, Mandalay Region on the eastern bank of the Ayeyawady River. It lies between 21° 53′ N to 21° 54′ N Latitude and 96° 03′ E to 96° 05′ E Longitude (Fig.1) and the area is about 495 km^2. The water inflows from the Ayeyarwady River and from Mandalay downtown.

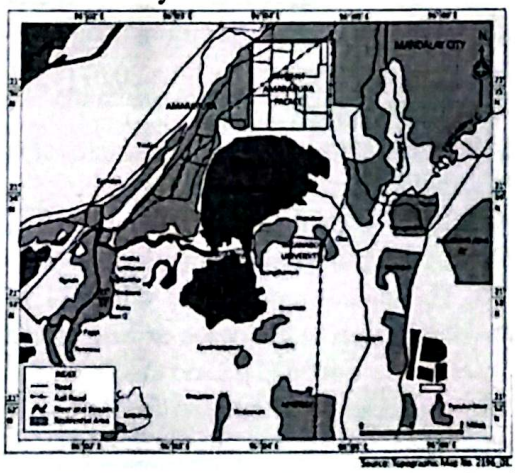


Fig. 1 A map of study area and study sites

The climate of the study area is characterized by three seasons: hot season (March - June), rainy season (July - October) and cold season (November - February). Two study sites were allocated as Southern part (Site A) at 21° 54.086'N and 96° 3.275'E and Northern part (Site B) at 21° 53.012'N and 96° 3.041'E.

Water Collection and Water Quality Parameters Analysis

Water samples were taken from two sites every four months starting in July 2019 until June 2020. Collection sites are selected according to Ahuja, 2003. There are varieties of pollutants being disposed into the nonpoint sources (i.e. runoff) as Site A and point sources (like industrial wastes, agricultural and sewage) as Site B. Water samples were carried with clean plastic bottles at 08.30 am and brought to the laboratory (Water and Sanitation Department, Mandalay City Development Committee, Mandalay) for analysis. Water temperature was measured during sampling with help of thermometer.

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Water Quality Index (WQI) Calculation

The water quality index for the Taunthaman Lake was calculated based on weighted arithmetic index method for 15 parameters namely: pH, DO, Temperature, Colour, BOD, TDS, NTU, Ca, TH, Mg, Fe, Mn, Cl, Alkalinity and SO_4 for fifteen stations in which each station got two sampling sites.

The weighted arithmetic water quality index method was applied followed after Cude (2001).

$$Qi = \left(\frac{Mi - Li}{Si - Li}\right) \times 100$$

$$Wi = \frac{K}{Si}$$

$$WQi = \sum_{i=1}^{n} \frac{WiQi}{\sum_{i=1}^{n} wi}$$

Where, *Qi* is the sub index of the i^{th} parameter, Wi is the unit weightage of the i^{th} parameter, *n* is the number of parameters included, *Mi* is the monitored value of the parameter, *Li* is the ideal value, *Si* is the standard value of the i^{th} parameter, *K* is proportionality constant.

According to Shweta *et al.*, 2013, the water quality index (WQI) classification is given in Table 1.

Table 1 Water quality index classification

Range	Quality
<25	Excellent
26-50	Good water
51-75	Poor water
76-100	Very poor (bad) water
>100	Unsuitable (unfit) for drinking

Results

In the present study, seasonality water quality values of 15 parameters with WHO standard values were recorded during July 2019 to June 2020 (Table 2).

Data Analysis of Water Quality Parameters

In the present investigated, the fluctuation of pH in the samples was from 7.1 to 7.6 at Site A and from 7.1 to 8 at Site B. The highest pH value (8) was obtained in the cold season at Site B and the lowest value (7.1) was found in rainy season and cold season at Site A and in the rainy season at Site B. The temperature variation ranges from 23.5 °C to 34.4 °C at Site A and from 23.4 °C to 34.5 °C at Site B. The highest temperature value (34.5 °C) in hot season and the lowest value (23.4 °C) was obtained in cold season at Site B. The concentration range of electrical conductivity (EC) value was from 328 $\mu S.m^{-1}$ to 828 $\mu S.m^{-1}$. The highest capacity EC value was 828 $\mu S.m^{-1}$ in in the hot season at Site A and the lowest value was 499 $\mu S.m^{-1}$ in the rainy season at Site B (Table 2-8).

Regarding the total dissolved soil (TDS) value varied from 223 mg/L to 450 mg/L. The highest TDS value 450 mg/L was obtained from study Site A in the hot season and the lowest value 223 mg/L from Site B in the rainy season. The range of turbidity (NTU) was from 10.8 to 217 in the study area. The highest NTU value 217 was recorded in the hot season at Site A and the lowest value 10.8 was in the cold season at Site B (Table 2-8).

Dissolved oxygen (DO) is ranged from 0.22 mg/L to 7.88 mg/L was recorded in the study period. The highest DO value 7.88 mg/L was obtained from Site A in the rainy season and the lowest value 0.36 mg/L was in the hot season at Site A. The range of biological oxygen demand (BOD) was from 25 mg/L to 55 mg/L. The highest BOD value 55 was obtained in rainy season at study Site A, and the lowest value 25 from Site B in the rainy season (Table 2-8).

The range of hardness concentration value was from 80 ppm to 188 ppm in this study period. The highest TH value 188 was at Site B in the cold season and the lowest TH value

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80 was from Site A in the rainy season. The amount of total alkalinity (TA) in the study area ranged between 148 mg/L and 460 mg/L. The highest amount of alkalinity was 460 mg/L in cold season at Site B and the lowest alkalinity value was 148 mg/L at Site A in the rainy season (Table 2-8).

The concentration range of calcium (Ca) value was from 16 mg/L to 48 mg/L in the present study. The highest Ca value 48 mg/L was obtained at Site B in the cold season and the lowest Ca value 16 mg/L was at Site A in the rainy season. The concentration range of magnesium (Mg) in the study period was from 10 mg/L to 30 mg/L. The highest Mg value was 30 at Site A in the cold season and the lowest value 10 at Site A in the rainy and the hot seasons and at Site B in the hot season (Table 2-8).

The Chloride (Cl) concentration varied from 30 ppm to 100 ppm. The highest Cl value was 100 ppm at Site A in hot season and at Site B in cold season and the lowest Cl value 30 ppm at Site A in the rainy season. The concentration of Sulphate (SO_4) value was 200 mg/L in all study sites (Table 2-8).

The Water Quality Index Analysis

Water quality index (WQI) rating during this study displayed significant fairly differences (Table 2). According the present data the water quality index at Site B (116.12) was more significant than at Site A (127.80) in the rain season (Table 3 and 6). In the cold season, the water quality index at Site B (118.70) was more significant than at Site A (136.93) (Table 4 and 7). In the hot season, the WQI vale 124.09 at Site B was more significant than 144.16 at Site A (Table 5 and 8).

In comparison, the highest WQI value 144.16 was recorded at Site A in hot season, followed by 136.93 in the cold season and 127.8 in the rainy season at Site A, 124.09, 118.70 in hot and cold is more seasons at Site B respectively and the lowest WQI value 116.12 was recorded in the rainy season at Site B (Table 9). Thus, Site B is more significant than Site A because the flooded water from Ayeyawady entered firstly at Site B and then the water was contaminated with waste water deposited at Site A.

Table 2 Seasonality data analysis of water quality parameters recorded at Taungthaman Lake (July 2019-June 2020)

No.	Parameters		Site A			Site B		
		WHO standard	Rainy	Cold	Hot	Rainy	Cold	Hot
1	pH	7.5	7.1	7.1	7.6	7.1	8	7.5
2	Temperature (°C)	25	31.5	23.5	34.4	31.5	23.4	34.5
3	Turbidity (NTU)	5	80.7	165	217	18.1	10.8	64.8
4	Dissolved Oxygen, DO (mg/L)	5	7.88	1.72	0.35	4.86	2.46	0.22
5	Biological Oxygen Demand, BOD (mg/L)	5	55	38	38	25	45	35
6	Total Dissolved Soil, TDS (mg/L)	500	249	276	450	223	306	350
7	Colour	5	50	50	50	50	50	50
8	Total Hardness, TH (CaCO3)	100	80	100	128	140	188	148
9	Total Alkalinity, TA (mg/L)	200	148	200	320	180	460	248
10	Calcium, Ca (mg/L)	75	16	24	32	32	48	40
11	Magnesium, Mg (mg/L)	30	10	30	10	15	15	10
12	Chloride, Cl (mg/L)	200	30	35	100	40	100	80
13	Total Iron, Fe (mg/L)	0.1	0.2	0.2	0.2	0.2	0.2	0.2
14	Manganese , Mn (mg/L)	0.05	0.03	0.03	0.03	0.03	0.03	0.03
15	Sulphate, SO4 (mg/L)	200	200	200	200	200	200	200

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Table 3 The water quality index of Taungthaman Lake, at Site A in the rainy season

No.	Parameters	Actual measured values (Mi)	WQ Standard value (Si)	Relative weight (Wi)	Quality rating (Qi)	Weighted values
1	pH	7.1	7.5	0.13	20	2.67
2	Temperature (°C)	7.88	5	0.20	70	14.00
3	Turbidity (NTU)	31.5	25	0.04	126.00	5.04
4	Dissolved Oxygen, DO (mg/L)	50	5	0.20	1000.00	200.00
5	Biological Oxygen Demand, BOD (mg/L)	55	5	0.20	1100.00	220.00
6	Total Dissolved Soil, TDS (mg/L)	249	500	0.00	49.80	0.10
7	Colour	80.7	5	0.20	1614.00	322.80
8	Total Hardness, TH (CaCO3)	16	75	0.01	21.33	0.28
9	Total Alkalinity, TA (mg/L)	80	100	0.01	80.00	0.80
10	Calcium, Ca (mg/L)	10	30	0.03	33.33	1.11
11	Magnesium, Mg (mg/L)	0.2	0.1	10.00	200.00	2000.00
12	Chloride, Cl (mg/L)	0.03	0.05	20.00	60.00	1200.00
13	Total Iron, Fe (mg/L)	30	200	0.01	15.00	0.08
14	Manganese , Mn (mg/L)	148	200	0.01	74.00	0.37
15	Sulphate, SO4 (mg/L)	200	200	0.01	100.00	0.50
			ΣWi	31.05	ΣWiQi	3967.75
					WQI	127.80

Table 4 The water quality index of Taungthaman Lake, at Site A in the cold season

No.	Parameters	Actual measured values (Mi)	WQ Standard value (Si)	Relative weight (Wi)	Quality rating (Qi)	Weighted values
1	pH	7.1	7.5	0.13	20	2.67
2	Temperature (°C)	1.72	5	0.20	134.17	26.83
3	Turbidity (NTU)	23.5	25	0.04	94.00	3.76
4	Dissolved Oxygen, DO (mg/L)	50	5	0.20	1000.00	200.00
5	Biological Oxygen Demand, BOD (mg/L)	38	5	0.20	760.00	152.00
6	Total Dissolved Soil, TDS (mg/L)	276	500	0.00	55.20	0.11
7	Colour	165	5	0.20	3300.00	660.00
8	Total Hardness, TH (CaCO3)	24	75	0.01	32.00	0.43
9	Total Alkalinity, TA (mg/L)	100	100	0.01	100.00	1.00
10	Calcium, Ca (mg/L)	30	30	0.03	100.00	3.33
11	Magnesium, Mg (mg/L)	0.2	0.1	10.00	200.00	2000.00
12	Chloride, Cl (mg/L)	0.03	0.05	20.00	60.00	1200.00
13	Total Iron, Fe (mg/L)	35	200	0.01	17.50	0.09
14	Manganese , Mn (mg/L)	200	200	0.01	100.00	0.50
15	Sulphate, SO4 (mg/L)	200	200	0.01	100.00	0.50
			ΣWi	31.05	ΣWiQi	4251.22
					WQI	136.93

Table 5 The water quality index of Taungthaman Lake, at Site A in the hot season

No.	Parameters	Actual measured values (Mi)	WQ Standard value (Si)	Relative weight (Wi)	Quality rating (Qi)	Weighted values
1	pH	7.6	7.5	0.13	120	16.00
2	Temperature (°C)	0.35	5	0.20	148.44	29.69
3	Turbidity (NTU)	34.4	25	0.04	137.60	5.50
4	Dissolved Oxygen, DO (mg/L)	50	5	0.20	1000.00	200.00
5	Biological Oxygen Demand, BOD (mg/L)	38	5	0.20	760.00	152.00
6	Total Dissolved Soil, TDS (mg/L)	450	500	0.00	90.00	0.18
7	Colour	217	5	0.20	4340.00	868.00
8	Total Hardness, TH (CaCO3)	32	75	0.01	42.67	0.57
9	Total Alkalinity, TA (mg/L)	128	100	0.01	128.00	1.28
10	Calcium, Ca (mg/L)	10	30	0.03	33.33	1.11
11	Magnesium, Mg (mg/L)	0.2	0.1	10.00	200.00	2000.00
12	Chloride, Cl (mg/L)	0.03	0.05	20.00	60.00	1200.00
13	Total Iron, Fe (mg/L)	100	200	0.01	50.00	0.25
14	Manganese , Mn (mg/L)	320	200	0.01	160.00	0.80
15	Sulphate, SO4 (mg/L)	200	200	0.01	100.00	0.50
			ΣWi	31.05	ΣWiQi	4475.88
					WQI	144.16

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Table 6 The water quality index of Taungthaman Lake, at Site B in the rainy season

No.	Parameters	Actual measured values (Mi)	WQ Standard value (Si)	Relative weight (Wi)	Quality rating (Qi)	Weighted values
1	pH	7.1	7.5	0.13	20	2.67
2	Temperature (°C)	4.86	5	0.20	101.46	20.29
3	Turbidity (NTU)	31.5	25	0.04	126.00	5.04
4	Dissolved Oxygen, DO (mg/L)	50	5	0.20	1000.00	200.00
5	Biological Oxygen Demand, BOD (mg/L)	25	5	0.20	500.00	100.00
6	Total Dissolved Soil, TDS (mg/L)	223	500	0.00	44.60	0.09
7	Colour	18.1	5	0.20	362.00	72.40
8	Total Hardness, TH (CaCO3)	32	75	0.01	42.67	0.57
9	Total Alkalinity, TA (mg/L)	140	100	0.01	140.00	1.40
10	Calcium, Ca (mg/L)	15	30	0.03	50.00	1.67
11	Magnesium, Mg (mg/L)	0.2	0.1	10.00	200.00	2000.00
12	Chloride, Cl (mg/L)	0.03	0.05	20.00	60.00	1200.00
13	Total Iron, Fe (mg/L)	40	200	0.01	20.00	0.10
14	Manganese , Mn (mg/L)	180	200	0.01	90.00	0.45
15	Sulphate, SO4 (mg/L)	200	200	0.01	100.00	0.50
			ΣWi	31.05	ΣWiQi	3605.17
					WQI	116.12

Table7 The water quality index of Taungthaman Lake, at Site B in the cold season

No.	Parameters	Actual measured values	WQ Standard value (Si)	Relative weight (Wi)	Quality rating (Qi)	Weighted values
1	pH	8	7.5	0.13	200	26.67
2	Temperature (°C)	2.46	5	0.20	126.46	25.29
3	Turbidity (NTU)	23.4	25	0.04	93.60	3.74
4	Dissolved Oxygen, DO (mg/L)	50	5	0.20	1000.00	200.00
5	Biological Oxygen Demand, BOD (mg/L)	45	5	0.20	900.00	180.00
6	Total Dissolved Soil, TDS (mg/L)	306	500	0.00	61.20	0.12
7	Colour	10.8	5	0.20	216.00	43.20
8	Total Hardness, TH (CaCO3)	48	75	0.01	64.00	0.85
9	Total Alkalinity, TA (mg/L)	188	100	0.01	188.00	1.88
10	Calcium, Ca (mg/L)	15	30	0.03	50.00	1.67
11	Magnesium, Mg (mg/L)	0.2	0.1	10.00	200.00	2000.00
12	Chloride, Cl (mg/L)	0.03	0.05	20.00	60.00	1200.00
13	Total Iron, Fe (mg/L)	100	200	0.01	50.00	0.25
14	Manganese , Mn (mg/L)	460	200	0.01	230.00	1.15
15	Sulphate, SO4 (mg/L)	200	200	0.01	100.00	0.50
			ΣWi	31.05	ΣWiQi	3685.32
					WQI	118.70

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Table 8 The water quality index of Taungthaman Lake, at Site B in the hot season

No.	Parameters	Actual measured values	WQ Standard value (Si)	Relative weight (Wi)	Quality rating (Qi)	Weighted values
1	pH	7.5	7.5	0.13	100	13.33
2	Temperature (°C)	0.22	5	0.20	149.79	29.96
3	Turbidity (NTU)	34.5	25	0.04	138.00	5.52
4	Dissolved Oxygen, DO (mg/L)	50	5	0.20	1000.00	200.00
5	Biological Oxygen Demand, BOD (mg/L)	35	5	0.20	700.00	140.00
6	Total Dissolved Soil, TDS (mg/L)	350	500	0.00	70.00	0.14
7	Colour	64.8	5	0.20	1296.00	259.20
8	Total Hardness, TH (CaCO3)	40	75	0.01	53.33	0.71
9	Total Alkalinity, TA (mg/L)	148	100	0.01	148.00	1.48
10	Calcium, Ca (mg/L)	10	30	0.03	33.33	1.11
11	Magnesium, Mg (mg/L)	0.2	0.1	10.00	200.00	2000.00
12	Chloride, Cl (mg/L)	0.03	0.05	20.00	60.00	1200.00
13	Total Iron, Fe (mg/L)	80	200	0.01	40.00	0.20
14	Manganese , Mn (mg/L)	248	200	0.01	124.00	0.62
15	Sulphate, SO4 (mg/L)	200	200	0.01	100.00	0.50
			ΣWi	31.05	ΣWiQi	3852.77
					WQi	124.09

Table 9 Seasonally assessment of water quality index at two study sites from Taungthaman Lake during the study period

Sites	Season	WQi	Water quality status
Site A	Rainy	127.8	Unsuitable
	Cold	136.93	Unsuitable
	Hot	144.16	Unsuitable
Site B	Rainy	116.12	Unsuitable
	Cold	118.70	Unsuitable
	Hot	124.09	Unsuitable

Discussion

The WQI was calculated by using the standards of the drinking water quality index, recommended by the World Health Organization (WHO). Based on the results of this research, some water physicochemical parameters such as concentration of pH, total dissolved soil (TDS) are good for as drinking and useless while the concentration of turbidity (NTU), Dissolve oxygen (DO), biological oxygen demand (BOD), total hardness (TH), total alkalinity (TA), calcium (Ca), Magnesium (Mg) and chlorine were demonstrated unsuitable for useless or drinking. Thus, present research pointed out that the water quality of the sample sites clearly degraded and unsuitable for the human uses especially in Site A than that of Site B. The pH (Potential Hydrogen) of a solution refers to its hydrogen ion activity and is expressed as the logarithm of the reciprocal of the hydrogen ion activity at a given temperature. The permissible limit of pH in drinking water is within 6.5-8.5 (BIS, 1991) while 7-8.5 WHO. pH in the present study, the fluctuation of pH in the samples was from 7.1 to 7.6 at Site A and from 7.1 to 8 at Site B. Thus, the water in the Taungthaman Lake is clearly fine as the point of pH view.

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Temperature is one of the most important factors in the aquatic environs (Dwivedi and Pandey, 2002). It affects the physical and chemical properties of water and also affects the aquatic vegetation, organisms and their biological activities. The temperature values in the ponds in the study area ranged from 26.8 °C to 29.6 °C (Choudary *et al.*, 2014). In this research, the temperature variation ranges from 23.5 °C to 34.4 °C at study Site A and from 23.4 °C to 34.5 °C at study Site B. Thus, It extremely low or increase than Choudary reported and then the temperature affects the low density of aquatic vegetation and other organisms in the lake especially at Site B.

Heydari and Bidgoli, (2012) stated TDS consists of constituent ions of inorganic salts which determine the saline behaviour of the water stream and also a small amount of organic matter that may be dissolved in water. The TDS higher than 500 undesirable for drinking (WHO, 2011). In this study period, TDS value varied from 223 mg/L to 450 mg/L. According to presented data, the water in the Taungthama Lake is suitable for drinking in the point of TDS.

Nadeem and Saeed, 2014 stated that the turbidity is caused by fine and colloidal suspended solids in water. The concentration of NTU is 5 mg/L for drinking water (WHO, 2011). In the study area, the range of turbidity value was from 10.8 to 217 in study area. The NTU is very high in these results, it due to mixing of turbid waste water. Thus, the water in the study area is unsuitable for drinking in the point of NTU.

Sajitha and Vijayamma (2016) described the present of dissolved oxygen is essential to maintain the higher forms of biological life and to keep proper balance of various pollutions thus making the water bodies healthy. The permissible value of DO is 5mg/L (WHO, 2011). In the present examination, DO is ranged from 0.22 mg/L to 7.88 mg/L was recorded. The highest DO value 7.88 mg/L was obtained in the rainy season and the lowest value 0.36 was at Site A in the hot season. It is due to may be the water at Site A is stable and it is mixing with flooded water from Ayeyawady River in the rainy season and reduce the amount of water in the hot season.

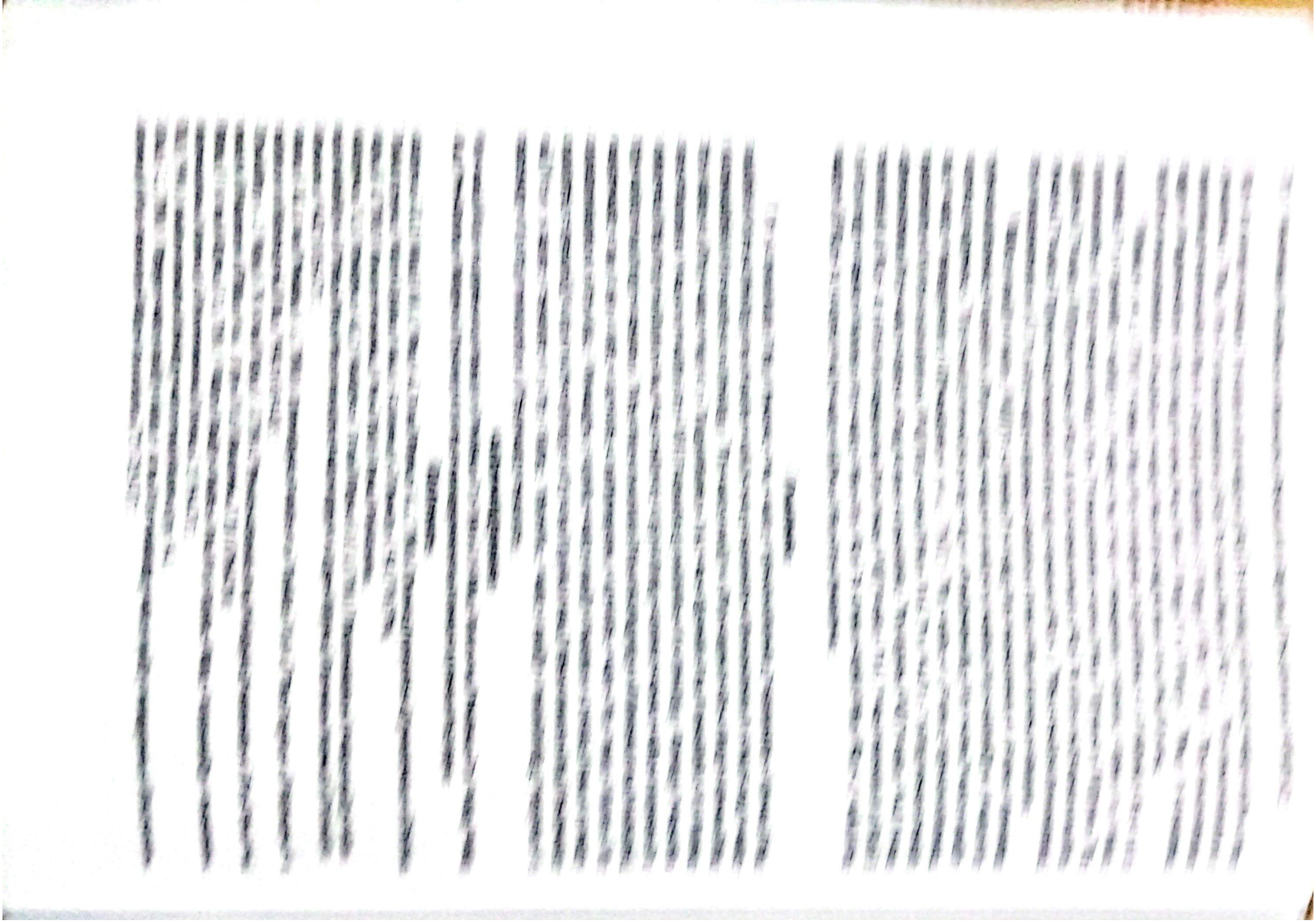
The BOD is a measure of bacterial contamination in water, which is an indirect indicator of water contamination by human/animal waste. The acceptable value of BOD is ≤ 1 mg/L for drinking water (Nadeem and Saeed, 2014). In the present study, the range of BOD was from 25 mg/L to 55 mg/L. Thus, this result demonstrated that the water at study Site A in the lake is unsuitable for drinking. The highest BOD value 55 mg/L was obtained in rainy season, the lowest value 25 mg/L was recorded at Site B in the rainy season. The depth of Site A is more than Site B, thus, Site A is more contaminated than Site B.

The total hardness of water is a measure of its capacity to form precipitates with soap and scales with certain anions present in the water. According to Choudhary *et al.*, (2014) the desirable limit for total hardness is 300 mg/L. In the present examination, the range of hardness concentration value was from 80 ppm to 188 ppm in this study period. It pointed out that the water in the study area is unsuitable for drinking water. The highest TH value 188 ppm at Site B was in cold season and the lowest TH value 80 ppm was at Site A in the rainy season. The water at Site B is distributed water inflows from the downtown and thus it is mixing with soap water reduced during the cold season, thus Site B is more concentration of TH than Site A.

The permissible value of alkalinity is 200 mg/L (WHO, 2011). In the present results, the amount of alkalinity in water sample ranged between 148 mg/L - 460 mg/L. The highest amount of alkalinity was 460 mg/L at Site B in cold season and the lowest alkalinity value was 148 mg/L at Site A in the rainy season. According to present data, that demonstrated the water of this study area is not designable for drinking.

Calcium is an important nutrient for aquatic, organism and it is commonly present in all water bodies (Ansari and Prakash, 2000). The highest Ca value 48 mg/L was obtained at Site B in cold season and the hot season and the lowest Ca value 16 mg/L was recorded at

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Assessment on Spatial Fluctuation of Biodiversity in Myitkyina Environs, Kachin State, Northern part of Myanmar

Thetsu Mar[1], Win Pyae Phyo Oo[2]

Abstract

Spatial fluctuation of biodiversity studied in Myitkyina Environs, Kachin State, Northern part of Myanmar. Kachin State were highest biodiversity hotspots and nationally important. In this study, a total of 72 reptiles and mammals from 14 species were recorded in different habitats from each study sites. Highest species composition was recorded for five species of turtle followed by four species of toad, lowest in deer and two species in wild cat. Spatial fluctuation of biodiversity was found in Site IV (34) reptiles and mammals followed by (19) in Site II and (15) in Site I and least recorded in only (4) individuals number in site III. The most abundance species was recorded in *Duttaphrynus. melanostictus* (Asian common Toad). The least concern species was recorded in *Muntiacus muntijak* (Red muntijak,Ji) and the most important threatened and critically endangered species was recorded in *Paradoxurus hermaphrodites* (common Palm Civet, Wild cat) that the effective conservation strategies was need in urgently. This study will contribute the knowledge on species composition and distribution of biodiversity.This will in turn help planning and implementation of a long-term biodiversity conservation and sustainable development in the Kachin state, Northern part of Myanmar.

Key words: Hotspots, Biodiversity, Conservation

Introduction

Myanmar has been identified as the mainland country having the largest variety of species and the most expanses of undisturbed forest. Kachin State is the northernmost state with snow-capped mountains in the far north where the confluence of the Maykha and Malikha Rivers gives rise to the mighty Irrawaddy River and third largest state of Myanmar.Covering 89,041 square kilometers. About 1.7 million people lived in Kachin State. The capital and largest city is Myitkyina. It is bordered by Yunnan China to the north and

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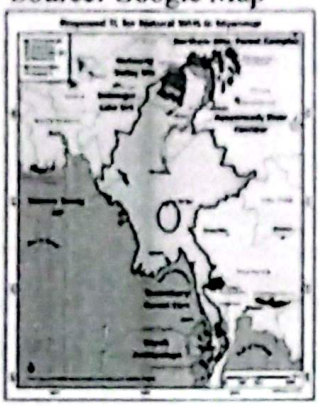
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Tibet, China to the east, Shan State to the south and Sagaing Region and Arunachal Pradesh in India to the west. Easten Himalaya zone ,highest peak Kha kabo Razi.Biodiversity in Kachin State is the arguably the highest priority for effective conservation measures. The area may hold the last remaining habitat for some of the eastern Himalayan species of fauna and flora. This study aims and objectives are to record the population of reptiles and mammals species, to assess distribution pattern of reptiles and mammals species, to examine habitat preference of reptiles and mammals in study area, to develop the sustainable biodiversity conservation.

Materials & Methods

Study Area

Source: Google Map



Study Sites



Fig 1. Map of study area and study sites, Myitkyina Township, Kachin state

The study area situated at North latitude 25° 23', East longitude 17° 23'and 144m above sea level and 220,887 acres. This area received humid with annual rainfall 1270mm. The study period was December 2021. Study land area is mostly covered with closed to open broadleaved evergreen or semi-deciduous forest. The Four study sites were selected as Site I (Tar Law Gyi), Site II (Pyi Daung), Site III(Pan ma Tee) , Site IV(Maw Phaung). Degraded forest borders the Nan Kway creek(Fig 1).The study site located on Maw Phaung Village and still maintaining as reserve forest. These forests had highest tree diversity and lowest dominance. They are partially managed and under the jurisdiction of the MFD. Thus, the study sites are left to regeneration on naturally. Denuded forest borders of Ayeyawady river in Pan Mati Quarter and is heavily used for illegal fishing and gold findings. Large areas have also been selectively cut for charcoal, fine wood, poles and construction materials and converted previously for paddy of field and agriculture plantation and residential areas. Now, this area had left disused (or) abandoned.

Data Collection

Data collection was done in different habitats and some mammal, reptiles species recorded in the survey areas. The reptiles and mammal's species were collected from 4 study sites in different habitats. Fauna was sampled at the selected sites using the time-based sampling method and using net for fauna. Fauna was caught on the basics of per unit effort in three sample plots catch per person in each study sites. The collected-on specimens were then identified based on de Man (1888), Alcock (1895- 1900), Chappgar (1956), Sakai (1965), Storer 1979, FAO 1996. Total numbers of trees and species were recorded.

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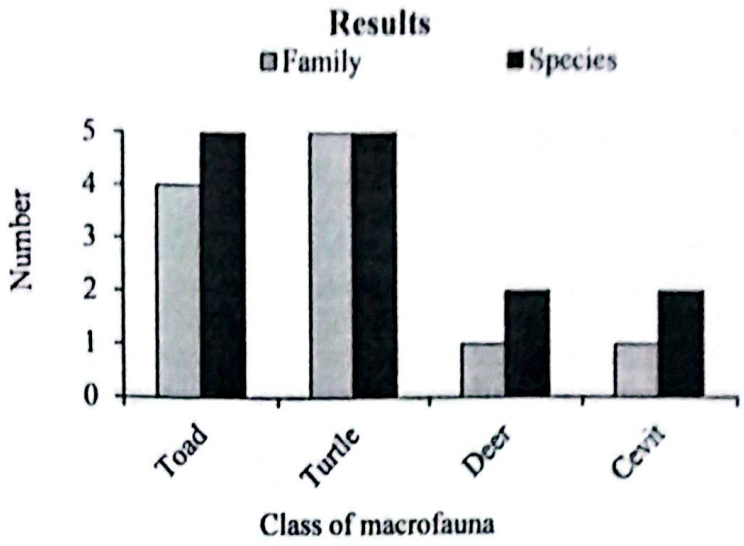


Fig 2 . Family and species of recorded reptiles and mammals

A total of 72 reptiles and mammals from 14 species were recorded from each study sites. This included 5 species of toad and frog,5 species of turtle and tortoises ,2 species of deer and 2 species of wild cat (Cevit) species in respectively. (Table 1 and Fig 2).

Species composition

14 species were recorded from only in Maw Phaung study site IV that were recorded dense forest and regenerated trees as secondary forest. 35 highest numbers of Toad and frog were widely distributed in Site I Tar Law Gyi and being recorded from others sites. Degraded study site was different from the other study sites and attributed to the high abundance of the reptiles and mammals. This species prefer clay muddy with dense litter fall leaves of mature forest which were the conditions at these study sites.

Table 1. Systematic position of recorded Reptiles and Mammals in this study area.

No	Family	Species Name	Common Name	Local Name	Status
1	Bufonidae	*Duttaphrynus. melanostictus*	Asian Common Toad	Phar pyoke	-
2	Dicroglossidae	*Fejervarya.greenii*	Paddy frog	Phar paung sin	-
3		*Hoplobatrachus.tigerinus*	Indian bullfrog	Sar phar	-
4	Microhylidae	*Kaloula.pulchra*	Banded bullfrog	Phar kon nyin	-
5	Rhacophoridae	*Polypedates.leucomystax*	Common tree frog	Phar pyan	-
6	Geoemydidae	*Cuora amboinensis*	Myanmar box turtle	Late yin kyoe	-
7		*Melanochelys trijuga*	Myanmar black turtle	Late pote	-
8	Trionychidae	*Amyda cartilaginea*	Asiatic soft shell turtle	Lake Pyaet	-
9	Platysternidae	*Platysternon megacephalum*	Big headed turtle	Kyat Tu Yway	-
10	Testucinidae	*Indotestudo elongsta*	Yellow tortise	Late wah	-
11	Cervidae	*Muntiacus muntijak*	Red muntijak	Ji	Least concern
12		*Axis porcinus*	Hog deer	Ji	Vulnerable
13		*Paradoxurus hermaphroditus*	Common Palm Civet	Wild Cat	Threatened
14		*Viverra zibetha*	Large Indian Civet	Cat Nant Thar	Critically endangered

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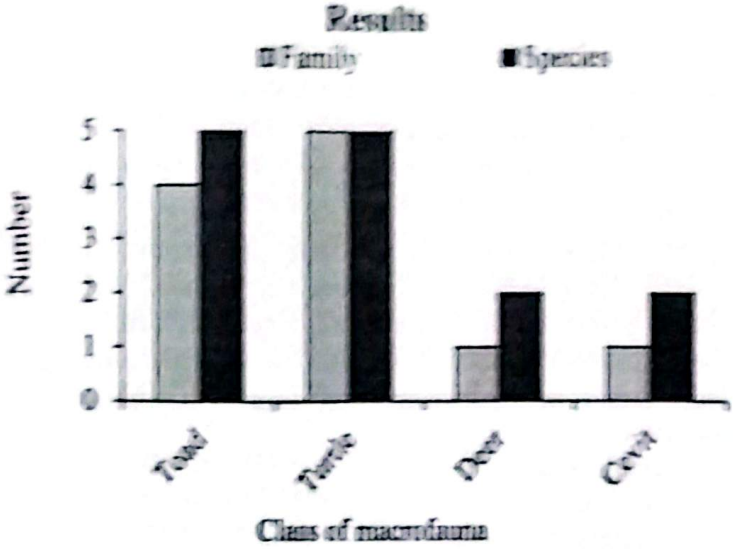


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2	Dicroglossidae	*Fejervarya greenii*	Paddy frog	Phar paung sin	-
3		*Hoplobatrachus tigerinus*	Indian bullfrog	Sar phar	-
4	Microhylidae	*Kaloula pulchra*	Banded bullfrog	Phar kon nyin	-
5	Rhacophoridae	*Polypedates leucomystax*	Common tree frog	Phar pyan	-
6	Geoemydidae	*Cuora amboinensis*	Myanmar box turtle	Late yin kyoe	-
7		*Melanochelys trijuga*	Myanmar black turtle	Late pote	-
8	Trionychidae	*Amyda cartilaginea*	Asiatic soft shell turtle	Lake Pyaet	-
9	Platysternidae	*Platysternon megacephalum*	Big headed turtle	Kyat Tu Yway	-
10	Testucinidae	*Indotestudo elongata*	Yellow tortise	Late wah	-
11	Cervidae	*Muntiacus muntjak*	Red muntjak	Ji	Least concern
12		*Axis porcinus*	Hog deer	Ji	Vulnerable
13		*Paradoxurus hermaphroditus*	Common Palm Civet	Wild Cat	Threatened
14		*Viverra zibetha*	Large Indian Civet	Cat Nant Thar	Critically endangered

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Morphological description

Order - Cetartiodactyla
Family - Axis
Species - Axis *porcinus* (Kerr, 1792)
Common name - Hog deer
Local name - ji

Head and body length varies from 1.62 to 2.7 m, Weigh as much as 54 kg with a 22 to 35 cm tail. Females are smaller than males. Antlers are typically up to 110 cm long in fully adult individuals. The tail is relatively long for deer, and in generally black above with a whitish underside. The shaggy coat can be anything from yellowish brown to dark grey in fur colour. Feeding on seedling, fruit, or seeds of many plants. They are active by day and can become relatively tame nocturnal.

Order : Cetartiodactyla
Family : Cervidae
Genus : Munticus
Species : *Muntiacus muntjak*
Common name : Red, or Indian Muntjac, 'barking deer'
Local name : Ji

Head and body length Males up to 55 cm, Weigh as much as 28 kg with a 20 to up cm in tail length. Females are smaller than males and possess enlarged upper canine teeth. Males have small antlers of up to 13 cm, arising from bony pedicels of up to 15 cm. Fur colour is varies from pale orange to reddish brown, paler underneath, and with a pale throat in juveniles. They were Facial markings with dark eyebrows and long dark eyelashes. Typical diet is young leaves, shoots, tree bark, grass and fallen fruits and small ground-dwelling vertebrates. Patterns of activity active by day and. Distribution and habitats are a wide variety of forest types including primary secondary rainforest, dry forest, hill forest and mountain habitats venturing into adjacent grassland to graze.

Order - Cetartiodactyla
Family - Cervidae
Genus - Paradoxurus
Species - *Paradoxurus hermaphroditus*
Common name - Common palm Cevit
Local name - Wild cat

Head and body length Males 40-75cm,weigh as much as 28 kg with 40- 60cm in tail length. Females are smaller than males and possess enlarged upper canine teeth and black long, stocky body, covered with coarse, shaggy hair, usually grayish in colour. They were Facial markings with dark eyebrows and long dark eyelashes. Typical diet is fruits and small macro-organisms, omnivore feeding Habits is forage evening and nocturnal. The palm civet is an omnivore feeding foremost on fruits such as berries and pulpy fruits but also small mammals and insects. Its sharp claws allow climbing of trees and house gutters. Palm civets are considered a nuisance since they litter in ceilings and attics of common households and make loud noises fighting and moving about at night. (Table 1).

Order - Cetartiodactyla
Family - Cervidae
Genus - Viverricula
Species - *V.indica*
Common name - Small india cevit
Local name - Taw Kaung

Small india cevit is a viverrid native to South and South east Asia. Since 2008,IUCN Red Listed as Least Concern .Its head-to-body length is about 53 cm (21 in)) long unringed tail. It weighs 2 to 5 kg (4 to 11 lb) long, stocky body, covered with coarse, shaggy hair,

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usually greyish in colour. A white mask across the forehead, a small white patch under each eye, a white spot on each side of the nostrils and a narrow dark line between the eyes. The muzzle, ears, lower legs, and distal half of the tail are black. It is both terrestrial and arboreal, showing a nocturnal activity pattern with peaks between late evening until after midnight. It is usually active between dawn and 4:00 in the morning, but less active during nights when the moon is brightest. The civet is an omnivore feeding foremost on fruits such as berries and pulpy fruits but also small mammals and insects. Its sharp claws allow climbing of trees and house gutters. Palm civets are considered a nuisance since they litter in ceilings and attics of common households, and make loud noises fighting and moving about at night. Its anal scent glands emit a nauseating secretion as a chemical defense when threatened or upset.(Table 1).

Class - Reptilia
Order - Chelonia
Family - Trionychidae
Species - *Amyda cartilaginea*

The species common name was Asiatic soft shell turtle (local name –Lake Pyaet). Carapace width (15cm-70cm), carapace length (18cm to 70cm) and weight 20g-200g.Carapace is round at oval ,olive gray to greenish brown with yellow rimmed black spots. Living in upland streams, muddy slow flowing lowland streams with swamps. Carnivorous, protected,IUCN (2012)- vulnerable, Myanmar Law MWL(1994) (Table 1).

Class - Reptilia
Order - Chelonia
Family - Testucinidae
Species - *Platysternon megacephalum*

The species common name was Big headed Turtle (Local name – Lake Kyat Tu Yawe).Big headed Turtle was recorded carapace width (13 cm to 30cm), carapace length (15cm to 35cm) and weight 25g. Body is flat with slight medial keel, yellow brown to olive dark radiations on each scute. Tail covered with large scales. They prefer living in mountain streams and brooks with abundant rocks and are mainly carnivorous. They usually eat small insect, shrimps, fishes and mollusks. Appendix II CITES and considered Endangered by IUCN(Table 1).

Order - Chelonia
Family - Testucinidae
Genus - *Indotestudo*
Species - *I.elongate*

The species common name was Yellow Tortoise (Local name – Lake Wah). Carapace width (12 cm to 25 cm), carapace length (15cm to 25cm) and weight 20g in respectively. Carapace is yellow brown or olive with black blotches on sautés. Plastron and bridge yellow, most scutes with dark blotches. They prefer living in forest areas and are mainly omnivorous. They usually eat cucumber and some fruits, small insect, shrimps, fishes and mollusks. This is an endemic turtle listed as endangered under CITES (2010) – Appendix II, IUCN (2012)- Endangered and MWL (1994)protected under Myanmar Law(Table 1).

Order - Chelonia
Family - Geoemydidae
Species - *Cuora amboinensis*

The species common name was Keeled box turtle (Local name – Kan lake). Keeled box turtle was carapace (18cm) elongated and flattened dorsally, marginal strongly serrated posterior. Carapace was yellowish brown to dark three developed keels. Plastron was yellow brown with darkened seams. Head was strongly hooked upper jaw and short non projecting snout. Forelimbs, hind limbs were grey and pointed tubercles at base of tail and adjacent thighs. They prefer living in forest areas and are mainly herbivorous. This is an vulnerable turtle listed as endangered under CITES (2010)- Appendix II, IUCN (2012)- vulnerable and MWL(1994)protected under Myanmar Law (Table 1).

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Order - Chelonia
Family - Geoemydidae
Species - *Melanochelys trijuga*

The species common name was Myanmar black turtle (Local name – Lake Poke). Myanmar black turtle was carapace (to 39cm) oval and flattened dorsally, marginal strongly serrated. Carapace was dark brown to brown with darker seams with three large black blotches lanes. Among these lines, the middle line was very prominent. Head was black colour with yellow spots and forelimbs, hind limbs and tail were dark-brown. They prefer living in creek related forest areas and are mainly herbivorous. This is IUCN (2012)- vulnerable and MWL (1994) protected under Myanmar Law (Table 1).

Class : Amphibia
Order : Anura
Family : Bufonidae
Species name : *Duttaphrynus melanostictus*

The species common name was Asian Common Toad (Local name-hpar pyok).It sized median with large toad and small head with pointed snout. Skin above covered with round warts of several tiny dark spines ventral surface has smallest warts.Dorsal surface was brown grayish or reddish brown, all digits capped black and ventral surface yellowish white.

Class : Amphibia
Family : Dicroglossidae
Species name : *Fejervarya.greenii* (Paddy frog)

The species common name was Common paddy frog (Local Name- Phar paung sin).A medium sized squat frog Head is moderately elongated and oval. Skin is more or less prominent warts with about eight longitudinal glandular folds on the back which are usually short or interrupted vertebral stripe broad. Colour of skin is olive or grey above with dark spots mainly along the longitudinal fold and with a yellow mid ventral band,dark cross bar on the limbs.

Class : Amphibia
Family : Dicroglossidae
Species name : *Hoplobatrachus tigerinus*

The species was common name ,Indian bullfrog(local name- Sarr phar gyi).The species was large frog and head with broadly triangular pointed snout. Skin on dorsal surface smooth with large prominent warts ventral surface smooth. Dorsal surface yellowish green marked with black spots. Yellowish colour line present and ventral surface white with a few spots.

Class : Amphibia
Family : Microhylidae
Species name : *Kaloula pulchra*

The species common name was Common Bull frog (Local Name- Phar Gone Nyin).A medium sized squat frog Head with stubby snout .Skin on dorsal surface granular with tubercles;ventral surface smooth. Dorsal surface was dark brown with scattered dark spots. Dorso-lateral with two broad irregular bands ventral surface powdered with grey.

Class : Amphibia
Family : Rhacophoridae
Species name : *Polypedates leucomystax*

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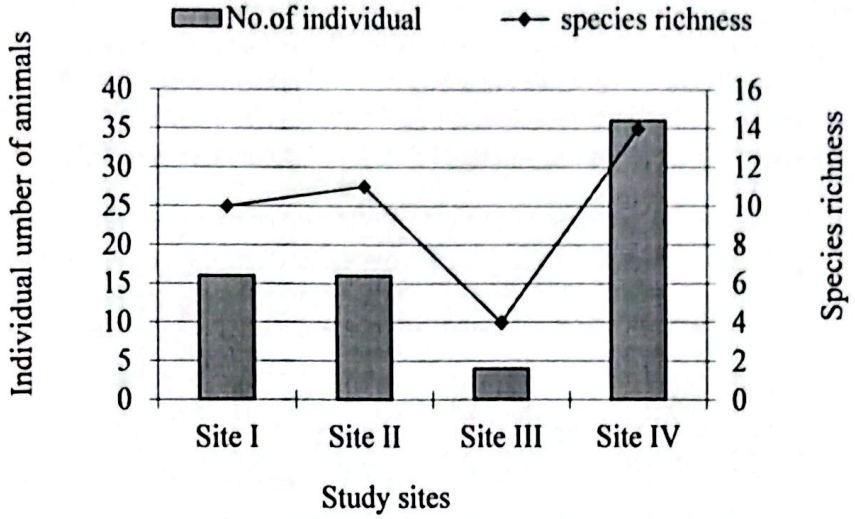


Fig 3 . Species composition and individual numbers of recorded fauna.

The species common name was Common tree toad (local name- Phar pyan).The species was small and head with skull bones and large sub-triangular. Skin is smooth, variable colours (grey, yellow, reddish, dark brown).Dorsal surface mottled slightly dark or brown. A few scattered small black spots over dorsum.

Habitat Utilization

In the present study, macro fauna were collected from 4 study sites representing different conditions of habitat types. These different habitats were determined by tree composition and background history of forest conditions as degraded forest, denuded forest and abandon paddy field in respectively (Fig, 2).

In study site I (Tar Law Gyi), a total of 16 individual numbers of reptiles and mammals from 10 species were recorded from each study sites. This included 5species of toad and frog,3 species of turtle and tortoises ,1 species of deer and wild cat (Cevit) species in each respectively. This study site was recorded dense forest and regenerated trees as secondary forest. 7 tree species with 25 trees 100m2(Fig 3, 4). In Site II (Pyi Daung),a rehabilitation of plantation, a total of 16 individual numbers of reptiles and mammals from 11 species were recorded from each study sites. This included 5 species of toad and frog, 2 species of turtle and tortoises ,2 species of deer and 2 species of wild cat (Cevit) species in respectively. This study site was recorded dense forest and regenerated trees as secondary forest. 8 tree species with 50 trees 100m2(Fig 3,4). In Site III (Pan ma Tee), lowest number of 4 individual numbers of reptiles and mammals from 4 species were recorded from study sites. This included only 4species of toad and no recorded in other fauna which were absent stand density on disused (or) abandoned paddy fields and agriculture land (Fig 3, 4). In site IV (Maw Phaung), a total of 36 reptiles and mammals from 14 species were recorded from this study sites. This included 5species of toad and frog,5 species of turtle and tortoises ,2 species of deer and 2 species of wild cat (Cevit) species in respectively. This study site was recorded dense forest and regenerated trees that had been restricted for protected area in this study site. Ten tree species with 35 trees 100m2 (Fig 3,4).

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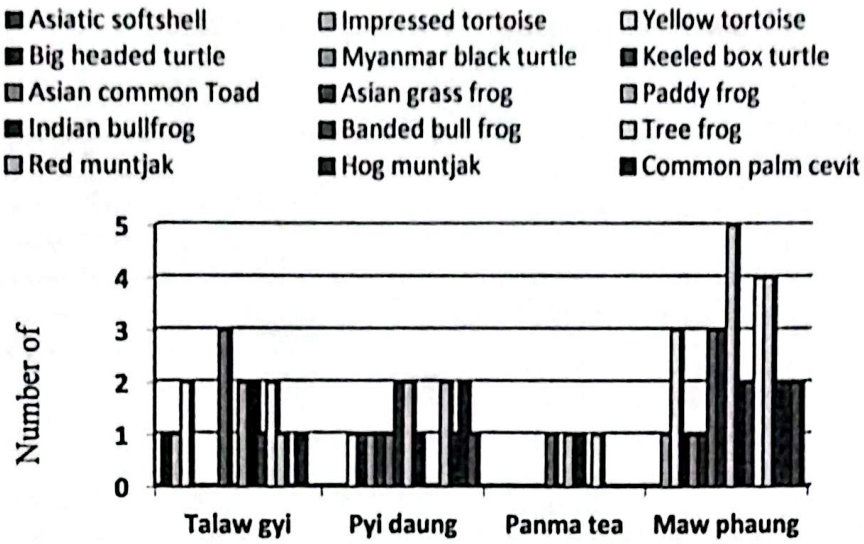


Fig 4. Spatial fluctuation of biodiversity in study area

Spatial fluctuation of biodiversity

Abundance of reptiles and mammals recorded in each study sites. The present study, highest fluctuations of biodiversity were recorded a total of 36 fauna in site IV(Maw phaung). There was observed 18 individual numbers of toad, 7 individual number of turtles , (6) individual number of deer and least (5) individual number of Cevit. The moderate fluctuations of biodiversity were recorded a total of 16 fauna in site II (Pi taung). There was observed 6 individual number of toad, 4 individual number of turtle and tortoise, (3) individual number of deer and Cevit in each respectively. The fluctuations of biodiversity were recorded a total of 16 fauna in site I(Tar Law Gyi). There was observed 10 individual number of toad, 4 individual number of turtle, least (1) individual number of cevit and deer in each respectively. The least fluctuations of biodiversity were recorded a total of 4 fauna in site III(Pan Ma tee). There was observed 3 individual number of toad , 1 individual number of turtle but no recorded the deer and cevit fauna(Fig4).

Discussion

Species compositions provide useful ecological indicators for habitat status. Highest species composition was recorded for turtle (5) followed by toad (5), lowest in deer and cevit (2).Spatial fluctuation of biodiversity was found in Site IV (36) reptiles and mammals followed by (16) in Site II and (16) in Site I and least recorded in only (4) individuals number in site III. Highest species number (14) in Site IV may indicate a good shelter habitat and low dominance in Site III (Pam ma Tee) that indicate a stressful environment by human impact. A total of 14 species of reptiles and mammals were recorded by direct sighting and interview information including six species are also endangered that area is habitat loss and logging. A total of 23 species of mammals were recorded and six species confirmed recorded of endangered species (Nyo tun,2001). A total of only 6 species of reptiles and mammals were recorded in zoology characteristic Flora and'-Fauna of the Kachin State, Northern Myanmar (Dr. Yi YI Win at el., 2005). Muntjacs deer was a key part of the prey base for large predators in many parts of Southeast Asia. According to local hunters from Tar law gyi and Maw Phaung Villages said that the hog deer species are rare and but sometimes easy to find found near the village when the grass are burnt in dry season and at the bottom of forest near of the creek area in last two year. In this year 2021, extension of paddy field and forest fire, the hog deer species were rarely seen in their habitat area. Deforestation has led to striking fragmentation of the natural landscapes throughout the world. They may be preyed upon by large cats such as Tigers and Leopards, large pythons, wild dogs (Lekagul & McNeely, 1977).

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The Asian palm civet helps to maintain tropical forest ecosystems via seed dispersal. The oil extracted from small pieces of the meat kept in linseed oil in a closed earthen pot and regularly sunned that can used indigenously as a cure for scabies. Phyo Wathone Hlaing (2020) stated that trade of wild animals in Myitkyina and Lweje Environs, Kachin state. Most of the mammal were used as fresh meat while others were killed often just for obtaining as a single body part (gall bladder, paws and legs that used for ingredients of traditional medicines collectors, trophies decorations and luxury items and also traded for zoological exhibits and transported from Myanmar to Yunnan province China. Education is critical for promoting the sustainable development and improving the capacity of the people to address their sustainable development concerns (Boulton and Knight, 1999).

Conclusion

The spatial fluctuation of biodiversity indicated the ecological damage in this area. The species composition (14) species of animals clearly showed that overexploitation as pets or bush meat and used for ingredients of traditional medicines. Among the habitat utilization of reptiles and mammals observed that population abundance was low dominance in Site III (Pam ma Tee) had stressful environment by human impact while highest species number in Site IV a degraded and secondary forest as good shelter habitat in wildlife sanctuary and protected area from government. It has been concluded that settlements the decline of mammals' population in the study area were the main cause of heavily hunting pressure and deforestation by had changed for agriculture land with human settlement. People whose livelihoods depend most on natural resources are affected by the effects of deforestation and direct biodiversity loss. The border trade for the wildlife parts should also be tightly secured and hunting season can be adjusted with the breeding season of the large mammal species. Therefore, law enforcement should be carried out for the complete protection. Effective conservation strategies need to be supported by a better understanding of the processes operating within ecosystems.

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Isolation and Identification of Endophytic Fungi from Twigs and Flowers of *Breynia androgyna* (L.) Chakrab. & N.P. Balakr.

Khin Myo Myat Hlaing[1], Phyu Phyu Oo[2], Seine Nyoe Nyoe Ko[3]

Abstract

Five endophytic fungi were isolated from twigs and flowers of *Breynia androgyna* (L.) Chakrab. & N.P. Balakr. (Mashaw). It was belonging to the family Phyllanthaceae. The plants were collected from Situpu Quarter, Myitkyina Township, Kachin State. This study was carried out at Microbiology laboratory, University Research Centre, Department of Botany, University of Myitkyina from December 2019 to July 2020. Potato Dextrose Agar (PDA) medium was used for the isolation of endophytic fungi. All isolates were identified based on morphological characteristics using the microscope. Five endophytic fungi, *Hansfordia* sp. (KMMH-1), *Monotospora* sp. (KMMH-2) and *Fusarium* sp. (KMMH-3) were isolated from twigs. *Colletotrichum* sp. (KMMH-4) and *Aspergillus* sp. (KMMH-5) were isolated from flowers. The morphology of *Breynia androgyna* (L.) Chakrab. & N.P. Balakr. and characteristics of endophytic fungi were described and presented with photomicrograph.

Key words: *Breynia androgyna*, endophytic fungi, PDA medium

Introduction

The genus *Phyllanthus* (Phyllanthaceae) consists of approximately 1000 species, spread over the American, African, Australian and Asian continents (Unonder *et al*., 1994). All three major habits, that is, trees, shrubs and herbs are seen amongest the *Phyllanthus* species. Most of the herbs belonging to genus *Phyllanthus* have been shown to contain different combination of secondary metabolites which render then with medicinal properties. The major class of bioactive compounds like alkaloids, flavonoids, lignans, phenols, tannins and terpenes has been isolated from these plants (Calixto *et al*., 1998 and Nahar *et al*., 2011).

Endophytes show a protective role against insect herbivore and many are potential producers of novel antimicrobial secondary metabolites (Tawere *et al*., 2017). During an investigation of fungi associated with marine macro-algae an interesting *hyphomycete* species from the alga *Colpomenia dinuosa* was found at the coast of Weihai, China. It is described here as a new taxon in the genus *Hansfordia*. Twenty one species names in the genus *Hansfordia* have been recorded (Cheng *et al*., 2011). Hughes (1955) examined the type of *Monotospora fasciculata* Sacc. is considered this fungus should be placed in the genus *Melanographium*. However, the taxon '*Monotospora fasciculata* Sacc.' could not be used for nomenclatural combination because it was a later homonym of *Monotospora fasciculata*. *Fusarium* sp. showed the highest level of activity against the pathogen and was further characterized (Hanada *et al*., 2010). *Fusarium* genus was against abroad ranges of bacteria and fungi pathogens (Tayung *et al*., 2011). Mutualistic benefits of *Colletotrichum* sp. to hosts include growth enhancement, disease resistance, and abiotic stress tolerance (Soltani *et al*., 2014). *Aspergillus* is a genus consisting of several hundred species found in various climates. (Ge *et al*., 2009).

The aim and objective were to isolate the endophytic fungi from twigs and flowers of *Breynia androgyna* (L.) Chakrab. & N.P. Balakr. and to identify the morphological characteristics of the endophytic fungi.

Materials and Methods

The present study was carried out at the Microbiology laboratory, Department of Botany, University Research Center, University of Myitkyina, Kachin State from December 2019 to July 2020.

[1] Demonstrator, Department of Botany, Mohnyin University
[2] Dr., Associate Professor, Department of Botany, University of Myitkyina
[3] Dr., Professor and Head, Department of Botany, University of Myitkyina

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Collection of Samples

Plant samples of *Breynia androgyna* (L.) Chakrab. & N.P. Balakr. were collected from Sitapu Quarter, Myitkyina Township, Kachin State in December 2019. The location map of study area was shown in Fig.1. The fresh and healthy twigs and flowers were chosen for sampling and they were recorded with photographs. Plant identification was done by Dessanayake, 1996.

Preparation of Culture Medium (Composition Per Liter)

Potato Dextrose Agar (PDA) medium

Potato Dextrose agar (PDA)	39 g
pH	6.5

After autoclaving chloramphenicol (0.1 g) was added to the medium.

Isolation Procedure of Endophytic Fungi

Healthy twigs and flowers of *Breynia androgyna* (L.) Chakrab. & N.P. Balakr. were used for isolation of endophytic fungi by the method of (Ando & Inaba, 2004). The healthy twigs and flowers were washed gently in tap water. Then the samples were sterilized by soaking with 70 % ethanol for 1 minute and rinsed with sterilize distilled water. The samples were dried on sterilized filter paper. Before the culture, the conical flask containing media, petri dishes, forceps and inoculation needle were sterilized by autoclave at 121°C for 15 minutes. After autoclaving, chloramphenicol 0.1 g was added to the medium to inhibit the growth of bacteria and samples were placed on potato dextrose agar (PDA) medium plates. The plates were incubated at room temperature for 7 days. The endophytic fungi growing on PDA medium were sub-cultured on fresh PDA to get pure colony.

Identification Procedure of Endophytic Fungi

The morphological and microscopical characters were observed by the method of (Barnett, 1955). The fungal spores were measured according to the method of (Kokate, 2000).



Figure 1. Location map of specimen collection site

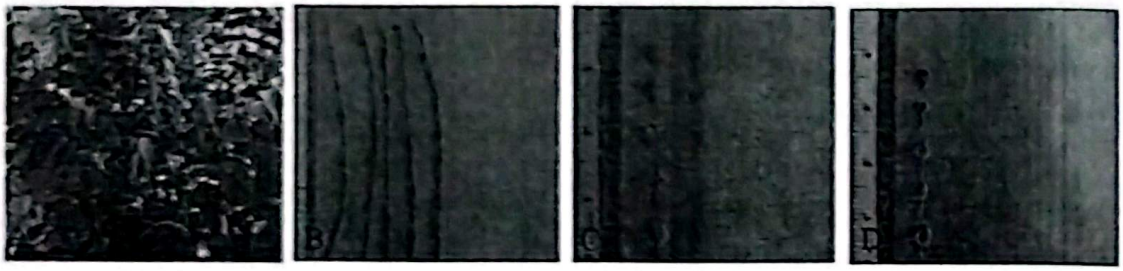
Results

Morphological Characters of *Breynia androgyna* (L.) Chakrab. & N.P. Balakr. (Figure 2. A-D)

Scientific name - *Breynia androgyna* (L.) Chakrab. & N.P. Balakr.
English name - Star gooseberry
Myanmar name - Mashaw
Family - Phyllanthaceae
Flowering period - June to December

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Perennial monoecious shrub, about 5 m tall; stems usually erect, slender, spreading, green, glabrous. Leaves simple, alternate; stipules lanceolate, 3 mm long; petiole 1.0 - 4.0 mm long; blade lanceolate, 8.0 - 15.0 cm by 2.0 - 3.5 cm, base obovate, margin entire, acute apex, glabrous. Inflorescences axillary racemes. Flowers unisexual, actinomorphic, hypogynous, yellowish-green. Staminate flower yellowish-green; pedicel 4.0 - 8.0 mm long, slender; calyx disciform, lobes broad, 4.5 - 5.9 mm diameter, glabrous; disk absent; stamens 3; filaments totally fused into free column, about 1.0 mm long, pale green; anthers dithecous, introse, basifixed, dehiscing by longitudinal slit. Pistillate flowers solitaty, yellowish-green; pedicels 5.0 - 10.0 mm long; bracts lanceolate 1.0 - 2.0 mm long; sepal 6, 5.0 - 7.0 mm by 5.0 - 6.0 mm, broadly obovate; accerescent, persistant in fruit; disk absent. Ovary superior, syncarpous, globoid, 1.5 - 2.0 mm in diameter, trilocular, two ovules in each locule on the axile placentae; style short; stigma trifid, recurved. Fruit capsular, despressed-globoid, 14.0 mm in diameter. Seeds trigonous, 8.0 - 10.0 mm long, black



A. Habit B. C. Female flowers D. Male flowers

Figure 2. ***Breynia androgyna*** **(L.) Chakrab. & N.P. Balakr.**

Isolation from Twigs

The pieces of twigs were cultured on PDA medium. Fig. 3B, 4B & 5B.

Macroscopical Characters of KMMH-1

After 3-7 days of cultivation, KMMH-1 colony was white. The reverse colony was pale orange in color on PDA medium at 25°C. The diameter of KMMH-1 colony was 2-5 cm and the optimal pH range was 6.5-7.0 Fig. 3C & D.

Microscopical Characters of KMMH-1

Hyphae were septate and hyaline branched. Conidiophores were stalk, hyaline, branched; conidia were globose, flexuous and attached at the apex, one celled and 5-7.5µm in diameter. According to these macroscopical and microscopical characters, the fungal KMMH-1 may be *Hansfordia* sp. Fig 3E &F.

Macroscopical Characters of KMMH-2

After 3-7 days of cultivation, KMMH-2 colony was white. The reverse colony was pale yellow in color on PDA medium at 25°C.The diameter of KMMH-2 colony was 3.5 – 4 cm. The optimal pH range was 6.5-7.0 Fig. 4C & D.

Microscopical Characters of KMMH-2

Hyphae were septate and branched. Conidiophores were erect, slender, septate and simple. Conidia were one celled, ovoid and ellipsoid, laterally and apically, 5-7.54µm. According to these macroscopical and microscopical characters, the fungal KMMH-2 may be *Monotospora* sp. Fig. 4E & F.

Macroscopical Characters of KMMH-3

After 3-7 days of cultivation, KMMH-3 colony was white. The reverse colony was orange in color on PDA medium at 25°C. The diameter of KMMH-3 colony was 3-5.6 cm. The optimal pH range was 6.5-7.0 Fig. 5C & D.

Microscopical Characters of KMMH-3

Hyphae were septate and branched. Conidiophores were hyaline, simple and slender. Conidia were septate and divided into 3-6 cells, slightly curved of bent to the ends, typically

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canoe shaped, 20-50µm in length and 5-7.5µm in width. According to these macroscopical and microscopical characters, the fungal KMMH-3 may be *Fusarium* sp. Fig. 5E & F.

Isolation from Flowers

Pieces of flower were cultured on PDA medium Fig. 6 B & 7 B.

Macroscopical Characters of KMMH-4

After 3-7 days of cultivation, KMMH-4 colony was white. The reverse colony was pale yellow in color on PDA medium at 25°C. The diameter of KMMH-4 colony was 2.7- 7 cm. The optimal pH range was 6.5-7.0 Fig. 6 C & D.

Microscopical Characters of KMMH-4

Hyphae were septate and hyaline branched. Conidiophores were hyaline and branched. Conidia were hyaline, 2-4 celled, ovoid to oblong, cylindrical with rounded ends and smooth walled, 12.5-17.5µm in length and 7.5-10µm in width. According to these macroscopical and microscopical characters, the fungus KMMH-4 may be *Colletotrichum* sp. Fig. 6 E & F.

Macroscopical Characters of KMMH-5

After 3-7 days of cultivation, KMMH-5 colony was white and brown alternate. The reverse colony was white and pale brown alternate in color on PDA medium at 25°C. The diameter of KMMH-5 colony was 3- 6.5 cm. The optimal pH range was 6.5 -7.0 Fig. 7 C & D.

Microscopical Characters of KMMH-5

Hyphae were septate, hyaline and branched. Conidiophores were upright, simple, terminating in a globose, bearing phialides. Conidia were 5-7.5µm in diameter, globose and one celled. According to these macroscopical and microscopical characters, the fungus KMMH-5 may be *Aspergillus* sp. Fig. 7 E & F.

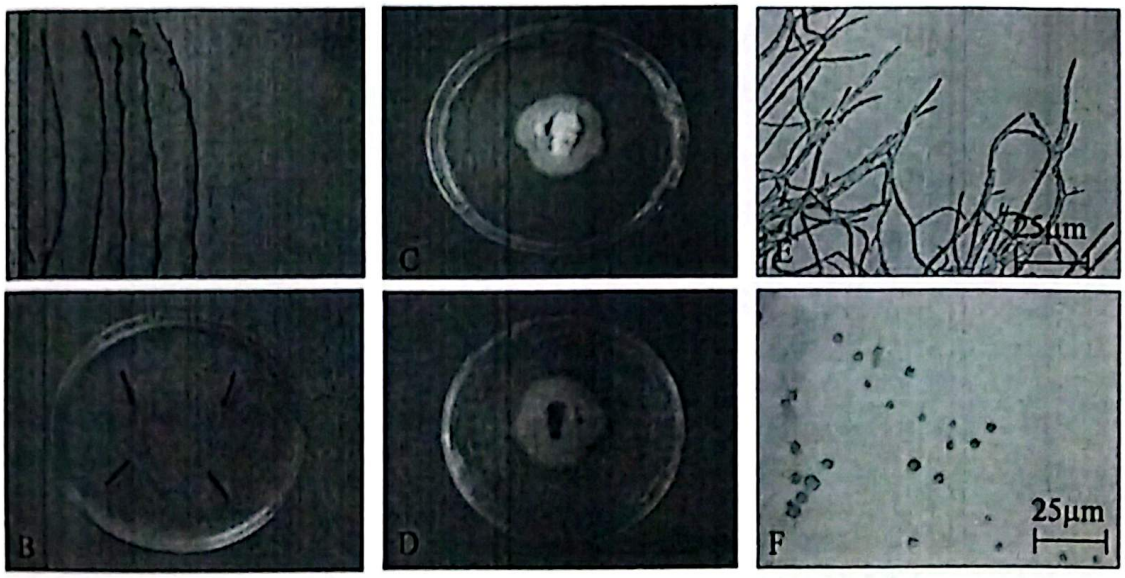


Figure 3. A. Twigs samples of *Breynia androgyna* (L.) Chakrab. & N.P. Balakr.
B. Pieces of twigs cultured on PDA medium
C. Surface colony characters of *Hansfordia* sp. (KMMH-1) 4-days
D. Reverse colony characters of *Hansfordia* sp. (KMMH-1) 4-days
E. Photomicrograph of *Hansfordia* sp. (KMMH-1)
F. Photomicrograph of *Hansfordia* sp. (KMMH-1)

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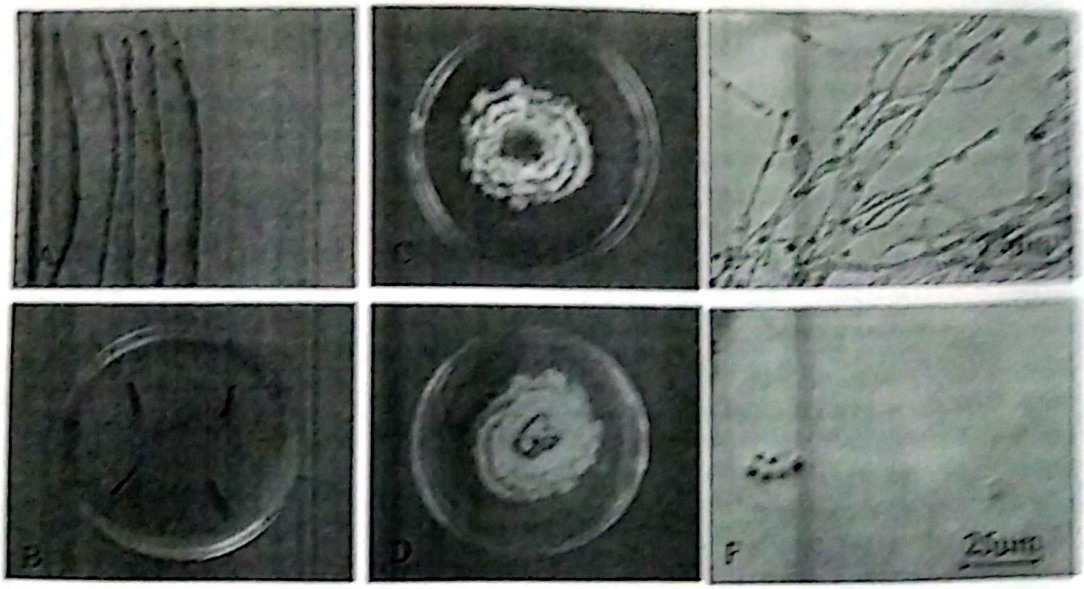


Figure 4. A. Twigs samples of *Breynia androgyna* (L.) Chakrab. & N.P. Balakr.
B. Pieces of twigs cultured on PDA medium
C. Surface colony characters of *Monosporo* sp. (KMMH-2) 4 days
D. Reverse colony characters of *Monosporo* sp. (KMMH-2) 4 days
E. Photomicrograph of *Monosporo* sp. (KMMH-2)
F. Photomicrograph of *Monosporo* sp. (KMMH-2)

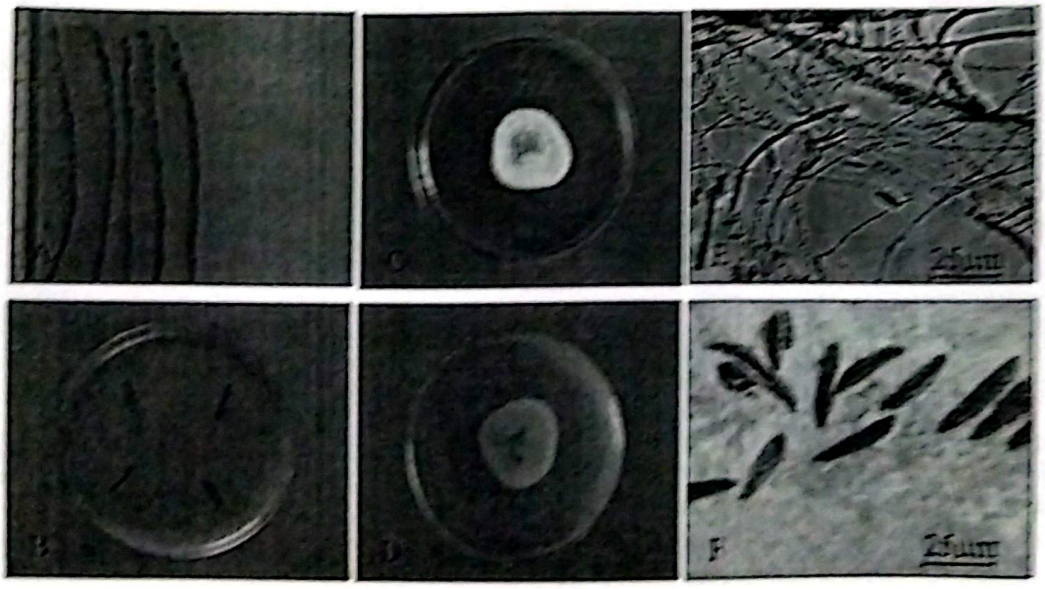


Figure 5. A. Twigs samples *Breynia androgyna* (L.) Chakrab. & N.P. Balakr.
B. Pieces of twigs cultured on PDA medium
C. Surface colony characters of *Fusarium* sp. (KMMH-3) 4 days
D. Reverse colony characters of *Fusarium* sp. (KMMH-3) 4 days
E. Photomicrograph of *Fusarium* sp. (KMMH-3)
F. Photomicrograph of *Fusarium* sp. (KMMH-3)

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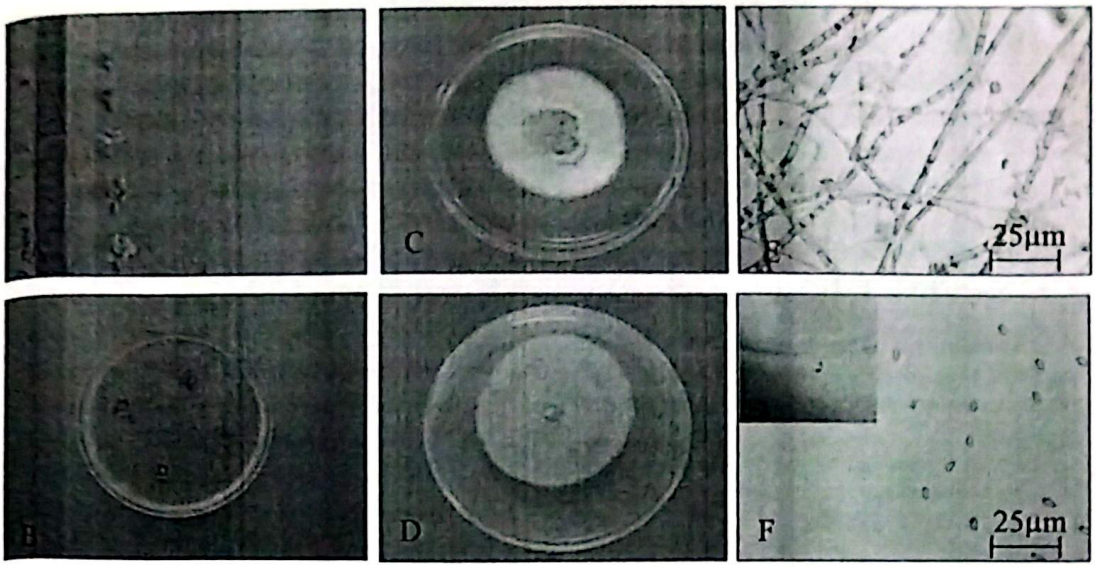


Figure 6. **A. Flowers (female) samples of *Breynia androgyna* (L.) Chakrab. & N.P. Balakr.**
B. Pieces of female flowers cultured on PDA medium
C. Surface colony characters *Colletotrichum* sp. (KMMH-4) 4 days
D. Reverse colony characters of *Colletotrichum* sp. (KMMH-4) 4 days
E. Photomicrograph of *Colletotrichum* sp. (KMMH-4)
F. Photomicrograph of *Colletotrichum* sp. (KMMH-4)

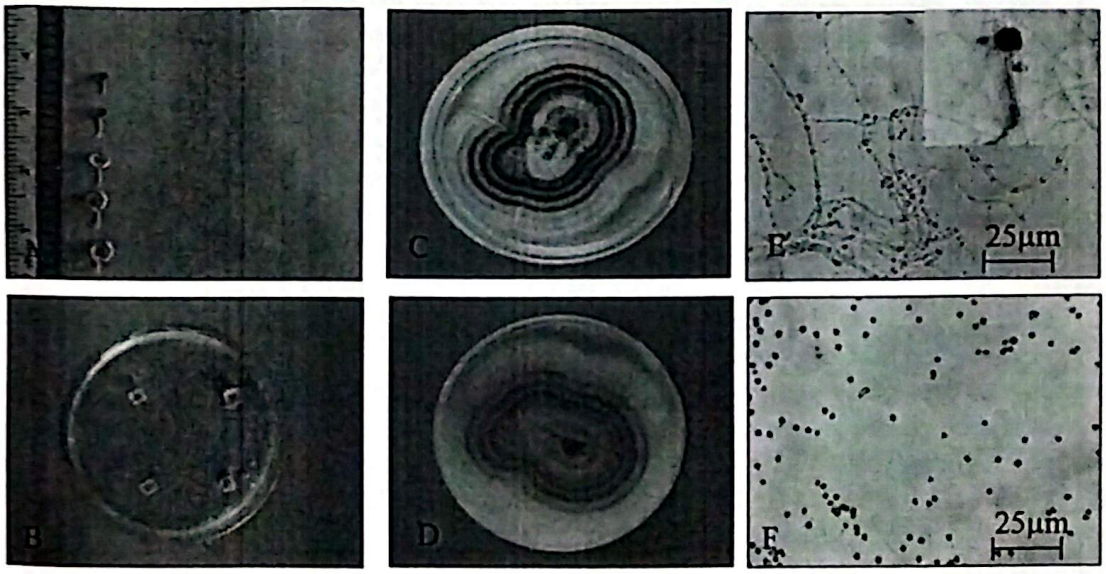


Figure 7. **A. Flowers (male) samples of *Breynia androgyna* (L.) Chakrab. & N.P. Balakr.**
B. Pieces of male flowers cultured of on PDA medium
C. Surface colony characters of *Aspergillus* sp. (KMMH-5) 7 days
D. Reverse colony characters of *Aspergillus* sp. (KMMH-5) 7 days
E. Photomicrograph of *Aspergillus* sp. (KMMH-5)
F. Photomicrograph of *Aspergillus* sp. (KMMH-5)

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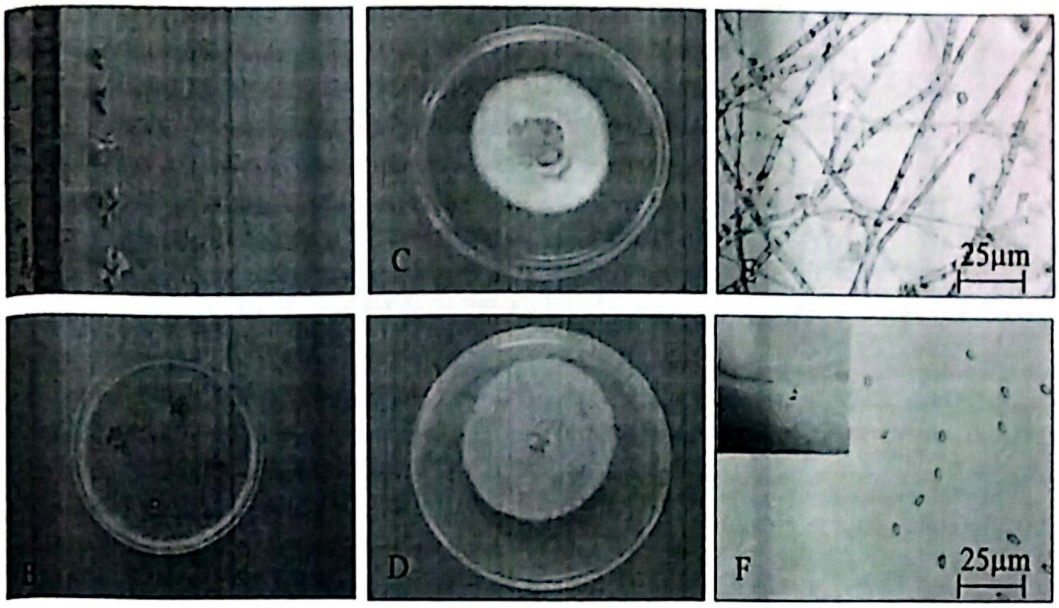


Figure 6. A. Flowers (female) samples of *Breynia androgyna* (L.) Chakrab. & N.P. Balakr.
B. Pieces of female flowers cultured on PDA medium
C. Surface colony characters *Colletotrichum* sp. (KMMH-4) 4 days
D. Reverse colony characters of *Colletotrichum* sp. (KMMH-4) 4 days
E. Photomicrograph of *Colletotrichum* sp. (KMMH-4)
F. Photomicrograph of *Colletotrichum* sp. (KMMH-4)

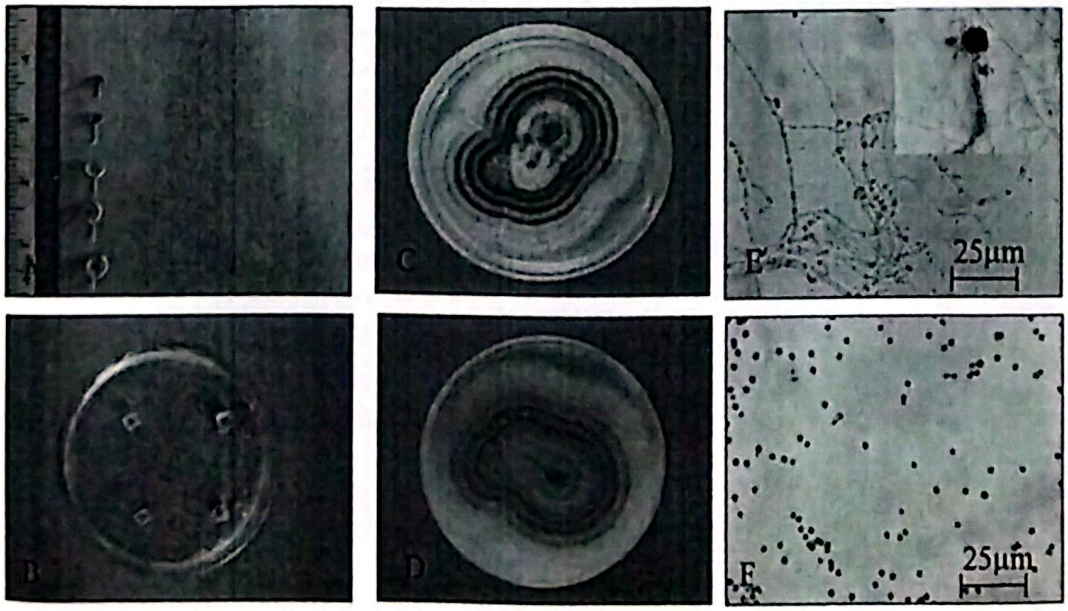


Figure 7. A. Flowers (male) samples of *Breynia androgyna* (L.) Chakrab. & N.P. Balakr.
B. Pieces of male flowers cultured of on PDA medium
C. Surface colony characters of *Aspergillus* sp. (KMMH-5) 7 days
D. Reverse colony characters of *Aspergillus* sp. (KMMH-5) 7 days
E. Photomicrograph of *Aspergillus* sp. (KMMH-5)
F. Photomicrograph of *Aspergillus* sp. (KMMH-5)

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Table 1. Characteristics of Endophytic Fungi Isolation from *Breynia androgyna* (L.) Chakrab. & N.P. Balakr.

Isolation strains	Endophytic Fungi	Macroscopical characters		Microscopical characters	Sources
		Surface	Reverse		
KMMH-1	*Hansfordia* sp.	White	Pale orange	Hyphae septate, hyaline branched; conidia, one celled, flexuous, globose.	Twigs
KMMH-2	*Monotospora* sp.	White	Pale yellow	Hyphae septate, branched; conidia laterally and apically, one celled, ovoid, ellipsoid.	Twigs
KMMH-3	*Fusarium* sp.	White	Orange	Hyphae septate, branched; conidia septate, canoe shaped, 3-6 celled.	Twigs
KMMH-4	*Colletotrichum* sp.	White	Pale yellow	Hyphae septate, branched; conidia hyaline, 2-4 celled, ovoid to oblong, cylindrical with rounded ends, smooth walled.	Female flowers
KMMH-5	*Aspergillus* sp.	White and brown alternate	White and pale brown alternate	Hyphae septate, hyaline branched; conidia globose, one celled.	Male Flowers

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Discussion and Conclusion

Twigs and flowers of *Breynia androgyna* (L.) Chakrab. & N.P. Balkr. were studied for the isolation and identification of endophytic fungi on Potato Dextrose Agar (PDA) medium. All isolates were identified based on morphological characteristics using the microscope. In the present study, the total five endophytic fungal species were obtained. They are three kinds of endophytic fungi; *Hansfordia* sp., *Monotospora* sp. and *Fusarium* sp. were found from twig and two kinds of endophytic fungi; *Colletotrichum* sp. and *Aspergillus* sp. were occurred from flower of *Breynia androgyna* (L.) Chakrab. & N.P. Balkr. respectively.

In the present study, the macroscopically characters of KMMH-1 fungal strain colony were white. The reverse colony was orange in color on PDA medium at room temperature. The optimal pH range was 6.5-7.0. The microscopically characters of KMMH-1 hyphae were septate, hyaline and branched. Conidiophores stalk hyaline, erect to repent. Conidia were globose, flexuous, one celled. Hughes (1952) reported that *Hansfordia* sp., conidiophores stalk hyaline to brown, erect to repent, lower part unbranched, branched above repeatedly and irregularly, the ultimate branched, flexuous, denticulate. Conidia attached at apex and sides of sporogenous cells, one celled, hyaline, globose, ovoid.

In the present study, the macroscopically character of KMMH-2 fungal strain colony was white. The reverse colony was pale yellow in color on PDA medium at room temperature. The optimal pH range was 6.5-7.0. The microscopically characters of LMMH-2 hyphae were septate and branched. Condiophores were erect, slender, septate and simple. Conidia were one celled, ovoid and ellipsoid, laterally and apically. Barnett (1955) reported that *Monotospora* sp., conidiophores were erect, slender, septate, and simple. Conidia sometime attached laterally, conidia large, one celled, ovoid to ellipsoid.

In the present study, the macroscopically characters of KMMH-3 fungal strain colony was white. The reverse colony was orange in color in PDA medium at room temperature. The optimal pH range was 6.5-7.0. The microscopically characters of KMMH-3 hyphae were septate and branched. Conidiophores were hyaline, simple and slender. Conidia were hyaline, septate and divided into 3-6 cells, slightly curved of bent to the ends, typically canoe-shaped. Gilman (1957) and Sherbakoff (1915) reported that *Fusarium* sp., Conidiophores were variable, slender and simple. Conidia hyaline, variable, several celled slightly curved or bent at the pointed ends canoe-shaped.

In the present study, the macroscopically characters of KMMH-4 fungal strain colony were white. The reverse colony was pale yellow in color on PDA medium at room temperature. The optimal pH range was 6.5-7.0. The microscopically characters of KMMH-4 hyphae were septate and hyaline branched. Conidiophores were hyaline and branched. Conidia were hyaline, 2-4 celled to oblong, cylindrical with rounded end and smooth walled. Navi *et al.* (1999) reported that *Colletotrichum* sp., condiophores were hyaline, fusiform, spindle shaped and with acute apices. Dube (1990) reported that conidia were hyaline, cylindrical or falcate (sickle-shaped).

In the present study, the macroscopically characters of KMMH-5 fungal strain colony were white and brown alternate. The reverse colony was white and pale brown alternate in color on PDA medium at room temperature. The optimal pH range was 6.5-7.0. The microscopically characters of KMMH-5 was hyphae were septate, hyaline and branched. Conidiophores were upright, simple, globose, bearing phialides. Conidia, globose and one celled. Thom & Raper (1945) reported that *Aspergillus* sp., conidiophores were upright, simple, terminating in a globose of cleavage swelling, bearing phialides at the apex of radiating from the entire surface. Conidia one celled, globose, often variously colored in masses, catenulate, produced basipetally.

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In conclusion, Isolation of endophytic fungi from medicinal and other plant results to produce bioactive compound which has greater activity against various pathogenic microbes. Therefore, these isolated endophytic fungi must be necessary fulfill the needs at agriculture and pharmaceutical industries.

Acknowledgements

We would like to express my sincere gratitude to Prof. Dr. Myin Zu Minn, Rector, Mohnyin University and Prof. Dr. Naing Naing Latt, Pro-rector, Mohnyin University for their allowing presented the paper in the University of Myitkyina.

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Morpho-anatomical Study of the Stems of *Capsicum annuum* L. (Solanaceae)

Khin Myo Wai[1], Thuzar Win[2], Irene Hpone Hpone Ko[3]

Abstract

Morpho-anatomical features were studied of the stems of *Capsicum annuum* L. (Kha ni awwe). The aim of the study was to evaluate the reliability of these characters for taxonomic identification. The specimens were collected from Shigu Quarter in Myitkyina Township, Kachin State during 2019 to 2020. In morphological study, stem terete or angular, leaves blade ovate-lanceolate, yellowish-white flowers, fruit baccate, oblong, red when ripe. In anatomical study, primary body of stem was quadrangular with 4 ridges margin in outline and vascular types was collateral. The secondary body of stem was quadrangular with slightly wavy margin in outline and vascular types were bicollateral. The stem had non-glandular multicellular uniseriate trichome, peltate non-glandular trichome, dark group of crystals and crystal sand.

Keywords: *Capsicum annuum*, collateral, bicollateral

Introduction

The genus *Capsicum* L. belongs to the family Solanaceae (Night shade). Members of the Solanaceae family are mostly herbs or under shrubs while some others are climbers. The family contains about 90 genera and nearly 3000 species (Stern 2000 and Vidyarth & Tripatha 2002). There are perhaps fifty thousand *Capsicum* L. cultivars grown worldwide (Jarret 2008). In Myanmar, *Capsicum* L. genus contains 4 species (Kress *et al.* 2003).

Morphological characters of *Capsicum annuum* L. are annual or perennial herbs; stem much branched, woody at base. Leaves alternate or the upper paired or clustered; leaf blade ovate to ovate-lanceolate, base cuneate, margin entire or obscurely sinuate, sparsely pubescent along midvein on adaxial surface; apex acuminate or acute. Flowers solitary in axiles of leaves or branches. Calyx cup-shaped, obscurely 5-toothed. Corolla white, 5-lobed. Stamens 5; anthers blue-purple; berry usually red, orange-yellow, variously shaped (Qi-ming *et al.* 2009).

Metcalfe & Chalk (1950) stated that Solanaceae is widely distributed family includes herbs and woody plants. The numerous hairs include a considerable diversity of glandular and non-glandular forms. *Capsicum annuum* L. has simple uniseriate trichomes (Purseglove 1968). In *Capsicum* L., small prismatic crystals are recorded (Metcalfe & Chalk 1950).

In transverse section of stem in *Capsicum* L., crystal-sand occur (Metcalfe & Chalk (1950). Wahua *et al.* (2014) mentioned that stem of *Capsicum annuum* L. showed a four sides or rectangular structure with swollen protuberances at each end. The hypodermis is made up of 5 layers of collenchymatous cells, and the general cortex has 3 layers of parenchyma of thin walls. The pericycle just below the endodermis is composed of 3 to 4 cells layers. The pith region is made up of large parenchymatous cells.

Capsicum L. is a crop that is widely cultivated because of its spicy nature and nutritional value. The crop accounts for a large portion of Vitamins A and C in many Nigerian diets (Heiser & Smith 1953). Most of these species are of great economic and nutritional value (Maiti *et al.* 2002). *Capsicum annuum* L. is further used as pungent spices for domestic culinary purposes and by food manufacturing industries for seasoning of processed food in the preparation of curry powder, hot sauce and in pickling (Tindall 1986).

The use of *Capsicum annuum* L. in trado-medicine is due to the presence of relevant phytochemical properties (Wahua *et al.* 2014). *Capsicum annuum* L. is an herb or

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sub-shrub wild and cultivated in this study area. The fruits are used for flavoring purpose and also used as spice of local people. The decoction of the leaves of *Capsicum annuum* L. is used as antistalogoues and expectorant. Therefore, there is no study about the morphological and anatomical characteristics of *Capsicum annuum* L. in Myitkyina, Kachin State.

The aim and objective of this research were to give the information of taxonomic evidence and to identify the anatomical characters of stems.

Materials and Methods

Morphological Studies

The selected species were collected from Sitapu Quarter (North Latitude 25° 24′ 33″and East Longitude 97° 24 28″) of Myitkyina Township, Kachin State during flowering and fruiting period from December 2019 to July 2020 (Figure 1). The elevation of Sitapu

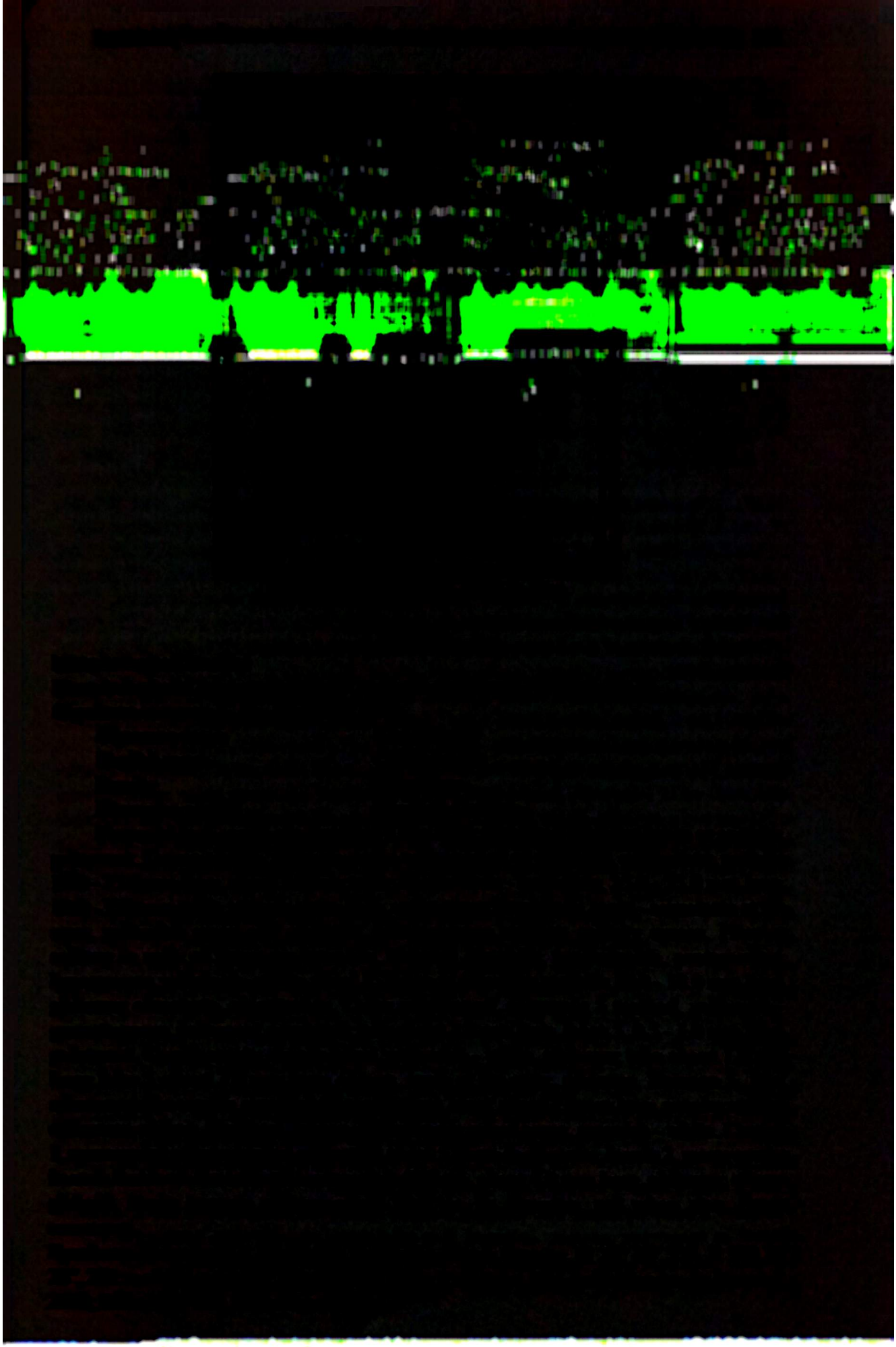
(Hundley & Chit Ko Ko 1987) and (Kress *et al*. 2003). The dried and pressed specimens were systematically mounted on herbarium sheets and deposited at Department of Botany, University of Myitkyina.

Anatomical Studies

For anatomical studies, the cross sections of stems was made by free hand section cutting with lazar blades and cleared with chloral hydrate solution. The sections were stained with safranin solution and mounted in 50% glycerine, covered with a cover slip and observed under compound microscope. All of them were photographed. The identification of anatomical characters was determined by using the literature of Anatomy of Dicotyledons, Vol II (Metcalfe & Chalk 1950).

Maceration of stem was made by boiling the materials with equal amount of 50% acetic acid and 50% hydrogen peroxide (Esau 1965). The macerated materials were placed on the glass slide, crushed and added one drop of safranin solution. Then, these slides were studied with compound microscope. The sizes of macerated elements were measured by setting with the help of ocular micrometer and calculated the size of the cells according to (Kokate 2000). In this work, anatomical characters of selected species were mentioned with dermal tissue system, ground tissue system and vascular tissue system. Photomicrographs were prepared from macerated materials.

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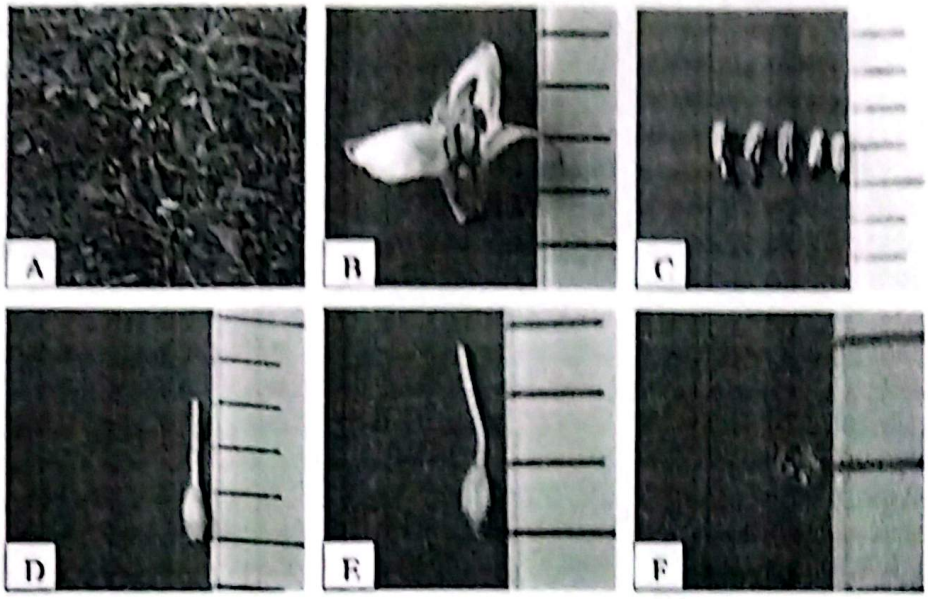


Figure 2. Morphological characteristics of *Capsicum annuum* L.
A. Habit B. L.S of flower C. Stamens
D. Pistil E. L.S of ovary F. T.S of ovary

Anatomical Studies

Anatomical Characteristics of *Capsicum annuum* L.

Internal Structure of the Stems of *Capsicum annuum* L. (Figure 3A -H)

Primary Body

In transverse section, stem Fig. 3A & B was quadrangular with 4 ridges margin in outline, 1.5 - 2.0 mm in length and 1.3 - 1.8 mm in breadth, distinguishable into dermal, ground and vascular tissue systems.

Dermal Tissue System: In transverse section, cuticle 6.0 – 8.0 µm in thickness, smooth; epidermal cells 1-layered, cells barrel or oval in shape, outer and inner walls convex, anticlinal walls straight, 10.0 – 30.0 µm in length, 10.0 – 22.0 µm in breadth; non-glandular multicellular uniseriate trichomes present, 70.0 – 154.0 µm in length, 14.0 – 21.0 µm in breadth, cells 30.0 – 50.0 µm in length, 20.0 – 30.0 in breadth and peltate non-glandular trichomes present.

Ground Tissue System: Differentiated into collenchymatous and parenchymatous tissues, the outer cortex collenchymatous cells composed of 2- to 3-layered, the layers 28.0 – 34.0 µm in thickness, cells polygonal in shape, 8.0 – 20.0 µm in length, 8.0 – 18.0 µm in breadth, collenchymatous cells at the ridges composed of 3- to 6-layered, the layers 50.0 – 80.0 µm in thickness, cells polygonal in shape, 6.0 – 20.0 µm in length, 6.0 – 18.0 µm in breadth. The inner cortex parenchymatous cells composed of 3- to 5-layered, the layers 70.0 – 160.0 µm in thickness, cells polygonal or rounded in shape, 10.0 – 50.0 µm in length, 8.0 – 44.0 µm in breadth; intercellular spaces present; dark group of crystals and crystal sand present; endodermis and pericycle indistinct; pith 420.0 – 490.0 µm in diameter, composed of parenchymatous cells, thin-walled, cells polygonal or nearly rounded in shape, 16.0 – 90.0 µm in length, 14.0 – 82.0 µm in breadth; intercellular spaces present; dark group of crystals and crystal sand present.

Vascular Tissue System: The vascular bundles embedded in the ground tissue, crescent shaped in transverse section, arranged in a continuous circular ring, consists of 4 to 5 bundles, collateral type, each bundle 140.0 – 350.0 µm in tangential diameter, 42.0 – 140.0 µm in radial diameter; phloem lying outside and xylem lying inside; bundle sheath

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indistinct. Phloem tissue 3- to 6-layered, the layers 36.0 – 50.0 µm in thickness, phloem cells 4.0 – 12.0 µm in length, 4.0 – 12.0 µm in breadth, phloem composed of sieve tubes, companions cells, phloem parenchyma and phloem fibers. Xylem tissue arranged in radial row, 1- to 5-layered, the layers 12.0 – 56.0 µm in thickness, xylem cells 6.0 – 14.0 µm in length, 6.0 – 14.0 µm in breadth, xylem composed of vessel elements, tracheids, xylem parenchyma and xylem fibers.

Secondary Body

In transverse section, stem Fig. 3C & D was quadrangular with slightly wavy margin in outline, 1.5 – 2.5 mm in length and 1.5 – 2.0 mm in breadth, distinguishable into dermal, ground and vascular tissue systems.

Dermal Tissue System: In transverse section, cuticle 6.0 – 7.5 µm in thickness, smooth; epidermal cells 1-layered, cells oval or polygonal in shape, outer and inner walls convex, anticlinal walls straight, 20.0 – 35.0 µm in length, 15.0 – 25.0 µm in breadth; multicellular uniseriate trichomes present, 100.0 – 130.0 µm in length, 20.0 – 30.0 µm in breadth, cells 20.0 – 40.0 µm in length, 20.0 – 30.0 µm in breadth and peltate non-glandular trichomes present.

Ground Tissue System: Composed of cortex, endodermis, pericycle and pith. The cortex differentiated into collenchymatous and parenchymatous tissues, the outer collenchymatous cells composed of 2- to 6 -layered, the layers 62.5 – 137.5 µm in thickness, cells oval or polygonal in shape, 20.0 – 35.0 µm in length, 15.0 – 32.5 µm in breadth. The inner parenchymatous cells composed of 2- to 4-layered, the layers 150.0 – 155.0 µm in thickness, cells oval or polygonal or rounded in shape, 37.5 – 82.5 µm in length, 32.5 – 55.0 µm in breadth; intercellular spaces present; dark group of crystals and crystal sand present. Endodermis 1-layered, parenchymatous cells, barrel in shape, 30.0 – 60.0 µm in length, 20.0 – 35.0 µm in breadth. Pericycle sclerenchymatous cells associated with phloem group, discontinuous, 1- to 3-layered, 15.0 – 70.0 µm in thickness, cells polygonal in shape, 15.0 – 40.0 µm in length, 15.0 – 40.0 µm in breadth. Pith 850.0 – 870.0 µm in diameter, composed of parenchymatous cells, thin-walled, cells polygonal or rounded in shape, 75.0 – 100.0 µm in length, 72.5 – 87.5 µm in breadth; intercellular spaces present; dark group of crystals and crystal sand present.

Vascular Tissue System: The vascular bundles embedded in the ground tissue, the bundles arranged in a continuous circular ring, bicollateral type, phloem lying outside and xylem lying inside. Phloem tissue 2- to 3-layered, the layers 32.5 – 35.0 µm in thickness, phloem cells 10.0 – 15.0 µm in length, 10.0 – 15.0 µm in breadth, phloem composed of sieve tubes, companions cells, phloem parenchyma and phloem fibers. Fascicular cambium 1- to 2-layered, 20.0 – 25.0 µm in thickness, cells rectangular in shape, 12.5 – 20.0 µm in length, 10.0 – 15.0 µm in breadth. Xylem tissue arranged in radial row, 3- to 7-layered, the layers 75.0 – 130.0 µm in thickness, xylem cells 15.0 – 27.5 µm in length, 15.0 – 27.5 µm in breadth, xylem composed of vessel elements, tracheids, xylem parenchyma and xylem fibers. Vessels (Figure 3 E, F) were measured 120.0 – 400.0 µm (mean 222.0 µm) in length and 16.0 – 30.0 µm (mean 18.2 µm) in breadth. Tracheids (Figure 3 G) were measured 140.0 – 350.0 µm (mean 298.9 µm) in length and 14.0 – 28.0 µm (mean 25.9 µm) in breadth. Fibers (Figure 3 H) were measured 385.0 – 700.0 µm (mean 565.8 µm) in length and 7.0 – 21.0 µm (mean 17.5 µm) in breadth.

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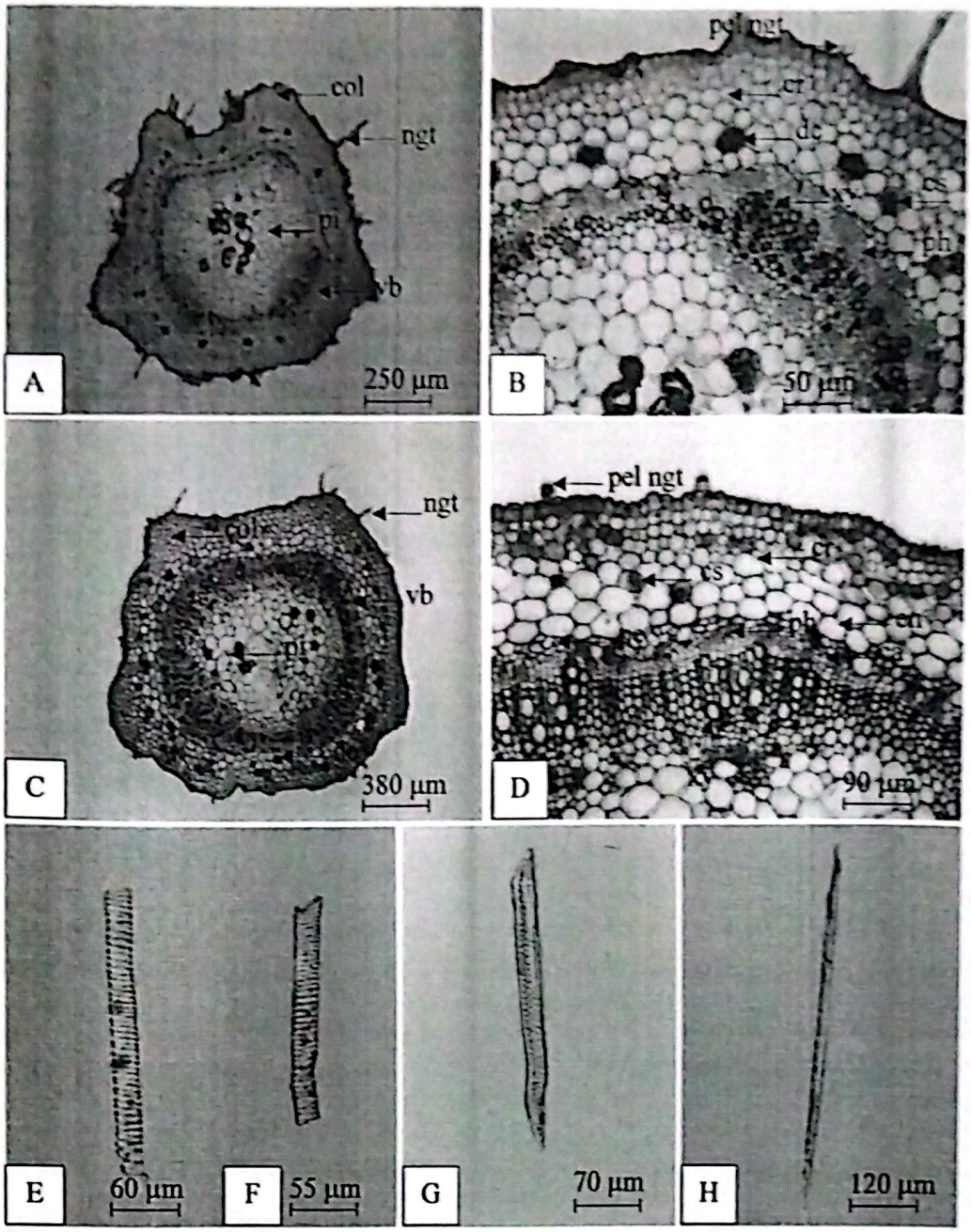


Figure 3. Internal structures of the stems of *Capsicum annuum* L.

A. Transverse section of primary body of stem in outline
B. Transverse section of primary body of stem showing peltate non-glandular trichome, crystal sand and dark group of crystals
C. Transverse section of secondary body of stem in outline
D. Transverse section of secondary body of stem showing peltate non-glandular trichome, pericycle and cambium
E. Vessel element (Spiral) F. Vessel element (Scalariform)
G. Tracheary element (Scalariform) H. Fiber

(pel ngt = peltate non-glandular trichome, ngt = non-glandular multicellular uniseriate trichome, cr = cortex, col = collenchyma, en = endodermis, pe = pericycle, vb = vascular bundle, ph = phloem, ca = cambium, xy= xylem, pi = pith, cs = crystal sand, dc = dark group of crystals)

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Materials and methods

The morphological and anatomical characteristics of *Cyperus amoenus* (L. & Saxay) Schrenk were studied in this research. Many were collected from Xiaoyao Township, Lianhua County, Guangdong Province (23°19' to 24°01' N, 113°45' to 114°23' E) during December 2017 to July 2018.

The value of *Cyperus amoenus* was presented here at the first. The leaves were simple with alternate. The leaves were long-ovate, acuminate and the margin was smooth. The inflorescence of *Cyperus amoenus* was solitary spikes. The edge of the spikes was sharp and serrulate. The color of leaves in *Cyperus amoenus* was yellowish-white. In this species, the fruit type was achene. These characters were in agreement with those mentioned by Wang et al. (2016) and Zhang et al. (2017).

In transverse section of glumes, fifty cells of *Cyperus amoenus* was observed quadrangular with 4 edges straight or curved. The type of thickening was not found in these cells. The first group of cuticle and cuticle ends were observed in this species. In *Cyperus amoenus* L., 2 to 3 layers of collenchymatous cells and 2 to 5 layers of parenchymatous cells were observed. The parenchymatous cells were arranged in 1 to 2 layers and the cells edges was parenchymatous cells were found in this species. These characters were in agreement with Mercado & Lavie (1956), and Wilson et al. (2016).

In conclusion, the present research concluded the information of classification in family Cyperaceae. We hope that these findings will be helpful in the field of systems conservation and ecological studies for the near future.

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Phytochemical Investigation of *Houttuynia cordata* Thunb. and its Antimicrobial Activity

Thae Su Naing[1], Khin Min Min Tswe[2]

Abstract

The present study was carried out the phytochemical constituents and antimicrobial activity of *Houttuynia cordata* Thunb.(Hitingiae).The plants were collected from Dukahtaung Quarter, Myitkyina. Phytochemical investigation were tested on powder leaves, stems and rhizomes. The elemental contents in sample was measured by Energy Dispersive X Ray Fluorescence Spectrophotometer (EDXRF) method. It was carried out at Department of Physics, University of Taunggyi. Potassium (K) and Calcium (Ca) were found abundantly in powdered leaves, stems and rhizomes. Other trace elements were found different percentages in all samples. Antimicrobial activity of various solvents extracts from leaves, stems and rhizomes were investigated. This experiment was conducted at laboratory of Development Center for Pharmaceutical Technology (D.C.P.T), Insein, Yangon. The ethyl acetate extract of the leaves, stems and rhizomes were shown highest inhibition zones on tested organisms. The plants can be used for preparing traditional medicine that are used for treating diuresis and used for detoxifying the body system due to its antibacterial and antiviral properties.

Keywords: *Houttuynia cordata* Thunb., Phytochemical, Antimicrobial

Introduction

Human depend on plants as food and medicine, since their existence on the earth. Plants contain hundreds of chemical compounds for function including defense against insects, fungis and diseases (You 2006). The genus of *Houttuynia* belongs to family Saururaceae in Piperales order. *Houttuynia cordata* Thunb. is also used for traditional foods of Kachin and Shan ethnics and folk medicine of local people. This plant is eaten as a medicinal salad for lower the blood sugar level.

Phytochemical tests are chemicals of plant origin. Phytochemicals are chemical produced by plants through primary or secondary metabolism. They generally have biological activity. In the plant host and play a role in plant growth or defense against competitors, pathogens or predators. Phytochemicals have been used as poison and in traditional medicine (Palermo *et al.* 2014). *H. cordata* Thunb. contains six major classes of phytochemicals essential oils, such as flavonoids, alkaloids, fatty acids, sterols and pharmacological activities like anti-cancer, anti-oxidant, anti-diabetic, anti-hypertension, anti-inflammatory, anti-mutagenic and anti-bacterial (Li *et al.* 2011).

H. cordata Thunb. has medicinal value and it was against the pathogenic microorganism. Houttuynin isolated from the rhizome of *H. cordata* Thunb. suppressed the growth of yeasts and molds. With the advance of modern medicine and drug research, chemical synthesis has replaced plants as the primary source of medicinal agents in industrialized countries. However, in 1985 the World Health Organization estimated that about 80% of the world's population relied on traditional medicine including herb medicine for their primary health care needs.

The aim of the study was to examine scientifically the medicinal plants which have effective medicinal values. The objectives of this research were to detect the phytochemical constituents, elemental analysis and to evaluate the of various extracts against antimicrobial organisms of leaves, stems and rhizomes of *H. cordata* Thunb..

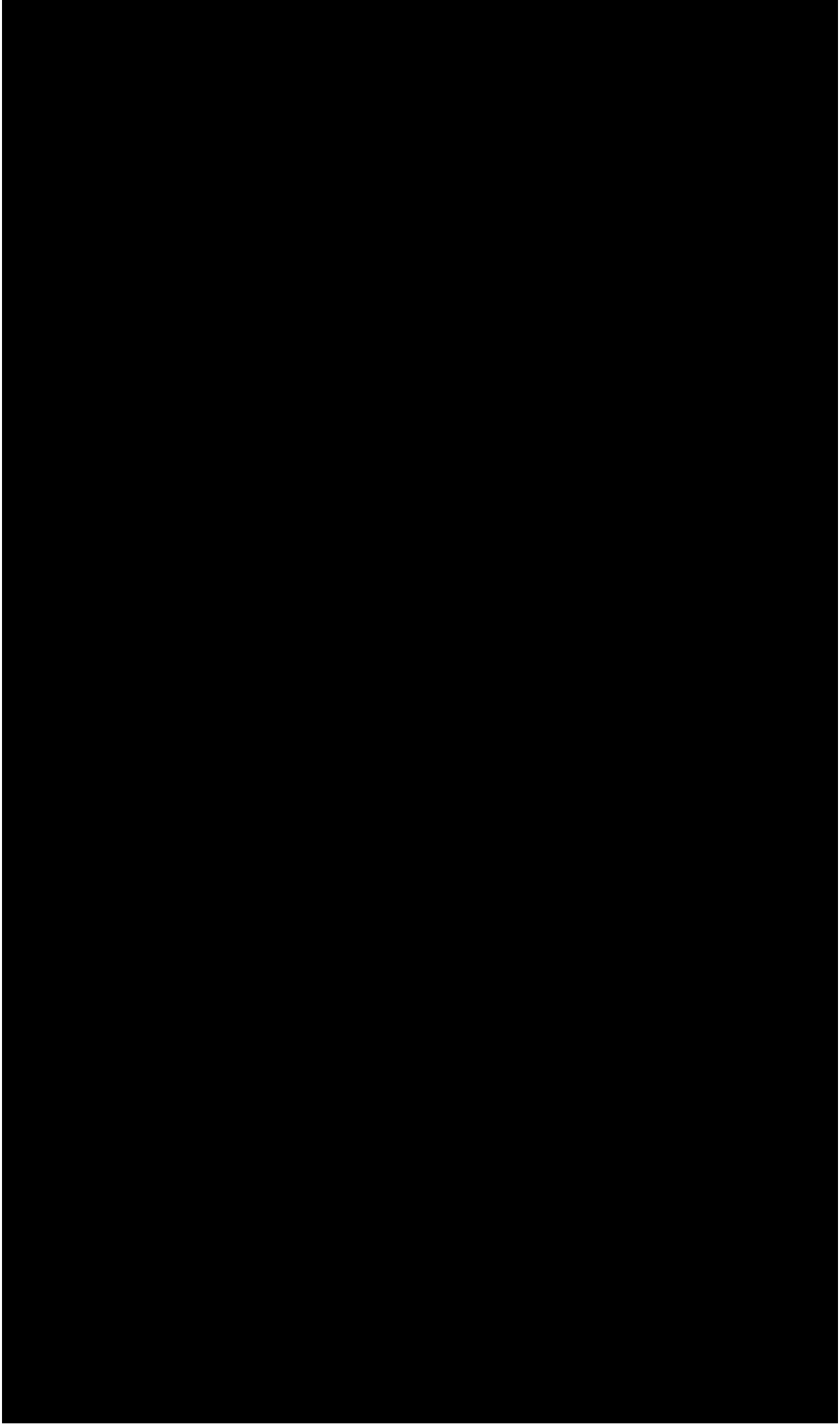
Materials and Methods

Collection of Plants

In this study, the plants samples were collected the from DuKahtawng Quater, in Myitkyina area, Kachin State. The collected specimens were studied, described and identified at Department of Botany, University of Myitkyina. The family of the collected

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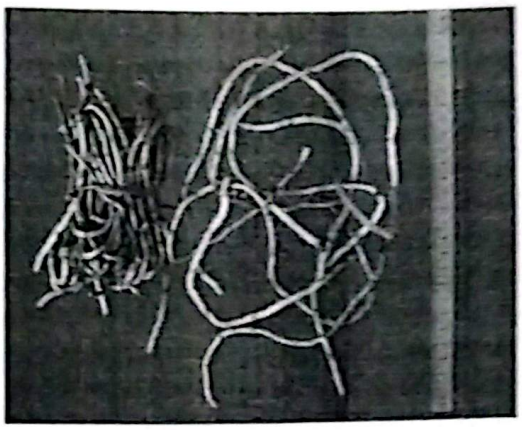
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A. Habitat



B. Rhizome

Figure 1. Morphological characters of *Houttuynia cordata* Thunb.

Preliminary Phytochemical Investigation

The preliminary phytochemical investigation from the leaves powder of *H. cordata* Thunb. indicated the presence of alkaloid, flavonoids, terpenoids, phenolic compounds, steroids, saponins, tannins, glycosides, carbohydrates and reducing sugar. The preliminary phytochemical investigation of stems powder of *H. cordata* Thunb. indicated the presence of alkaloid, flavonoids, terpenoids, phenolic compounds, steroids, saponins, tannins, glycosides were present. Carbohydrates and reducing sugar were absent. The preliminary phytochemical investigation of rhizomes powdered of *H. cordata* Thunb. indicated the presence of alkaloid, flavonoids, phenolic compounds, steroids, saponins, tannins, glycosides, carbohydrates were present. Terpenoids and reducing sugar are absent Table 1.

Elemental Analysis by Using EDXRF

By comparing EDXRF result, Potassium (K) percentages were found abundantly in leaves, stems and rhizomes powder. Calcium (Ca) percentages is higher in leaves powder and other trace elements were found different percentages in all samples. These result are shown in Table 2.

Antimicrobial Activity of Various Solvent Extracts

The antimicrobial activities of *H. cordata* Thunb. were investigated. In the present study, the extracts of all plants parts were showed different activities on the test microorganisms. Ethyl acetate extracts of *H. cordata* Thunb. leaves, stems and rhizomes were highly effective extract against all tested microorganism causing maximum inhibition zone. These result are shown in Table 3.

Antimicrobial Activity of Leaves Extracts

Chloroform extract of leaves was showed the minimum inhibition zone (13 mm) against on *B. subtilis, B. pumilus, S. aureus, P. aeruginosa, E. coli* and *C.albican.* Methanol extracts of leaves showed the minimum inhibition zone (13 mm) against on *B. subtilis, S. aureus, P. aeruginosa, C.albican* and the minimum inhibition zone (14 mm) zone against on *B. pumalis* and *E. coli.* Ethyl acetate extract of leaves showed the medium inhibition zone (18 mm) against on *B.pumalis* and showed the maximum inhibition zone (20 mm) against on *B. subtilis, S. aureus, P. aeruginosa, C.albican* and *E. coli.* Ethanol extract of leaves showed the minimum inhibition zone (14 mm) against on *B. pumilus,S. aureus* and *C.albican* and the medium inhibition zone (15 mm) against on *B. subtilis, P.aeruginosa* and *E.coli.* Pet-ether extract from the leaves did not show any activities. These result are shown in Table 3.

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Tabel 1. Comparison of Preliminary Phytochemical test on Leaves, Stems and Rhizomes

No.	Tests	Extracts	Test reagents	Observation	Remarks		
					Leaves	Stems	Rhizo
1.	Alkaloids	1%HCL	Dragendroff's reagent	Orange ppt	+	+	+
			Wagner's reagent	Red ppt	+	+	+
			Mayer's reagent	Cream colouration	+	+	+
2.	Flavonoids	EtOH	Mg turning, conc:HCL	Yellow colouration	+	+	+
3.	Terpenoids	EtOH	$CHCl_3$, coc:H_2SO_4	Reddish brown	+	+	_
4.	Phenolic compounds	EtOH	5%$FeCL_3$	Black colouration	+	+	+
5.	Steroids	$CHCl_3$	Acetic anhydride, conc: H_2SO_4	Reddish brown	+	+	+
6.	Saponins	H_2O	Distilled water	Marked frothing	+	+	+
7.	Tannins	H_2O	5% $FeCL_3$	Blue black colouration	+	+	+
8.	Glycosides	H_2O	10% Lead acetate	White ppt	+	+	+
9.	Carbohydrates	H_2O	10%α-naphthol, conc:H_2SO_4	Violet colourring Of the interface of two layers	+	_	+
10.	Reducing sugar	H_2O	Benedict' solution	Brickredcolouration	+	_	_

(+) = Presence,(-) = Absence

Tabel 2. Comparison analysis of leaves, stems and rhizomes powders of *H. cordata* Thunb. by EDXRF

No.	Elements	Percentage present in leaves	Percentage present in stems	Percentage present in rhizomes
1.	Potassium (K)	83.8	88.9	83.8
2.	Calcium(Ca)	8.48	5.49	6.59
3.	Chlorine (Cl)	1.38	0.393	1.70
4.	Iron (Fe)	0.777	0.942	0.879
5.	Manganese (Mn)	0.150	0.108	0.146
6.	Rubidium (Rd)	0.0998	0.110	0.0723
7.	Zinc (Zn)	0.0341	0.0648	0.00281
8.	Strontium (Sr)	0.0261	0.0179	0.0170
9.	Copper(Cu)	0.0102	0.0164	0.0103
10.	Bromine (Br)	0.0060	0.0016	0.0035
11.	Titanium (Ti)	0.0026	-	-

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Antimicrobial Activity of Stems Extracts

Pet-ether extract of stems was showed that the minimum inhibition zone (13 mm) against on *B. subtilis*. Chloroform extract of stems showed the minimum inhibition zone (13 mm) against on *B. subtilis*. Methanol extract of stems showed the minimum inhibition zone (12 mm) against on *B. subtilis*and the minimum inhibition zone (13 mm) against on *C.albican*. Ethyl acetate extract of stems showed the medium inhibition zone (19 mm) against on *B. subtilis*and *C.albican*. Ethyl acetate extract of stems showed the maximum inhibition zone (21 mm) against on *E. coli*. Ethanol extract of stems showed the minimum inhibition zone (12 mm) against on *B. subtilis* and the minimum inhibition zone (14 mm) against on *C.albican*. Ethanol extract of stems showed the medium inhibition zone (15 mm) against on *E. coli*. Any solvents were not showed activity on *S. aureus, P. aeruginosa* and *B. pumilus*. These result are shown in Table 3.

Antimicrobial Activity of Rhizomes Extracts

Pet-ether of rhizomes was showed the minimum inhibition zone (14 mm) against on *B. subtilis* and the medium inhibition zone (15 mm) against on *P. aeruginosa*. Chloroform extract of rhizomes indicated that the minimum inhibition zone (12 mm) against on *B. subtilis*. Chloroform extract of rhizomes indicate that the medium inhibition zone (15 mm) against on *P. aeruginosa*. Methanol extract of rhizomes showed the minimum inhibition zone against (12 - 13 mm) against on *B. subtilis*and *P. aeruginosa*. Methanol extract of rhizomes showed the maximum inhibition zone (23 mm) against on *B. pumilus*.Ethyl acetate extract of rhizomes showed the minimum inhibition zone (13 mm) against on *P. aeruginosa*. Ethyl acetate extract of rhizomes indicated the maximum inhibition zone range from (24 - 25mm) against on *B. subtilis, S. aureus, C. albicans* and *E. coli*. Ethanol extract of rhizomes showed minimum inhibition zone (14 mm) against on *B. subtilis*. Ethanol extract of rhizomes showed the medium inhibition zone (17 mm) against on *P. aeruginosa*. Pet- ether, chloroform and methanolic extracts from the rhizome did not showed activity *Staphylococcus aureus, Candida albicans* and *Escherichia coli*. These result are shown in Table 3.

Tabel 3. Comparison on antimicrobial activities of *H. cordata* Thunb.

Sample	Solvents	Test Microorganism and zone of inhibition (mm)					
		Bascillus subtilis	*Bascillu spumilus*	*Stphylococcus aureus*	*Pseudomonas aeruginosa*	*Escherichia coli*	*Candida albicans*
Leaves	PE	-	-	-	-	-	-
	CHCL	13	13	13	13	13	13
	MeOH	13	14	13	13	14	13
	EtoAc	20	18	20	20	20	20
	EtoH	15	14	15	14	15	14
Stems	PE	13	-	-	-	-	-
	CHCL	13	-	-	-	-	-
	MeOH	12	-	-	-	-	13
	EtoAc	19	-	-	-	21	19
	EtoH	12	-	-	-	15	14
Rhizomes	PE	14	-	15	-	-	-
	CHCL	12	-	15	-	-	-
	MeOH	12	23	13	-	-	-
	EtoAc	25	-	13	24	24	24
	EtoH	14	-	17	-	-	-

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Discussion and Conclusion

In this researchphytochemical constituent and antimicrobial activity of *Houttuynia cordata*Thunb belonging to family Saururaceae were studied. The plants specimens were collected from Dukaintawng Quarter, in Myitkyina area, Kachin State.

In recent study indicated that the phytochemical investigation of the leaves powder gives positive result of alkaloids, flavonoids, terpenoids, phenolic compounds, steroids, saponins, tannins, glycosides, carbohydrates and reducing sugar. The stems powder gives positive results of alkaloids, flavonoids, terpenoids, phenolic compounds, steroids, saponins, tannins, glycosides. Carbohydrate and reducing sugar were absent. The rhizomes powder gives positive results of alkaloids, flavonoids, phenolic compounds, steroids, saponins, tannins, glycosides and carbohydrates. Terpenoids and reducing reducing were absent. (Parasadet *al.* 2012) stated that the leaves, stems and rhizomes of *H. cordata* Thunb. have alkaloids, flavonoids, carbohydrates, reducing sugar.

Chen (2003) reported that preliminary phytochemical analysis of the extract revealed the presence of phenols, flavonoids, tannins and alkaloids as a major component. Secondary metabolites of plants which is a definite physiological action on the human body. Elements from leaves, stems and rhizomes of *H. cordata*Thunb. were analyzed by Energy Dispersive X-Ray Fluorescence (EDXRF) spectrophotometer. Macronutrients (Principle elements) are potassium, calcium, magnesium, phosphorous as a large amount in human body for growth of requirements (Martin *et al.* 1981).

According to Tannen (1996) potassium is that it helps control or lower higher blood pressure. Potassium is also good for our bone health. Potassium is an essential mineral that has many roles in body. It helps regulate muscle constructions, maintain healthy nerve function and regulate fluid balance. A low-potassium diet is rarely the cause of potassium deficiency or hypokalemic. The primary function of potassium in the body include regulating fluid balance and controlling the electrical activity of the heart and other muscle. Potassium supports blood pressure, cardiovascular health, bone strength and muscle strength. The leaves, stems and rhizomes of *H. cordata*Thunb. of study area also present large amount of potassium (83.8%, 88.9%, 83.8%).

Cohn *et al.* (2000) stated that most people know that calcium is needed for strong bones, but it's also needed to help blood vessels and muscles contract and expand to send messages through the nervous system and to secrete hormones and enzymes. Calcium are found in leaves, stems and rhizomes of *H. cordata* Thunb..

Health problems associated with magnesium loss include diabetes, poor absorption, chronic diarrhea, celiac disease and hungry bone syndrome. Micronutrients (trace elements) are iron, manganese, zinc, copper, chlorine and nickel as a small amount in human body for growth of requirements. In this research, the trace amount of chlorine, manganese, iron, copper, zinc, nickel are found in leaves, stems and rhizomes of *H. cordata*Thunb..

Manganese are present in leaves, stems and rhizome of *H. cordata*Thunb.. Freeland-Graves 1988) mentioned that manganese is applied to the skin for wound healing. Manganese is an essential nutrient involved in many chemical processes in body including processing of cholesterol, carbohydrates and protein. Manganese is taken by mouth for prevention and treatment of manganese deficiency, a condition in which the body doesn't have enough weak bones, painful joints (osteoarthritis), a type of tried blood (anemia), weight loss and symptoms of premenstrual syndrome. Therefore *H.cordata*Thunb. is valuable medicinal purposes.

Shankar and Prasad (1998), showed that zinc is taken by mouth for the treatment and prevention of zinc deficiency and its consequences, including stunted growth and acute diarrhea in children, slow wound healing, and Wilson's disease. It is also used for

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boosting the immune system, improving growth and heath in zinc deficiency infants and children for treating lower respiratory infections, swine flu, bladder infections, ringing in the ears, and severe head injuries. It is also used for malaria and other diseases caused by parasites. Zinc are present in leaves, stems and rhizome of *H. cordata*Thunb..

Baird-Gunning and Bromley (2018) indicated that iron deficiency can lead to iron deficiency anemia in adults and iron deficiency anemia in children. Iron is also important for our immune systems, brain function and muscle strength.Iron are present in leaves, stems and rhizome of *H. cordata*Thunb..

According to the present study, elemental analysis on leaves, stems and rhizomes of *H. cordata* Thunb. indicated the present of higher percentages in potassium and calcium. The other principle elements and trace elements are required for the normal growth of human body. Theleaves, stems and rhizomes powder of *H. cordata* Thunb. have rich in macroelements and microelements that needed for normal development of man.

According to the results of antimicrobial test, the extracts made by organic solvents revealed that the distinct antimicrobial activity on most of all microorganisms. In this study, it has been noted that among the solvent extracts the ethyl-acetate are the most effective and showed the maximum clear zone of 25 mm on six microorganisms.

In antimicrobial screening, chloroform, methanol, ethyl acetate and ethanoic extracts of leaves showed inhibition zone of 13 mm, 13 - 14 mm, 18 - 20 mm and 14 - 15 mm on the six tested pathogenic microorganisms respectively. However, the pet-ether extracts of leaves did not show antimicrobial activities on six tested pathogenic microorganisms. In antimicrobial screening of the stems showed inhibition zone of pet-ether 13 mm, extract of chloroform showed 13 mm, extracts of methanol showed 12- 13 mm, ethyl acetate showed 19 - 21 mm and in ethanol 12 - 15 mm on three tested pathogenic microorganisms. The ethyl acetate extracts of the stems exhibited the largest inhibition zone of 21 mm especially more sensitive against *Escherichia coli* which can cause dysentery, diarrhea and urinary tract infection. These results exhibited *H. cordata*Thunb. can be used for curing the disease similarly with those of described by (Cruickshank *et al.*1975).

Methanol and ethyl acetate extract of the rhizomes showed inhibition zone ranging from 23 - 25 mm on five tested microorganisms, among which *Bacillus subtilis*, *Staphylococcusaureus*, *Candida albican* and *Escherichia coli* showed significant result. According to Horneck (2010) *Bacillus subtilis* can cause gastrointestinal and urinary tract diseases and *H. cordata* Thunb. can be used for curing these diseases. The antimicrobial assay, the leaves extracts was more antimicrobially active than stems and rhizomes.

According to the result, the leaves, stems and rhizomes of *H. cordata* Thunb. are very useful in treating the diseases of food spoilage caused by *Bascilllus subtilis*; soft tissue infection caused by *Bascillu spulilus*; boils, abscesses, wound sepsis caused by *Staphylococcus aureus*; skin infection, and respiratory tract infection caused by *Staphylococcus aureus, Pseudomonas aeruginosa* and *Candida albicans*; skin infection, urinary infection, sores and ringworms caused by *Candida albicans*; diarrhea, hemorrhagic diarrhea, dysentery, bed sores and gastroenteritis caused by *E. coli.* Therefore, *H. cordata*Thunb. have good potency as reliable medicinal plant for the threatened of infectious diseases caused by pathogenic microorganisms (Cruickshank *et al.* 1975).

A comprehensive study by Kumar *et al.* (2014) *H. cordata* Thunb. contains anti-diabetic properties thus can be a potential cure for diabetic patients, its pharmacological abilities in regulating blood sugar level in human beings. It contains anti-obesity properties thus can be regality eaten to excess weight. *H. cordata* Thunb. serves as green vegetable for preparing and garnishing assorted meals such as salad. The plants can be used for preparing traditional medicine that are used for treating diuresis and used for detoxifying

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the body system due to its antibacterial and antiviral properties. It can be used for treating pneumonia, abnormal lung symptoms and SARS (Severe Acute Respiratory Syndrome). It can be used for treating infectious diseases and is also known as poison-blocking plant due to its ability to neutralized poisonous substances.

According to Bora (2001) the whole plant is antimicrobial, anti- inflammatory, anti microbial, antichloristic, antiviral, depurative, diuretic, emmenagogue, febrifuge, hypoglycemic, laxative. A decoction of leaves is used for internally in the treatment of many ailments including cancer, coughs, dysentery, enteritis and fever. According to the result of phytochemical screening, some of these compounds are exhibited antimicrobial activity. The effectiveness of antimicrobial activity is not only depending upon the active substances but also upon the various elements of plant extracts could be observed. This research may be important due to their biological properties and their potential use in medicine.

In conclusion, it has been observed that the leaves of *H. cordata* Thunb. are more effective than the rhizomes. Actually, local people in Kachin State are mostly used rhizomes than leaves of *H. cordata* Thunb.. It is hoped that, the results have the useful information of traditional medicine isolated from indigenous medicinal plants and references for other researchers.

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Morphological, Anatomical, Phytochemical and Antimicrobial Activities of *Clitoria ternatea* L. Flower

Phyu Phyu Oo[1]

Abstract

The present research was carried out the morphological, anatomical, phytochemical and antimicrobial activities of *Clitoria ternatea* L. flower. Flowers were collected from Yan-gyi-aung Quarter, Myitkyina Township, Kachin State. The morphological, anatomical, phytochemical and antimicrobial activities were performed at University Research Center, Department of Botany, University of Myitkyina from June to December, 2019. In morphological studies, plants were perennial, trifoliolate compound leaves, flowers were blue and papilionaceous. In petal anatomical study, stomata type was actinocytic and unicellular or multicellular trichomes were uniseriate. Anticlinal walls were observed slightly sinuous on both surfaces. In phytochemical analysis were observed the presence of alkaloids, terpenoids, steroids, flavonoids, phenolic compounds, terpenes, saponins, glycosides, reducing sugar, carbohydrates, organic acids and starch but the absence of polyphenols and tannins. Strains of six bacterial and one fungal were taken for antimicrobial activity. The various solvent extracts as ethanol, aqueous and methanol were tested on seven test microorganisms such as *Escherichia coli*, *Bacillus pumilus*, *Bacillus subtilis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Agrobacterium tumefaciens* and *Candida albicans* by using agar well diffusion method. Among them, result in the zone of inhibition methanol extract was better than other extracts.

Keywords: *Clitoria ternatea* L., anatomical, phytochemical and antimicrobial activities

Introduction

Clitoria ternatea L. which is one of the Myanmar indigenous medicinal plants known as Aung-mae-nyo. It belonging to family Fabaceae known as butterfly pea. A relatively easily maintained, herbaceous twining vine, the butterfly pea produces deep blue to purple flowers capable of blooming nearly year-round (Park and Knox, 2016). Petal anatomical features such as stomata, trichomes and other characters are useful anatomical tools and valuable in the identification of the plants. Several specialists Agbagwa and Ndukwu (2004); Akin (2009); Tahir and Rajput (2010) have stressed the taxonomic value of petal anatomical characters. *Clitoria* has three varieties *Clitoria ternatea* L. var. *ternatea* Hook. F. (white), *Clitoria ternatea* L. var. *ternatea* Hook. F. (Blue) and *Clitoria ternatea* L. var. *pleniflora* Fantz. (Blue var). World ethnobotanical information about it is a big challenge to fully exploit medicinal biodiversity to look for phytochemicals with insulin mimetic property (Alarcon Aguilar *et al.* 1998).

Clitoria ternatea L. varieties contain phytochemical constituents with important pharmacological activities. Butterfly pea flower contains high amounts of anthocyanin pigments. In ancient human civilization, *Clitoria ternatea* has been used to treat neurological disorders (Khadatkar *et al.* 2008). Moreover, there has been a research suggesting that anthocyanin helps in protecting the cell, as an anti-ageing agent, protects cell damage and promoting healthy eyes (Skinstitut, 2013). Therefore, in realizing the many benefits of *C. ternatea* to humans, it is very important to investigate the phytochemicals of the plant by varying several parameters for better quality. The production of phytoconstituents in *C. ternatea* can be controlled by changing in Southeast Asia the flowers are used to color food. The chemistry, biochemistry and molecular biology of the biosynthesis of flavonoids are identified, that is the largest and important group of flower color pigments is anthocyanin. It is a subclass of flavonoids which not only functional as coloring agents, but also contain an array of health promoting benefits (Gomez and Kalamani, 2003), and antimicrobial activities (Kamilla *et al.* 2009). Anthocyanins are a Greek word which refers to anthos meaning flower, while kyanos

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means blue (Andersen, 2001). Tannin can serve as antidotes for poison. Alkaloids are mainly used in medicines. They act as life drugs in some serious disorders like heart failure, cancer, and blood pressure. *C. ternatea* varieties are strongly highlights their use in various antimicrobial activities (Rabeta and Nabil, 2013).

The main aim of this research is to observe the valuable information of *Clitoria ternatea* L. To achieve this aim to determine the morphological, anatomical, phytochemical and antimicrobial activity of *Clitoria ternatea* L.

Materials and Methods

1. Collection and Identification of Plant Sample

Flowers of *Clitoria ternatea* L. sample were collected from Yang-gyi-aung Quarter, Myitkyina Township, Kachin State. The morphological, anatomical, phytochemical and antimicrobial activities. This research were performed in University Research Center, Department of Botany, University of Myitkyina. The genus and species were identified by Flora of Cyelon (Varva, 1988). Myanmar name was determined by Trees, Shrubs, Herbs and Principal Climbers etc. (Hundley and Chit Ko Ko, 1987).

2. Anatomical Study of Petal

Petal anatomical investigations were carried out hand section on the petal surfaces and observed under light microscope. The nature of epidermal cells, pigments, stomata and trichomes were identified by (Esau, 1965). The size of cells and macerated materials were measured with the help of ocular micrometer and calculated the cells size according to (Kokate, 2000).

3. Phytochemical Activity of Flower

In phytochemical study, the flowers were cleaned by washing thoroughly with water and cut into small pieces and then air dried at room temperature for one week. The dried sample was ground to produce fine powder by using electric blender. This powdered sample was stored in air-tight containers to prevent other contamination according to (Harbone, 1984). The *Clitoria ternatea* L. samples were screened for alkaloids, terpenoids, steroids, flavonoids, phenolic compounds, terpenes, polyphenols, tannins, saponins, glycosides, reducing sugar, organic acids, starch and carbohydrates which helps to confirm the presence of the secondary metabolites in the prepared extract according to the standard phytochemical methods (Tin wa, 1972). It was carried out at department of Chemistry, University of Myitkyina.

4. Antimicrobial Activity of Flower

The dried flower was grinded into fine powder. And then, methanol, ethanol and aqueous solvent were prepared. 5 gm of powder sample was dissolved in 100 mL of distilled water, 95 % of ethanol and 60 % of methanol solution. The flasks were kept in room temperature, on intelligent shaker at 100 rpm for 72 hrs. Then these extracts were filtered separately by using Whatman No.1 filter paper and stored refrigerator at 4° C (Harbone, 1984). One day old culture test organism broth (200 µL) was added as 25 mL warm assay medium (glucose 10 gm, peptone 3 gm, KNO_3 1 gm, distill water 1000 mL and agar18 gm) and thoroughly mixed and poured into plate. After solidification, the agar was left to set. The Cork borer was used to make the wells (8 mm in diameter). And then, the flower extract broth (200 µL) was carefully added into the well and incubated at (30°C) in incubator for 24 – 48 hours. The diameter of the zones of inhibition around each well measured and recorded after 24 – 48 hours incubation. Antimicrobial activity tests by agar well diffusion method (NITE, 2004).

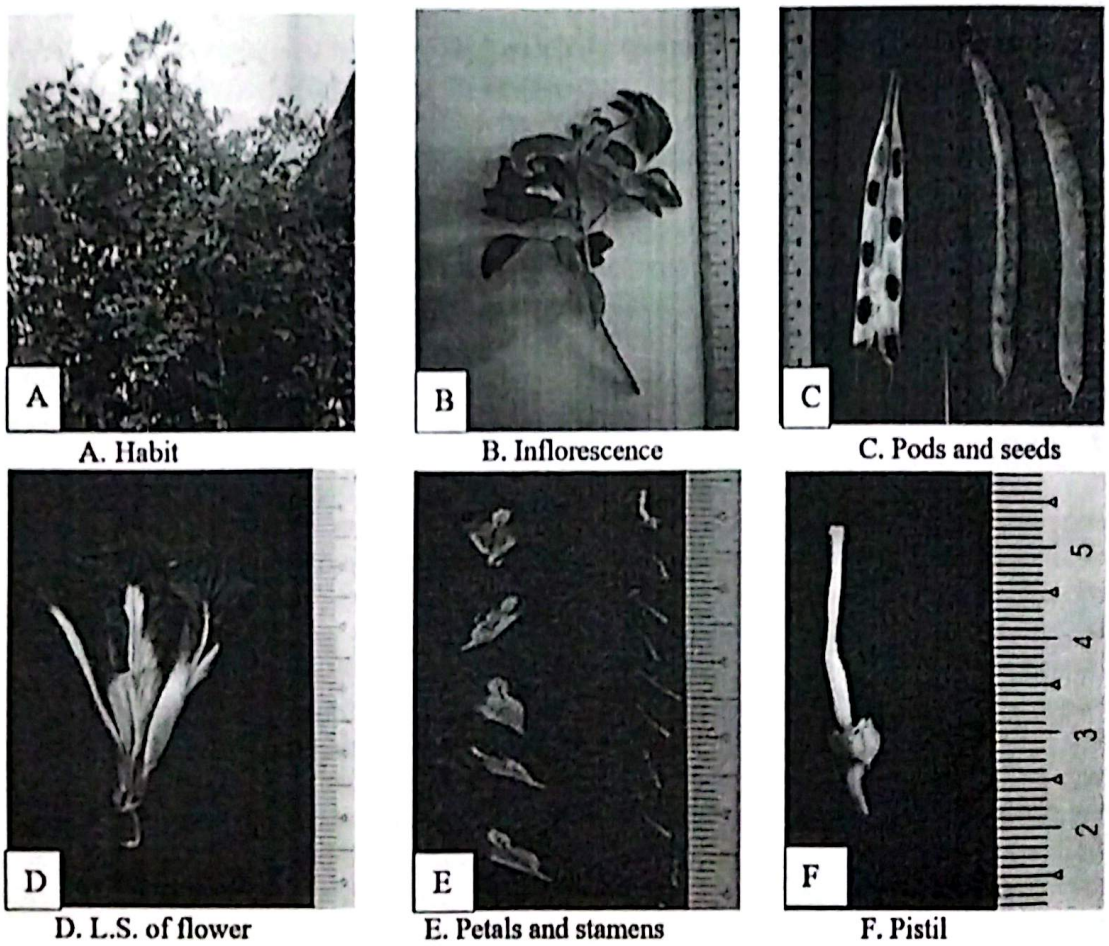
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Results

1. Morphological Characters of *Clitoria ternatea* L.

Family Name : Fabaceae
Scientific Name : *Clitoria ternatea* L.
Common Name : Butterfly pea
Myanmar Name : Aung mae nyo

Clitoria ternatea L. is perennial twiner herb, stem is aerial weak. Leaf is imparipinnately compound, alternate, stipulate, leaflets, stipellate, pulvinate showing reticulate venation. Inflorescence is usually a raceme, axillary, solitary. Flower is bracteate, pedicellate, bracteolate, complete, bisexual, pentamerous, zygomorphic and hypogynous. Calyx is 5 lobesgreen, synsepalous showing valvate aestivation. Petals 5, blue colored, polypetalous showing descending imbricate. The outer most petal is large called standard. Two lateral petals are lanceolate and curved. They are called wing petals. Two anterior innermost petals are called keel petals. The stamens and pistil are enclosed by these keel petals. All the petals have a claw at their bases. This type of irregular corolla is described as papilionaceous corolla. Stamens 10, usually diadelphous. Nine stamens are fused to form bundle and the tenth stamen is free (9) +1. Anther dithecous, basifixed and dehiscing by longitudinally slit. Ovary superior, monocarpellary, stalk. Ovary is unilocular with one ovule, with marginal placentation. Style simple and bent. Stigma is flat. Fruit is legume. Seeds are non-endosperm and kidney shaped Fig. 1. A, B, C, D, E and F.



A. Habit B. Inflorescence C. Pods and seeds

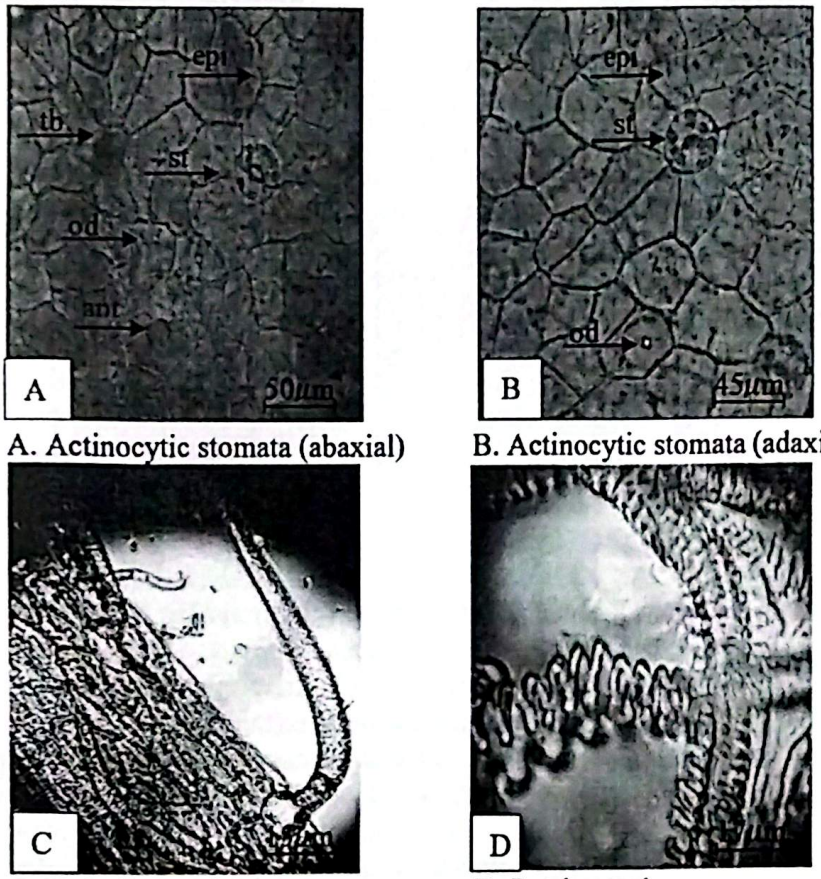
D. L.S. of flower E. Petals and stamens F. Pistil

Figure 1. Morphological characters of *Clitoria ternatea* L. (Aung mae nyo)

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2. Anatomical Study of Petal

In anatomical study of petal surface, epidermal cells are parenchymatous, polygonal in shape, anticlinal walls straight and thin walled at adaxial side, 26 – 50 µm in length, 22 – 40 µm in width. Abaxial epidermal cells are parenchymatous, polygonal in shape, anticlinal walls slightly wavy and thin walled at abaxial side, 44 – 76 µm in length, 28 – 44 µm in width. Trichomes are non-glandular, unicellular or multicellular uniseriate, 60 – 74 µm in length, 6 – 18 µm in width and actinocytic stomata type are present on the both sides, oval or rounded in shaped, guard cell 22 – 24 µm in length, 6 – 10 µm in width. The vessel element is 220 – 320 µm in length, 10 – 14 µm in width. Oil droplets are present, oval or rounded in shape on both sides. Anthocyanin present on abaxial Fig. 2. A, B, C and D.



A. Actinocytic stomata (abaxial) B. Actinocytic stomata (adaxial)

C. Unicellular trichome D. Petal vessel

tb = trichome base, st = stomata, epi = epidermal cell, od = oil drop, ant = anthocyanin

Figure 2. Anatomical characters of *Clitoria ternatea* L.

3. Phytochemical Activity of Flower

The preliminary phytochemical tests were determined by color test. The preliminary phytochemical constituents of alkaloids, terpenoids, steroids, flavonoids, phenolic compounds, terpenes, saponins, glycosides, reducing sugar, carbohydrates, organic acids and starch were observed. Polyphenols and tannins were not detected in *Clitoria ternatea* L. flower. These results are shown in Table 1.

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Table 1. Results of phytochemical tests of the flower extract of *Clitorea ternatea* L.

No	Constituents	Extract	Reagent	Observation	Results
1	Alkaloids	1% HCl	(i) Dragendorff's reagent (ii) Mayer's reagent (iii) Wagner's reagent	Orange ppt White ppt Brown ppt	+ + +
2	Terpenoids	$CHCl_3$	Acetic anhydride and conc: H_2SO_4	Brown colour	+
3	Steroids	Pet-ether	Acetic anhydride, Conc; H_2SO_4	Green color	+
4	Flavonoids	95% EtOH	Conc: HCl and Mg turnings	Pink color	+
5	Phenolic compounds	95% EtOH	5% $FeCl_3$ solution	Yellowish brown color	+
6	Terpenes	95% EtOH	Acetic anhydride and conc:H_2SO_4	Pale red color	+
7	Polyphenols	95% EtOH	10% $FeCl_3$ and 1% $K_3[Fe(CN)_6]$	No green color	-
8	Tannins	D/W	Gelatin	No ppt	-
9	Saponins	D/W	Shaken vigorously	Frothing	+
10	Glycosides	D/W	10% Lead acetate	White ppt	+
11	Reducing sugar	D/W	Benedict's solution and conc: H_2SO_4	Yellow ppt	+
12	Carbohydrates	D/W	10% α-naphthol and conc: H_2SO_4	Red ring	+
13	Organic acids	D/W	Bromothymol green	Red color solution	+
14	Starch	D/W	Iodine	Violet color	+

Note: (+) = presence (−) = absence

4. Antimicrobial Activity of Flower

The flower extract was also screened for antimicrobial activity against *Escherichia coli*, *Bacillus pumilus*, *Bacillus subtilis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Agrobacterium tumefaciens* and *Candida albicans* using agar well diffusion method. The methanol extract of flower were showed the maximum zone of activity against on four bacteria and one fungi pathogen and ethanol extract were showed the maximum zone of activity against one bacterium and one fungi. The results are shown in Table 2 and Fig. 3.A–G.

Table 2. Results of antimicrobial activity on flower extract of *Clitoria ternatea* L.

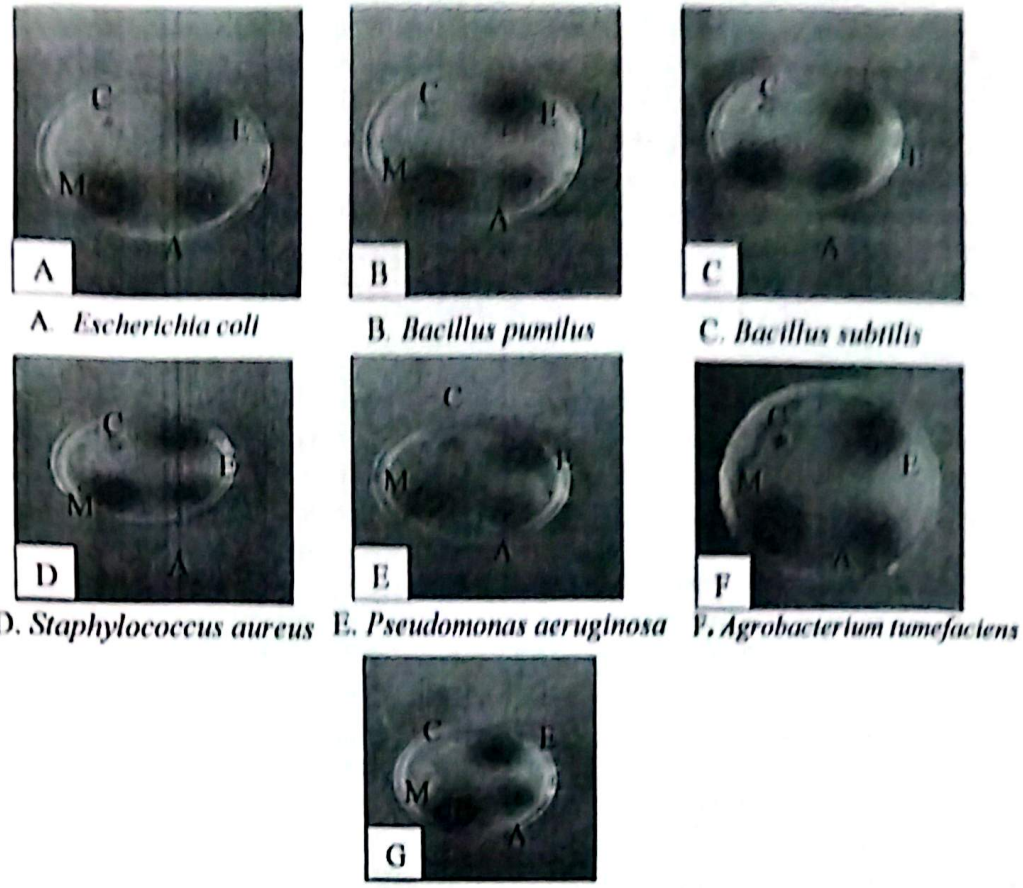
Solvent	Extracts (µl)	Test microorganism and zone of inhibition (mm)						
		E. coli	*B. pumilus*	*B. subtilis*	*S. aureus*	*P. aeruginosa*	*A. tumefaciens*	*C. albicans*
Ethanol	200	15 (++)	16(++)	16(++)	16(++)	14(++)	19(+++)	20(+++)
Control		-	-	-	-	-	-	-
Aqueous	200	14 (++)	14(++)	17(++)	14(++)	15(++)	14(++)	13(++)
Control		-	-	-	-	-	-	-
Methanol	200	16 (++)	18 (+++)	18 (+++)	16(++)	19(+++)	17(++)	21(+++)
Control		-	-	-	-	-	-	-

Agar well-8mm

(- Not active), 8mm-12 mm (+) minimum, 13mm-17mm (++) medium, 18 mm - above (+++) maximum

E. coli = *Escherichia coli*, *B. pumilus* = *Bacillus pumilus*, *B. subtilis* = *Bacillus subtilis*, *S. aureus* = *Staphylococcus aureus*, *P. aeruginosa* = *Pseudomonas aeruginosa*, *A. tumefaciens* = *Agrobacterium tumefaciens*, *C. albicans* = *Candida albicans*

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A. *Escherichia coli* B. *Bacillus pumilus* C. *Bacillus subtilis*

D. *Staphylococcus aureus* E. *Pseudomonas aeruginosa* F. *Agrobacterium tumefaciens*

G. *Candida albicans*

C = control, E = Ethanol, A = Aqueous, M = Methanol

Figure 3. Antimicrobial activity of flower extract against seven test microorganisms

Discussion and Conclusion

The present study was carried out the taxonomic position and delimitation of the taxa on the basis of petal anatomical features. *Clitoria ternatea* L. was perennial twining herb, trifoliate compound leaves, flower blue coloured, papilionaceous flower composed of standard, wings and keels. The type *Clitoria ternatea* L. are pod. The petal is blue color due to the presence of anthocyanin. Aruna *et al.* (1999) stated that *Clitoria ternatea* L. is a perennial herbaceous plant, with elliptic, obtuse leaves. *Clitoria ternatea* L. belonging to the family Fabaceae, commonly known as Butterfly pea. It is a perennial twinning herb with blue and white flowers. Ojeda *et al.* (2009) indicated that epidermal cell shape of petals was different among standard, wing and keel of papilionoid flowers. These characters were agreement with Aruna *et al.* (1999) and Ojeda *et al.* (2009).

In the present study, anatomical characters of petal surface, epidermal cells are parenchymatous, polygonal in shape, anticlinal walls straight and thin walled at adaxial and abaxial side. Trichomes are present. Actinocytic stomata type are present on the both sides. The vessel element is 220 – 320 µm in length, 10 – 14 µm in width. Akin (2009) founded that micromorphological features on dorsal surfaces of petals could be useful for species level diagnosis. Esau (1965) stated that the nature of epidermal cells, pigments, stomata and trichomes were present in petal. Those characters were agreed with the statement of Esau, (1965); Aruna *et al.* (1999); Agbagwa and Ndukwu (2004) and Tahir and Rajput (2010).

Andersen (2001) reported that *C. ternatea* L. was also identified as having phytochemical compounds as the flower contains a deep blue color that consists of

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anthocyanins. Agrawal *et al.* (2007) stated that a wide range of secondary metabolites including triterpenoids, flavanol, glycosides, anthocyanin and steroids has been isolated from *C. ternatea* L., its extracts possess a wide range of pharmacological activities. Harborne *et al.* (1998) prepared that the plant extracts were analyzed for the presence of alkaloids, carbohydrates, terpenoids, saponins, proteins, amino acids, fixed oils, phenolic compounds, tannins, flavonoids, steroids etc. Qualitative analysis of crude flower extract was carried out for alkaloids, terpenoids, steroids, flavonoids, phenolic compounds, terpenes, saponins, glycosides, reducing sugar, carbohydrates, organic acids and starch, polyphenols and tannins.

The present study, phytochemical analysis of flower extract was done by using HCl, $CHCl_3$, Pet-ether, and distilled water. It was observed that most of the components were present in water. The saponins, glycosides, reducing sugar, carbohydrates, organic acids and starch are present but tannins were not. In the EtOH extract shows flavonoids, phenolic compound and terpene are present but polyphenols is not. In HCl, $CHCl_3$ and pet-ether extract, steroid, terpenoids and alkaloids are present. These characters were agreed to those mentioned by Harborne *et al.* (1998).

In antimicrobial activities of three solvent sample extract were carried out by agar well diffusion assay with seven test microorganisms. Among them, methanol extract showed the more antimicrobial activity. It showed the maximum antibacterial activity (16 mm, 18mm, 18mm and 19mm) against *E. coli*, *Bacillus pumilus*, *Bacillus subtilis* and *Pseudomonas aeruginosa*. Especially the methanol extract exhibited the maximum antifungal activity (21mm) on *Candida albicun*. Aqueous extractalso showed the medium antimicrobial activity on all test organisms. And then, ethanol extract was showed the medium antibacterial activity (16mm) on *Staphylococcus aureus*, (19mm) on *Agrobacterium tumefaciens* and (20mm) on *Candida albicun*.

Pratap *et al.* (2012) stated that the antimicrobial activity of aqueous extract of flower of *C. ternatea* L. has been evaluated in agar well diffusion method and found effective against bacteria causing dental caries. Uma *et al.* (2009) also mentioned the anti-microbial activity of aqueous, methanol and chloroform extracts of *C. ternatea* L. flower against uropathogenic *E. coli*, *Klesiella pneumonia* and *Pseudomonas aureginosa* in disc diffusion method. Ponnusamy *et al.* (2010) stated that ethyl acetate extracts of *Clitoria ternatea* L. showed maximum zone of inhibition againts *A. formicans* (18 mm), *A. hydrophilia* (19 mm), *B. subtilis* (19mm) and *P. aeruginosa* (21 mm) next to that ethanol extract of *Clitoria ternatea* L. showed maximum zone of inhibition against *A. formicans* (18 mm) and *E. coli* (14 mm) followed by the acetone extract with showed maximum zone of inhibition against *S. agalactiae* (19 mm) and *K. pneumonia* (17mm). The present results were agreed that by Ponnusamy *et al.* (2010).

It can be concluded that the extract of *Clitoria ternatea* L. flower would direct to the establishment of some compounds that could be used to invent new and more potent antimicrobial drugs of natural origin.

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Taxonomic Study on Ten Species of Family Fabaceae Found in Tamu District, Sagaing Region

Tin Myo Khaing[1], Nwé Nwé Yi[2]

Abstract

The research deals with taxonomic study on Ten members of Fabaceous plant distributed in Tamu District. The species of Fabaceae Family were collected, preserved and identified from June 2018 to March 2020. In this research, the Fabaceous plants of 10 species belonging to 8 genera were presented. *Bauhinia acuminata* L. was erect shrub, *Dysolobium grande* Prain was woody climber, *Clitoria ternatea* L., *Crotalaria juncea* L., *Crotalaria pallida* Aiton., *Pachyrhizus erosus* (L.) Urb., *Rhynchosia minima* (L.) DC., *Senna occidentalis* (L.) Link, *Senna hirsuta* L. and *Tephrosia villosia* (L.) Pers. were herbs. Among them, *Clitoria ternatea* L. was very famous for its beautiful flower of medicinal uses. An artificial key to the species were also constructed.

Keywords: Taxonomic study, Fabaceae, Tamu District

Introduction

The present research deals with the members of Fabaceae growing in Tamu District, Sagaing Region. It lies between 23° 20' and 24° 40' N Latitude and 94° 00' and 94°40' E longitude. The total area of Tamu District is about 677. 2 sq km and the elevation is about 180 m.

The family Fabaceae was widely distributed in temperate, tropical and subtropical of the world. About 727 to 732 genera and 19,000 to 197,000 species were recorded in the world (Heywood 2007). More then, Kress *et al* (2003) recorded that 84 genera and 510 species were mentioned in Myanmar. The distinctive characters of this family are by the presence of only one carpel, unilocular ovary with marginal placentation and leguminous fruits. Some species of this Family were very economically important in Myanmar.

Fabaceous is mostly common in proteinaceous plants and some cultivated species for edible purpose were recorded in Myanmar. Most species of the Fabaceae family as wild is very attractive for recording as interesting species in Myanmar. The aim and objectives of this research is to identity and classify the members of Fabaceae distributed in Tamu District, to record the taxonomic characters of various kinds of Fabaceous plant and to certain the nomenclature of Fabaceae plant resources distributed in Tamu District.

Materials and Methods

Plant collections were made June 2018 to December 2020. A Taxonomic identification of the collected specimens were determined by referring to available literatures such as Hooker (1875-1897), Backer & Brick (1963-1968), Dassanayake (1980-2001), and Qi-ming *et al.* (2007-2009). All of nomenclatural studies were recognized by referring to the website of International plant Names Index (IPNI) and Online Botanical Database of Tropical plants (TROPICOS). Myanmar names and their distribution of the studied species were referred to Hundley and Chit Ko Ko (1987) and Kress *et al.* 2003. The studied species were systematically arranged into families according to APG IV (2016). The arrangement of genera and species under the families were placed alphabetically.

Results

1. List of Collected Species from Tamu District, Sagaing Region

The collected specimens Ten species belonging to Family Fabaceae.

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Table 1. List of the Species of Fabaceae Distributed in Tamu District

No.	Scientific Name	English Name	Myanmar Name	Specimens Location
1.	*Bauhinia acuminata* L.	Orchid tree	Swedaw, Palan	Kyuntawyayshin village N Latitude 23° 67' and E longitude 94°14', elevation 244 m, 20 August, 2018
2.	*Clitoria ternatea* L.	Butterfly pea	Aung me nyo	Kanmagyi village N Latitude 23° 80' and E longitude 94°15', elevation 212 m, 12 October, 2018
3.	*Crotalaria juncea* L.	indian hemp	Pan Paik San	Khampat Town N Latitude 23° 78' and E longitude 94°14' , elevation 222 m, 16 October, 2018
4.	*Crotalaria pallida* Aiton	smooth crotalaria	Unknown	Near Tamu Township N Latitude 24° 22' and E longitude 94° 31', elevation 178 m; 4 may, 2019
5.	*Dysolobium grande* Prain	Unknown	Unknown	Khampat Town N Latitude 23° 78' and E longitude 94°14', elevation 222 m, 16 October, 2018
6.	*Pachyrhizus erosus* (L.) Urb.	Chinese potato	Pe sein sa	Sayarsan village N Latitude 24° 35' and E longitude 94° 37', elevation 188 m; 12 July, 2020
7.	*Rhynchosia minima* (L.) DC.	Unknown	Taw pe	Sayarsan village N Latitude 24° 35' and E longitude 94° 37', elevation 188 m; 12 July, 2020
8.	*Senna hirsuta* L.	Unknown	Kandauk	Khampat Town N Latitude 23° 78' and E longitude 94°14', elevation 222 m, 16 October, 2018
9.	*Senna occidentalis* (L.) Link	Country senna	Kazawbok; dangywe	Nan Khauk Khauk village N Latitude 23° 68' and E longitude 94°14', elevation 204 m, 24 October, 2018
10.	*Tephrosia villosa* (L.) Pers.,	Unknown	Me yaing	Near Tamu Township N Latitude 24° 22' and E longitude 94° 31', elevation 178 m, 14 July, 2020

1. *Bauhinia acuminata* L., Sp. Pl.: 375.1753. (Figure 1)

Bauhinia candida Ait., Hort. Kew. 2. 49. 1789.

Perennial erect shrubs, up to 1.5 m high; stems and branches zigzag, when young gray is pubescent. Leaves simple, alternate; stipules lanceolate, glabrous, caducous; petioles sparsely pubescent; blades longer than broad, divided one-third down into two ovate, obtuse, or triangular acute lobes. Inflorescences terminal raceme with many flowers;

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peduncles appressed pubescent. Flowers bisexual, zygomorphic, hypogynous, white; bracts linear-lanceolate, persistent; pedicel glabrous. Calyx spathaceous, acuminate with 5 setaceous teeth; tube thinly short-hairy or glabrous. Petals 5, free, oval or elliptic, white, subequal, usually with a distinct claw. Stamen 10, free, exserted, unequal; long filaments, pubescent at the base. Carpel 1; ovary superior, unilocular with many-ovules in the locule on the marginal placenta, linear; style filiform, pale green; stigma small peltate. Pods linear, 10-14 seeded, strap-shaped, dehiscent. Seeds numerous, compressed, endospermic.

2. *Clitoria ternatea* L., Sp. Pl. 2: 753.1753. (Figure 2)

Perennial twining herbs, stems and branches terete, slender, pubescent. Leaves unipinnately compound, imparipinnate, alternate; stipules lanceolate; petioles terete; stiples setaceous; leaflets elliptic-ovate, cunate at the base, entire along the margins, rounded at the apex, sparsely pubescent on both surfaces. Inflorescences axillary, solitary cymes; peduncles pubescent. Flowers bisexual, zygomorphic, pentamerous, resupinate, purplish-white, large and showy; bracts linear, unequal; bracteoles orbicular. Calyx tubular, 5-toothed; tube sparsely pubescent; teeth acuminate. Corolla papilionaceous; standard obovate, emerginate at the apex, pale yellow at the center, clawed; wings oblong, clawed; keels oblong. Stamens 10, diadelphous, inserted; staminal tubes. Carpel 1; ovary superior, oblong, unilocular with many ovules on the marginal placenta, pubescent; styles curved, pubescent apically; stigmas simple. Pods linear-oblong, flat, beaked by persistent style, sparsely pubescent, 8-10 seeded. Seeds oblong, black.

3. *Crotalaria juncea* L., Sp. Pl. 1: 714. 1753. (Figure 3)

Crotalaria bericea Willd., Sp. Pl. 3: 519. 1803.

Annual erect herbs, up to 1.0 m high; stems and branches terete, solid, pubescent. Leaves unifoliate compound, alternate; stipules linear, pubescent, caducous; petioles terete, pubescent; blades oblong to oblanceolate, glabrous or sparsely pubescent, obtuse at the base, entire along the margin, obtuse to subacute at the apex. Inflorescences terminal racemes, many-flowered; peduncles terete, yellowish green, pubescent. Flowers bisexual, zygomorphic, hypogynous, pentamerous, bright yellow; bracts triangular, acuminate, green; pedicels slender, tomentose; bracteoles linear, puberulous. Calyx subbilabiate; tubes brownish-green, velutinous; lobes oblong actue or linear-lanceolate, brownish-green, velutinous. Corolla papilionaceous, exserted; standards suborbicular, bright yellow, sparsely hairy, clawed long; wings oblong, yellow, glabrous; keels falcate, curved, yellow, glabrous. Stamens 10, united, monadelphous; filaments filiform, yellowish white, glabrous. Carpel 1; ovary superior, unilocular with many ovules in each locule on the marginal placenta, oblongoid; style incurved, yellowish white, glabrous; stigma simple. Fruits simple, pods, oblongoid; sessile. Seeds reniform, pale brown to black, glabrous, endospermic.

4. *Crotalaria pallida* Aiton, Hort. Kew. 3: 20-21. 1789. (Figure 4)

Perennial herbs, up to 1 m high; stems and branches terete, ribbed, densely appressed pubescent. Leaves trifoliolate compound, alternate; stipules acicular, caducous; petioles pubescent; petiolules pubescent; leaflets oblong, entire along the margin, obtuse with mucronate at the apex, sparsely pubescent on both surfaces. Inflorescences terminal racemes, many-flowered; peduncles cylindrical. Flowers bisexual, zygomorphic, pentamerous, hypogynous, yellow; bracts linear, pubescent; bracteoles linear. Calyx campanulate, 5-lobed, green, pubescent. Corolla papilionaceous, yellow; standard elliptic, yellow with reddish-brown vein, two appendages at the base; wings oblong, pubescent; keels oblong. Stamens 10, monadelphous. Carpel 1; ovary superior, oblongoid, unilocular, with many ovules in the locule on the marginal placenta; styles terminal, pubescent; stigmas simple. Pods oblongoid, cylindrical, pubescent, many-seeded. Seeds reniform, nonendospermic.

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5. ***Dysolobium grande*** **Prain, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 66: 427. 1897. (Figure 5)**

Phaseolus grandis Wall., Cat 5602, non, Dalzell. 72. 1861.

Canavalia grandis Kurz, Journ. As. Soc. Beng. 43(3); 185. 1874.

Annual, large woody climbers; stems and branches terete, tomentose. Leaves pinnately trifoliolate compound, alternate; stipules ovate, brown pubescent; petioles grooved above, tomentose; leaflets ovate-orbicular, truncate or obliquely truncate at the base, entire along the margin, obtuse or acute at the apex; stipels linear-lanceolate, pubescent. Inflorescences axillary racemes, erect; peduncles pubescent. Flowers bisexual, zygomorphic, purple; bracts linear-ovate; bracteoles ovate, pubescent. Calyx campanulate, 5-lobed. Corolla papilionaceous, much excreted; standard reniform or orbicular, pale-purple; wings oblong, purple glabrous; keels spirally twisted beaked, incurved, purple, glabrous. Stamens 10, diadelphous. Carpel 1; ovary superior, oblong, rusty-tomentose, unilocular with few ovules in the locule on the marginal placenta; styles filiform, stigma oblique. Pods linear oblong, cylindrical, straight or slight falcate, woody, septate between the seeds, with a hard beak, canaliculate on both surfaces, velutinous. Seeds oblongoid, brown.

6. ***Pachyrhizus erosus*** **(L.) Urb., Symb. Ant. 4: 311. 1905. (Figure 6)**

Dolchos bulbosus L., Sp. Pl. 2, 1021. 1762.

Perennial twining herbs; stems and branches terete. Leaves pinnately trifoliolate compound, alternate; stipules lanceolate, green, glabrous; petioles terete, green, sparsely pubescent; stipels lanceolate, green, setaceous, persistent; petiolules terete, dark green, pubescent; leaflets rhomboid, green, pubescent on both surfaces, cuneate at the base, entire along the margin with coarsely dentate lobed, acute at the apex. Inflorescences axillary elongated racemes, 2- to 4-flowered in a clusters; peduncles terete, erect, green, brownish pubescent. Flowers bisexual, zygomorphic, hypogynous, pentamerous, bluish-violet: bracts absent; pedicels cylindrical, brownish green, pubescent; bracteoles linear-lanceolate, green, pubescent. Calyx 4-lobed; tubes campanulate, brownish, pubescent; lobes acute, whitish-green, pubescent. Corolla papilionaceous, exserted; standard obovate, purple with a basal green blotch, shortly clawed; wings oblong, purple, glabrous, clawed long; keels oblanceolate, whitish-purple, glabrous, clawed long. Stamens 10, diadelphous; filaments filiform, white, glabrous. Carpel 1; ovary superior, unilocular with many ovules in the locule on the marginal placenta; styles filiform, yellowish-white, curved; stigmas oblique. Fruits leguminous, linear, compressed, 4- to 9-seeded, green, glabrous. Seeds flattened, dark brown, shining, non-endospermic.

7. ***Rhynchosia minima*** **(L.) DC., Prod. 2:385.1825. (Figure 7)**

Dolichos minimus L., Sp. Pl. 2:726. 1753.

Perennial, trailing herbs, stems and branches terete, glabrescent. Leaves pinnately trifoliolate compound, alternate; stipules linear lanceolate; stipels linear; petioles angular, pubescent; leaflets ovate to rhomboid-oval, entire along the margin, acute to acuminate at the apex, glabrous on both surfaces. Inflorescences axillary, lax raceme, few-flowered; peduncles glandular, tomentose. Flowers small, bisexual, zygomorphic, cyclic, pentamerous, hypogynous, pale yellow; bracts acute. Calyx campanulate, 5-lobed. Corolla papilionaceous; standard obovate, clawed auriculate, pale yellow, pubescent, glandular; wings narrower and shorter than the keel, oblanceolate, clawed, articulate, pale yellow, glabrous; keel articulate, clawed, pale yellow. Stamens 10, diadelphous; filaments filiform. Carpel 1; ovary superior, linear oblong, unilocular, 1 or 2 ovules on the marginal placenta; styles filiform; stigmas sub-globose. Pods dehiscent, oblong falcate, 2-seeded, non-septate, brown. Seeds oblongoid, reniform, grey or black.

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8. *Senna hirsuta* L., Sp. Pl. 378. 1753. (Figure 8)

Cassia hirsuta L., Sp. Pl. 378. 1753.

Annual herbs, sometimes suffrutescent, up to 2.5 m high; stems and branches terete, hirsute. Leaves unipinnate-compound, imparipinnate, alternate; stipules linear, pubescent; petioles terete, with a gland above the pulvinus; leaflets 3- to 5-paired, opposite, elliptic to ovate-elliptic or ovate-lanceolate, hirsute on both surfaces, rounded at the base, entire along the margin, acute or subacuminate at the apex. Inflorescences axillary or terminal in panicles, few-flowered. Flowers bisexual, zygomorphic, hypogynous, pentamerous, yellow; racts linear, green, pubescent. Sepals 5, obovate, yellowish-green, hirsute at the base, glabrous above. Petals 5, obovate, unequal, clawed. Stamens 10, free, 7 fertile, 3 strile; staminodia 3, yellow, glabrous. Carpel one, ovary superior, unilocular with many ovules in the locule on the marginal placenta, linear, white, pubescent; style filiform, incurved; stigma simple. Pods capsuler, compressed, curved, densely hirsute. Seeds orbicular, light brown, endospermic.

9. *Senna occidentalis* (L.) Link, Handb. 2: 140. 1831. (Figure 9)

Cassia occidentalis L., Sp.Pl. 377. 1753.

Annual, foetid herbs, up to 1.0 m high; stems and branches terete, glabrous. Leaves unipinnate compound, paripinnate, alternate; stipules linear lanceolate, glabrous; petioles pubescent with dark purple gland above the pulvinous; leaflets 3- to 5-paired, opposite, oblong-lanceolate, entire along the margin, acute to acuminate at the apex. Inflorescences axillary racemes, few-flowered. Flowers bisexual, zygomorphic, cyclic, pentamerous, hypogynous, bright-yellow, pubescent; bracts lanceolate, caducous. Sepals 5, free, oblong, glabrous. Petals 5, free, obovate, shortly clawed, hyaline, glabrous. Stamens 10, free, 6-fertile, inserted; filaments filiform, unequal, the longer 2-tumid, 4-shorter and 4-sterile; staminodia 4. Carpel 1; ovary superior, linear, unilocular, many ovules in each locule on the marginal placentae; style filiform, curved, glabrous; stigma capitate, hairy. Pods linear, compressed, many-seeded, glabrous. Seeds obovate, compressed, brown.

10. *Tephrosia villosa* (L.) Pers., Syn. Pl. no.23.329.1807. (Figure 10)

Cracca villosa L., Sp. Pl. 752. 1753.

Annual or perennial erect herbs, up to 1.0 m high, sometimes suffrutescent; stems and branches angular, pubescent with white apressed hairs. Leaves unipinnately compound, imparipinnate, alternate; stipules deltoid subulate, densely pubescent; entire along the margin, acute or mucronate at the apex, pubescent or glabrous above, sericeous beneath. Inflorescences terminal or leaf opposed, racemose, many-flowered; peduncles sessile, pubescent. Flowers bisexual, zygomorphic, cyclic, pentamerous, hypogynous, violet; bracts linear, deltoid; Calyx campanulate, 5 lobed; tube villous, green; lobes filiform, villous. Corolla papilionaceous; standard obovate, short clawed, violet; wings oblong, glabrous, keel incurved, oblique-oblong, long clawed, glabrous. Stamens 10, diadelphous; filaments, glabrous. Carpel 1; ovary superior, linear oblong, subcompressed, unilocular, 5 to 8 ovules on the marginal placenta; styles glabrous; stigmas sub-capitate. Pods oblong-falcate, 5- to 8-seeded. Seeds reniform, dark brown, non-endospermic.

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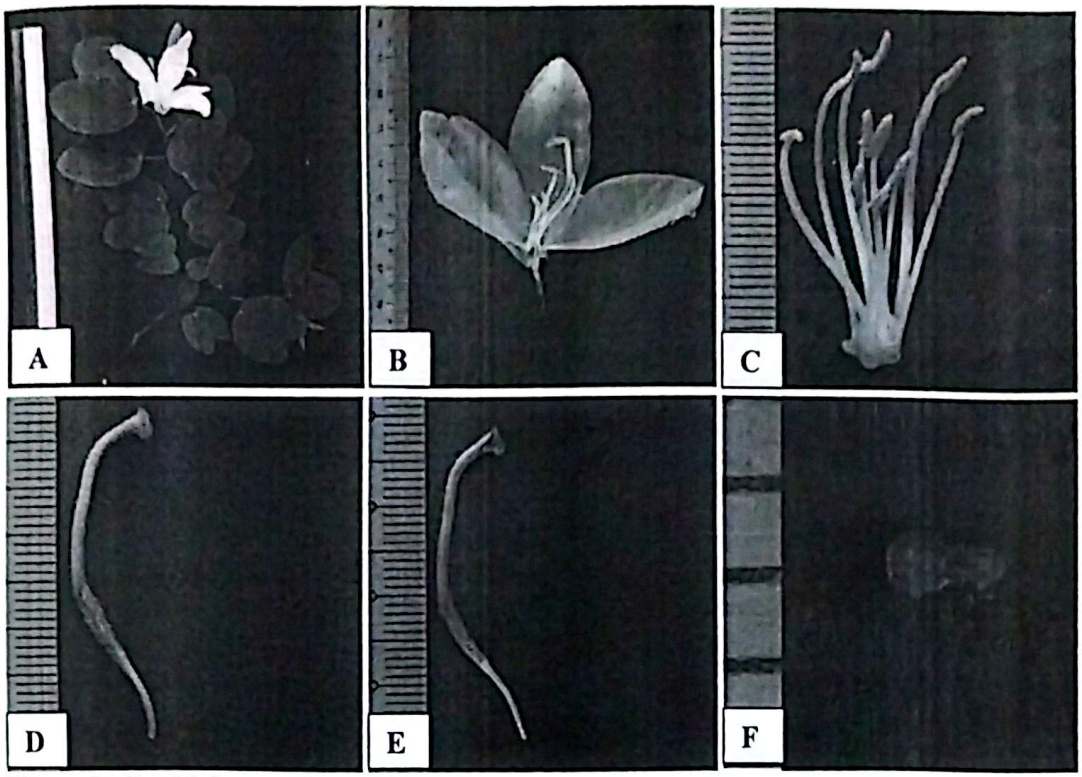


Figure 1. ***Bauhinia acuminata*** **L.**

A. Inflorescence B. L.S of flower C. Stamens
D. Pistil E. L.S of ovary F. T.S of ovary

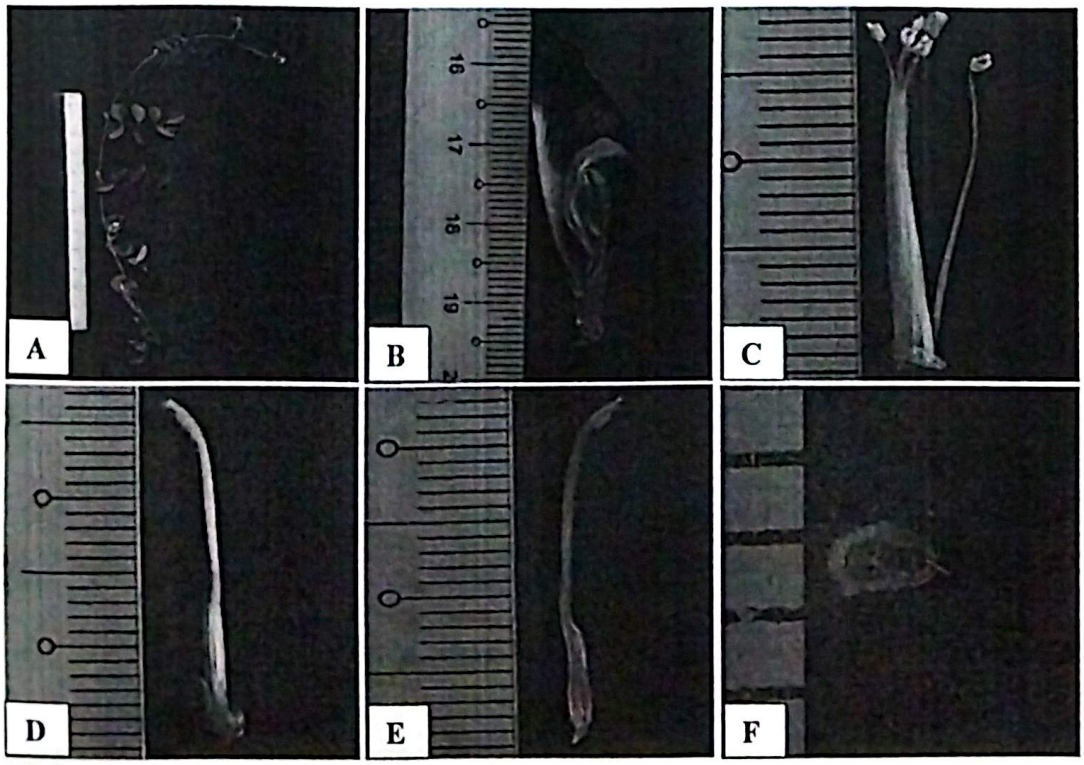


Figure 2. ***Clitoria ternatea*** **L.**

A. Inflorescence B. L.S of flower C. Stamens
D. Pistil E. L.S of ovary F. T.S of ovary

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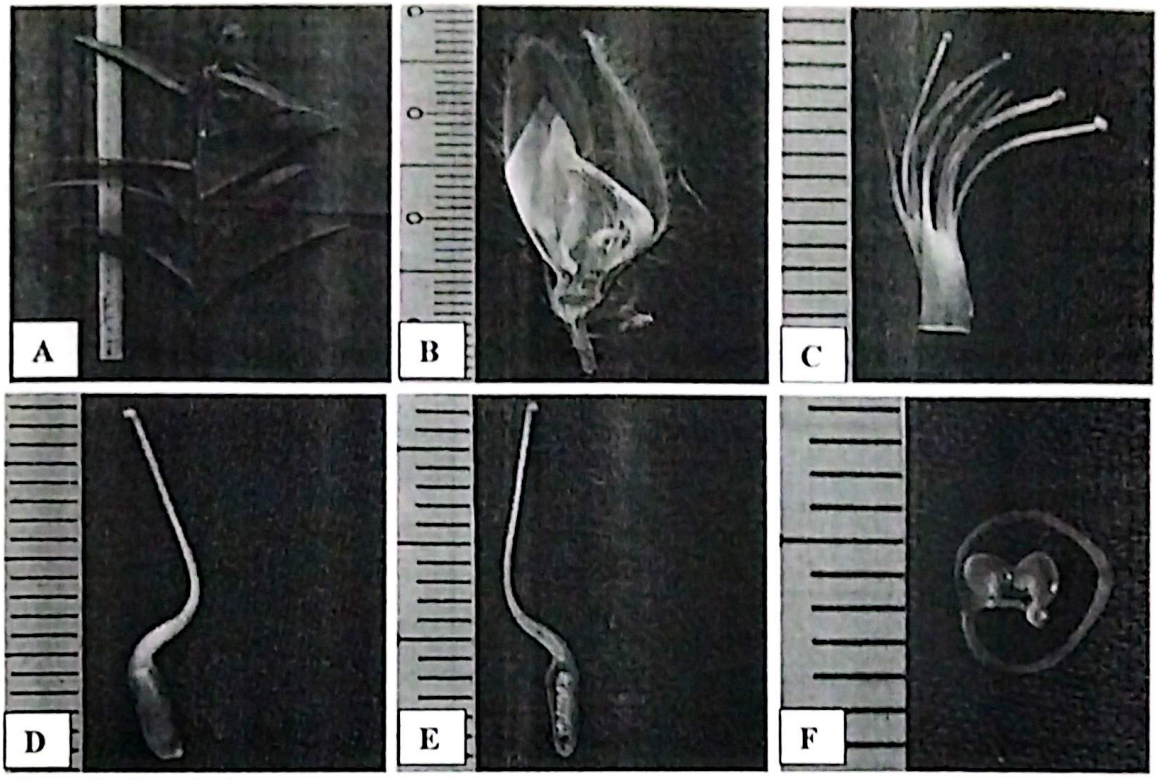


Figure 3. ***Crotalaria juncea*** **L.**

A. Inflorescence B. L.S of flower C. Stamens
D. Pistil E. L.S of ovary F. T.S of ovary

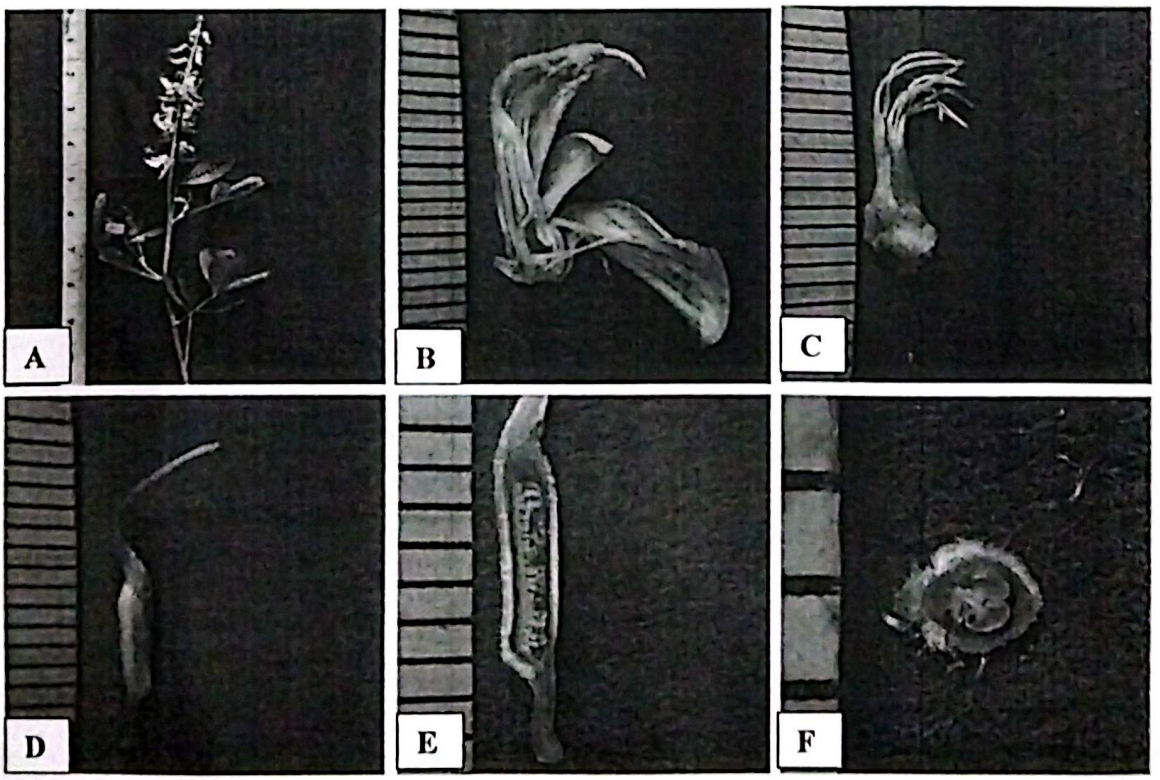


Figure 4. ***Crotalaria pallida*** **Aiton**

A. Inflorescence B. L.S of flower C. Stamens
D. Pistil E. L.S of ovary F. T.S of ovary

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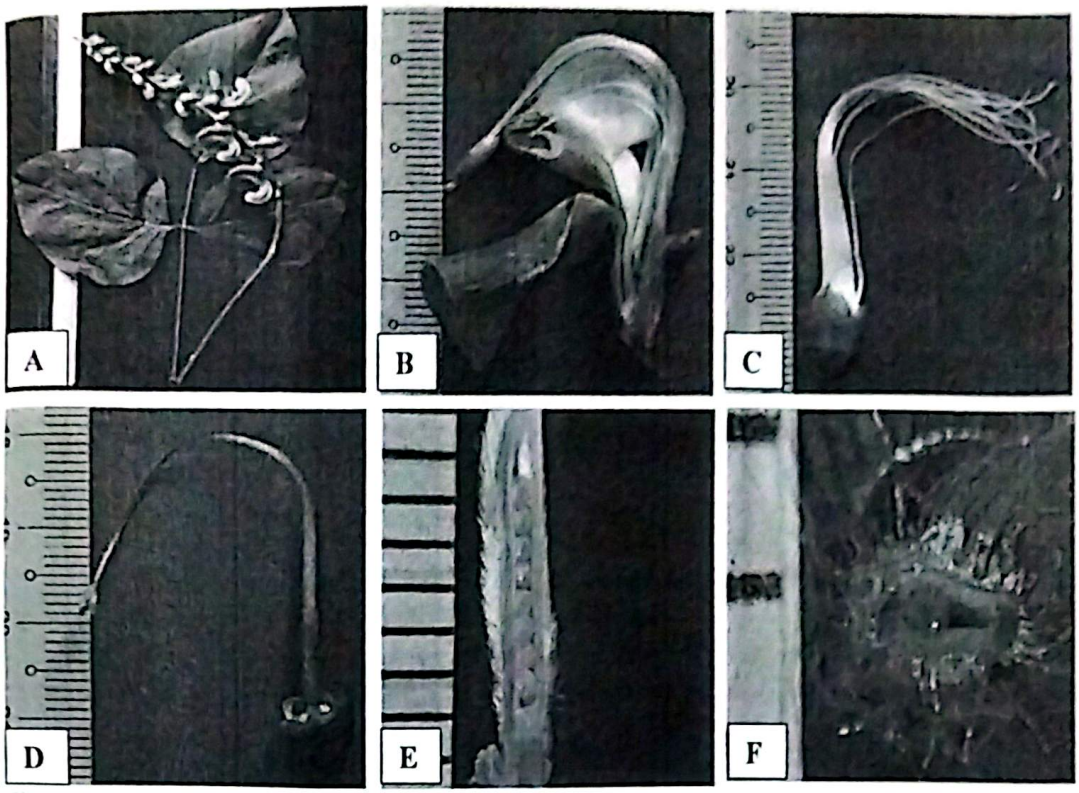


Figure 5. ***Dysolobium grande*** Prain

A. Inflorescence B. L.S of flower C. Stamens
D. Pistil E. L.S of ovary F. T.S of ovary

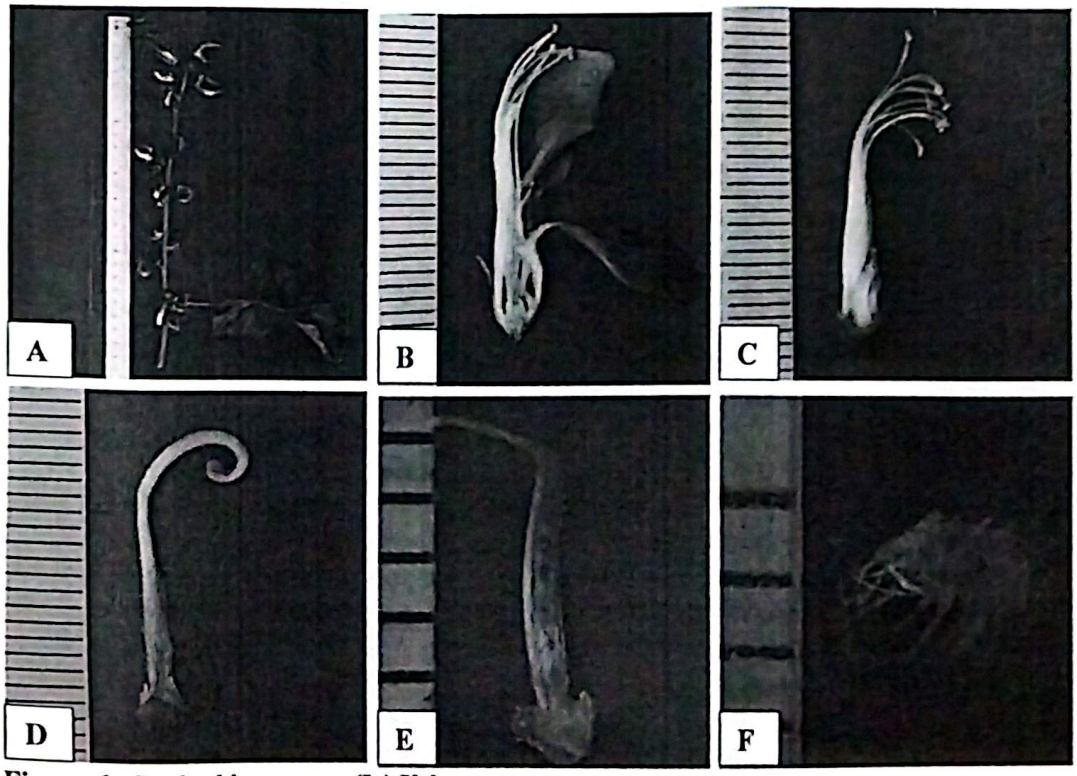


Figure 6. ***Pachyrhizus erosus*** **(L.) Urb.**

A. Inflorescence B. L.S of flower C. Stamens
D. Pistil E. L.S of ovary F. T.S of ovary

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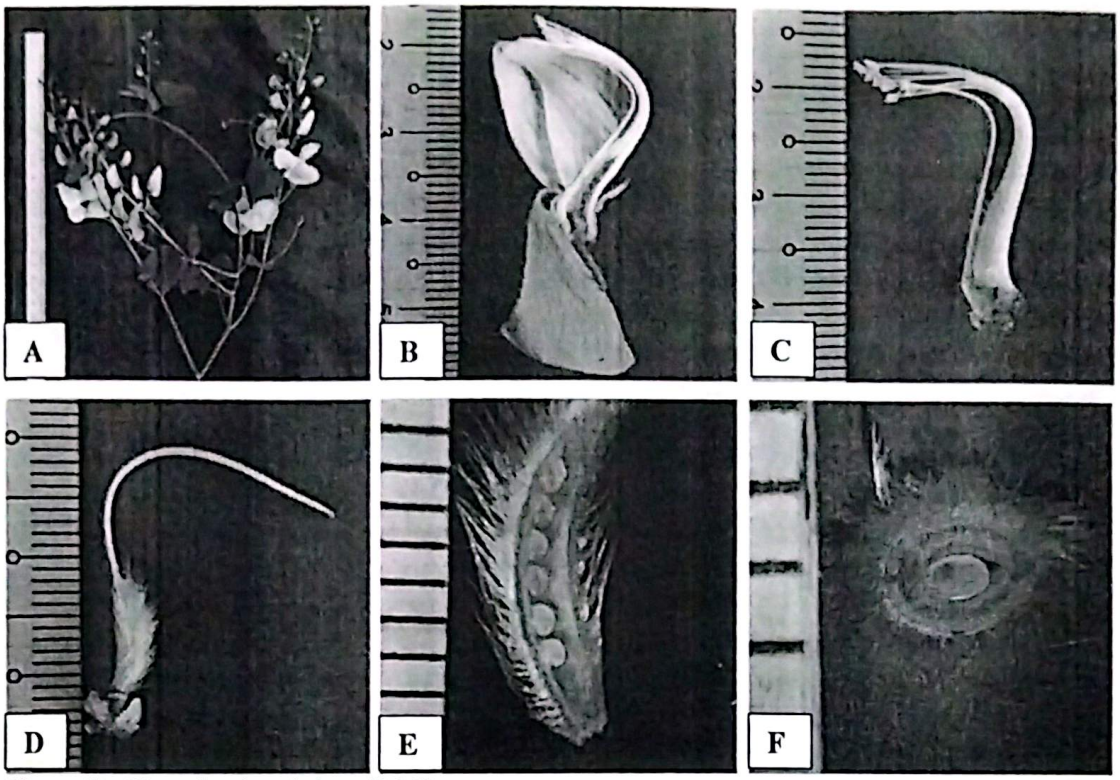


Figure 7. ***Rhynchosia minima*** **(L.) D.**

A. Inflorescence B. L.S of flower C. Stamens
D. Pistil E. L.S of ovary F. T.S of ovary

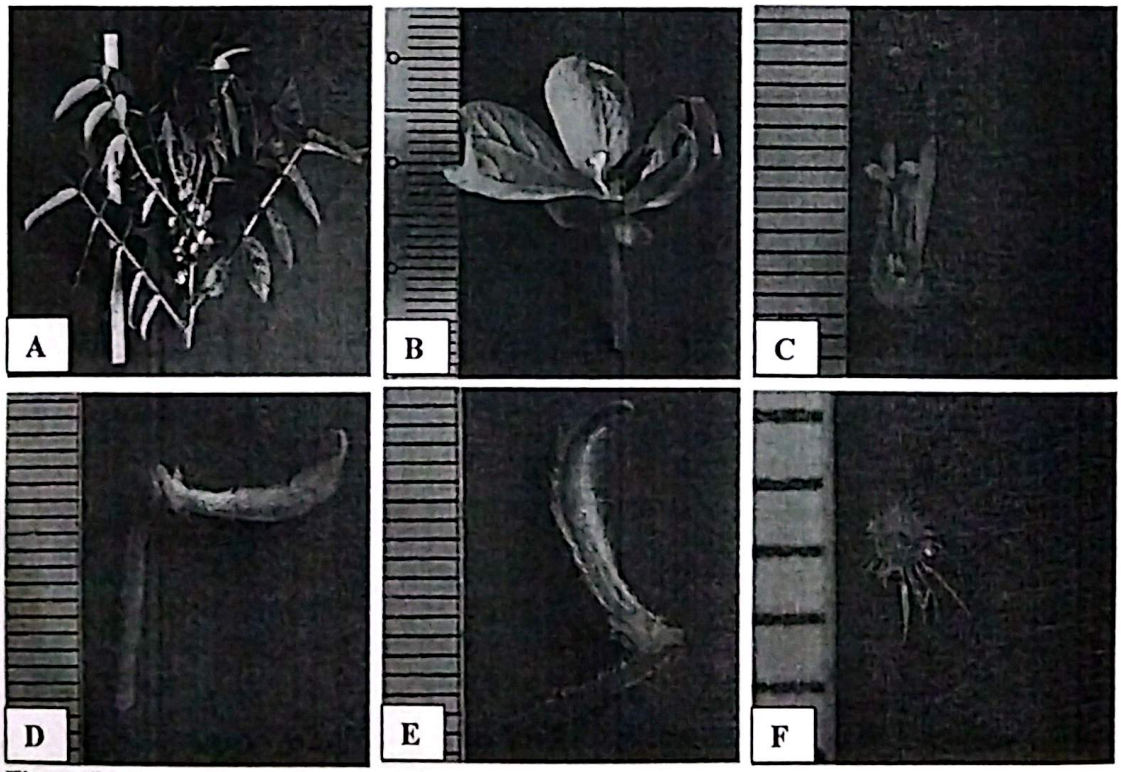


Figure 8. ***Senna hirsuta*** **L.**

A. Inflorescence B. L.S of flower C. Stamens
D. Pistil E. L.S of ovary F. T.S of ovary

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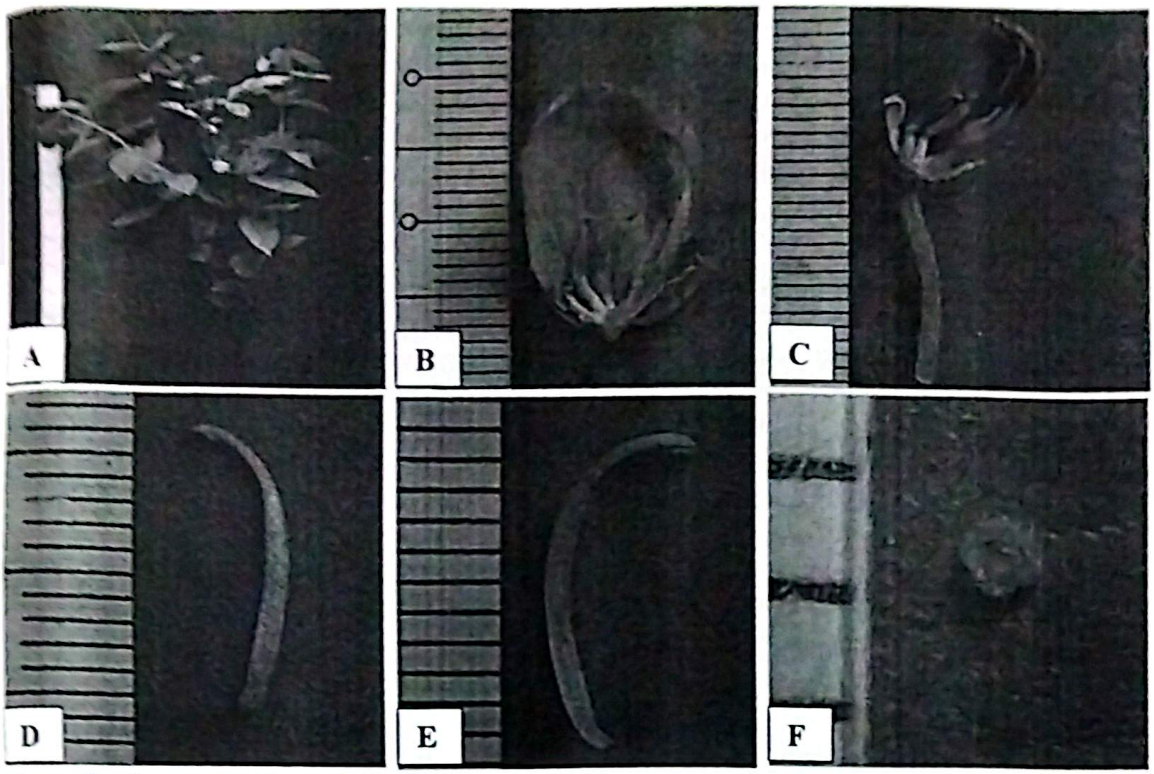


Figure 9. *Senna occidentalis* (L.)Link

A. Inflorescence B. L.S of flower C. Stamens
D. Pistil E. L.S of ovary F. T.S of ovary

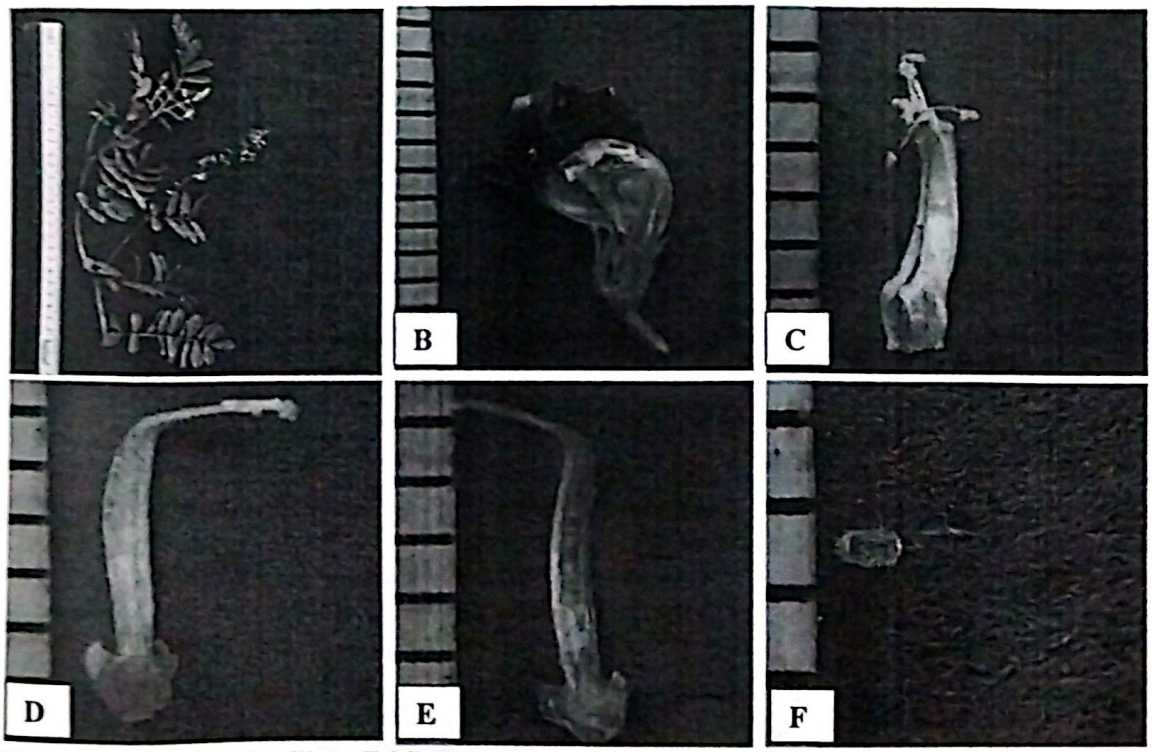


Figure 10. *Tephrosia villosa* (L.) Pers.

A. Inflorescence B. L.S of flower C. Stamens
D. Pistil E. L.S of ovary F. T.S of ovary

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An Artificial Key to the Studied Species

1. Stamens free ---------- 2
1. Stamens united ---------- 4
   2. Leaves simple, pulvinous absent ---------- 1. *Bauhinia acuminata*
   2. Leaves unipinnately compound, pulvinous present ---------- 3
3. Staminodia 4; leaflet sparsely pilose ---------- 7. *Senna occidentalis*
3. Staminodia 3; leaflets hirsute on both surface ---------- 8. *Senna hirsuta*
   4. Plants twiner or woody climber ---------- 5
   4. Plants traling or erect herbs ---------- 7
5. Standard reniform or orbicular; stipules ovate ---------- 6. *Dysolobium grande*
5. Standard obovate; stipules lanceolate ---------- 6
   6. Calyx tubular; bracts present ---------- 2. *Clitoria ternatea*
   6. Calyx campanulate; bracts absent ---------- 5. *Pachyrhizus erosus*
7. Stems and branches angular;flower coloured violet ---------- 10. *Tephrosia villosa*
7. Stems and branches terete; flower coloured pale or bright yellow ---------- 8
   8. Keels falcate; bracts triangular ---------- 3. *Crotalaria juncea*
   8. Keels articulate or oblong; bracts acute or linear ---------- 9
9. Stamens monadelphous; stigmas simple ---------- 4. *Crotalaria pallida*
9. Stamens diadelphous; stigmas sub-globose ---------- 9. *Rhynchosia minima*

Discussion and Conclusion

In the present research, the taxonomic study on some member of Fabaceous plants growing in Tamu district, West Northern part of Sagaing Region. The ten collected species of Fabaceae Family has been found in study area. The growing habits of the Fabaceous plants vary in the studied area. *Bauhinia acuminata* L. was the erect shrubs and showy white flower. *Dysolobium grande* Prain was the large woody climbers. Other species such as

Clitoria ternatea L., *Crotalaria pallida* Aiton, *Crotalaria juncea* L., *Pachyrhizus erosus* (L.) Urb., *Rhynchosia minima* (L.) DC., *Senna occidentalis* (L.) Link, *Senna hirsuta* L., and *Tephrosia villosa* (L.) Pers. were twining herbs and erect herbs.

All species were bisexual, zygomorphic, pentamerous, hypogynous. *Bauhinia acuminata* L. was the simple leaves and other 9 species are compound. The inflorescences type of Fabaceae plant were terminal raceme, axillary raceme and axillary cyme. The various colour of flower such as yellow, and purple were found in some member of Fabaceous plants. These characters were agreeded with the description of Dassanyake (1998),

In this research, *Crotalaria pallida* Aiton, *Crotalaria juncea* L., possess monadelphous stamens and other species were free and diadelphous stamens. Although most of the Fabaceous plants were protein rich. Ten species of them mentioned above are inedible. Moreover, some of the Fabaceae plants such as *Clitoria ternatea* L., *Crotataria juncea* L., *Dysolobium grande* Prain, *Senna occidentalis* (L.) Link and *Senna hirsuta* L. are useful the traditional medicinal plants. It is hope that these valuable natural resources will also be useful for further studies.

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Petrographic Interpretation of Igneous Rocks Exposed in The Bum Taung-Inwant Kaung Area, Waingmaw Township, Kachin State

Htet Htet Wint Wah[1], Me Me Aung[2]

Abstract

The study area is situated about 29 km (18 miles) east of Myitkyina Township, Kachin State. The main rock units exposed in the study area are igneous and metamorphic rocks. The igneous rocks possess Middle Jurassic to Cretaceous in age and metamorphic rock units of Paleozoic in age. The igneous rocks comprise pegmatite/aplite, hornblende granite, granodiorite, diorite, basalt, dolerite, lherzolite and pyroxenite. The metamorphic rock units are hornblende-biotite gneiss and biotite gneiss. Granite occurs as boulder nature and show exfoliation characters. Xenoliths of biotite gneiss can be observed in the granite body in the eastern part of the Inwant Kaung village. The main aim of this research is the petrography of igneous rocks and geological map of the study area. Lab works are conducted in Geology Department, University of Myitkyina. Almost all igneous rocks show medium- to coarse-grained, hypidiomorphic granular texture although aplite displays allotriomorphic granular texture. Ophitic texture is also recognized in these rocks. Cross-hatched twin are common in alkali feldspar and zoning and twinning are frequent in plagioclase. Chloritization, epidotization and serpentinization are observed in the study area. Based on the petrographic criteria, the igneous rocks of the study area are formed by the fractional crystallization process, i.e. the mineral crystallized out of the magma to in a certain order.

Keywords: Petrography, hypidiomorphic granular texture, zoning and twinning

Introduction

The study area, Bum Taung-In Want Kaung Area, is situated about 29 km (18 miles) east of Myitkyina, Waingmaw Township in Kachin State. It is bounded by North latitude from 25° 21' to 25° 24' and East Longitude from 97°40' to 97° 47' in UTM maps (2597-11 and -15). Location map of the study area is shown in figure (1). Purposes of study are to study the distribution of the major rock units, to prepare a fairly detailed geological map of the study area and to describe the petrographic interpretation of igneous rocks.

The study area is situated in the eastern part of the Myitkyina Township. The main rock units exposed in the study area are igneous and metamorphic rocks. The igneous rock unit exposed in this area is Middle Jurassic to Cretaceous in age and metamorphic rock units of Paleozoic in age. The igneous rock units are Pegmatite/aplite, hornblende granite,

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granodiorite, diorite, basalt, dolerite, lherzolite and pyroxenite. The metamorphic rock units are hornblende-biotite gneiss and biotite gneiss.

Methodology

Before the date of the field study, the various kinds of previous literatures printed by many previous authors. The UTM map and Google map was used as a base map for preliminary studies. The UTM maps are enlarged to a scale of 4 inches to a mile and used as base map to plot all the measured geological data. Brunton Compass, a geological hammer and GPS will be carried out during the field trip. More than (30) thin sections are used for petrographic interpretation. Petrographic microscope is used to identify the minerals and textural characteristics of rocks.

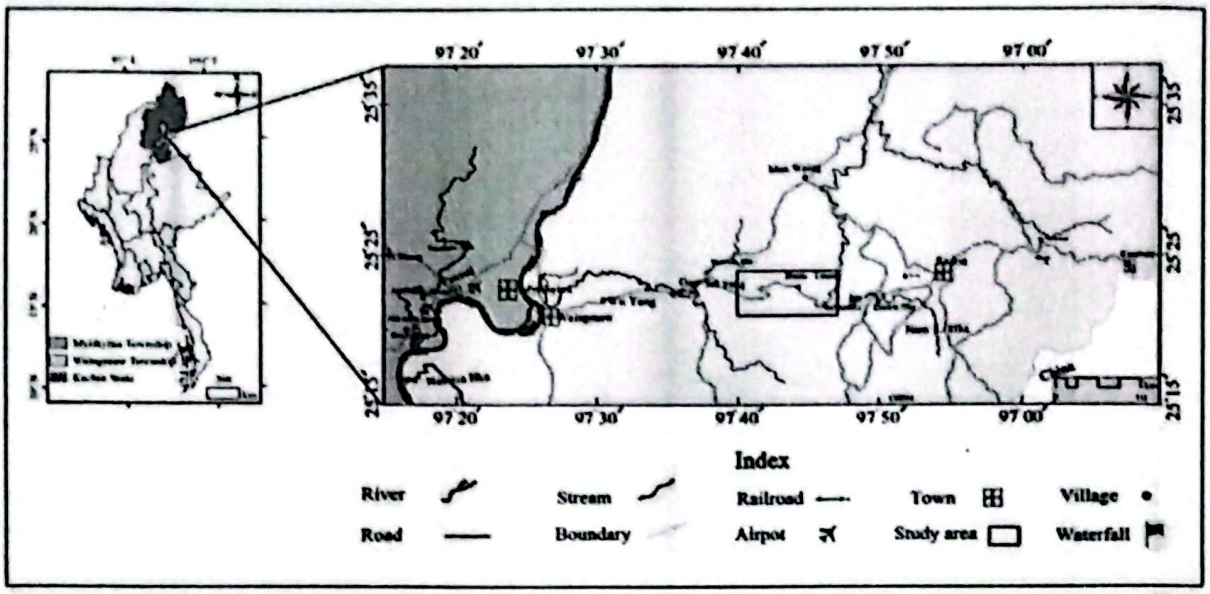


Fig (1) Location map of the Bum Taung-Inwant Kaung Area

General Geology

Although the rocks exposed from the study area are recognized as the Tagaung-Myitkyina Belt (TMB) and Mogok Metamorphic Belt (MMB), the age of the protoliths of the metamorphic rocks, the formation age of igneous rocks and their related tectonic history are still controversial.

Geological accounts on the Mogok region with respect to the pre-metamorphosed lithology include those by Chhibber (1934a), and by Iyer (1953) who regarded the ruby-bearing marbles as Precambrian. Searle and Haq (1964) considered the Mogok metamorphics to be equivalent of Precambrian to Jurassic rocks of the Shan Plateau and Clegg (1941) considered the Jurassic sedimentary rocks to the south. Myint Thein et al. (1987) considered the pre-metamorphosed lithology of the Mogok metamorphic to be equivalent of Jurassic-Cretaceous Panlaung Formation and Myint Lwin Thein et al. (1990) the Silurian and Ordovician sedimentary sequence of the Shan Plateau. Bertrand et al. (1999) suggested the Oligocene to Lower Miocene age for the Mogok metamorphism and that the metamorphism has related to the northward migration of the eastern Himalayan syntaxis, characterized by crustal thinning, resulting from the India-Asia oblique collision. Barley et al. (2003) mentioned the magmatic age of the protolith of orthogneisses from the Mandalay hill and Kyanikan was Jurassic (170 ± 1Ma) which were recrystallized during an Eocene (~43Ma) high-grade metamorphic event. Searle et al. (2007) proposed two Tertiary metamorphic events, the Paleocene event and the Late Eocene to Oligocene event, affected the Mogok metamorphic belt.

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For Kachin State, Clegg (1941) described the peridotite, diorites and gabbro were associated with tuffs in consequence of post-Cretaceous to Early Eocene igneous activity in the Katha and Myitkyina area. Bender (1983) mentioned the region E of Putao is built up of highly metamorphosed metasediments (gneiss, amphibolite, quartzite and marble). This belt of crystalline rocks can be traced via Bhamo to the area of Mogok. There is a connection between parts of the E Himalayas and the East Kachin/Shan Unit of the Sino-Burman Ranges. Yang et al. (2012) reported zircon U–Pb dating on different rock types from Myitkyina-Sadon area (including pyroxenite, hornblende gabbro, diorite and granodiorite) and Myitkyina ophiolite (including andesitic basalts, leucogabbros, pyroxenites and plagiogranites), which obtain Middle Jurassic age of ~166–177 Ma and ~166–176 Ma, respectively. Liu, et al. (2016b) have conducted zircon U–Pb dating on gabbro and rodingite dikes in peridotite from Myitkyina-Myitsone area, which yield cal 173 Ma. In 2018, Zhang, et al. explained the Myitkyina-Mogok ultramafic-diorite belt, within the Cimmerian continental silver, was generated in a Jurassic continental margin arc, which extended southwards to the Kyanigan Hills (18 km northeast of Mandalay), Mandalay Hill and Padatchaung, along the western Shan-Thai Plateau.

According to field criteria and previous authors' radiometric dating result the metamorphic rocks are estimated to be Paleozoic to Jurassic in age. The igneous rocks are estimated to be Mid Jurassic to Cretaceous in age. On the basis of field criteria, the probable rock succession of the study area is shown in Table (1).

The main rock types comprising in the study area are intrusive and extrusive igneous rock associated with minor amount of metamorphic rocks. Igneous rocks are ranging in composition from felsic to ultramafic. Based on their texture, constituent minerals and field criteria, igneous rocks can be divided into eight types. Almost all of the igneous units show medium- to coarsed-grained, hypidiomorphic granular texture although aplite displays allotrimorphic granular texture. Xenoliths of biotite gneiss can be observed in the granite body in the eastern part of the Inwant Kaung village. Geological map of the study area is shown in (Fig.2).

Table (1) Rock Succession of Bum Taung- In Want KaungArea

Lithologic Unit	Age
Sedimentary Units	
Alluvium	Quaternary
Igneous Units	
Pegmatite/Aplite Hornblende granite Granodiorite Diorite Lherzolite Pyroxenite	Early Cenozoic to Cretaceous
Dolerite Basalt	Cretaceous to Mid. Jurassic
Metamorphic Units	
Hornblende-biotite gneiss	Jurassic
Biotite gneiss	Lower Paleozoic

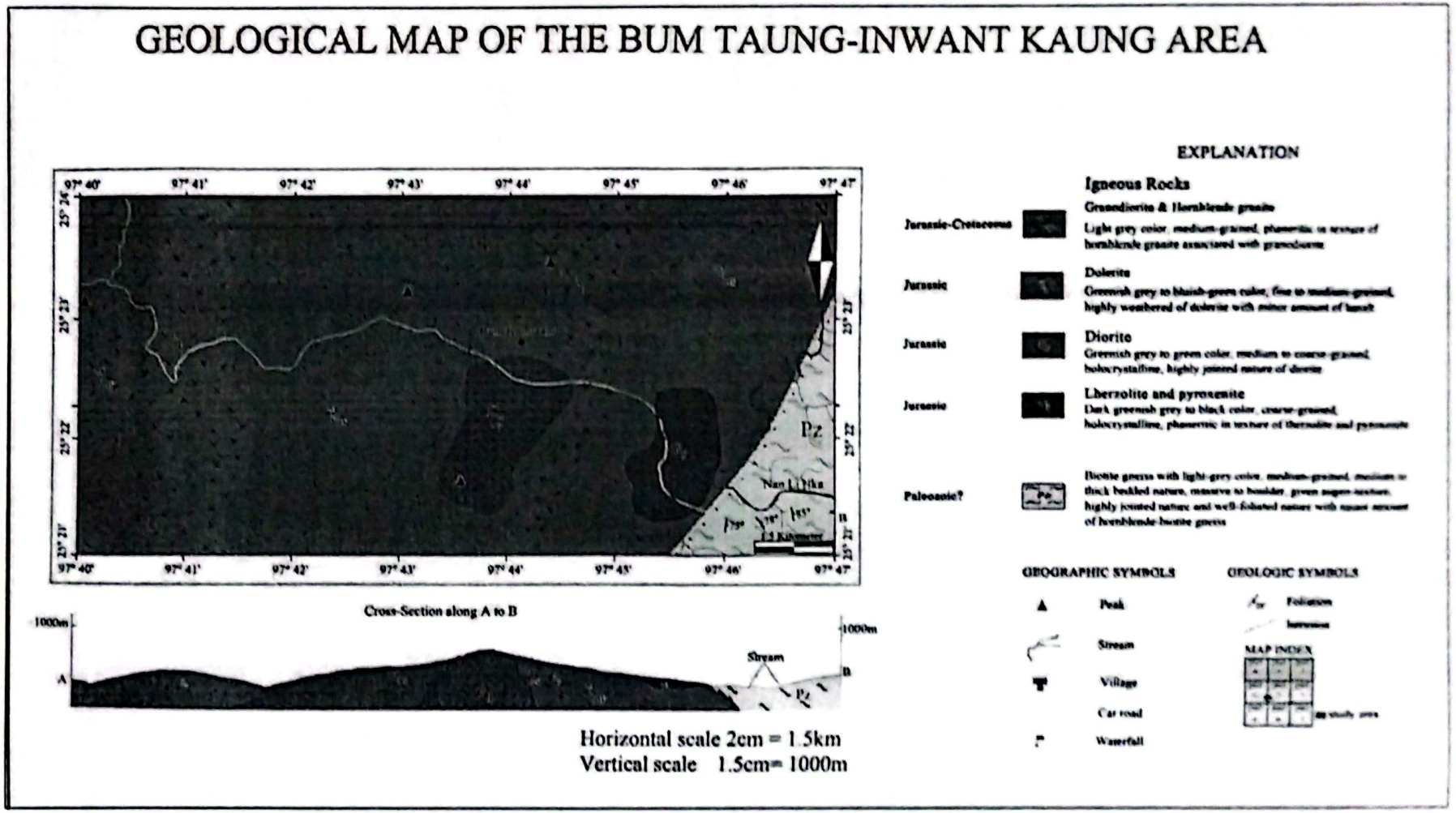


Fig (2) Gelological map of the study area

Petrography

Pegmatite/Apalite

Pegmatite is found as veins and small dykes. Most of the veins are 1inch to 10inches in width and composed chiefly of quartz and feldspar. In some places, tourmaline and hornblende minerals contain as minor amount (Fig.3). It is whitist in colour, medium- to coarse-grained, leucocratic rock. Some pegmatite veins show boudinage nature which indicates brittle-ductile deformation (Fig.4). Apalite and quartzo-feldspathic veins are intruded into metamorphic and all igneous units.

It is composed mainly of quartz and feldspar that shows hypidiomorphic-granular texture. Apalite displays allotriomorphic-granular texture and it characterized by very small grain size.

Hornblende Granite

It has complex nature with granodiorite, i.e., change from granitic to granodioritic composition within a batholith. This rock exhibits dark grey color on weathered surface and light grey color on fresh surface. It is medium-grained, granular and phaneritic in texture and composed mainly of quartz and feldspar as felsic minerals and hornblende and biotite as mafic minerals. It occurs as boulder nature (Fig.5).

It is consists of feldspar (40-50%), quartz (30-35%), plagioclase (10-15%), hornblende (2-5%) and biotite (2-5%). This rock shows holocrystalline, hypidiomorphic to xenomorphic granular texture.

In this rock, more than half of the feldspar is potassium feldspar especially orthoclase and microcline. Orthoclase feldspar occurs either in simple twin or in Carlsbad twins and sometimes zoning in (Fig.6). Microcline is clearly recognized by the typical cross-hatched twinning and there are small marks of microperthitic texture. They show subhedral to anhedral nature. Myrmekitic texture is rarely found. Compositional zoning is quite common.

Quartz commonly occurs as anhedral smaller interstitial grains with wavy extinction, infrequently enclosed plagioclase and potassium feldspar crystals. It displays undulatory extinction as signs of deformation.

In plagioclase, An_{10}-An_{20} in composition, albite and carlsbad twinned is rather common. It shows subhedral nature with straight or corroded grain outlines.

Hornblende occurs as anhedral to subhedral forms. It has strongly pleochroic from pale brown to dark green colour. Brown hornblende resembles biotite, but the latter has better cleavages and almost parallel extinction. It is rather altered to form pale green to grey green chlorite at its rims or along its cleavages.

Biotite occurs as anhedral to subhedral form. It has strongly pleochroic from pale brown-greenish brown and yellowish brown. It also occurs as small flakes within grains and fractures of feldspar and quartz. Some crystals show curvature and faulting of the twin lamellae due to tectonic overprint.

Granodiorite

This rock is dark grey color on weathered surface and light grey color on fresh surface. It has coarse-grained, hard and compact nature and exhibits holocrystalline, phaneritic in texture. It has more mafic minerals and plagioclase feldspar than hornblende granite. It occurs as small semi-circular body with exfoliation nature (Fig.7).

It is composed of plagioclase feldspar especially oligoclase (40-43%), potassium feldspar (10-15%), quartz (25-30%) and mafic minerals especially hornblende (5-10%) and biotite (2-5%). Accessory minerals include sphene, apatite and iron-oxides. It shows holocrystalline and hypidiomorphic granular texture.

Plagioclase, An_5-An_{20} in composition, shows subhedral to euhedral form. Some grains exhibit zoning and albite, Carlsbad and polysynthetic twinning (Fig.8). Plagioclase alteration to sericite is common, frequently at the core of the crystal.

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Potassium feldspar displays subhedral to anhedral form especially orthoclase and microcline are the main constituents. Orthoclase displays prominent Carlsbad and pericline twins. Cross-hatched microcline twinning is clearly identified. It is rather altered to sericite.

Quartz usually occurs as separate crystals (0.1 to 3 mm) or as irregular aggregates with very variable sizes, filling interstices between the feldspar crystals. Some large crystals display undulatory extinction as a result of strain processes. Quartz is rarely found as intergrowths in myrmekites and as inclusions within feldspar crystals.

Hornblende occurs as subhedral to anhedral crystals and has rather high relief. It is pleochroic in shades of pale brown to dark green. Brown hornblende resembles biotite, but the second has better cleavage.

Biotite occurs as subhedral to anhedral forms. It occurs as separate crystals or as intergranular aggregates.

Diorite

This rock shows greenish brown to dark grey color on the weathered surface and greenish grey to green color on the fresh surface. It is medium- to coarse-grained, holocrystalline and highly jointed nature (Fig.9). It is mainly composed of plagioclase, feldspar, hornblende, biotite and minor composed of quartz and alkali feldspar.

It is mainly composed of plagioclase feldspar especially andesine (50-65%), hornblende (20-30%), biotite (10%) and quartz and orthoclase (5%). Tiny sphene, apatite and magnetite are present as accessories. It shows hypidiomorphic to xenomorphic granular texture.

Plagioclase, An_{30}-An_{50} in composition, shows subhedral form. They often exhibit zoned and twinned character.

Potassium feldspar especially orthoclase occurs as subhedral form. Most crystals have untwined nature and cloudy surface.

Hornblende has strong pleochroism from yellowish green to brownish green. Some crystals have one directions cleavage traces which parallel to the outlines. Some crystals have cleavage in two directions that intersect at approximately 56° and 124°. It has high relief and pale yellow interference color. Hornblende is partly altered and replaced by chlorite (Fig.10).

Pyroxene especially clinopyroxene occurs as anhedral grains and is identified by its distinct two set of cleavage which across at nearly right angles.

Intergranular quartz displays undulose extinction and their grain boundaries are irregular nature.

Dolerite and Basalt

The contact between basalt and dolerite unit is complex and penetrated nature (Fig.11). These rocks are bluish dark to dark grey color on the weathered surface and dark green color on the fresh surface. It is fine- to medium-grained, hard and compact nature. It is mainly composed of plagioclase and pyroxene. The outcrop patterns are massive, boulder with highly jointed. The joint portions are rather weathered and mostly epidotized. In some places, vesicular structures are well found on the weather surface. These vesicles were filled up with silica and feldspar.

Dolerite is mainly composed of plagioclase feldspar (45-50%), pyroxene especially augite and enstatite (35-40%) and olivine (5-10%) are major constituents. Opaque oxides, apatite and sphene include as accessories amount. It shows ophitic and subophitic textures (Fig.12).

Plagioclase, An_{40}-An_{70} in composition, commonly labradorite occurs as both phenocrysts and groundmass. Lath-shaped plagioclase crystals are especially andesine, prominent albite twin lamellas. Phenocrysts form as subhedral with embayed or straight outlines and reached up to 2mm in length.

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Pyroxene minerals especially augite and enstatite occur as anhedral nature. Alteration of pyroxene to serpentine is well observed.

Basalt is mainly composed of plagioclase feldspar especially andesine to labradorite in composition (50-60%), pyroxene usually clinopyroxene augite (25-30%), olivine (10-15%). Magnetite and ilmenite are constituents as accessory minerals. This rock show aphanitic, sub-ophitic texture.

Plagioclase, An_{40}-An_{70} in composition, occurs as microlites with very small amounts of phenocrysts. Microlites are small crystals, elongate, more or less uniform in size, scattered throughout the whole groundmass and display interlocking texture.

Clinopyroxene especially augite occurs as anhedral nature. It has high relief and middle second order interference color. Epidotization and chloritization are easily seen within the grains (Fig.13).

Sometimes olivine alters to serpentine along the cracks. Olivine occurs as both microgranular and phenocrysts in groundmass.

Lherzolite and Pyroxenite

This rock show dark grey color on weathered surface and dark greenish grey to dark green color on fresh surface. They possess coarse-grained texture and composed mainly of olivine and pyroxene. They have dense, hard and compact nature and occur as rather complex nature within a same boulder and a dyke (Fig.14). Partially or completely altered to serpentine minerals is well observed on weather surface of the ultramafic body.

Lherzolite is mainly composed of olivine (40%), orthopyroxene (28%), clinopyroxene (30%)(Fig.15). It shows coarse-grained, holocrystalline and hypidiomorphic granular texture. Accessory minerals include plagioclase, chromite, ilmenite and magnetite.

Olivine occurs as anhedral nature with polygonal form and Irregular fractures common. It has high relief and displays upper second order interference color. Serpentization is found at the cracks of the crystal.

Orthopyroxene especially enstatite occurs as subhedral nature and is identified by high relief, pale yellow interference color and lack of pleochroism. Partially serpentinization is quite observed along the cleavage planes. In longitudinal sections, the cleavage traces are in one direction parallel to the outlines.

Clinopyroxene especially diopside occurs as subhedral crystals of short prismatic habit and has high relief. It shows upper second order interference color. Two set of cleavage are well observed which across at nearly right angles.

Pyroxenite is mainly composed of pyroxene especially olivine (20%), enstatite (45%) and clinopyroxene (32%) (Fig.16). Accessory minerals include chromite (7%), ilmenite and magnetite. It shows coarse-grained, holocrystalline and allotriomorphic granular texture.

Orthopyroxene especially enstatite occurs as subhedral to euhedral nature. It has faint pleochroism, high relief and pale yellow interference color. Two set of cleavage are well observed which across at nearly right angles. Veinlets of chrysotile cross cut within grains. Tiny anhedral grains of chromite are concentrated within the enstatite.

Clinopyroxene occurs as subhedral to anhedral crystal. It shows colorless, pale greenish and pale purplish brown. It often displays two sets of cleavage. It is rather altered to tremolite-actinolite.

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Fig (3) Photograph showing tourmaline mineral in pegmatite vein. (Loc: N 25° 21′ 27.6″; E 97° 46′ 18.5″)

Fig (4) Photograph showing small boudinage nature in pegmatite vein. (Loc: N 25° 21′ 36.10″; E 97° 44′ 50.7′)



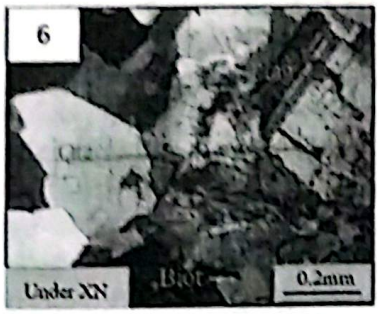


Fig (5) Photograph showing boulder nature in hornblende granite. (Loc: N 25° 22′ 53.6″; E 97°43′ 34.5″)

Fig (6) Photomicrograph showing simple twin and zoning in anhedral and subhedral large orthoclase in hornblende granite.



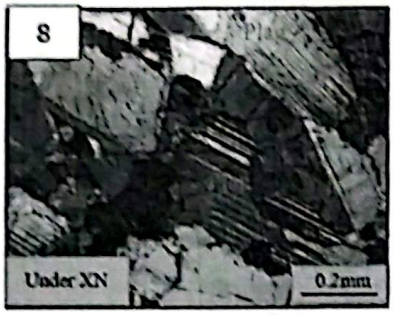


Fig (7) Photograph showing small semi-circular body with exfoliation nature in granodiorite. (Loc: N 25° 22′ 48.9″; E 97° 41′ 35.1″)

Fig (8) Photomicrograph showing albite and Carlsbad twinning in plagioclase of the granodiorite.



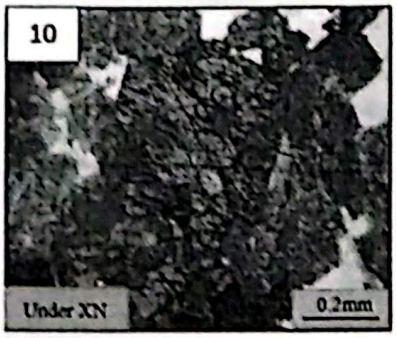


Fig (9) Photograph showing jointed nature in diorite (Loc: N 25° 22′ 29.4″; E 97° 44′ 9.9″)

Fig(10)Photomicrograph showing replacement of hornblende by chloritization in diorite.

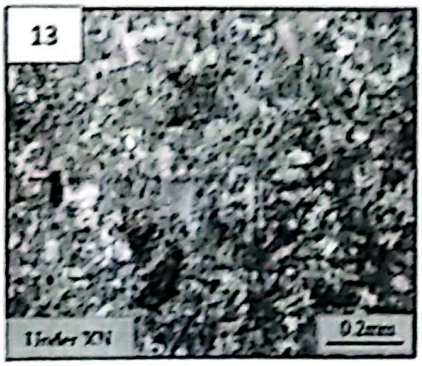
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Fig (11) Photograph showing complex and penetrated nature within dolerite and basalt. (Loc: N25° 22′ 40.5″; E 97° 41′ 25″)

Fig (12) Photomicrograph showing assemblages of olivine, pyroxene and feldspar displaying ophitic texture in dolerite.





Fig(13) Photomicrograph showing pervasive epidotization and chloritization within the augite grains in basalt.

Fig(14) Photograph showing complex nature of lherzolite and pyroxenite within a boulder (Loc: N25° 21′ 51.5″; E 97° 45′





Fig (15) Photomicrograph showing olivine, diopside and enstatite minerals in lherzolite.

Fig (16) Photomicrograph showing orthopyroxene and clinopyroxene minerals in pyroxenite.

Petrogenesis

The study area lies within the northern continuation of the Mogok Metamorphic Belt (MMB) and Tagaung-Myitkyina Belt (TMB). The MMB and TMB are famous not only for its tectonic nature but also for gem minerals. Petrogenesis of igneous rock is based on petrographic criteria, field data and previous published literature.

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Field Criteria

1. Mafic microgranular enclaves are found in hornblende granite and granodiorite. In some places, gabbro is found as enclave in granodiorite. Most of the enclaves are ellipsoidal in shape and their size ranges from 2cm to 3ft.. In some rocks, plagioclase xenocrysts sparsed in enclaves that point to the local magma mingling within the host granite. These facts suggest that the introduction of mafic magma into the magma chamber and its subsequent cooling following incomplete mixing.
2. According to the geological map of the study area, granite and granodiorite contain 50 to 70% of the total outcrop area, diorite 5 to 10%, lherzolite and pyroxenite 5 to 10%. Dolerite and basalt contains 10 to 25% of the overall abundance but pillow structure is not found.
3. In the study area, the composition range from **basalt to rhyolite** in volcanic is corresponding by the **peridotite -diorite-granodiorite-granite** plutonic sequence. This igneous suite is similar to the Cordilleran-Type batholiths which exposed along the American Cordillera. Therefore, the igneous rocks from the study area may be formed by plumbing system feeding the continental arc volcanic.
4. Mostly discordant and some concordant structural relations to the country rocks.
5. Temperature of country rock, metasedimentary rocks, from the study area may be greater than 450°C, i.e.; the country rock belongs to amphibolite facies.

Petrographic Criteria

The estimate modal composition of granite, granodiorite and diorite are plotted on the QAP diagram for classifying the igneous rocks. In the diagram, some of the igneous rocks fall in the field of granite, granodiorite and diorite (Fig.17).

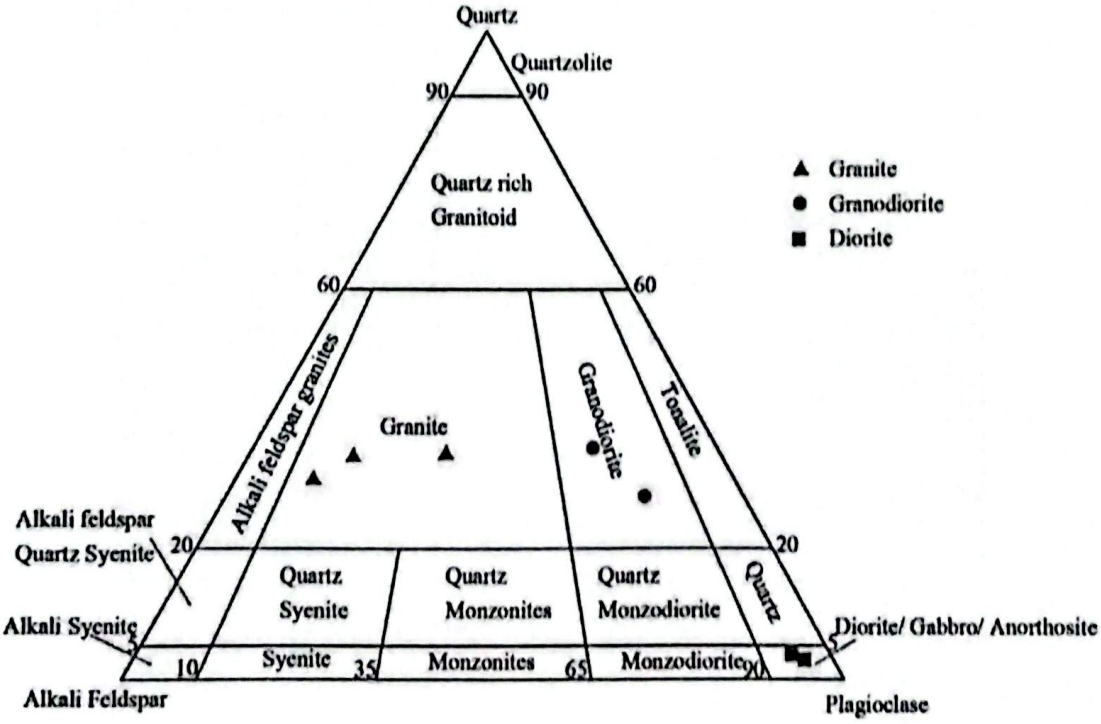


Fig (17) Q-A-P diagram for the granitic rocks of the study area (Source: Winter, 2010)

1. Under the microscope, hornblende is common mafic minerals in granite (Fig.18) and granodiorite whereas pyroxene and olivine constitute in lherzolite and pyroxenite.
2. Dolerite exhibits ophitic texture that indicates the minerals crystallized out of the magma to in a certain order: first plagioclase, then pyroxene.
3. Cross-hatched twin are frequent in alkali feldspar. Zoning and twinning are common in plagioclase (Fig.19).

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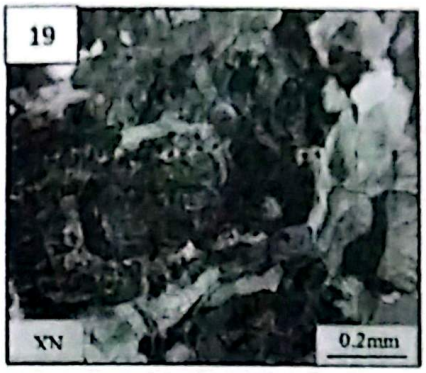


Fig (18) Photomicrograph showing hornblende mineral in hornblende granite.

Fig (19) Photomicrograph showing zoning and twining in plagioclase.

Discussion and Conclusion

The main rock units exposed in the study area are igneous and metamorphic rocks. According to previous works and field observation, the igneous rock unit exposed in this area is Middle Jurassic to Cretaceous in age and metamorphic rock units of Paleozoic in age. The igneous rock units are pegmatite/aplite, hornblende granite, granodiorite, diorite, basalt, dolerite, lherzolite and pyroxenite which exposed at the south-western part of the Bum Taung village.

According to field data, pegmatite is found as veins and small dykes. Some pegmatite veins show boudinage nature which indicates brittle-ductile deformation. Apalite and quartzo-feldspathic veins are intruded into metamorphic and all igneous units. Hornblende granite has complex nature with granodiorite, i.e., change from granitic to granodioritic composition within a batholith.

Under the microscope, pegmatite shows hypidiomorphic-granular texture and apalite displays allotrimorphic-granular texture. Hornblende granite shows holocrystalline, hypidiomorphic to xenomorphic granular texture. Granodiorite shows holocrystalline and hypidiomorphic granular texture. Diorite shows hypidiomorphic to xenomorphic-granular texture and basalt exhibit aphanitic and subophitic texture. Dolerite shows ophitic and subophitic textures. Lherzolite and pyroxene shows hypidomorphic granular texture. Cross-hatched twin are common in alkali feldspar and zoning and twinning are frequent in plagioclase.

All of the above facts collectively indicate that the igneous rocks from the study area may be formed as continental arc which related to India-Eurasia subduction or Meso- and Ceno-Tethys evolution during the Mesozoic and Early Cenozoic time. The origin of continental arc is rather complex. The magma source of igneous rocks may relate the partial melting of subduction oceanic plate generates primary magma and then at the base of the less dense crust where assimilation and the solidification of a gabboric crustal underplate process may take place. Subsequent partial melting of this mafic underplate may result from heat carried upward by subsequent basaltic magma. Fractional crystallization and contaminated by continental crust materials occurred when it travel through the crust. Some granite and pegmatite probably formed by partial melting of lower or middle crust.

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Sedimentray Facies and Environments of Devonian Units in Taungtalon-Nyaunggon Area, Pyin Oo Lwin Township

Mya Mya Win[1]

Abstract

The Devonian Zebingyi Formation and Maymyo Dolomite Formation of Taungtalon-Nyaunggon area is located to the North of Pyin-Oo-Lwin and forms western marginal part of the Shan Plateau region. The facies study together with modal analysis of carbonate-silicilastic sediments have been recently carried out to unravel the depositional environments of the Devonian succession. Nineteen facies types were distinguished from the detailed observation on both outcrops and thin sections under microscope. Each of the facies is incorporated into the six-lithofacies association as depositional architectural elements; shallow basinal, deep subtidal, shoal, lagoon, shallow subtidal and peritidal. The evidences of geometry and stratigraphy lead to the interpretation that the Devonian carbonate-siliciclastic sequence is accumulated on a homoclinal carbonate ramp.

Keywords: Devonian, Facies, Lithofacies

Introduction

The study area is located to the north of Pyin Oo Lwin and formed as a western marginal part of the Shan Plateau region. It is between the Latitude 22° 02' 48" to 22° 12' 18" N and the Longitude 96°23'12"E to 96° 31" 12' E. The present work seeks to document types of petrography of Zebingyi and Maymyo Dolomite formations and finally to reconstruct the environments in which the Devonian sediments were deposited.

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Materials and Methods

The study carried out for achieving the desired goals and objectives included two stages: field studies and laboratory studies.

I. Field Studies: First an investigation of the geological evidence was done together with a choice of the best exposures in the study area and seventy samples were taken basis on the facies and lithologic changes.

II. Laboratory Studies: Microscopic thin sections were prepared and studied with a polarized microscope for the petrographic analysis. Microfacies studies include the analysis of matrix and grains, textural features, fossil content, petrographic and energy index classification and standard microfacies zone by using Dunham, 1962 and Wilson, 1957. Correlation and interpretation criteria, along with depositional model, were determined from thin sections.

Results

Facies Analysis

These microfacies recognized are readily compared with the standard microfacies types (SMF) of Wilson (1975). Six major depositional environments are identified in the Devonian of the Taungtalon-Nyaunggon area based on a variety of sedimentologic indicators including grain types and textures, bedding styles and sedimentary structures, siliciclastic composition, as well as biofacies. The Devonian Zebingyi and Maymyo Dolomite Formations delineated 19 different depositional facies or lithotypes (Table. 1). These 19 lithofacies represent six major environments. These are peritidal, shallow subtidal, lagoon, shoal, deep subtidal and shallow basinal environments. The sedimentary depositional facies and facies relationships of those strata are as follow.

Shallow Basinal Lithofacies (FZ 1)

MF 1. Peloidal calcisiltite: It is dark grey to black and contains pellets with micro-bioclasts showing very fine grainstone or packstone textures. Locally, chert stringers are observed. This facies are thin-bedded, very even, planar, millimeter laminations and small scale rhythmic bedding consisting of very thin shale layers (Fig.1.A).

Interpreted depositional environment: The sediments and rhythmic bedding styles with millimeter scale lamination may be shallow basinal of SMF (2) and SFB (1).

MF 2. Ribbon limestone-marl rhythmites: They are marked as dark grey to black wackestone interbedded with light grey to reddish color, fossiliferous argillaceous limestone (marl). They contain pellets, ooids, calcispheres, tentaculites fragments, ostrcods, thin-shelled bivalves, algae (Fig.1.B). Silt size quartz, micrite nodules and some bioclasts are floated in the microstylolites seams. Cephalopods, crinoids' stems and other fossil fragments frequently occurred. Rhythmites are thin, even to nodular-bedded; showing very even planar millimeter lamination and no bioturbation.

Interpreted depositional environments: Rhythmites bedding styles, thin-shelled bivalves and very diverse shelly fauna show deeper water below normal wave base of FB (1).

Deep Subtidal Lithofacies (FZ 2)

MF 3. Packstone-siltstone-shale: Light to dark grey with abundant quartz silt of this facies contains calcispheres, thin-shelled fragments and cephalopods, crinoid and much pelleting of micrite matrix. Some are enough to form calcisiltite. Siltstone is generally quartz poor but shales are dolomitic (Fig.1.C). Thin to medium-bedded, wavy to nodular bedded packstone interbedded with thin to medium-bedded, bioturbated siltstone and they pass finining upward into shales; vugs (2-6 cm) filled with sparry calcite. Locally, small scale hummocky cross-stratification is common.

Interpreted depositional environment: Fauna, sediments and wavy to nodular bedding show deep quiet water below normal wave base of SMF (2) and FB (2).

MF 4. Bioclastic wackestone-fine calcisiltite: This facies represent dark grey wackestone with fine calcisiltite showing coarsening and fining upward sequences: wackestone with corals, thin-shelled bivalves, crinoids' stems and cephalopods; silt size quartz also common

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(Fig.1.D). Calcisiltites with few quartz grains are fine and unfossiliferous (Fig.1.E). Thin-bedded mudclasts-bearing wackestone interbedded with thin-bedded fine calcisiltite with shale cap are marked. Calcisiltite with planar lamination and burrows are common.
Interpreted depositional environment: Fauna and sediments show deep quiet water below normal wave base. These facies may resemble basinal sediment of SMF (2, 8) FB (2).

Shoal Lithofacies (FZ 3)

MF 5. Wackestone-packstone-grainstone: Dark grey to black wackestone interbedded with packstone containing abundant quarz silt; packstones are admixed to form as grainstone. Skeletal grains comprise fragments of crinoids, bivalves, corals, cephalopods and ostracods. Rare calcisphere and darker appearance of incipient pellets are randomly scattered. They contain microcrystalline dolomites with relics of packstone texture. Medium to thick-bedded, wackestone is wavy, even or nodular bedding with intercalated mud layers. Grainstone are even or possibly cross-bedded. Mudclasts are parallel to the bedding planes and fair common obvious birdseyes structure (Fig.1.F&G).
Interpreted depositional environment: Grain-supported texture, cross-bedded and erosion at the base indicate very shallow water and repeated subaerial exposure of high-energy shoal environment (Weidlich and Bernecker, 2007) of SMF (16) and FB (7).
MF 6. Oolitic-peloidal dolomitized packstone: Grey, tentaculites rich dolomitized packstone contains microcrystalline dolomite with ghost of ooids. Fragments of ooids, pellets and quartz silt are randomly scattered. Fragments of cephalopods, crinoids, trilobites, bivalves and some spicules are present (Fig.1.H). Medium to thick-bedded; wavy but weakly cross-bedded; rarely fenestrae vugs; burrows vertically penetrated the beds are markable.
Interpreted depositional environment: Mixing of ooids and pellets of this facies with cross-bedded showing slow accumulation of coarse material in zone of winnowing of SMF (14) and FB (6).
MF 7. Sandy packstone: Light grey to grey, sandy packestones are unfossiliferous where subrounded to rounded, quartz grains are floated in the micrite matrix; rare ooids with quartz nucleus (Fig.1.K). This facies show medium to thick-bedded, even or nodular bedded.
Interpreted depositional environment: Ooid admixed with rounded quartz sand and rarely bioclast fragments were probably deposited under high energy shoal environment of FB (6).

Lagoon Lithofacies (FZ 4)

MF 8. Peloidal packstone-shale: Greyish brown or reddish brown packstone consisting of pellets, quartz, gypsum, pyrite pigments and minute organic debris. Pellets and quartz grains are intimately mixed and enough to form a packstone (Fig.1.L). Locally with crinoids stem; silty shales are fissile and unfossiliferous. They are medium to thick-bedded and showing wavy laminations and lamonoid fenestrae. Thin-mud layers and concretions occurred in some parts. Hardground surfaces present.
Interpreted depositional environment: Low organic content, wavy laminations and shaly sandstone concretions might have accumulated in poorly agitated, poorly circulated reducing water of lagoonal basin of SMF (17) and FB (7).
MF 9. Fossiliferous peloidal dolomitized packstone-shale: Light grey, dolomitized packstone contains microcrystalline dolomite with relics of pellets. Locally, replacements of medium-grained crystalline dolomites also occur in some bioclastic grains. It is dominated by tentaculites but crinoids also common. Gastropod, bivalve fragments and cephalopods are frequently occurred (Fig.2.A). Shales are unfossiliferous. Medium-bedded; wavy laminations and non-laminar bubble fenestrae are present. Burrow common.
Interpreted depositional environment: Diverse shelly fauna, wavy laminations and bubble fenestrae indicate the shelf lagoon of SMF (19) and FB (7).
MF 10. Microbial wackestone: Grey to dark grey, wackestones yield abundant gastropods with brachiopods, crinoids' plates, bivalves and trilobite fragments. The gastropods and

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crinoid plates are trapped in the weakly laminae and layers of micrites. Pellets and euhedral to subhedral pyrite crystals are common. Calcispheres and microstylolites seams in some parts (Fig.1.B). They are noted as thick-bedded to massive; intercalated with mud layers; bioturbated and locally show cut and fill laminations.

Interpreted depositional environment: Thick-bedded to massive, microbial wacke-stones are part of the highstand system tracts. This facies is formed in very restricted bays and ponds of SMF (19) and FB (8).

MF 11. Dolomitic and bioclastic wackestone: Light to dark grey, dolomitic wackestone with large size and thick-shelled brachiopods fragments; microcrystalline dolomite has filled in the ooids. Abundant quartz silt and contain microcrystalline dolomite, pellets, euhedral to subhedral pyrite; crinoids, gastropods and algae. Some quartz grains are fine sand size and rounded to subrounded (Fig.2.C). They are marked as medium to thick-bedded, some show massive; dolomitized wackestone intercalated with calcareous shale; bioturbated and locally show cut and fill laminations; highly jointed and brecciated.

Interpreted depositional environment: The dolomitized mud supported that sediments were deposited in a shallow restricted lagoon (Alsharhan, 1992) of SMF (9) and FB (7).

MF 12. Homogeneous calcimudstones: Dark grey, homogeneous unfossiliferous calcimudstones which are consisting of randomly scattered angular quartz silt and pyrite grains (Fig.2.D). Thick-bedded to massive, wavy laminations; mud drapes or mud layers parallel to the bedding are marked and moderate bioturbation and algal laminations in some parts.

Interpreted depositional environment: The sediments, bedding styles and lack of fossils of this facies represent deposition in low energy environment but poor wave agitated water of a lagoonal environment of SMF (19) and FB (7).

MF 13. Dolomudstones: Whitish to light grey, dolomudstones contain microcrystalline dolomite with rare relics of pellets and some anhydrite patches; microstylolite seams in some parts (Fig.2.E). They are thick-bedded to massive, compact but highly jointed and locally with chert layers.

Interpreted depositional environment: The dolomudstone was probably deposited in a low-energy environment between a lagoon and the supratidal zone (Alsharhan, 1992) SMF (23) and FB (8).

Shallow Subtidal Lithofacies (FZ 5)

MF 14. Calcimudstone-siltstone: Dark grey to black unfossiliferous calcimudstone but rarely contain small fragments of cephalopods and brachiopods. Some authigenic quartz grains are floated in the matrix (Fig.2.F). They include medium to thick-bedded, calcimudstone interbedded with thin to medium-bedded siltstones. They show wavy or even to planar lamination and locally with concretions. Mud drapes in some parts; hardground present.

Interpreted depositional environment: Poorly fossiliferous, homogeneous and wavy laminations in this facies were probably deposited in shallow water with very moderate circulation of SMF (23) and FB (7).

MF 15. Dolomitized wackestone-packstone: Dolomitized poorly fossiliferous wackestone and packstone contain fine to medium-grained crystalline dolomite with ghost of ooids, pellets and some bioclasts. Microfractures are filled with calcite and/or dolomite crystals; iron-stained microstylolite seams in some parts (Fig.2.G). Very thickly-bedded to massive, highly brecciated, compact and showing discontinuous even or planar laminations are marked.

Interpreted depositional environment: The pore types have mainly intraparticle porosity with rare dissolution vugs representing the shallower parts of outer lagoonal area (Alsharhan, 1992) FB (8).

MF 16. Medium-grained quartzose sandstone: Pinkish, whitish or ash color, medium-grained, compact sandstone is a relatively pure quartzitic sandstone (Fig.2.H) and slightly

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iron-stained. Brachiopods and cephalopods contain in the lowerstmost sandy marl layer. They represent thin to medium-bedded but massive in some parts; generally lack of internal structures; intercalated with thin to medium-bedded, coal- bearing arenaceous limestones; fining and coarsening upward sequence with thinly laminated light grey or ash color shale.
Interpreted depositional environment: Compact sandstone intercalated with laminated mud layers; fining and coarsening upward succession indicate the complex of intertidal and shallow subtidal zones (Walker and James, 1992).

Peritidal Lithofacies (FZ 6)

MF 17. Laminite: Light grey to grey calcimudstone showing laminate and fining up sequence; some silt size quartz and manganese dark spots are mottled. Crinoids' stems and other fossils fragments are fairly common. Some are dolomudstone consisting of microcrystalline dolomite mottled with quartz grains and relics of pellets (Fig.2.I). They show very thin to medium-bedded; weakly laminated; fine-scale planar laminations associated with irregular fenestrae. These argillaceous limestones pass upward into laminated shale and locally show concretions.
Interpreted depositional environment: Laminated and fine-grained dolomites, desiccation features and fine-scale lamination associated with fenestrae represent peritidal environment(Tucker and Wright, 1990).
MF 18. Calcisiltite-calcimudstone: Light grey or pinkish calcisiltites with scattered silt size quartz grains; grey to black, calcimudstone contains clay-size grains of quartz and minute organic debris rarely anhydrite and microstylolite seams. In some parts cephalopods and crinoids also common. Calcimudstones are unfossiliferous and homogeneous (Fig.2.J&K). Thin to medium-bedded calcimudstones; beds of calcisiltites are commonly discontinuous and display fining upward grain-size. They show planar laminations but locally, wavy. Calcimudstones are structureless, compact and less bioturbated; common irregular fenestrae with some obvious birdseyes structures.
Interpreted depositional environment: Planar laminated and fining upward features, fine-scale lamination and fenestrae fabrics in this facies pointed out the low energy supratidal condition (Tucker and Wright, 1990) SMF (20) FB (8).
MF 19. Bioclastic wackestone-shale: Light grey to grey, bioturbated wackestones are shelly and argillaceous. Mostly, fragments of crinoids, bivalves and cephalopods are common. Clear silt size quartz grains are floated and blocky sparite filled in the shells. Shales are fissiles, dolomitized and unfossiliferous. Pyrite pigments and rare ooids with relatively thin cortices also present (Fig.2.L). Thin-bedded; weakly laminated; mud clasts parallel to the bedding planes and some are filled with calcite as laminoid fenestrae or birdseyes; locally, hardground. Moderately bioturbated and marl patches in some places.
Interpreted depositional environment: Thining and fining upward sequence with lamination, muddy and dolomitized shale caps of SMF (19) and FB (8).

Disscusion

In this study, peritidal facies are characterized by thinly laminated vertically burrowed micritic limestones. Dolomitize and some evaporate minerals within this facies indicating the potential hypersalinity and low-organic content and fenestrae fabrics are distinct features of this facies.

Shallow subtidal lithofacies are marked as mixed lithology. These facies show thickly-bedded to massive, planar laminations and concretions. They are nearly everywhere bioturbated but some are dolomitized. The occurrence of quartzose sandstone indicates the presumed coastline.

The lagoonal facies contains abundance of homogeneous mud-supported sediments or peloidal, diverse shelly fauna showing low energy condition but the presence of wavy lamination circulated reducing water of lagoonal environment. The variable amount of fine-grained quartz

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Table.1 Types of microfacies in Devonian Units

Facies type	Facies name	Texture and structure	Composition	Environment
MF 1	Peloidal calcisiltite	Thin-bedded, very even, planar, millimeter laminations	Pellets with micro-bioclasts	Shallow basinal
MF 2	Ribbon limestone-marl rhythmites	Thin, even to nodular-bedded	Pellets, ooids, calcispheres, tentaculites, ostrcods, bivalves, algae, silt size quartz	Deeper water below normal wave base
MF 3	Packstone-siltstone-shale	Thin to medium-bedded, finining upward	Calcispheres, cephalopods, crinoid and much pelleting of micrite matrix	Deep quiet water below normal wave base
MF 4	Bioclastic wackestone-fine calcisiltite	Thin-bedded, planar lamination and burrows	Corals, thin-shelled bivalves, crinoids' stems and cephalopods, silt size quartz	Deep quiet water below normal wave base
MF 5	Wackestone-packstone-grainstone	Medium to thick-bedded, even or nodular, cross-bedded	Quarz silt, crinoids, bivalves, corals, cephalopods and ostracods, pellets	shoal
MF 6	Oolitic-peloidal dolomitized packstone	Medium to thick-bedded, wavy	Microcrystalline dolomite ooids, pellets and quartz silt, cephalopods, crinoids, trilobites, bivalves	shoal
MF 7	Sandy packstone	Medium to thick-bedded, even or nodular bedded	Quartz grains in the micrite matrix	High energy shoal
MF 8	Peloidal packstone-shale	Medium to thick-bedded, showing wavy laminations and lamonoid fenestrae	Pellets, quartz, gypsum, minute organic debris	Lagoonal basin
MF 9	Fossiliferous peloidal dolomitized packstone-shale	Medium-bedded, wavy laminations and non-laminar bubble fenestrae	Microcrystalline dolomite	Shelf lagoon
MF 10	Microbial wackestone	Thick-bedded to massive, bioturbated, cut and fill laminations	Gastropods, brachiopods, crinoids' plates, bivalves and trilobite fragments	Very restricted bays and ponds
MF 11	Dolomitic and bioclastic wackestone	Medium to thick-bedded, bioturbated, cut and fill laminations	Microcrystalline dolomite, quartz silt brachiopods, crinoids, gastropods , algae pellets, euhedral to subhedral pyrite	Lagoonal
MF 12	Homogeneous calcimudstones	Thick-bedded to massive, wavy laminations, algal laminations	Quartz silt, pyrite grains	Lagoonal
MF 13	Dolomudstones	Thick-bedded to massive, some chert layers	Microcrystalline dolomite	Between a lagoon and the supratidal zone
MF 14	Calcimudstone-siltstone	Medium to thick-bedded, wavy or even to planar lamination	cephalopods and brachiopods. authigenic quartz grains	Shallow water
MF 15	Dolomitized wackestone-packstone	Very thickly-bedded to massive, discontinuous even or planar laminations	Crystalline dolomite, bioclasts	Shallower parts of outer lagoonal area
MF 16	Medium-grained quartzose sandstone	Thin to medium-bedded, fining and coarsening upward sequence	Quartz, brachiopods, cephalopods	Intertidal and shallow subtidal zones
MF 17	Laminite	Very thin to medium-bedded, weakly laminated, fine-scale planar laminations	Silt size quartz, crinoids' stems, fossils fragments	Peritidal
MF 18	Calcisiltite-calcimudstone	Thin to medium-bedded, planar laminations, discontinuous and display fining upward, irregular fenestrae	Silt size quartz grains, minute organic debris	Low energy supratidal condition
MF 19	Bioclastic wackestone-shale	Thin-bedded, weakly laminated, laminoid fenestrae or birdseyes,	Crinoids, bivalves, cephalopods, silt size quartz	Peritidal

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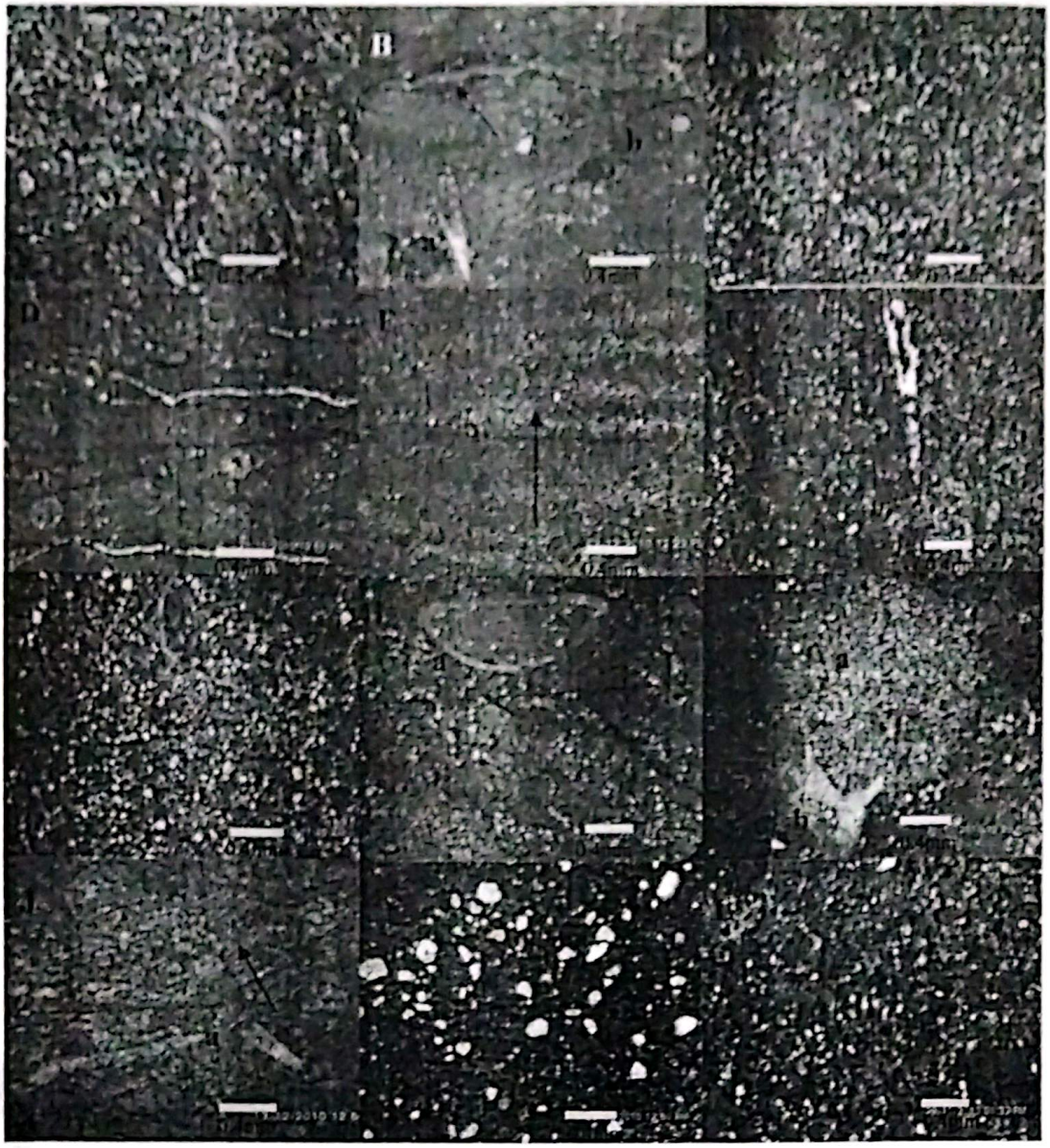


Fig. 1 **Photomicrographs of microfacies from the Devonian Units (A) Peloidal calcisiltite with microbioclasts (MF1), (B) Wackestone (MF2) showing micrite nodules, tentaculites (a), ostracods, (b) and microstylolite seams (arrow), (C) Packstone (MF3) with abundant quartz silt, pellets and crinoid plate, (D) Bioclastic wackestone (MF4), (E) Fine calcisiltite (MF4) with laminae grading from fine calcisiltite up to dark micrites (arrow), (F) Wackestone to packstone (MF5) spar filled fenestrae (a) in the center may have been a tentaculite, (G) Cross-bedded grainstone (MF5), (H) Oolitic peloidal, dolomitized packstone (MF6) tentaculite (a), (I) Oolitic peloidal, dolomitized packstone (MF6), dolomitized ooid (a) and crinoid plate (b), (J) Tentaculite rich dolomitized packstone (MF6) tentaculites (a), and lamination (arrow) (K) Sandy limestone (MF7), (L) Peloidal packstone (MF8) abundant quartz silt, dark color pellets and anhedral pyrite.**

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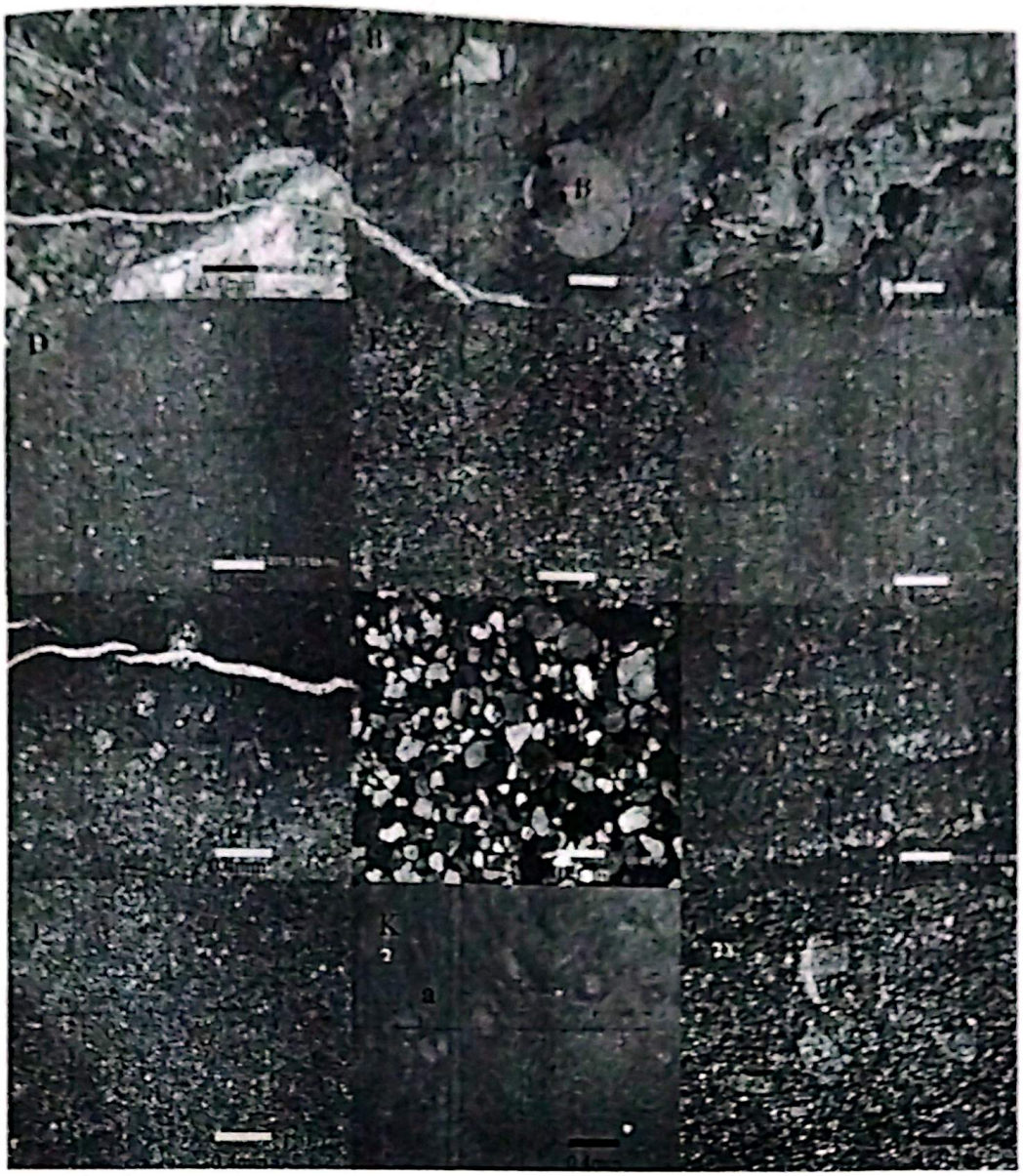


Fig. 2 **Photomicrographs of microfacies from the Devonian Units (A) Fossiliferous peloidal dolomitized packstone (MF9) (a) tentaculites, and crinoid plate (b), (B) Microbial wackestone (MF10) containing crinoid plate (a), gastropod (b) and subhedral to euhedral pyrite crystal (c), (C) Dolomitic bioclastic wackestone (MF11) with thick-shelled fragment of brachiopod, (D) Homogeneous calcimudstones (MF12) with quartz silt, (E)Dolomudstones (MF13) including microcrystalline dolomite, (F) Calcimudstones (MF14), (G) Dolomitized wackestone-packstone (MF15) with colonial rugose corals (a) and calcite seam (b), (H) Medium-grained quartzose sandstone (MF16) containing moderately sorted, rounded to well rounded quartz grains, (I) Laminite (MF17) millimeter laminae grading from coarse sediment up to fine sediment (arrow), (J) Calcisiltite (MF18), (K) Calcimudstone (MF18) showing algae (a), (L) Bioclastic wackestone (MF19) showing weakly lamination, shell fragment (a).**

(silt size) in these sediments and shale indicate that lagoon had carbonate-terrigeneous sedimentation and these siliciclastic sediments transported from rivers on the shoreline or from shoal.

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Shoal facies are marked by sorted packstone to grainstones with cross-bedded and wavy, even or nodular bedded. The occurrence of coarse grain sizes indicate that these rock units were commonly influenced by wave winnowing processes. Burr-owing is absent and winnowing of comminuted crinoids, bivalves and ostracods debris is recognized.

Deep subtidal facies contain some storm beds with lesser amount of siliciclastic to dolomitic shale that represent quiet water deposition. Some show small scale hummocky cross-stratification and wavy to nodular bedding. The fining upward from an erosional base of calcisiltite or sorted fine packstone passes into shale is remarkable.

Shallow basin is characterized by ribbon limestone with rhythmic-bedding, chert stringers and even, planar millimeter lamination. Calcisiltite with much pellets and microbioclasts are marked. The dark organic-rich thin-shale and marl layers suggested that they were deposited in environments that were very much oxygen-depleted or otherwise euxinic.

The carbonate-siliciclastic sequence of the Devonian units of the present area show the environmental characteristics of a typical carbonate- siliciclastic sequence similar to the sequence of Wilson, 1975. The peritidal- to- basin lithofacies associations are shown in the modified figures (3) and (4) based on Tucker and Wright, 1990 and Read, 1983.

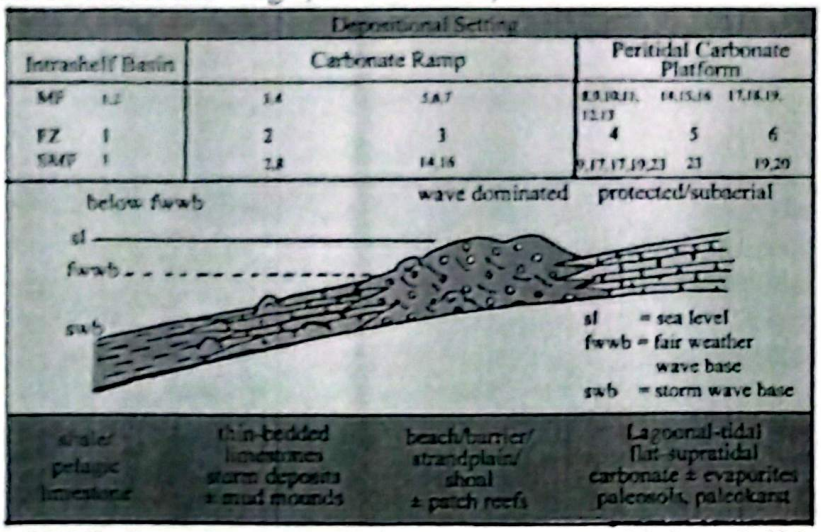


Fig.3 Early to Middle Devonian homoclinal carbonate ramp with intrashelf basin model of Medaw-Nyaunggon area. Modified after Tucker and Wright, 1990 & Holland, Brett and others, 2004.

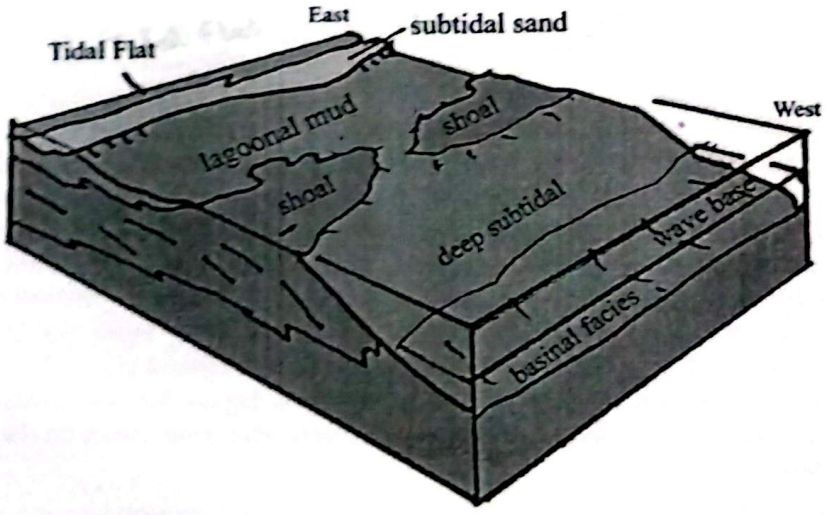


***Fig.4* Carbonate ramp facies model during Early to Middle Devonian. Modified after Read, 1985.**

Conclusion

The Devonian stratigraphic succession in the study area is recognized as Zebingyi Formation and Maymyo Dolomite Formation. The Devonian units were mixed carbonate-siliciclastic sequence, rich fossils and displaying facies change parallel to and across the regional NE-SW trend. Current data of grain types, sedimentary structures, vertical and lateral facies relationships with typical fossils and geometry indicate that Devonian sediments were deposited on a gently sloping, low energy condition homoclinal carbonate ramp.

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The Petrographic Criteria of the Metamorphic Rocks in the Bomin Taung Area, Katha Township, Sagaing Region

Than Thet Mar[1], Aye Aye Nyein[2]

Abstract

The study area is situated between Naba and Katha townships, Sagaing Region. In the study area, metamorphic rocks are low to medium grade, regionally metamorphosed schist and quartzite with metabasite, and a few sedimentary rocks. The metamorphic rocks units are subdivided into three informal units based on dominant minerals and lithologies. These rock units are primarily derived from pelitic and psammitic rocks with metabasite of Ngapyawdaw Chaung Formation of Late Jurassic to Early Cretaceous age and fall within the green schist to amphibolite facies. The metamorphic grade is increase from east to west and chlorite, biotite, garnet and staurolite zones are formed. The time of metamorphism could be assigned to Late Eocene to Early Oligocene.

Key words : Pelitic, psammitic, dominant minerals, lithology

Introduction

The study area constitutes the north western part of Katha Township, Sagaing Region. It lies between N 24° 10' to 24°15' and E 96° 15' to 96° 20'. The total coverage area has about 35 square miles. The area occupies one-inch topographic maps 92 D/3, 92 D/4, 92 D/7 and 92 D/8 respectively.The location map of the study area is shown in Fig.(1).

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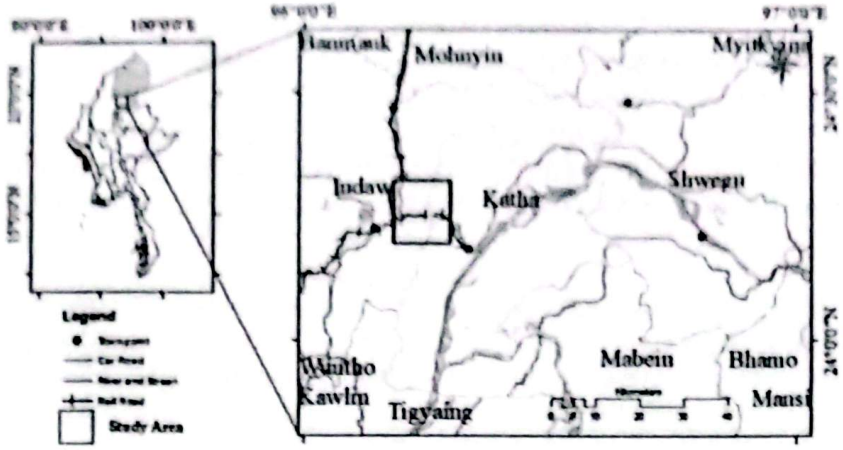


Fig.(1) Location map of the study area

The study area, Bomin Taung is mainly composed of low to medium grade regionally metamorphosed rocks which occupies parts of Katha Metamorphics. Based on constituents mineral assemblages, lithologic character, grade of metamorphism, these metamorphic rocks can be subdivided into three informal units. Unit-I : Garnet graphite schist, Garnet chlorite biotite graphite schist, Garnet hornblende graphite schist, Garnet Staurolite Schist ; Unit-II : Epidote albite chlorite schist, Metabasite, Actinolite chlorite schist, Biotite chlorite schist; Unit-III : Talc chlorite schist, Talc chlorite graphite schist, Graphite schist, and Graphite bearing quartzite. The general trends is NNE-SSW and dipping south eastward. The geological map of the study area is shown in Fig.(2).

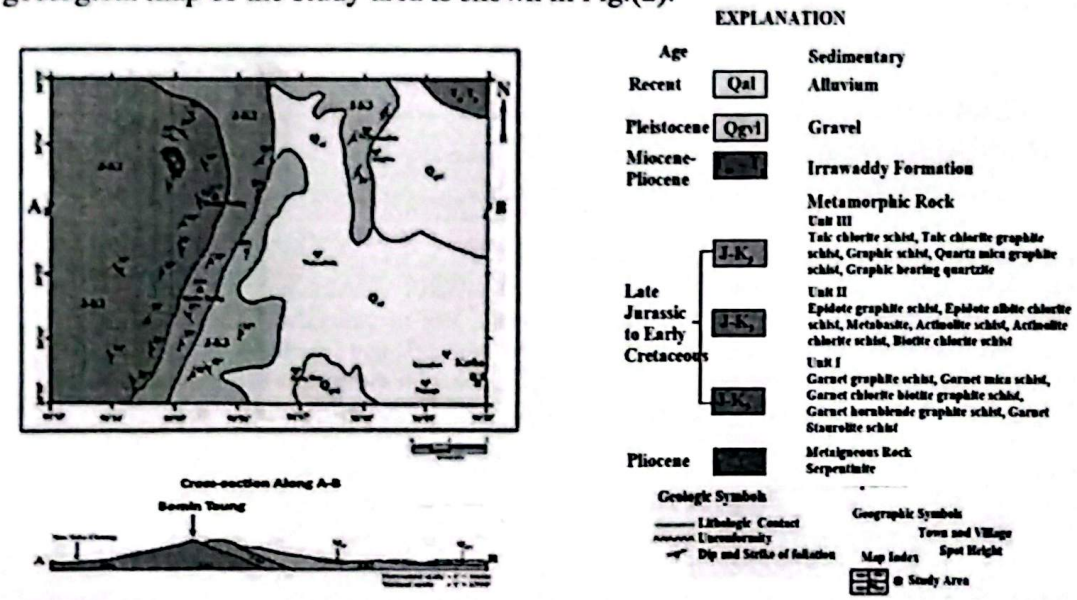


Fig.(2) Geological Map of Bomin Taung area, Katha Township. (Modified from Thaire Phyu Win, 2011)

Depending on the field observations, structural trends and lithology, the possible rock sequences of the study area is given in Table(1). The petrographic study in the present area is maded on field observations, microscopy and other available published and unpublished geological informations.

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Table 2.1 Rock Sequeces of Bomin Taung area

Lithologic Units		Age
Sedimentary Units		
Recent Alluvium		Recent
~~	Unconformity	~~~~~~~~~~~~~~~~~~~~
Gravel		Pleistocene
~~	Unconformity	~~~~~~~~~~~~~~~~~~~~
Irrawaddy Formation		Pliocene to Pleistocene
~~	Unconformity	~~~~~~~~~~~~~~~~~~~~
Metaigneous Rocks		
Serpentinite		? Tertiary
Metamorphic Rocks		
Unit III (Upper Unit)		Late Jurassic
Talc-chlorite-schist, Talc-chlorite-graphite-schist, Graphite-schist, Graphite-bearing-quartzite		
Unit II (Middle Unit)		to
Epidote-albite-chlorite-schist, Metabasite, Actinolite-chlorite-schist, Biotite-chlorite-schist		
Unit I (Lower Unit)		
Garnet-graphite-schist, Garnet-chloritebiotite-graphite-schist, Garnet-hornblende-graphite-schist, Garnet-staurolite-schist		Early Creataceous

Petrography

In the study area, at least 45 thin sections were made from representative rock units. Petrographic descriptions were based on modal composition, textures of Willian, Turner and Gilbert (1953) and field observation. In the study area, the lower Unit. I are mostly exposed at western part of Bomin Taung. The middle Unit-II is well distributed at the eastern part of the Bomin Taung area. The upper Unit-III also occurred eastern, southearthern and northearst thern parts of this area respectily.

Unit-I

Garnet Graphite Schist

It is dark color, thinly foliated and strongly schistose, intercalated and folded with graphite bearing quartzite Fig.(3-A).This rock is hard, compact and reddish brown color garnet grains are highly concentrated.This rock contains garnet (10%), quartz (25%), muscovite (15%), feldspar (20%), graphite (25%) and little amount chlorite (5%). The groundmass is muscovite, quartz and graphite. The large euhedral to subhedral garnet porphyroblasts, 0.3 to 0.5`mm in size, occur in a fine-grained matrix. Strings or aggregated layers of graphite are parallel and aligned with foliation and warp around the garnet porphyroblast Fig(3-B).This rock exhabits porphyroblastic texture due large grain, garnet crystals enclosed in a finer grained, matrix Fig(3-C)

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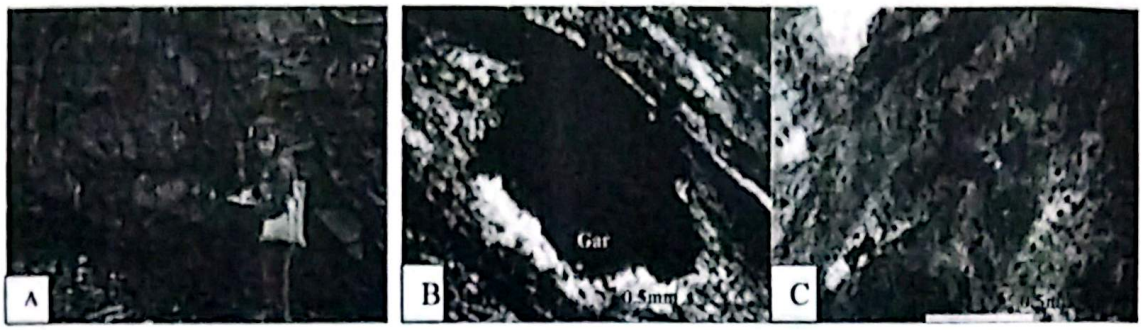
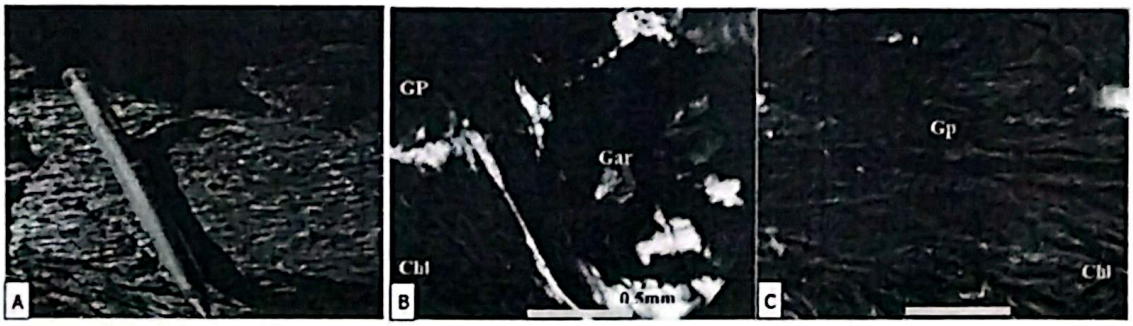


Fig (3). Photograph showing garnet graphite schist (N 24° 14' 29.4"-E 96° 16' 34.5"). A. Garnet graphite schist intercalated with the folded and banded quartizite B. Garnet porphroblast is developed in well foliation of garnet graphite schist (PPL). C. Minute, anhedral garnet grains littered in garnet graphite schist(PPL)

Garnet Chlorite Biotite Graphite Schist

It appears light greenish grey color on fresh surface and weathered green color, little soft . This rock have thinly foliated and garnet grains are parallel alignment on superfacial rock Fig.(4-A). This rock is composed of biotite (15%), chlorite (10%), graphite (10%) and porphyroblasts of garnet (15%) , plagioclase (25%), quartz (20%) and iron ore minerals (5%). This rock has porphyroblastic texture in which (0.5 mm) euhedral garnet grains in a fine matrix of chlorite and graphite. Quartz, albite and magnetite inclusions are embedded in skeletal garnet porphyroblasts which tend to warp along the foliation plane (Fig.4-B). Rotated porphyroblast garnet in this rock gives sense of ductile shear. The inclusion assemblages in garnet are larger size than the surrounding matrix. This fact pointed out the nucleation and the growth of garnet crystal has gone to the progade metamorphism. The foliation is intensely crenulated due to the parallelism of biotite, chlorite and graphite minerals. This rock also show fine grained texture with crenulation cleavage and kink bands (Fig.4-C).

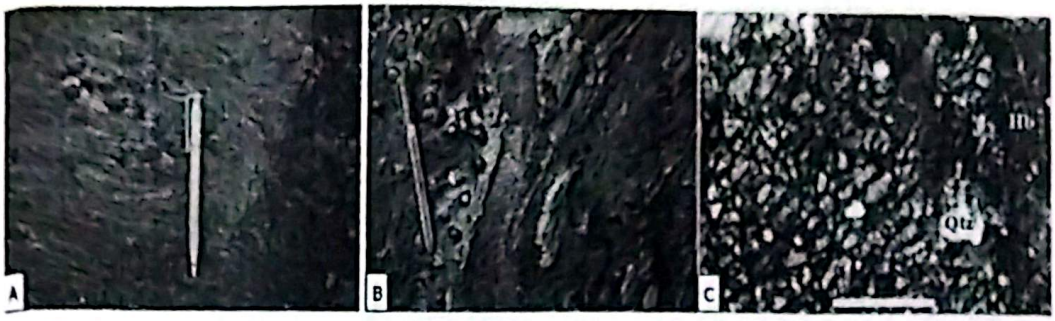


Fig(4). Photograph showing garnet chlorite biotite graphite schist (N 24° 16' 46"-E 96° 14' 30"). A. linear arrangement of reddish brown garnet grainsB. Inclusions bearing garnet porphyroblast tends to warp around the foliation plane.(XPL) C. Strongly schistosity with crenulations cleavage and kink bands. (XPL)

Garnet Hornblende Graphite Schist

It is dark grey , faint foliation, and medium to coarse grained garnets are embedded along the surficial foliation plane Fig(5-A). Quartz veins are formed as patches and lens shaped Fig(5-B) This rock consists of hornblende (25%), or brownish red garnet (20%), graphite (15%) plagioclase (70%) and quartz (20%).Brown or green, hornblende with ragged termination are dominant minerals. The polarization color of hornblende is bright 2nd order, grain size ranges from 0.1mm to 0.3mm in length. Fine-grained inclusions in garnet 0.5mm to 1mm are predominantly of quartz showing skeletal texture Fig(5-C). Ground mass is anhedral quartz, albite, muscovite and graphite is strings of dark grains following foliation and association of homblende and opaque minerals.

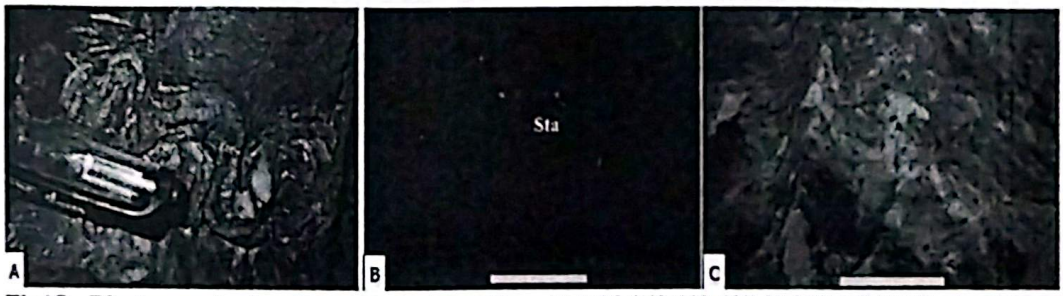
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Fig(5). Photograph showing garnet hornblende graphite schist (N 24° 14' 18"-E 96° 14' 57"). A. Coarse grained garnets are embedded along the surficial foliation plane.. B. Quartz patches and lens and garnet grains in hornblende graphite schist. C. Skeletal garnet porphyroblast with quartz inclusion

Garnet Staurolite Schist

Medium to thick bedded, hard and compact, weathered dark grey color and bluish grey color on fresh, small scale symmetrical folding can be seen Fig(6-A).This rock unit is composed of staurolite (15%), garnet (15%), graphite (15%), muscovite (20%), quartz (20%), feldspar (oligoclase) (15%) and other opaque minerals. Staurolites are euhedral to subhedral porphyroblast which have 0.5mm in size, high relief, straw yellow color in PPL position Fig(6-B). They show strongly pleochroic in yellow and brownish-yellow shades, twining often seen and polarization colors slightly higher than quartz. Its distinctive feature is minor small scale folding produced by the parallel orientation of quartz, mica, staurolite bands and garnet, graphite bands Fig(6-C). Schistosity is formed by fined garined quartz muscovite, garnet and feldspar minerals.



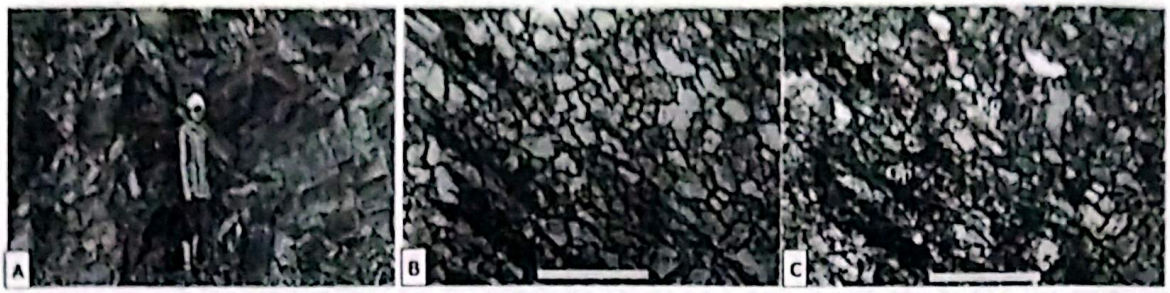
Fig(6). Photograph showing garnet staurolite schist (N 24° 12' 49"-E 96° 16' 21"). A. Minor symmetrical folded in garnet sturolite schist (pan cap scale 4cm),. B. Euhedral staurolite porphyroblast set in fine matrix. (PPL) C. Minute garnet grains occurs as small scale folding. (PPL)

Unit-II

Epidote Albite Chlorite Schist

This rock have striking differene colors buff on weathered and pale green fresh surfaces, medium to thick bedded, intercalated with graphit schist, and highly jointed Fig(7-A) This rock is mainly composed of epidote (30%), chlorite (10%), quartz (25%), albite (20%) and minor mangnetite (5%) and graphite (10%). Epidote is fine to medium grain granules and colorless, high relief in PPL position color zonging in XPL. The parallelism of these grains are intergrowth with albite and chlorite forming granoblastic texture. The parallel alignment of epidote, albite, chlorite minerals gives the well foliation in nature Fig(7-B,C). Small irregular flakes chlorite is pale yellowish green in PPL and smiple twin albite laths, graphite strings and opaque minerals are observed.

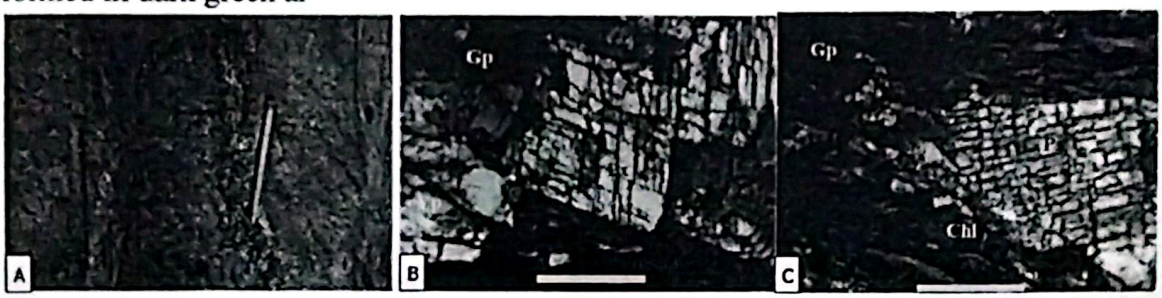
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Fig(7). Photograph showing epidote albite chlorite schist (N 24° 12' 57"-E 96° 16' 39"). A. Medium to thick bedded nature of yellowish or buff color. B. Epidote minerals are parallel alignment with many strings graphite.(PPL) C. Color zoning epidote minerals and albite crystals are parallism. (XPL)

Metabasite

This rock is medium to coarse grained and show dark green color. Strongly aggregated and mostly parallelism of pyroxene minerals are formed Fig(8-A). It is composed of pyroxene (30%) (possibility orthopyroxene), plagioclase feldspar (30%), and opaque minerals magnetites (5%). This rock retains relics of pre-extisting igneous minerals and textures, with metamorphic chlorite (5%), epidote (5%), actinolite (10%), mica (10%) and quartz (5%) under extensive metamorphism. The original pyroxene is euhedral to subhedral, pale-greenish, the pleochroism not well-mark. The polarization color shows first order grey, good cleavages nearly 90° are highly altered because of cloudy appearance and the fringe of pyroxene is incipiently crowded with small garnet grains.Corroded, relicts of pyroxene are sharply defined Fig(8-B,C). Basal section of pyroxene mineral range in 0.5 to 0.8mm in length and squarish form. The alteration minerals are chlorite, actinolite, muscovite and quartz formed in dark green ar

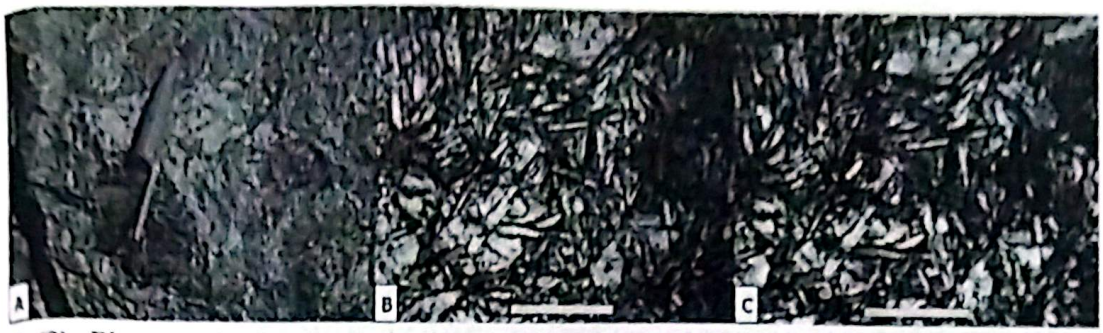


Fig(8). Photograph showing metabasite (N 24° 14' 36"-E 96° 14' 55") A. Medium to coarse grained pyroxene mineral seggregation on surfical bodies. B. Corroded lozense shape and basal section of pyroxenes (XPL). C. Tiny plates inclusions (iron oxide) in pyroxene found in metabasite (XPL) C.

Actinolite Chlorite Schist

The fresh surface shows light green to grey color and dark to greenish grey color on weathered. Thin to medium bedded, highly brecciated and easily fragmentation Fig(9-A). This rock is composed of actinolite (50%), chlorite (20%), albite (10%) with minor biotite (7%), quartz (10%) and a few amount of opaque minerals (3%) (magnetite and illmanite). actinolite forms accicular or needle shape and less preferred orientation. Actinolite shows yellowish green color and markedly shades of yellow and green in pleochroism. Polarization colors of this mineral exhabit bright 2nd order. Minute lath shape albite twin plagioclass, anomaloces brown interference color chlorite laths and anheedral quartz are disperse throughout the matrix. Muscovite and biotite occur as laths shape. This rock show diablastic texture formed by composed of non-aligned, radiating to randomly oriented acicular actinolites, chlorites, albite and muscovite Fig(9-B,C)

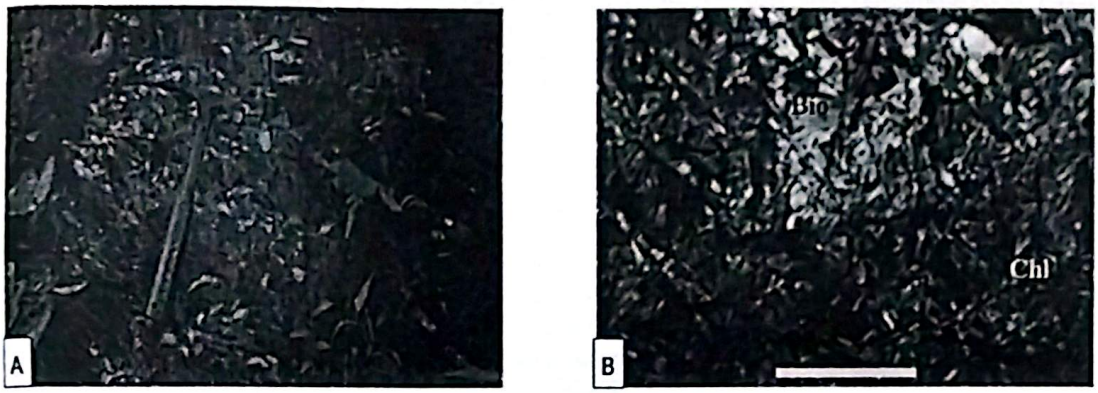
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Fig(9). Photograph showing actinolite chlorite schist (N 24° 15' 0.05"-E 96° 17' 49"). A. Aggregates of accicular actinolite crystals. B. Diablastic texture produced by actinolite, chlorite minerals. (PPL) C.(XPL)

Biotite Chlorite Schist

It is light yellow color on wealthered surface and grey color on fresh surface, well foliated and friable nature, in tercalated with graphite schist and graphite bearing quartzite Fig(10-A). The rock composed of biotite (35%), chlorite (20%), muscovite (10%), quartz (15%), feldspar (15%) and minor accessory magnetite (5%). In thin section, biotite appears as laths, shape, yellowish to brownish yellow and shows strongly pleochroic in brown, reddish brown color. It is subhedral to enhedral, polarization colors masked by strong body color. The poorly aligned biotite and chlorite minerals give lepidoblastic texture and poorly schistose texture Fig(10-B). The bright interference colors in this rock are due to the high proportion of biotite present. Fine grained groundmass are muscovite, plagioclase quartz and opaque minerals.



Fig(10). Photograph showing biotite chlorite schist (N 24° 10' 36.4"-E 96° 16' 15.2"). A. Highly brecciated or thinly foliated. B. Weakly foliated, lepidoblastic texture of biotite and chlorite minerals. (XPL)

Unit – III

Talc Chlorite Schist

This rock is whitish gray on weathered and light green color on fresh surface and silky lustre due to presence of talc and chlorite minerals. This unit has thinly foliated layers, friable, soft and soapy appearance Fig(11-A). This rock mainly composed of fine-grained talc (35%), chlorite (25%), white mica (10%), quartz (10%), feldspar (15%) and other accessory minerals (5%). Talc formed as flaky crystals and colorless in plane polarized light. Talc is resembled to muscovite in thin section but is distinguished in the hand specimen of the rock. Talc reveals bright higher order pink and green like as muscovite. Fibrous aggregates of chlorite shows greenish color and bending inter growth with muscovite. The foliation of the rock is defined by the parallel orientation of chlorite, talc and muscovite gives schistose texture Fig(11-B,C). Quartz, mica and albite feldspars are more or less elongated and complex fabric due to deformation.

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Fig(11). Photograph showing talc chlorite schist (N 24° 14' 33"-E 96° 14' 54"). A. Light color, soft and soapy feeling of talc chlorite schist. B. Delicate high order pink polarzation colors showing talc mineral in schistose texture (PPL). C. (XPL)

Talc Chlorite Graphite Schist

The weathering color is dark greenish grey color on reddish grey and dark grey color in freshy. This rock shows thinly foliated, soft and little sopy appearance, minor small scale folding, S-shape quartz veins are well observed Fig.(12-A). This rock is essentially composed of talc (40%), chlorite (25%), graphite (10%), muscovite (10%), quartz (10%), and other accessory minerals (5%). In thin section, talc occurs as laths or wisps shaped in thin slice. Talc minerals are colorless in PPL and delicate high order green polarization color under XPL. Talc may be misidentified by muscovite but can be distinguished by hand specimen. This rock displays strongly schistose texture due to the parallel arrangement of talc, chlorite, graphite and muscovite flakes Fig(12-B,C). Chlorite and graphite aggregates define a complex fabric and aligned with foliation plane. Muscovite and albite feldspar are present in minor amount.

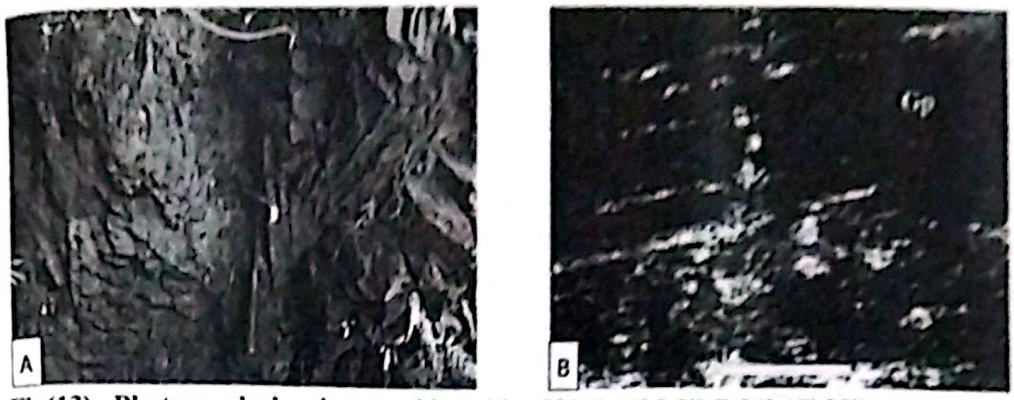


Fig(12). Photograph showing talc chlorite graphite schist (N 24° 10' 58"-E 96° 16' 17"). A. S-shaped quartz veins(5-feet in length) minor folding on thinly foliated, little soft greasy rocks. B. Excellent schistose and well marked foliation (PPL). C. (XPL)

Graphite Schist

It is well distributed, thin to medium foliated, lead grey or dark grey color, sub-metallic lustre, soft, friable and fine grained texture. This unit have S-shaped quartz veins, micro folds, kink bands and minor drag folds Fig(13-A) This rock is mainly composed of quartz (35%), muscovite (20%), graphite (25%), feldspar (10%) and chlorite (10%). Graphite is primarily identified by its occurrences as strains or strings of dark grains following the foliation. Strongly preferred orientation of muscovite and a lesser extent of chlorite produce schistosity in rock. Sutured quartz grains, turbid feldspars grains and shapeless muscovite, fibrous chlorite are formed as fined matrix. The parallelism of muscovite and graphite is slightly contorted and across the foliation plane Fig(13-B). This rock also shows lepidoblastic texture because of platy minerals (chlorite, graphite and muscovite) are predominantly concentrated.

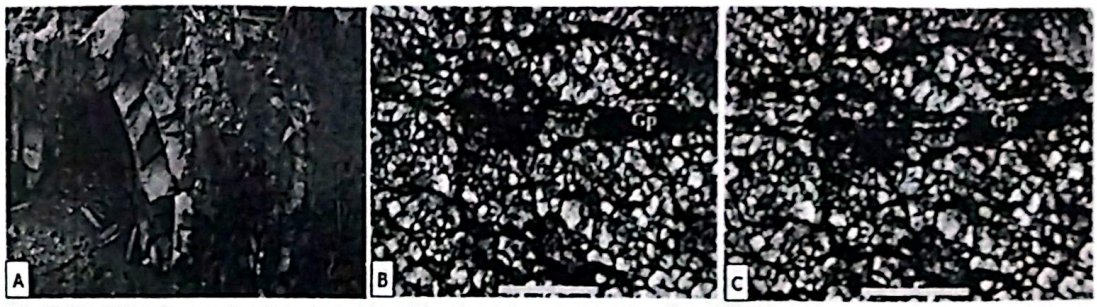
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Fig(13). Photograph showing graphite schist (N 24° 16' 0.3"-E 96° 17' 35"). A. Microfold, kink bands nature.
B. Strongly schistosity and slightly curved (PPL).

Graphite Bearing Quartzite

This rock is characterized by hard and compact, fine to medium grained texture, medium to thick bedded or foliated, and jointed and slightly curve in nature Fig(14-A). Weathering dark grey color and whitish grey on freshing, interculated with graphite schist. It comprise of dominant quartz (85%), graphite and minor accessory minerals are (15%). Most of the quartz grains have suture boundaries and show undulatory extinction. Graphite is occurrences as trains or strings of dark gray to dark color under XPL. Most of the graphite strings are randomly oriented as labyrinthic pattern and yields poorly schistose texture. Fig. (14-B,C). Minor amounts of mica, feldspar and opaque minerals are observed.



Fig(14). Photograph showing graphite bearing quartzite (N 24° 12' 13.5"-E 96° 16' 49"). A. Medium to thick foliated, slightly folded nature. B. Graphites strings are forming as web-like or labyrinthic pattern.(PPL). C. (XPL)

Explanation

Actinolite = Act , Biotite = Bio , Chlorite = Chl , Epidote = Ep , Feldspar = Feld , Garnet = Gar , Graphite = Gp , Hornblende = Hb , Muscovite = Mus , Plagioclase = Plg , Pyroxene = Px , Quartz = Qtz , Staurolite = St

Types of Metamorphism and Time of Metamorphism

Prograde regional metamorphism is formed by the occurrence well foliations, mineral lineation, schistosity and rotation of large porphyroblasts and crenulation cleavage; recrystallization and neomineralization products such as garnet porphyroblasts, actinolite and hornblende; appearance of new minerals or sequence of zones; inclusion assemblage in garnet pointed out the nucleation and the growth of garnet crystal; strongly preferred orientation of mica, distorted mica flakes, ragged terminated hornblende, intensely fractured grains in schist and minor tightly folded or kink bands are suggest that this area may be slightly occurred dynamic metamorphism. Radiometric dating for the study area has not been done, so there is no precise time of metamorphism. According to, Ghose and Sign (1950), Mitchell and Me Kerrow (1975), Mitchell (1993), M.O.G.E (1998), Bertrand et al. (1999,2001), Garnier et al (2006), Aung Win (2008), Myo Min (2007), Tharie Phyu Win (2011) and several others have established the time of metamorphism in the study area is based on the regional framework,

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lateral continuitity and lithologic similarity. Radiometric ages performed on metamorphic rocks, in the Katha and Kuman ranges indicate the time of metamorphism is 37 to 32 Ma. (G.I.A.C Project, 1999).Therefore, the time of metamorphism in the present area could be assigned to Late Eocene to Early Oligocene.

Metamorphic Mineral Assemblages and Metamorphic Facies

Based on the petrographic analysis, (8) representative equilibrium mineral assemblages are defined: (4) in metapelites and (4) in metabasites.

Mineral Assemblages in Metapelites

Talc+Chlorite+Muscovite+Quartz

2.Chlorite+Biotite+Muscovite+Albite+Quartz+ Graphite

3. Garnet+Chlorite+Muscovite+Biotite +Quartz+Graphite

4. Garnet+ Staurolite + Biotite + Muscovite + Quartz

Mineral Assemblages in Metabasite

5. Actinolite+Epidote +Chlorite + Albite + Quartz + Magnetite

6. Epidote + Chlorite + Quartz +Garnet +Albite

7. Hornblende + Albite + Garnet + Epidote + Actinolite

8. Pyroxene + Epidote + Chlorite + Plagioclase + Garnet + Magnetite

On the basis of various mineral assemblages, the study area may be recognized as greenschist facies to epidote-amphibolites facies. The greenschist facies is marked by chlorite+muscovite+albite+quartz+epidote mineral assemblages and temperature pressure condition is low to moderate metamorphism. In epidote amphibolite facies, mineral assemblages of garnet +biotite+muscovite+quartz and staurolite+garnet+ biotite+muscovite+ quartz for metapelitic rocks; and the hornblende+epidote +garnet+ plagioclase for metabasite of temperature condition is slightly above 500°C (Bucher and Frey, 1994).

Metamorphic Zone

The metamorphic zones are defined by the index mineral or minerals and appearance or disappearance of minerals.Depending on the mineral parageneses, metapelitic rocks are divided into chlorite, garnet, biotite and staurolite zones. Chlorite zone are represented by talc chlorite schist and chlorite schist. Garnet zone is marked by the first appearance of almandine garnet porphyroblast. When temperature and pressure increase, minerals in chlorite zone unstable and give garnet zone of medium pressure and temperature conditions. Biotite zone is defined by the first appearance of biotite in chlorite+muscovite+ biotite+graphite+quartz assemblages. In biotite zone, minor chlorite and variable in plagioclase composition indicates increase in temperature conditions 420°C at about 3.5 Kb (Bucher and Frey, 1994). Staurolite zone is recognized by the occurence of garnet-staurolite schist. The first appear staurolite and almandine garnet marks the transition from the greenschist facies to amphibolite facies of temperature slightly above 500°C of (Bucher and Frey, 1994) in metapelitic rocks. Metabasite rocks are also divided into chlorite zone and garnet zones in order of increasing metamorphic grade. Metabasite in the chlorite zone is relatively undeformed and primary mineral pyroxene is well preserved and plogioclase is transformed into chlorite, epidote and actinolite. In the chlorite zone, distinct mineral assemblages is pyroxene, plagioclase, actinolite, garnet, chlorite, magnetite and quartz. The garnet zone are marked by the assemblages of garnet, hornblende, epidote and plagioclase with minor muscovite, quartz and magnetite. The metabasite rock is differs from pelitic schist in mineralogy(Bucher and Frey,1994) suggested changes from greenschist facies to amphibolite facies as decrease in abundance of actinolite, chlorite, epidote and albite ; increase in abundance of hornblende, garnet and Ca-plagioclase.

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Discussion

The study area , the rock units are composed of Katha Metamorphic rocks, especially pelitic to psammitic schists and metabasites. Type of metamorphism is recognized regional metamorphism, which reflects the occurrence of strongly foliated, mineral lineations and segregation, recrystallzation and neomineralization products such as garnet, actinolite and hornblende. Locally, less dynamic metamorphism is also noted by sutured grain boundary, undulose extinction, intensely fractured grains and crenulation of mica flakes. The metamorphic grade is increase from east to west due to the progressive changes of minerals such as chlorite, biotite, garnet and staurolite. Based on the mineral assemblages the study area fall within the greenschist facies to epidote amphibotite facies. The petrogenesis study by mineral assemblages leads to conclusion of metamorphic conditions are about 420°-550°C and 0.35-0.6 Gpa (Bucher and Frey, 1994). Generally, The lower Unit-I consist of dominant garnet and staurolite can be assumed garnet and staurolite zone. The middle Unit-II is probably defined biotite zone and the upper Unit-III is considered as chlorite zone. In the study area garnet-staurolite schist, biotite-chlorite schist, garnet-graphite schist belong to pelitic group. Quartzite and epidote schist posses psammitic type. Actinolite and garnet-hornblende-schist fall in basic group. Some graphite schist and graphite bearing quartzite may probably be alternate sequence of pelite and quartzose sandstone. The abundant constituents of garnet in schist indicate Fe and Mg rich parent rock. Graphite schist may come from organic rich sediment. The minerals assemblages actinotite, epidote albite and chlorite in actinolite schist and hornblends, epidote, actinolite and albite in hornblende graphite-schist of two rocks unit are closely related and suggests that the emplacement of basalt layers and later deposition of pelitic sediments over them.

The time of metamorphism can be correlate with the neighbouring area and depending the regional structure, and lithologic similarity have been established many authors. Metamorphic rocks exposed in the study area were stated Katha-Gangaw Ranges by Clagg (1941) as Precambrian; Bender (1983) Paleozoic rocks of the West Kachin Highlands; Myit Thein et al, (1983) Katha-Gangaw Range may be correlated with Tagaung Kyaukphyu area. La Ja, (1985) and Aung Kyaw Thin (2006) described microfossils, radiolarian from chert of Ngapyawdaw Chaung. Formation at Tagaung area as Late Jurassic to Early Cretaceous. With the lack of Cretaceous limestone, the metamorphic rocks exposed in the present area is partly similar and derived from Ngapyawdaw Chaung Formation of Late Jurassic to Early Cretaceous in age.

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Stratigraphy and Depositional Environments of the Rock Units Exposed in Kin Area, Kyaukse Township, Mandalay Region

Wai Mar Hlaing[1]

Abstract

The study area is located in Kyaukse Township. The rocks units in study area crop out in descending order: Chaungmagyi Group (Precambrian), Pindaya Group (Ordovician), Mibayataung Group (Silurian), Thitsipin Limestone Formation (Permian) and Nwabangyi Dolomite Formation (Early to Middle Triassic). The dominant lithology of the Chaungmagyi Group is metasedimentary rocks with tight and complex foldings. The Pindaya Group has two lithologic units of formational ranks that are Lokepyin and Wunbye Formations. Mibayataung Group consist the Linwe Formation. The Thitsipin Limestone Formation is highly fossiliferous. Moderately preserved ammonites are collected from the cephapodal limestone horizon in Nwabangyi Dolomite Formation. The metasediments of the Chaungmagyi Group in the study area are deposited in deep-water, reducing environment in a geosyncline. The Lokepyin Formation may be accumulated in a warm, slightly agitated, shallow-marine environment. The Wunbye Formation deposited in a warm, shallow, marine environment. The Linwe Formation was possibly deposited in a slightly agitated, warm, fairly deep-marine environment with alternating oxidizing and reducing condition. Thitsipin Limestone Formation could be laid in warm, shallow, open sea environments. The dolomitic limestone of the Nwabangyi Dolomite Formation may be deposited in a shallow carbonate shelf.

Key words: *metasediments, limestone, shallow-marine environment*

Introduction

The study area is situated in Kyaukse Township, is bounded by north latitudes 21˚ 24' to 21˚ 30' and east longitude 96˚ 18' to 96˚ 23' in one inch topographic map 93 C/7. Location map of the study area is shown in Fig.(1). The study area locates at the eastern part of Shan Boundary Fault.

The area occupies south-eastern part of the kyaukse Township. The study area lies in the western marginal zone of the Shan massif. It is bounded by the Eastern Trough in the west

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and the Myogyi Uplift in the east. Structurally, the area lies between the Shan Boundary Fault in the west and the Pan Laung Fault in the east. The regional geologic setting of the study area is shown in Fig.(2).

The Kin area is part of a Precambrian to Mesozoic shelf in which the stratigraphic sequence consists of the Chaungmagyi Group, the Ordovician Pindaya Group, the Silurian Mibayataung Group and Permian-Triassic Plateau Limestone Group. To the east (Pindaya Range), the Precambrian Mogok Gneiss is faulted against thick Ordovician strata (Pindaya Group, Myint Lwin Thein, 1973) which overlies the Molohein Group.

The Chaungmagyi Group widely exposes the inner part of a major anticline, located in the North of Ye-U and Ywa-ngan Township. This unit is widely distributed in the north-east and east of study area. There, the Lower Paleozoic rocks are unconformable overlain by the Permian-Triassic sequence of the Plateau limestone Group. The rocks of Pindaya Group (Ordovician) expose between Padauk-aik and Kin villages and occupying the highest ranges in the area. They are trending in the NNW –SSE direction.

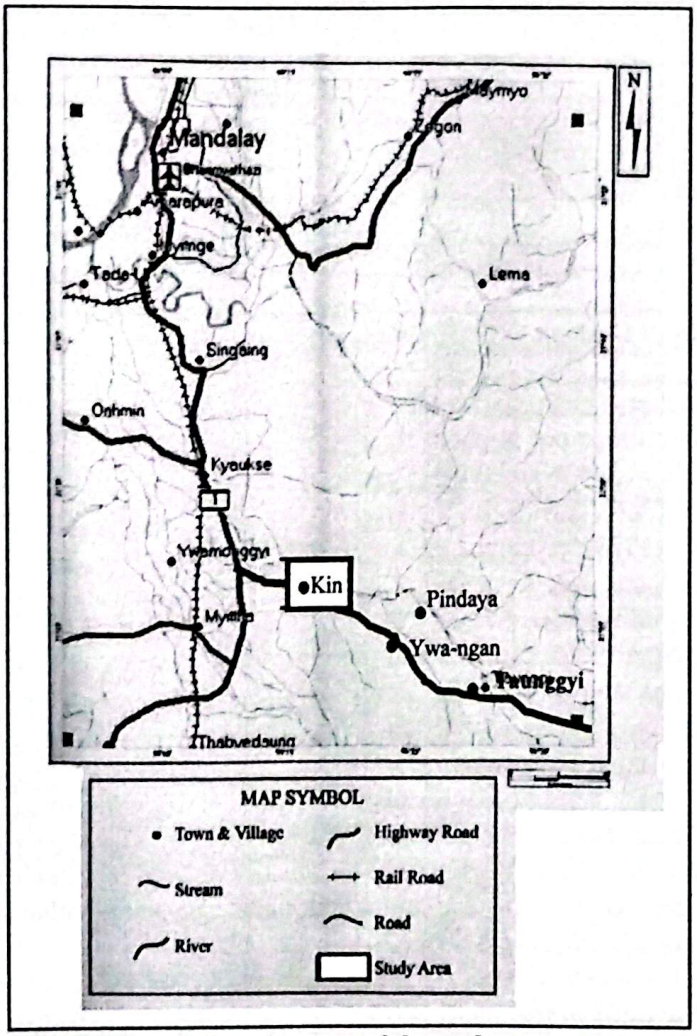


Fig.1 Location map of the study area

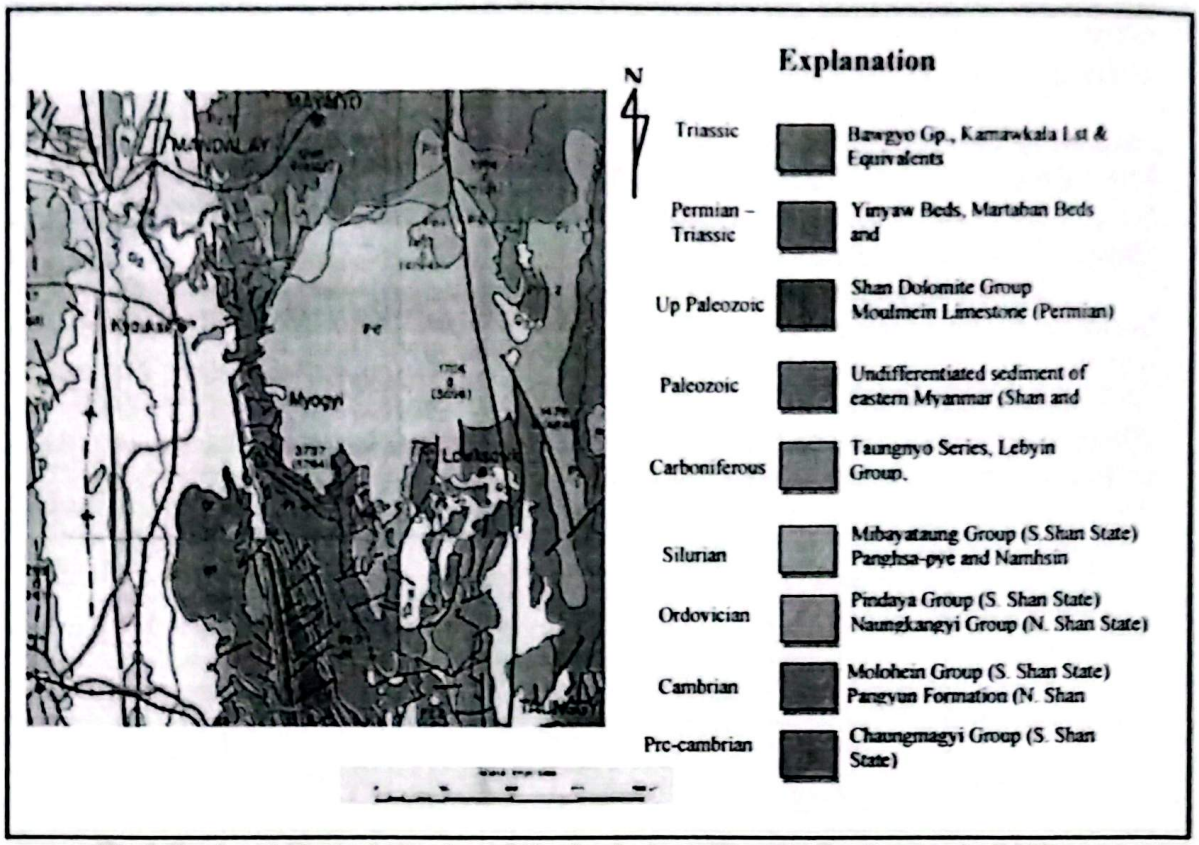


Fig.2 Regional Geologic Setting of the Study Area (Source: Bender, et *al.*, (1983)

The Linwe Formation (Early to Middle Silurian) exposes in the intermountain valleys. Especially, this unit crops out at about three miles south- east of Kin village. The Plateau Limestone Group is widely exposed at the whole of western part of the Kin area. Maung Thein and Ba Than Haq (1969), carried out the Pre-Paleozoic and Paleozoic stratigraphy of Burma. Myint Lwin Thein (1973), proposed the lower Paleozoic stratigraphy in the western part of the Southern Shan State.

The geology of the adjoining area to the north was done by Hla Min (1980) mentioned that the Chaungmagyi metasediments and the Ordovician limestones were exposed in the Bodawgyi range. The study area had been mapped and studied by Ko Ko Myint (1989). Zaw Win (1991) studied the lithostratigraphy and carbonate petrology of Lungyaw, Sakangyi area in Myittha and Ywa-ngan Townships.

Materials and Methods

The specimens were collected from all formations along the Kin-Myogyi car-road , Kyaukse Township, Mandalay Region. The sections have been measured bed by bed and samplings have been collected depending on rock units. The petrographic study and modal analysis have been undertaken with about 20 thin sections.

Stratigraphy

Lithostratigraphic units of the Study Area

The study area occupies a small segment in the western margin of the Eastern Shan Highlands. The Paleozoic sequence of the present area contains dominantly carbonate rocks. There are five lithostratigraphic units, Chaungmagyi Group (Precambrian), Lokepyin Formation (Early Ordovician), Wunbye Formation (Mid-Ordovician), Linwe Formation (Early Silurian) and Plateau Limestone Group (Permian to Triassic). The geological map of the Kin area is shown in (Fig.3).

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1. Chaungmagyi Group

In the study area, the Chaungmagyi Group is well exposed in the stream section and road-cuts, especially along the Zawgyi River, and the vicinity of Hseywa village. The general lithology is metagreywacke which is NNW-SSE trending. This Formation is the oldest one in the study area. The upper part of the Chaungmagyi Group occupies the area between the eastern slope of Bodawgyi Taung and north of Hseywa village.

The lower part of the Chaungmagyi Group consists of a thick sequence of low-grade metasedimentary rocks. It is mainly composed of medium to thick-bedded, hard and compact, greenish grey metagreywacke intercalated with silt partings and silt patches (Fig.4.a).

The upper part of this unit is composed of thin-bedded phyllites, slates and metagreywackes (Fig.4.b). Thin to medium bedded foliated chlorite phyllite is very common. Weathered surface displays a reddish, whitish and grayish color and flaggy appearance.

Fauna, Age and Correlation

The Chaungmagyi Group unconformably underlies the Pindaya Group which is faunally dated as Ordovician in age. Based on its stratigraphic position and lithology, the Chaungmagyi Group of the study area can be correlated with the Chaungmagyi Series of La Touche (1913), Chaungmagyi Group of Garson et. al (1976) and Myint Lwin Thein (1973). On the basis of stratigraphic position, the low-grade metasedimentary rocks of the Chaungmagyi Group are assigned to Late Precambrian age.

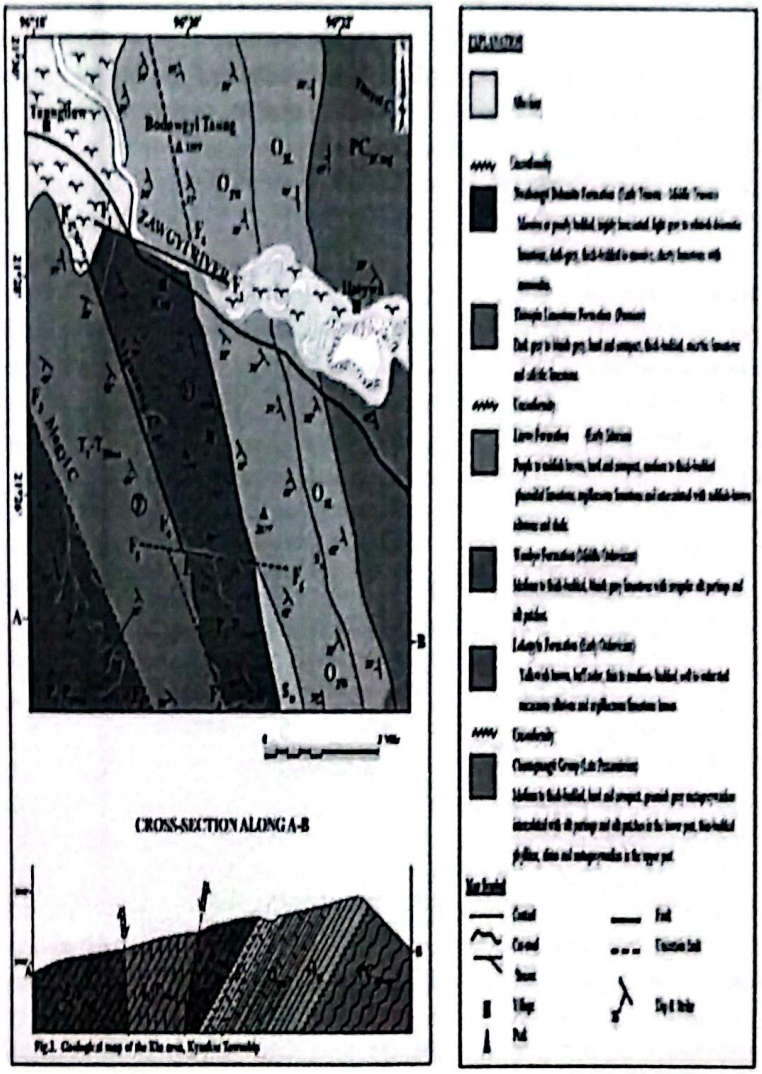


Fig.3 Geological map of the Kin area, Kyaukse Township
(Source: modified from Dr. Ko Ko Myint, 1989)



(a) (b)

Fig.4. (a) Photograph showing medium to thick-bedded, hard and compact, yellowish grey to greenish grey metagreywacke intercalated with dark green slate of the lower part of the Chaungmagyi Group

(b) Photograph showing the greenish grey, thin-bedded chlorite phyllites and slates of the upper part of the Chaungmagyi Group.

2. Pindaya Group

Myint Lwin Thein (1973) established the Ordovician units in the western part of southern Shan State which are well distributed in the Pindaya and Bawsaing ranges. These units are Tanshauk Member, Nan-on Formation, Wunbye Formation and Lokepyin Formation from top to bottom. Among them, Lokepyin Formation (Early Ordovician) and Wunbye Formation (Middle Ordovician) expose and overlies the Chaungmagyi Group in the study area.

2.1 Lokepyin Formation

In the present area, this Formation crops out along the car-road between Kyunpingaing and Padauk-aik and also exposes at the eastern slope of Bodawgyi range. These strata show a general trend of NNW-SSE. This unit is more developed on the northern side of the Zawgyi River than on the southern side. The stratigraphic measurement of the Lokepyin Formation is carried out along the motor-road and its thickness is approximately 2000 feet.

Lithology

The lower part of this formation is mainly composed of yellowish brown, buff color, thin to medium- bedded, soft to indurated micaceous siltstone and argillaceous limestone lenses (Fig.5.a). The upper part of this unit comprises thin to medium-bedded, grey to pinkish limestone intercalated with calcareous marl (Fig.5.b). The general trend of the Lokepyin Formation is NNW-SSE and dips to the west from 30° to 45°.

Fauna, Age and Correlation

Trilobite (*Asaphid* sp.), Brachiopod (*Dalmanella* sp.) and locally Orthid brachiopods abundant and crinoid stems are collected by Garson et al. (1976) and Myint Lwin Thein (1973) from the Lokepyin Formation. According to these faunal assemblages, the age of the Lokepyin Formation is regarded as Early Ordovician in age.

Stratigraphically, this unit conformably underlies the Wunbye Formation. Middle Ordovician fauna were obtained from the limestones of the Wunbye Formation. Thus, the age of this Formation in the study area may be assigned to Early Ordovician according to the stratigraphic position.

This Formation can be correlated with the lower Naungkangyi Bed of La Touche (1913) in northern Shan State on the basis of lithology and stratigraphic position.

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(a) (b)

Fig.5.(a) Photograph showing the yellowish brown, buff color, thin-to medium- bedded, soft to indurated micaceous siltstone and argillaceous limestone lenses of the Lokepyin Formation.

(b) Photograph showing the thin-to medium-bedded, grey to pinkish limestone intercalated with calcareous mud of the Lokepyin Formation.

2.2 Wunbye Formation

This unit is widely distributed at the east of Kin village, west of Kyunpingaing village and at Bodawgyi Taung. This unit has a general trend of NW-SE and dips in south-west direction with 25°-50°.

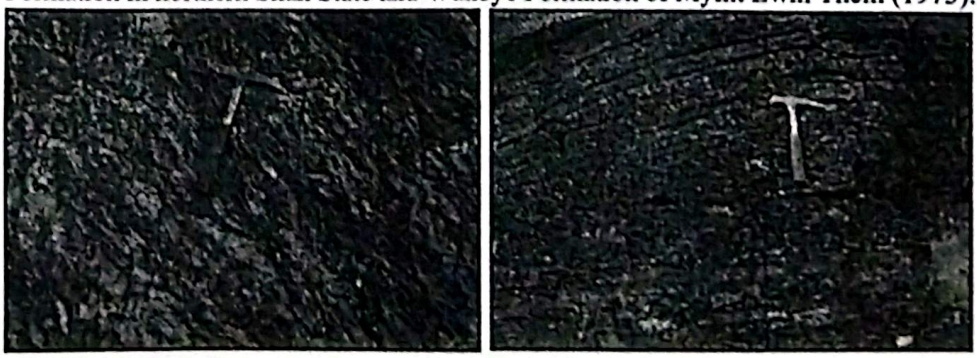
Lithology

The lower part of the Wunbye Formation is mainly composed of medium to thick-bedded, bluish grey limestone with irregular silt partings and silt patches (Fig.6.a). These units are folded, highly jointed and joint planes are filled with iron oozes, silt particles and calcite. Burrowing structures are also formed in this limestone. The upper part of the Wunbye Formation comprises the stromatolitic limestone with small scale cross-lamination and irregular silt-parting (Fig.6.b).

Fauna, Age and Correlation

This unit is usually fossiliferous, especially fossils are found in bioclastic limestone and burrowed limestone. Myint Lwin Thein (1973) collected *Actinoceras* sp., *Armenoceras* sp., *Endoceras* sp. and *Ormoceras* sp. and large gastropods from the Wunbye Formation of the Ywa-ngan area.

On the basis of lithologic character, faunal assemblage and stratigraphic relation, the age of the Wunbye Formation is assigned as Middle Ordovician. The Wunbye Formation of the study area can be correlated with the lower Naungkangyi Stage of La Touche (1913), Sitha Formation in northern Shan State and Wunbye Formation of Myint Lwin Thein (1973).



(a) (b)

Fig.6.(a) Photograph showing the medium-to thick-bedded, bluish grey limestone with irregular silt partings and silt patches of the Wunbye Formation.

(b) Photograph showing the medium-to thick-bedded, bluish grey stromatolitic limestone of the Wunbye Formation.

3. Linwe Formation

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The Linwe Formation is exposed at three miles about south-east of Kin village, trending NW-SE. In this area, this formation forms a narrow, ribbon-like strip intervening between the Wunbye Formation and Plateau Limestone Group.

Lithology

Linwe Formation is mainly composed of grey to purple to reddish brown, hard and compact, medium to thick-bedded phacoidal limestone, argillaceous limestone and intercalated with reddish-brown siltstone and shale (Fig.7.a).

Fauna, Age and Correlation

Michelinoceras sp. and *Monograptus* sp. and *Climacograptus* sp., had been collected from the phacoidal limestone and white shale in Pindaya Range of the western part of southern Shan State (Myint Lwin Thein, 1973). He regarded as Early Silurian for the Linwe Formation.

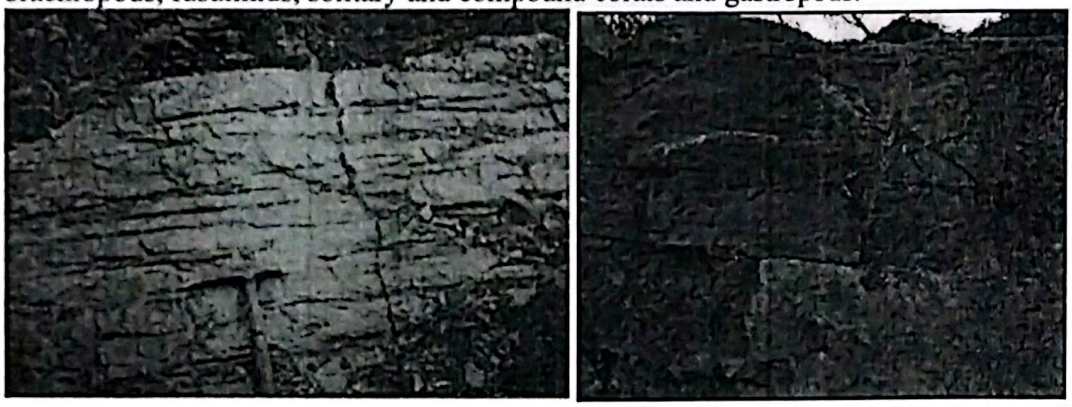
On the basis of lithologic features and faunal content, the age of the Linwe Formation of the study area can be assigned to Early Silurian.

4. Thitsipin Limestone Formation

The Thitsipin Limestone Formation is well exposed at the western flank of Kin range near Kin village. To the west, the unit disappears under the alluvial cover and crops out again between Manaung and Magyi Chaungs as two isolated hills (Htidawyeik and Taungdaw). These strata have a trend of NW-SE with 20° – 30° dip towards SW.

Lithology

The Thitsipin Limestone Formation is mainly composed of dark grey to bluish grey, hard and compact, thick-bedded, micritic and calcitic limestone (Fig.7.b). These limestones are commonly massive but locally thinly laminated to well-bedded, which contains brachiopods, fusulinids, solitary and compound corals and gastropods.



(a) (b)

Fig.7.(a) Photograph showing the purple to reddish brown, hard and compact, medium to thick-bedded phacoidal limestone,of the Linwe Formation..

(b) Photograph showing the dark grey to bluish grey, hard and compact, thick-bedded, micritic limestone and calcitic limestone of the Thitsipin Limestone Formation.

Fauna, Age and Correlation

Gastropod : Gastropod coiling (Fig.8.a)

Coral : *Syringopora* sp. (Fig.8.b)

Parafusulina sp. and *Pseudofusulina* sp. of the foraminiferal assemblages were collected in the Dattaw-Taungmema area, Kyaukse Township, approximately about 10 miles north of the present area (Zaw Min Thein, 2006). The compound corals such as *Syringopora* sp. is found in the micritic limestone of the Thitsipin Limestone Formation.

Than Naing (1978) collected *Syringopora* sp., *Lithostrotion* sp., *Fenestellina* sp. and *Productus* sp. from the Dattaw limestone of the Plateau Limestone Group in Kyaukse Township. He assigned as Middle to Late Permian for this unit.

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Therefore, the faunal content indicates that the Thitsipin Limestone Formation may be Early to Late Permian. The Thitsipin Limestone Formation of the study area can be correlated with the Thitsipin Limestone Formation of Garson et. *al.* (1976).



(a) (b

Fig.8.(a) Photograph showing the gastropods coiling in the calcitic limestone of the Thitsipin Limestone Formation. (Loc. N 21° 27'30", E 96° 19'32")
(b) Photograph showing the *Syringopora* sp. in the calcitic limestone of the Thitsipin Limestone Formation. (Loc. N 21° 27'35", E 96° 19'51")

5. Nwabangyi Dolomite Formation

The Nwabangyi Dolomite Formation exposed in the area between Manaung and Magyi Chaungs. This unit is faulted against to the Thitsipin Limestone Formation.
the area between Manaung and Magyi Chaungs. This unit is faulted against to the Thitsipin Limestone Formation.

Lithology

The Nwabangyi Dolomite Formation is composed of massive or poorly bedded, highly brecciated, light grey to whitish dolomitic limestone (Fig.9.a). This dolomitic limestone shows crystalline texture giving rise to sugar appearance. In some places, dark-grey to black, thick-bedded to massive, cherty limestone which is about 4 to 6 feet thick occurs as a cephapodal limestone horizon. Moderately preserved ammonites and mostly fragments are collected from the cephapodal limestone horizon.

Fauna, Age and Correlation

Several ammonite fossils are collected from Nwabangyi Dolomite Formation.

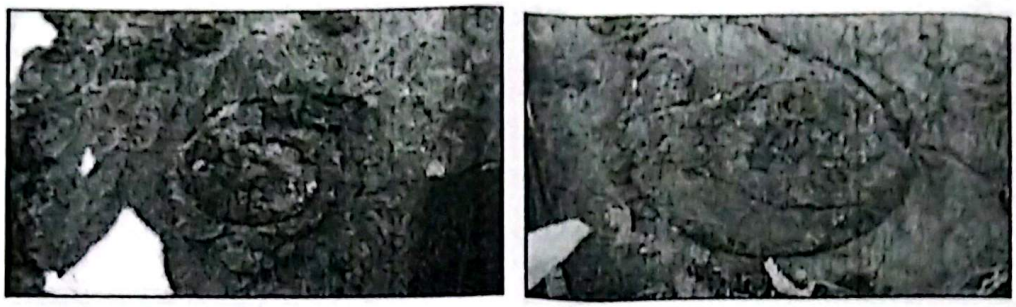
Cephalopods : *Ceratites* sp. (Fig.9.b)
Columbites sp. (Fig.10.a)
Danubites sp. ? (Fig.10.b)



(a) (b)

Fig.9.(a) Photograph showing the massive or poorly bedded, highly brecciated, light grey to whitish dolomitic limestone of the Nwabangyi Dolomite Formation. (Loc. N 21° 27'22", E 96° 19'37")
(b) *Ceratites* sp. (Loc.N21°27'21", E96°19'37")

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(a) (b)

Fig.10. (a) *Columbites* sp. (Loc.N21°27'21", E96° 19' 39")
(b) *Danubites* sp.? (Loc.N21°27'21", E96° 19'39")

Dr. Myint Thein et *al.* (1988) have reported the occurrence of Early Triassic Ammonites from the upper part of the Plateau Limestone exposed at the northern part tip of the Dattaw Range, NE of Kyaukse. Dr. Zaw Win (1991) has been collected from the cherty limestone unit bearing a cephalopodal horizon which includes ammonites (*Meekoceras* sp., *Danubites* sp. *Ceratites* sp. and *Ptychites* sp.) and assigned as Early to Middle Triassic (upper Anisian).

The age of Nwabangyi Dolomite Formation in the Kin area is regarded as Early to Middle Triassic (Upper Anisian) according to lithologies and faunal contents.

The Nwabangyi Dolomite Formation of the present area is correlated with the Nwabangyi Dolomite Formation of Garson et. *al* (1976) on the basis of both lithology and stratigraphic position.

Depositional Environments

1. Chaungmagyi Group

Metagreywacke, phyllite and slate in the Chaungmagyi Group are deposited in deep-water environment. The thick sequence of metagreywacke and slate are a product of geosynclinal sedimentation (Pettijohn, 1974).

The presence of pyrite in slate and phyllite suggest that it is formed in a stagnant and reducing environment. The presence of small folds in slate and phyllite of the Chaungmagyi Group are resulted by low-grade regional metamorphism. Thus, the field observations and lithologic sequence suggest that the sediments of the Chaungmagyi Group in the study area are deposited in deep-water, reducing environment in a geosyncline.

2. Lokepyin Formation

According to Scoffin (1989), the presence of pellets in limestone indicates in low-energy, warm, restricted sea circulation. From the above evidences, the Lokepyin Formation may be accumulated in a warm, slightly agitated, sha
llow-marine environment.

3. Wunbye Formation

The stromatolitic structures in the limestones of the Wunbye Formation formed by calcareous algae which bind the fine detritus and calcium carbonate precipitated biochemically. The colour variation of limestone in this formation was influenced by the changing E_h (oxidation-reduction potential) condition.

According to the lithologic characters and faunal content, the depositional condition of the Wunbye Formation was a warm, shallow, marine environment.

4. Linwe Formation

The colour variation of limestones in Linwe Formation may be assumed that the beds were deposited under varying E_h condition. The pigment of the sediment is partly due to the ratio of the ferrous and ferric iron. From the above facts, it is concluded that the Linwe Formation was deposited under alternating oxidizing and slightly reducing conditions.

The nodular bedding of the limestone is the obvious structure of the Linwe Formation. On the basis of lithologic and petrologic features, faunal content and sedimentary structures,

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the Linwe Formation was possibly deposited in a slightly agitated, warm, fairly deep-marine environment with alternating oxidizing and reducing condition.

5. Thitsipin Limestone Formation

The Thitsipin Limestone is in large part of a fusulinids limestone. They are believed to flourish in open, shallow sea environment below the zone of wave action. The massive cherty limestone may have accumulated in areas of quiet water which was free from the supply of clastic material (Garson et *al.*, 1976).

According to lithology and faunal characteristics, the depositional environment of the Thitsipin Limestone Formation of the study area could be warm, shallow, open sea environments.

6. Nwabangyi Dolomite Formation

In the study are, this unit consists of light grey to grey, massive to rarely thick-bedded, dolomitic limestone which is highly brecciated. The depositional condition may have been higher Mg++ activity during the diagenetic dolomitization process.

Thin to medium-bedded, grey cephalopodal limestone beds are observed in this unit. Thus, it may be suggested that the dolomitic limestone of the Nwabangyi Dolomite Formation may be deposited in a shallow carbonate shelf.

Discussion

The rocks exposed in Kin area are mainly consisting of carbonate and metasediments. In the study area, Chaungmagyi is mainly composed of low-grade metamorphosed rocks including slate, phyllite and metagreywacke. The presence of small folds in slate and phyllite of the Chaungmagyi Group are resulted by low-grade regional metamorphism.

The variation of limestone in Wunbye Formation was influenced by the changing E_h (oxidation-reduction potential) condition and may be precipitated in warm, shallow marine environment. The purple to reddish brown, grey to bluish grey limestones in Linwe Formation may be deposited under varying E_h condition and alternating and slightly reducing condition. Thitsipin Limestone Formation of the study area could be precipitated in warm, shallow, open sea environments. The dolomitic limestone of the Nwabangyi Dolomite Formation may be deposited in a shallow carbonate shelf.

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