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Aims and Objectives

Aims

- To emerge highly qualified research which can fulfil both regional and local needs
- To collaborate with other faculty members to produce and develop highly qualified applied researches
- To be able to produce researches which meet international standards

Objectives

- To encourage university teachers to become motivated in research work
- To exchange research work among universities
- To provoke university teachers to carry out applied research more and more

Taxonomic Study of Some Species of Rosaceae Distributed in Pangwa Township

Lanan Kaw Ja Bu[1], Kalaya Lu[2], Sanda Htun[3]

Abstract

The research deals with taxonomic characteristics on some member of rosaceous plants distributed in Pangwa Township, Kachin State. It lies between 25° 32' and 26° 03' North Latitude and between 98° 13' and 98° 42' East Longitude. The elevation of Pangwa is 2103.12 m above the sea level and the whole area of township is mostly in higher elevation. Rosaceae is mostly native to the temperate region and only the cultivated species can be seen in lowland of Myanmar. The members from Pangwa Township were collected, preserved and identified from June 2017 to August 2018 in Department of Botany, University of Myitkyina. Altogether 11 species belonging to 6 genera occurred and these species are *Chaenomeles cathayensis* (Hemsl.) C.K.Schneid., *Prunus cerasoides* D.Don, *Prunus mume* (Siebold) Siebold & Zucc., *Pyrus betulaefolia* Bunge, *Rosa chinensis* Jacq., *Rosa longicuspis* Bertol., *Rosa omeiensis* Rolfe., *Rubus ludwigii* Eckl. & Zeyh., *Rubus parvifolia* L., *Rubus rosifolius* Smith. and *Spiraea japonica* var. *acuta* T. T. Yu were included. Among them, *Chaenomeles cathayensis* Hemsl was formally cited as *Cydonia catharencis* Hemsl. by Hundley (1987) and Kress *et al.* and from the present study, the unrecorded species of Myanmar are *Pyrus betulaefolia* Bunge, *Rosa chinensis* Jacq., *Rosa omeiensis* Rolfe., *Rubus ludwigii* Eckl. & Zeyh., *Rubus parvifolia* L., *Rubus rosifolius* Smith. and *Spiraea japonica* var. *acuta* T. T. Yu. These newly recorded species are very valuable for the compilation of Flora of Myanmar.

Keywords: Taxonomic study, rosaceous plants, Pangwa Township, Kachin State.

Introduction

Angiosperms or flowering plants form the largest group of plant kingdom, including about 411 families, 8,000 genera and 3, 00,000 species (Subrahmanyam 1999). They are the most important group of plants in the world, providing the overwhelming majority of plant species, perhaps 400,000 in all, and most the biomass on land and are very basic for nearly all our food (Andrew & David 2005). The present research deals with the members Rosaceae growing Pangwa Township in Northern Kachin State. According to Lawrence (1964), it is a large family of perhaps 115 genera and 3200 species, distributed over most of the earth and abundant in eastern Asia, North America, and Europe. The largest genera in this family include: *Potentilla*, *Rubus*, *Rosa*, *Prunus* and *Spiraea*.The Rosaceae family as a unit is a more natural assemblage than are some other large family. The family of Rosaceae is considerable economic importance in temperate regions. This is especially true of its fruit-production members from which are obtained the apple (*Mallus*), pear (*Pyrus*), quince (*Chaenomeles*), cherry, plum, peach (*Prunus*), black-berry, paspberry (*Rubus*) and rose (*Rosa*).

The Kachin State is the second largest state of Myanmar. The Kachin State in Myanmar is famous for its rich biodiversity and its valuable natural resources. Kachin State is the northern most part of Myanmar, extending Himalaya and Sino-Hamalaya region being flanked by China, Tibet and Assam of India. The Sino-Himalaya also contains the head water of major river systems of Myanmar and it is traditional zone between tropical Indomalaya biodiversity of the south and the temperate and alpine Sino-Himalaya of the north.

The present study focused the botanical survey of Rosaceae on the existing flora of Pangwa. Pangwa Township is located in Northern Kachin State of Myanmar. It lies between 25° 32' and 26° 03' North latitude and between 98° 13' and 98° 42' East longitude. The elevation of Pangwa Township is 2103.12 m above the sea level. The total area is 333.66

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square kilometer and established by 3 quarters, 9 village tracts and 30 villages within the township. It is bounded by China in the east and north, Chi-phwe Township in the west and in the north, Wai-maw Township in the south.

Topographically, the town is built up mountainous. The soil type in the area is most commonly red ferruginous. The coldest months of Pangwa Township are December and January with an average temperature being – 4°C. At the highest altitude sites around Pangwa which is bounded by snowcapped hill slopes, there occur the herbaceous vegetation and growth after the snows begin melting.

There are distinct zones of temperate on these mountains. The climate is temperate at the high altitude. The highest mountains have cold winter season and vegetation of temperature at the high altitudes. The highest mountains have cold winter season and vegetation of temperate zone species. These effects of temperature have most upon the species composition of the forest.

There are four ethnic races and tribes, namely La-chick, La-vou, Li-su and Jin-phaw living in its villages with a total area is 333.66 square kilometer. These hill tribe people possess their own firms.

In Upper Myanmar, Sandar Htun (2009) had reported the floristic studies of Chi-Phwe Township, Northern Kachin State. Khin Win Naing (2010) stated the floristic studies of some native orchids from Southern Kachin State. However, the complete taxonomic information of Rosaceae in Pangwa Township is still lacking. Therefore, the flora of Pangwa Township was selected and studied.

The aim and objectives of this research are to classify and identify the members of Rosaceae distributed in Pangwa Township, to record the taxonomical characters of various kinds of rosaceous plants and to contribute the floristic information or rosaceous plant resources of Kachin State.

Materials and Methods

The field work was conducted starting from June 2017 to August 2018 in different area of Pangwa Township in Northern Kachin State. All the collected specimens were recorded individually by photographs while flowering period and labeled by collection numbers. Field notes were made on the natural habit and plant location by using Global Positioning System (GPS). Then, the specimens are pressed between in the sheets of newspapers and kept immediately into the plastic bags to identify and classify systematically. Identification of an unknown specimen is carried out by utilizing the floras or manuals and checklist of the particular region.

The Families of the collected specimens were determined by using key to the Families of Flowering Plants of the World (Hutchinson 1959), Thonner's analytical key to the families of flowering plants (Franz Thonner's 1981), Identification of genera and species are carried out by referring to the available literature such as Hooker (1881-1887), Backer & Brink (1963-1968), Brandis (1906), Dassanayake (1980-2001), Qi-maing and De-lin (2008) and Flora of China Vol 9 (2003). The index for nomenclature data was referred to Index Kewensis (Jackson 1885), the website of international plant name index and online database of tropicos containing taxonomic information on plants by wtich the name and synonyms of plants up to the rank of species being confirmed. Myanmar names are referred to Hundley and Chit Ko Ko (1987) and Kress *et al.* (2003).

The collected species were identified and described their taxonomic description. Detail floral characters were also photographed. The generic and specific arrangements under the families were described alphabetically. The artificial key to the studied species were also constructed by using their different characters. Each dry specimen was mounted with a label

of field data on a herbarium sheet. They were deposited in the Herbarium of Botany Department, University of Myitkyina for references and other academic filed.

Results

Altogether 11 species belonging to 7 genera from Rosaceae were resulted and stated in Table 1. The morphological and taxonomic characteristics were described. The detailed characters were stated in Figures 2 to 12.

Table 1. List of the species of Rosaceae distributed in Pangwa Township

No.	Species	Local name	Common name	Specimens Location
1.	*Chaenomeles cathayensis* (Hemsl.) C.k. Schneid.	Chinsaw ga, Ma kwar, Mawau	Quince	Chyi Chya area, N Latt 25° 40' 06.41" and E Long 98° 20' 45.21" Elevation 1954.37 m
2.	*Prunus cerasoides* D.Don	Taung Cherry, Byin-bying, Chairi, Maisein, Pannu	Cherry	Lupi area, N Latt 25° 42' 11.26" and E Long 98° 20' 07.89" Elevation 1979.98 m
3.	*Prunus mume* (Siebold) Siebold & Zucc.	Maman	Sow Thistle, Plum	Chyi Chya area, N Latt 25° 39' 18.54" and E Long 98° 21' 11.97" Elevation 2022.04 m
4.	*Pyrus betulifolia* Bunge	Thittaw yaing	Unknown	Lu Pi area, N Latt 25° 42' 56.28" and E Long 98° 19' 21.25" Elevation 1875.43 m
5.	*Rosa chinensis* Jacq.	Hnin-si Yaing	China rose	Saw Zan area, N Latt 25° 42' 50" and E Long 98° 19' 19", Elevation 1933.34 m
6.	*Rosa longicuspis* Bertol.	Hnin-si Yaing	Shillong Climbing Rose	Lu Pi area, N Latt 25° 40' 41.21" and E Long 98° 20' 34.92" Elevation 1861.41 m
7.	*Rosa omeiensis* Rolfe.	Hnin-si Yaing	Wingthorn Rose	Lu Pi area, N Latt 25° 42' 53.50" and E Long 98° 19' 19.70" Elevation 1900.42 m
8.	*Rubus ludwigii* Eckl. & Zeyh.	Stawberry yaing	Unknown	Lu Pi area, N Latt 25° 42' 53.50" and E Long 98° 19' 19.70" Elevation 1900.42 m
9.	*Rubus parvifolia* L.	Stawberry nwe	Unknown	Lu Pi area, N Latt 25° 42' 56.28" and E Long 98° 19' 21.25" Elevation 1875.43 m
10.	*Rubus rosifolius* Smith.	Gahyeng	Paspberry	Saw Zan area, N Latt 25° 42' 54.51" and E Long 98° 19' 20.98" Elevation 1875.43 m
11.	*Spiraea japonica* var. *acuta* T.T. Yu	Unknown	Unknown	Saw Zan area, N Latt 25° 42' 53" and E Long 98° 19' 19", Elevation 1919.02 m

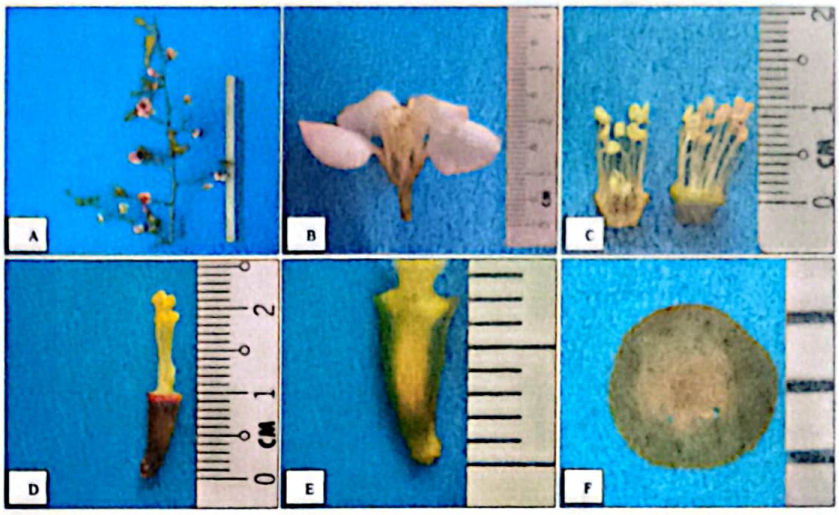

Figure 1 ***Chaenomeles cathayensis*** (Hemsl.) C.K. Schneid., A. Inflorescence, B. L.S of flower, C. Stamens, D. Pistil, E. L.S of ovary, F. T.S of ovary

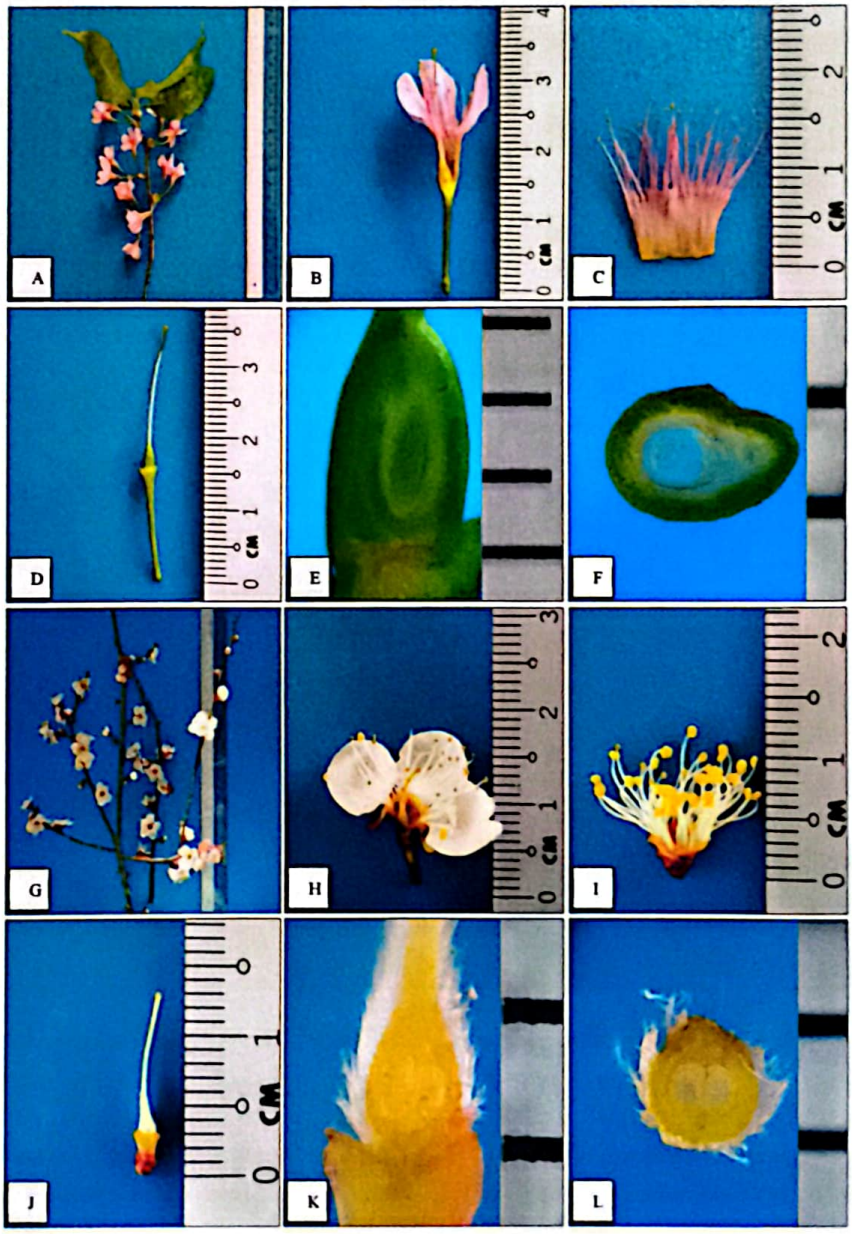

Figure 2 ***Prunus cerasoides*** D.Don, A. Inflorescence, B. L.S of flower, C. Stamens, D. Pistil, E. L.S of ovary, F. T.S of ovary; ***Prunus mume*** (Siebold) Siebold & Zucc., G. Inflorescence, H. L.S of flower, I. Stamens, J. Pistil, K. L.S of ovary, L. T.S of ovary

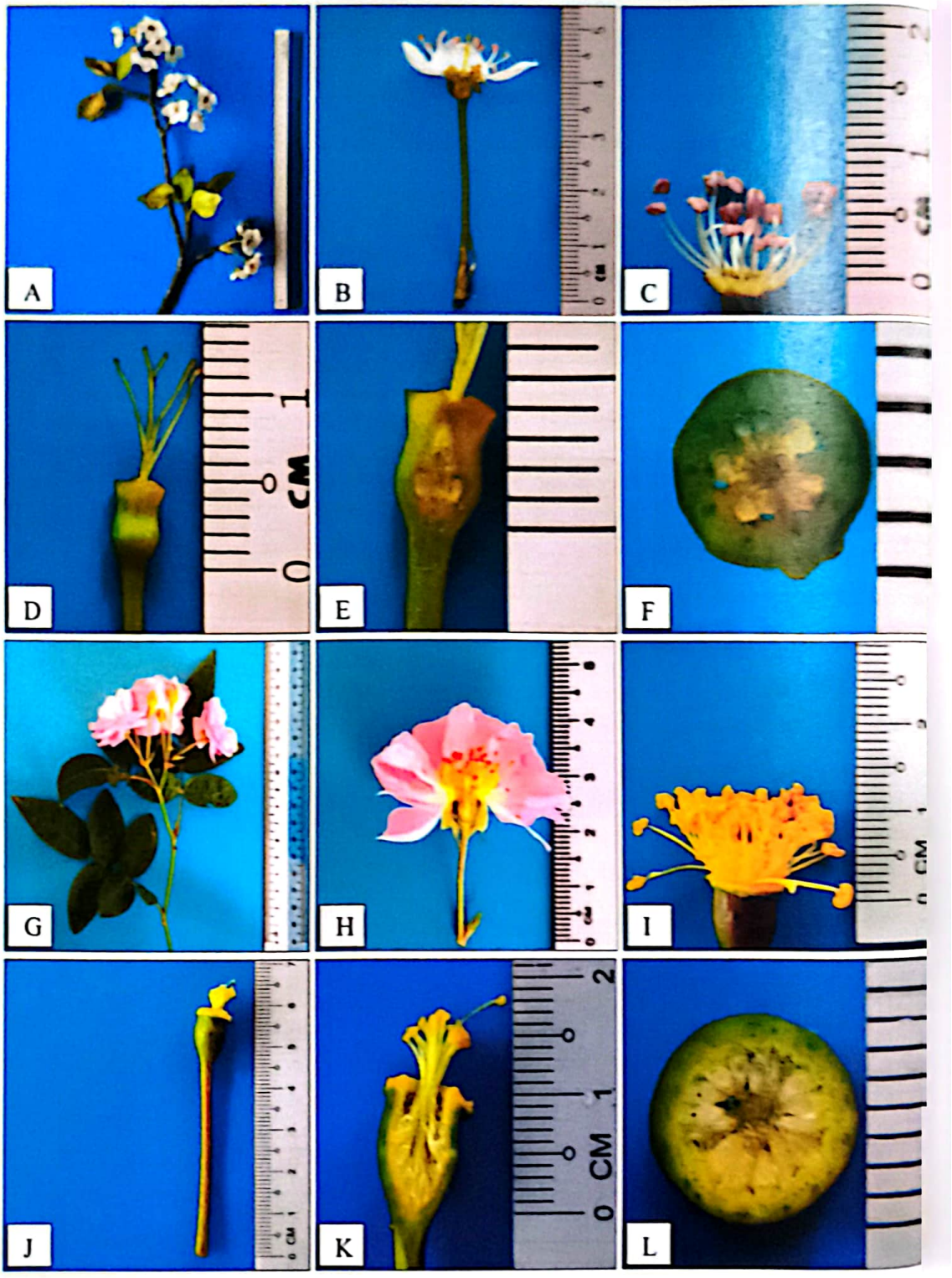

Figure 3 ***Pyrus betulifolia*** Bunge, A. Inflorescence, B. L.S of flower, C. Stamens, D. Pistil, E. L.S of ovary, F. T.S of ovary; ***Rosa chinensis*** Jacq., G. Inflorescence, H. L.S of flower, I. Stamens, J. Pistil within the hypanthium, K. L.S of ovaries within the hypanthium, L. T.S of ovaries within the hypenthium

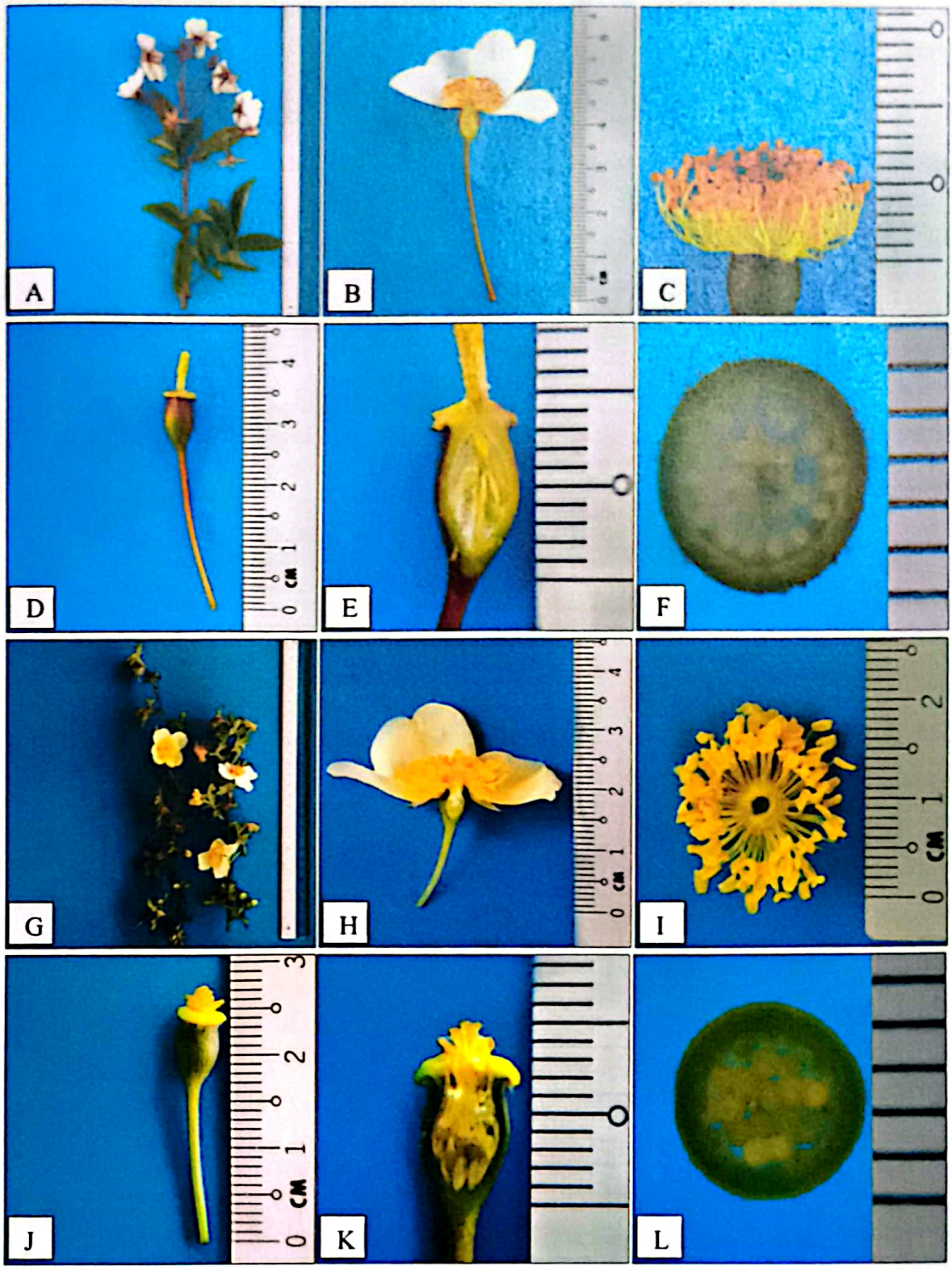

Figure 4 ***Rosa longicuspis*** Bertol., A. Inflorescence, B. L.S of flower, C. Stamens, D. Pistil within the hypanthium, E. L.S of ovaries within the hypanthium, F. T.S of ovaries within the hypanthium; ***Rosa omeiensis*** Rolfe, G. Inflorescence, H. L.S of flower, I. Stamens, J. Pistil within the hypanthium, K. L.S of ovaries within the hypanthium, L. T.S of ovaries within the hypanthium

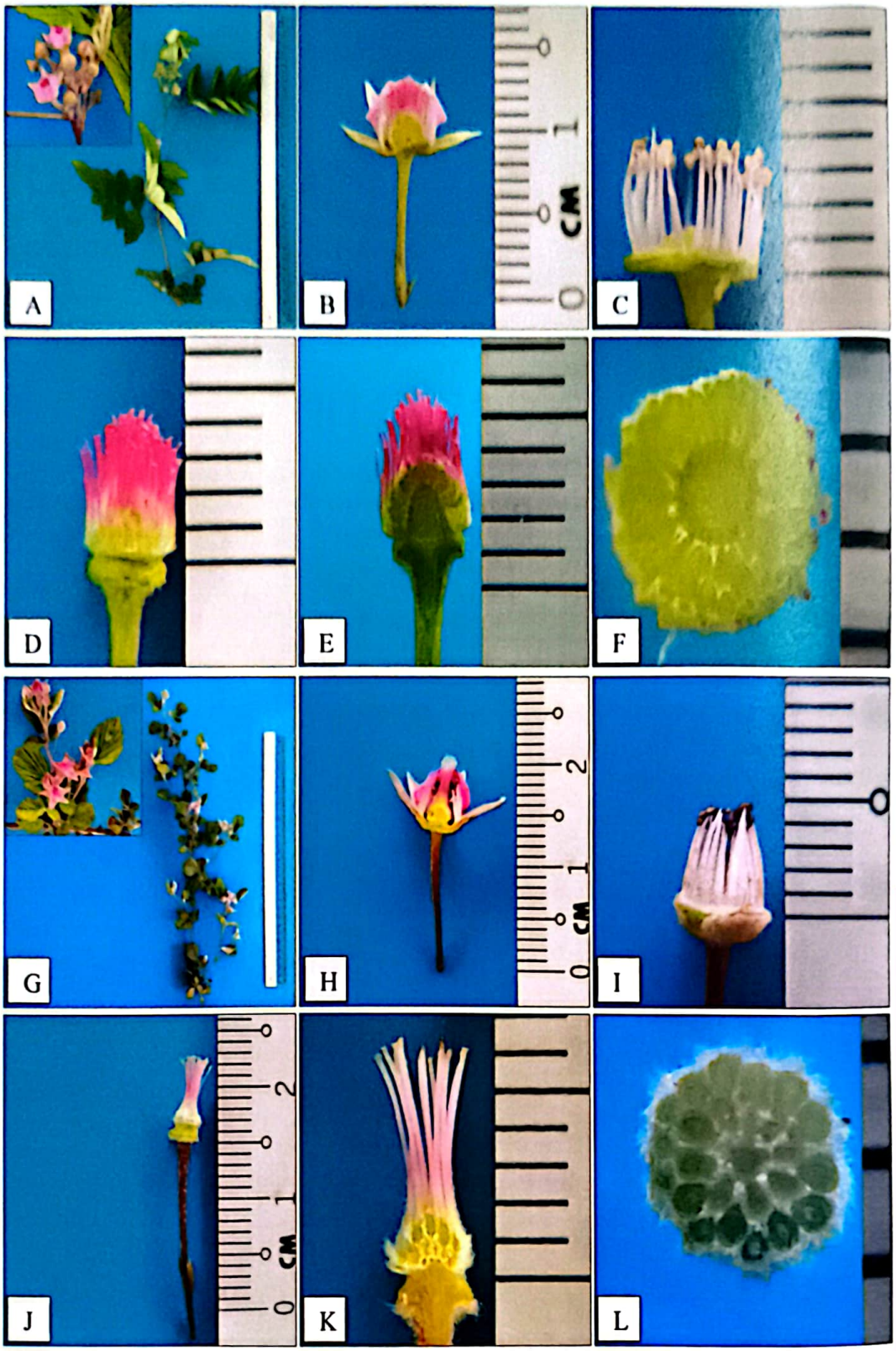

Figure 5 ***Rubus ludwigii*** Eckl. & Zeyh., A. Inflorescence B. L.S of flower, C. Stamens, D. Pistils, E. L.S of ovaries, F. T.S of ovaries; ***Rubus parvifolia*** L., G. Inflorescence, H. L.S of flower, I. Stamens, J. Pistils, K. L.S of ovaries, L. T.S of ovaries

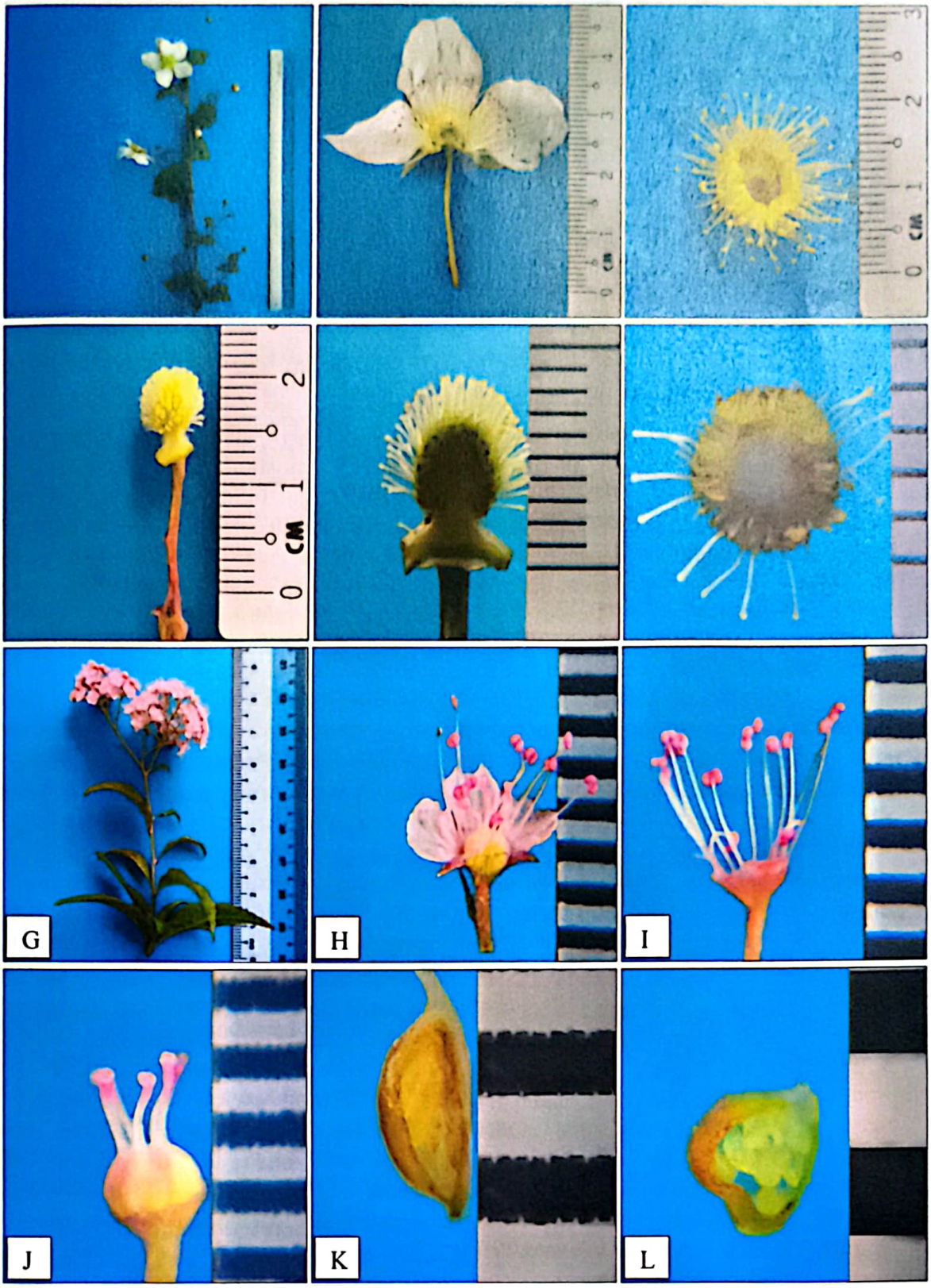

Figure 6 ***Rubus rosifolius*** Smith., A. Inflorescence, B. L.S of flower, C. Stamens, D. Pistils, E. L.S of ovaries, F. T.S of ovaries; ***Spiraea japonica*** var. ***acuta*** T. T. Yu, G. Inflorescence, H. L.S of flower, I. Stamens, J. Pistils, K. L.S of ovary, L. T.S of ovary

1. ***Chaenomeles cathayensis*** (Hemsl.) C.K. Schneid. Ill. Handb. Laubholzk. 1: 730, f. 406 e-f. 1906. (Figure 1, A - F)

Cydonia cathayensis Hemsl. Hooker's Icon. Pl. 27(3): Pl. 2657, 2658. 1900.

Flowering period : April to May

Perennial; erect small trees, about 4 m tall; stems and branches with densely tomentoses. Leaves simple; alternate; stipules 9 landula; petiolate; blades ovate to oblong, serrulate along the margin. Inflorescences axillary, solitary, cyme. Flowers bisexual, actinomorphic, perigynous, pink; sessile. Hypenthium campanulate. Sepals 5, united at the base, dark red. Petals 5, free, orbicular. Stamens numerous, free, filiments filiform; anthers dithecous, dorsifixed, creamy, longitudinal dehiscing. Carpels 5 fused; with many ovules in each locule on the axile placenta. Fruits pome.

2. ***Prunus cerasoides*** Buch.-Ham. ex D.Don, Prodr. Fl. Nepal. 239. 1825. (Figure 2, A - F)

Flowering period : November to January

Perennial; erect trees, deciduous, up to 3 to 50 m high; stems and branches grayish black, glabrous. Leaves simple; alternate; stipules linear, basally fimbriate; petiolate, apex with 2-nectaries; blades oblong lanceolate, serrate along the margin. Inflorescences axillary, cyme, umbellate, 2 to 4-flowered. Flowers bisexual, actinomorphic, perigynous, pink; pedicelate. Hypanthium campanulate. Sepals 5, free, triangular, reddish. Petals 5, free, obovate. Stamens numerous, free; anthers dithecous, dorsifixed, oblong, yellow, longitudinal dehiscing. Carpels 1, free; with one ovule in the locule on the basal placentae. Fruits drupe.

3. ***Prunus mume*** (Siebold) Siebold & Zucc. Fl. Jap. 1: 29, pl. 11. 1836. (Figure 2, G - L)

Armeniaca mume Sieboled, Verh. Batav. Genootsch. Kunst. 12(1): 69. 1830.

Flowering period : January to March

Perennial; erect small tree, deciduous, about 4 m high; stems and branches blackish gray. Leaves simple; alternate; stipulate, 9 landula; petiolate, with nectaries; blades ovate to elliptic, acutely serrate along the margin. Inflorescences axillary, cymose, solitary or 2 in a fascicle. Flowers bisexual, actinomorphic, perigynous, white; pedicelate. Sepals 5, free, ovate to suborbicular. Petals 5, free, obovate. Stamens numerous, free; filaments filiform; anthers dithecous, dorsifixed, oblong, yellow, dehiscing by longitudinal. Carpels 1, free; ovary with densely pubescent, with two ovules in the locule on the basal placentae. Fruits Drupe.

4. ***Pyrus betulifolia*** Bunge, Mém. Acad. Imp. Sci. St,-Pétersbourg Divers Savans 2: 101. 1835. (Figure 3, A - F)

Flowering period : March to May

Perennial; deciduous tree, about 5 m tall; stems and branches glabrous. Leaves simple; alternate; stipules caduceus, pubescent; petiolate; blades deltoid to ovate, serrate along the margin. Inflorescences terminal, raceme umbellate, 7 to 8-flowered. Flowers bisexual, actinomorphic, perigynous, white; pedicelate. Hypenthium copular. Sepals 5, united at the base, triangular to ovate. Petals 5, free, broadly ovate. Stamens numerous, free; filaments filiform, white; anthers dithecous, dorsifixed, oblong, pink, longitudinal dehiscing. Carpels 5 fused; with two ovules in each locule on the basal placenta. Fruits pome.

5. ***Rosa chinensis*** Jacq. Observ. Bot. 3:7, t. 55. 1768 (Figure 3, G - L)

Flowering period : May to July

Perennial; erect shrubs, mostly prickly, about 1 m high; stems and branches pubescent. Leaves compound, imparipinnate; alternate; stipules adnate to the petiole; petiolate; blades ovate, serrate along the margin. Inflorescences terminal, corymb, few-flowered. Flowers

bisexual, actinomorphic, perigynous, pink; pedicelate. Sepals 5, united at the base, ovate. Hypanthium ovoid. Petals multiple, free, obovate. Stamens numerous, free; filaments filiform, pale yellow; anthers dithecous, basifixed, oblong, longitudinal dehiscing. Carpels many, free; ovary inserted at base of hypanthium , unilocular, with one ovule in each locule on the basal placentation. Fruits hips.

6. ***Rosa longicuspis*** Bertol. Mem. Reale Accad. Sci. Ist Bologna. 11: 101, pl. 13. 1861. (Figure 4, A-F)

Flowering period : May to July

Perennial; evergreen, climbing shrubs, about 1.5 to 4 m tall; stems and branches purplish brown, prickles sparse or scattered, curved, stout, flat, tapering. Leaves compound, imparipinnate; alternate; stipules adnate to petiole; petiolate; rachis with a few hooked prickles; leaflets 5 to 9, ovate to elliptic, leathery, serrate along the margin. Inflorescences terminal, corymbose, many-flowered. Flowers bisexual, actinomorphic, perigynous, white; pedicelate, with sparse glandular pubescent. Hypanthium obovoid, sparsely glandular-bubescent. Sepals 5, free, lanceolate, abaxially intermixed with glandular-hairy. Petals 5, free, broadly obovate, Stamens numerous, free; filaments filiform; anthers dithecous, dorsifixed, bright yellow, longitudinal dehiscing. Carpels many, free, inserted at base of hypanthium, unilocular, with one ovule in each locule on the basal placentae. Fruits hip.

7. ***Rosa omeiensis*** Rolfe, Bot Mag. 138: t. 8471. 1912. (Figure 4, G - L)

Flowering period : March to May

Perennial; erect shrubs, up to 1 to 2.5 m high; stems and branches with pairs of winglike prickles present at leaves base. Leaves compound, imparipinnate; alternate; stipules adnate to petiole, serrate margin; petiolate; rachis with a few small prickles; leaflets 5 to 9, elliptic to oblong, serrate along the margin. Inflorescences axillary, solitary, cymose. Flowers bisexual, actinomorphic, tetramerous, perigynous, pale yellow; pedicelate. Hypanthium obovoid, densely pubescent. Sepals 4, free, lanceolate. Petals 4, free, obovate. Stamens numerous, free. filaments filiform; anthers dithecous, dorsifixed, bright yellow, longitudinal dehiscing.Carpels many, free; unilocular, with one ovule in each locule on the basal placentae. Fruits hip.

8. ***Rubus ludwigii*** Eckl. & Zeyh., Enum. Pl. Afr. Austral. 263. 1835. (Figure 5, A - F)

Flowering period : May to June

Perennial; scandent shrub, about 2. 5 m tall; stems and branches reddish brown, with long and curved prickles. Leaves compound, imparipinnate; alternate; stipulate; petiolate, with curved prickles; blades of leaflets lanceolate, serrate along the margin, abaxially white tomentose. Inflorescences terminal panicle, or in leaf axils, cymose, many-flowered. Flowers bisexual, actinomorphic, pentamerous, perigynous, pink; pedicelate with tomentose. Hypenthium campanulate, tomentose. Sepals 5, united at base, ovate-lanceolate, densely pubescent on both surfaces. Petals 5, free, obovate, shorter than sepals. Stamens numerous, free; filaments filiform, white; anthers dithecous, dorsifixed, oblong, creamy yellow, longitudinal dehiscing. Carpels many, free; unilocular, with 1 ovule in each locule on the basal placentae. Fruits aggregate.

9. ***Rubus parvifolia*** L. Sp. Pl. 2: 1197. 1753. (Figure 5, G - L)

Flowering period : May to July

Perennial; climbing shrubs, about 2 m high; stems and branches with soft hairy and curved prickles. Leaves compound, imparipinnate; alternate; stipulate; petiolate with soft hairy and minute prickles; blades of leaflets obovate to orbicular, irregularly incised-double serrate along the margin, abaxially densely gray tomentose. Inflorescences terminal panicle or solitary in uppermost leaft axils, cymose, 1 to many- flowered. Flowers bisexual, actinomorphic, perigynous, pink; pedicelate, with densely gray tomentose. Hypenthium campanulate,

tomentose and sparse prickles. Sepals 5, united at base, ovate-lanceolate, with sparse prickles. Petals 5, free, obovate, shorter than sepals. Stamens numerous, free; filaments filiform; anthers dithecous, dorsifixed, oblong, longitudinal dehiscing. Carpels many, free, ovoid, unilocular, with 1 ovule in each locule on the basal placentae. Fruits aggregate.

10. ***Rubus rosifolius*** Smith, Pl. Icon. Ined. 3: 60. 1791. (Figure 6, A - F)

Flowering period : March to May

Perennial; erect shrubs, about 1 m tall; stems and branches with straight to curved prickles. Leaves compound, imparipinnate; alternate; stipulate; petiolate; blades of leaflets ovate to lanceolate, double serrate along the margin, minute prickles along midvein. Inflorescences terminal or in leaf axils, cymose, 1 to 2-flowered. Flowers bisexual, actinomorphic, perigynous, white; pedicelate, with minute prickles. Hypenthium urceolate. Sepals 5, united at base, ovate-lanceolate, with soft hairy and 11landular. Petals, free, obovate. Stamens numerous, free; filaments filiform, anthers dithecous, dorsifixed,spread, oblong, creamy yellow, longitudinal dehiscing. Carpels many, free; unilocular, with 1 ovule in each locule on the basal placentae. Fruits aggregate.

11. ***Spiraea japonica*** **var.** ***acuta*** T. T. Yu, Acta Phytotax. Sin. 8: 215. 1963. (Figure 6, G - L)

Flowering period : August to October

Perennial; erect shrubs, about 2.5 m heigh; stems and branches glabrous. Leaves simple; alternate; exstipulate; petiolate; blades elliptic, serrate along the margin. Inflorescences terminal, corymbs, many-flowered. Flowers bisexual, actinomorphic, perigynous, pink; pedicelate. Sepals 5, united at the base, ovate. Petals 5, free, obovate,. Stamens numerous, free; filaments filiform; anthers dithecous, dorsifixed, globose, pink, longitudinal dehiscing. Carpels 5, free; unilocular, with many ovules in the locule, parietal placentation. Fruits follicles.

Discussion and Conclusion

A total of 11 species belonging to 6 genera of Rosaceae were distributed. The growing habits of the rosaceous plants vary in the studied area. The 4 species such as *Chaenomeles cathayensis*, *Prunus cerasoides*, *Prunus mume* and *Pyrus betulifolia* were growing as tree. 5 species such as *Rosa chinensis*, *Rosa omeiensis*, *Rubus ludwigii*, *Rubus rosifolius* and *Spiraea japonica* var. *acuta* were growing as shrub and other 2 species such as *Rosa longicuspis* and *Rubus parvifolia* were climbing shrubs.

Prunus cerasoides, *Prunus mume*, *Pyrus betulifolia* and *Spiraea japonica* var. *acuta* have glabrous stems. The prickles were present in stem of *Rosa chinensis*, *Rosa longicuspis*, *Rosa omeiensis*, *Rubus ludwigii*, *Rubus parvifolia* and *Rubus rosifolius* and the stem of *Chaenomeles cathayensis* has tomentose hairs.

The leaf arrangements were simple in *Chaenomeles cathayensis*, *Prunus cerasoides*, *Prunus mume*, *Pyrus betulifolia* and *Spiraea japonica* var. *acuta* and other species such as *Rosa chinensis*, *Rosa longicuspis*., *Rosa omeiensis*, *Rubus ludwigii*, *Rubus parvifolia* and *Rubus rosifolius* possessing imparipinnate compound leaves. The inflorescences of *Chaenomeles cathayensis*, *Prunus cerasoides* D.Don, *Prunus mume*, *Rosa omeiensis* Rolfe. and *Rubus rosifolius* were axillary cymose type while terminal racemose type was observed in *Pyrus betulifolia* Bunge, *Rosa chinensis*, *Rosa longicuspis*, *Rubus ludwigii*., *Rubus parvifolia* and *Spiraea japonica* var. *acuta*.

All species were bisexual, actinomorphic, pentamerous and perigynous flowers with campanulate hypanthium. But, the flower of *Rubus rosifolius* has urceolate hypanthium. The various colour of flower such as pink, white and pale yellow were found in some member of

rosaceous plants. Those were pink colour in *Chaenomeles cathayensis*, *Prunus cerasoides*, *Rosa chinensis*, *Rubus ludwigii*, *Rubus parvifolia* and *Spiraea japonica* var. *acuta*, white colour in *Prunus mume*, *Pyrus betulifolia*, *Rosa longicuspis* and *Rubus rosifolius*, and pale yellow colour in *Rosa omeiensis*. The types of rosaceous fruits were varying, such as drupe, aggregate, pome, follicle and hip. The fruits were drupaceous in *Prunus cerasoides* and *Prunus mume*, aggregate in *Rubus ludwigii*, *Rubus parvifolia* and *Rubus rosifolius*. The pomes were found in *Chaenomeles cathayensis* and *Pyrus betulifolia* and the types of hip fruits possessing in *Rosa chinensis*, *Rosa longicuspis* and *Rosa omeiensis*.

Qi-ming & De-lin, (2008) stated that the fruits of *Chaenomeles cathayensis*, *Prunus cerasoides*, *Prunus mume*, *Pyrus betulifolia*, *Rosa longicuspis*, *Rosa omeiensis*, *Rubus ludwigii*, *Rubus rosifolius* and *Rubus parvifolia* are edible. The ornamental plants were *Prunus mume*, *Rosa chinensis* and *Spiraea japonica* var. *acuta* and the plants of medicinal value were *Prunus cerasoides*, *Prunus mume*, *Rosa chinensis*, *Rubus rosifolius* and *Rubus parvifolia*.

Chaenomeles cathayensis Hemsl was formally cited as *Cydonia catharensis* by Hundley (1987) and Kress *et al.* the unrecorded species of Myanmar are *Pyrus betulaefolia*, *Rosa chinensis*, *Rosa omeiensis*, *Rubus ludwigii*, *Rubus parvifolia*, *Rubus rosifolius* and *Spiraea japonica* var. *acuta*. These newly recorded species are very valuable for the Flora of Myanmar. It was hope that the research work of floristic study on Rosaeae of Pangwa Township in Northern Kachin State will provide the valuable of taxonomic information and distribution of plant species for further scientific research works.

Acknowledgements

We would like to express my gratitude to Dr Soe Myint Aye, Pro-rector, University of Myitkyina, for his kind and valuable suggestions. My heartful thanks are due to Dr Khin Win Naing, Professor and Head, Department of Botany, University of Myitkyina, for her kindly providing all the necessary facilities and encouragement. My sincere thanks are also due to Dr Seine Nyoe Nyoe Ko, Professor, Department of Botany, University of Myitkyina, for her kind permission to conduct this research paper.

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Structural Elucidation of Pure Bioactive Organic Compound from *Alyxia fascicularis* Benth.

Khin Thida Saw[1], Hnin Thanda Aung[2], Mya Mu Aye[3], Myint Myint Sein[4]

Abstract

In this study, one Myanmar indigenous medicinal plant, *Alyxia fascicularis* Benth., locally known as Taw Noe Yee, belonging to the family Apocynaceae was selected for the analysis of chemical constituents. For the structural elucidation of the pure bioactive organic compound (KTDS-2), the advanced spectroscopic methods such as FT IR, ^{1}H NMR (600 MHz), ^{13}C NMR (150 MHz), DEPT, DQF-COSY, HSQC, HMBC and FAB-mass spectral data were used.

Keywords: FT IR, ^{1}H NMR (600 MHz), ^{13}C NMR (150 MHz), DEPT, DQF-COSY, HSQC, HMBC and FAB-mass

Introduction

Medicinal plants, medicinal herbs, or simply herbs have been identified and used from prehistoric times. Plants make many chemical compounds for biological functions, including defense against insects, fungi, and herbivorous mammal (Lichterman, 2004). In this study, one of the Myanmar indigenous medicinal plants, *Alyxia fascicularis* was selected for the structural elucidation of pure compound from *Alyxia fascicularis*. This plant locally used in Kachin State for several diseases such as paralyses, archorrhgia, arthroagraosis, sore throat, hemias and backaches. It can be used to treat for several diseases. For instance, people suffering stroke can consume the sink in alcohol to get the good health. In this research work, the pure compound (KTDS-2) was isolated by advanced separation techniques. In addition, the structural elucidation of isolated compound (KTDS-2) was done by using advanced spectroscopic methods such as FT IR, ^{1}H NMR (600 MHz), ^{13}CNMR (150 MHz), DQF-COSY, HSQC, HMBC and FAB-mass spectra data respectively.

Materials and Method

General Experimental Procedure

FT-IR spectra (KBr pellets) were recorded on a Perkin Elmer Paragon 100 PC spectrometer. EI-Mass spectrum was obtained with a JEOL JMS MS-700, respectively. The 1D and 2D NMR spectra were recorded with a Bruker Advance III HD600 spectrometer equipped with Prodigy liq. Nitrogen cryoprobe. Chemical shifts for ^{1}H-and ^{13}C NMR are given in ppm (δ) relative to solvent signal (MeOH-d_4: δ_H 3.30 and δ_C 49.0; $CDCl_3$: δ_H 7.26 and δ_C 77.0) as internal standard. HPLC reversed phase column (C-8-UG-5) was used for purification of compounds. The specific optical rotations were measured on a JASCO P-2200 Polarimeter. Analytical and preparative TLC separations were performed on 0.25 mm silica gel 60 (GF254, Merck) aluminium supported foils.

Plant Material

The stem of *Alyxia fascicularis* were collected from a forest of Inkhaing Bum mountain, Myitkyina, Kachin State in March 2016. The plant was identified by Professor, Dr Moat War Dai Naw, Department of Botany, University of Mandalay, Myanmar and Associate Professor, Dr. Sanda Tun, Department of Botany, University of Myitkyina.

Extraction and Isolation of Bioactive Compounds

The stem of *Alyxia fascicularis* (800 g) were percolated with 3 L of methanol. The methanolic extract was concentrated in *vacuo*, and dried extract was obtained (106.4 g). The

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[3]Lecurer, Dr., Department of Chemistry, Myingyan Degree College

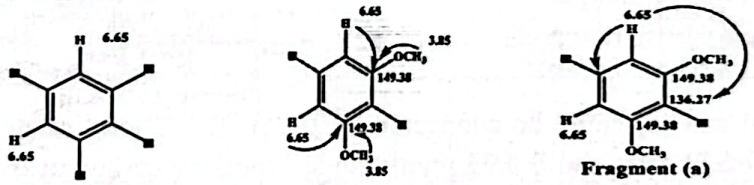
[4]Professor (Rdt.), Dr., Department of Chemistry, University of Mandalay

extract was then partitioned with ethyl acetate and 1-butanol against water successively to give ethyl acetate (25.34 g), 1-butanol (24.7g) and water-soluble fractions (51.25 g). The ethyl acetate fraction was partitioned again with acetonitrile and hexane to afford acetonitrile (15.45 g) and hexane (4.4 g). The acetonitrile fraction (5.43 g) was separated on RP-18 and eluted with MeOH: water (decreasing polarity from 3:7 to 9:1, MeOH only) to give 20 main fractions (A-T). The fraction A (359.9 mg) was separated by HPLC with reversed phase column (C-30, UG-5) with a gradient system of (A) methanol–water (2:98): (B) MeOH (95:5 to 50:50) as a mobile phase to give five subfractions (A-1 to A-5). The sub fraction (A-2) was purified by HPLC reversed phase column(C-8, UG-5) with a gradient system of (A) methanol–water (2:98):(B) MeOH (95:5 to 60:40) as a mobile phase to give pure compound (KTDS-2).

Results and Discussion

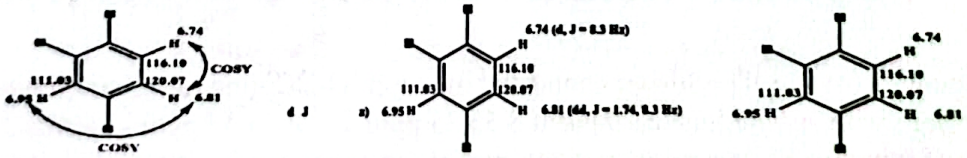
Complete Structural Elucidation of the Pure Compound (KTDS-2)

According to FT IR spectrum, Figure (1), the pure compound (KTDS-2) contains–OH group, sp^2 hydrocarbon, sp^3 hydrocarbon, aromatic benzene ring, ether group, trans or *E* and cis or *Z* alkenic groups. In the ^1H NMR spectrum, Figure (2), the two chemical shift equivalent protons δ 6.65 ppm implied the following tetra-substituted benzene ring. In HMBC spectrum, Figure (8), there was observed the α ^1H-^{13}C long range signal of aromatic proton at δ 6.65 ppm with aromatic quaternary carbon at δ 149.38 ppm. Moreover, in HMBC spectrum, Figure (8), the occurrence of β ^1H-^{13}C long range signal of singlet methyl methoxy group at δ 3.85 ppm with the down field chemical shift aromatic quaternary carbon at δ 149.38 ppm lead to the following fragment. In addition, the existence of the α ^1H-^{13}C long range correlation between the aromatic proton at δ 6.65 ppm with the aromatic quaternary carbon at δ 133.18 ppm in HMBC spectrum, Figure (8) produced the following fragment. Moreover, in HMBC spectrum, Figure (8), the aromatic methine proton at δ 6.65 ppm has β ^1H-^{13}C long range coupling with aromatic quaternary carbon at δ 136.27 ppm gave rise to the following fragment (a).



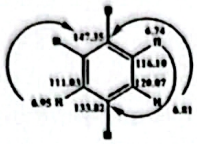
Fragment (a)

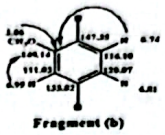
In the DQF-COSY spectrum, the occurrence of medium graphic area between two aromatic protons δ 6.74 ppm and δ 6.81 ppm and small graphic area between two aromatic protons δ 6.81 ppm and δ 6.95 ppm produced the following tri-substituted benzene ring. The above fragment could be confirmed by the splitting patterns and coupling constants of these three aromatic protons δ 6.81 ppm (dd, J = 1.74 Hz and 8.3 Hz), δ 6.74 ppm (d, J = 8.3 Hz) and δ 6.95 ppm (d, J = 1.74 Hz) in ^{1}HNMR spectrum, Figure (2) as illustrated below. As shown in Figure (7), the HSQC spectrum supported ^1H-^{13}C direct correlation of the above three aromatic protons with their respective aromatic carbons as indicated below.



Moreover, according to HMBC spectrum, Figure (8) the observation of β ^1H-^{13}C long range signal of the aromatic proton δ 6.74 ppm with sp^2 quaternary carbon at δ 133.82 ppm afforded the following fragment. Furthermore, the occurrence of β ^1H-^{13}C long range signals of two aromatic protons δ 6.81 ppm and δ 6.95 ppm with quaternary carbon at δ 147.35 ppm

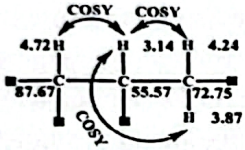
gave rise the following fragment In this HMBC spectrum, Figure (8), it was observed that α and β ^{1}H-^{13}C long range signals of the aromatic protons δ 6.95 ppm and δ 6.74 ppm with sp^2 quaternary carbon at δ 149.14 ppm. Moreover, in HMBC spectrum, Figure (8), the occurrence of β ^{1}H-^{13}C long range signal of methyl methoxy group at δ 3.86 ppm with down field chemical shift aromatic quaternary carbon at δ 149.14 ppm led to following fragment (b).

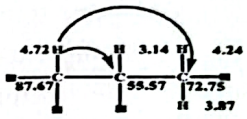




Fragment (b)

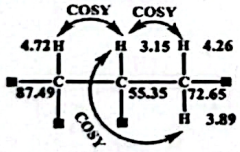
In the DQF-COSY spectrum, Figure (5), sp^3 methine proton δ 3.14 ppm was found to be correlated with another sp^3 methine proton at δ 4.72 ppm and sp^3 methylene protons at δ 3.87 ppm and δ 4.24 ppm. It was revealed the following fragment (c). The above fragment (c) could be proved by α and β ^{1}H-^{13}C long range signals of sp^3 methine proton δ 4.72 ppm with sp^3 methine carbon at δ 55.57 ppm and sp^3 methylene carbon at δ 72.75 ppm in HMBC spectrum.

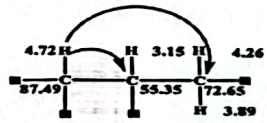




Fragment (c)

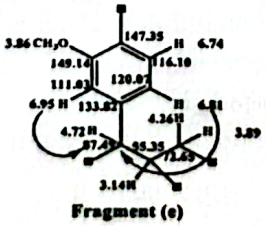
In the DQF-COSY spectrum, Figure (5) sp^3 methine proton δ 3.15 ppm showed the medium graphic areas with sp^3 methine proton δ 4.72 ppm and sp^3 methylene protons δ 3.89 ppm and δ 4.26 ppm afforded the following fragment (d). The fragment (d) could be assured by the appearance of α and β ^{1}H-^{13}C long range coupling of aromatic proton δ 4.72 ppm with the sp^3 methine carbon at δ 55.35 ppm and sp^3 methylene carbon at δ 72.65 ppm in HMBC spectrum, Figure (8).



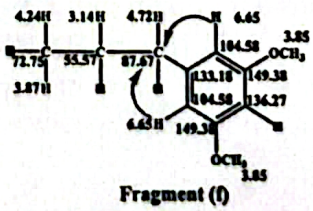


Fragment (d)

Fragments (b) and (d) could be connected by the β ^{1}H-^{13}C long range couplings of aromatic protons δ 6.81 ppm and δ 6.95 ppm with sp^3 methine carbon at δ 87.49 ppm in HMBC spectrum, Figure (8) producing the following the partial fragment (e).Fragments (a) and (c) could be connected by the β ^{1}H-^{13}C long range coupling of aromatic proton δ 6.65 ppm with sp^3 methine carbon at δ 87.67 ppm in HMBC spectrum, Figure (8) resulting the following partial fragment (f).

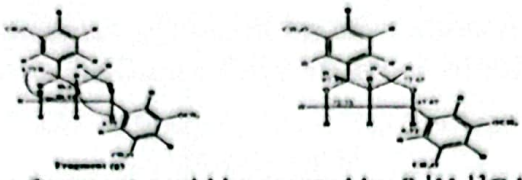


Fragment (e)

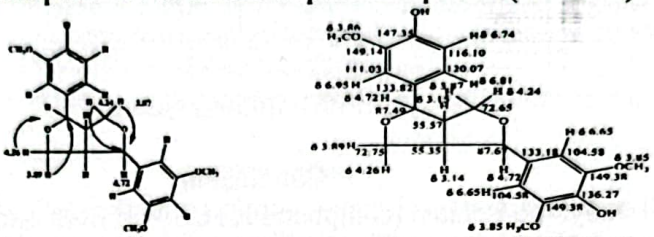


Fragment (f)

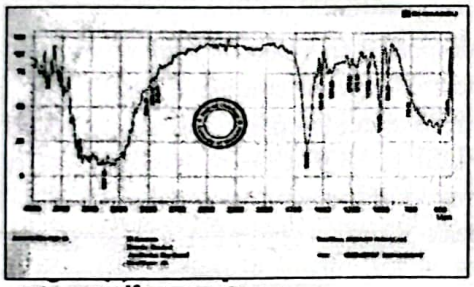
Fragments (e) and (f) could be connected by the β ^{1}H-^{13}C long range couplings of proton δ 4.72 ppm with sp^3 methine carbons at δ 55.35 ppm and δ 55.57 ppm in HMBC spectrum, Figure (8)giving rise the following the partial fragment (g).In this stage, the elucidated hydrogen deficiency index (HDI) is 8. The HDI calculated from molecular formula is 10. Thus, the remaining HDI is 2 and there must be two cyclic rings. Therefore, the reliable down field chemical shift carbons at δ 87.49 ppm and δ 72.65 ppm were assumed to be oxygen bearing carbons and give rise the following extended fragment.



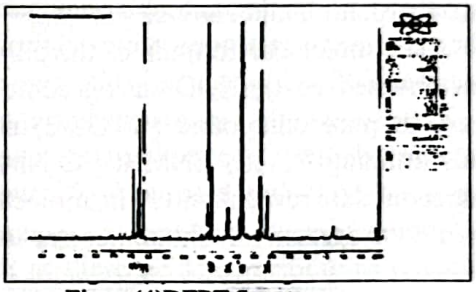
Moreover, the above fragment could be assured by β ^{1}H-^{13}C long range connection of sp^3 methylene protons δ 4.24 ppm and δ 3.87 ppm with sp^3 methine carbon at δ 87.67 ppm, another sp^3 methylene protons δ 4.26 ppm and δ 3.89 ppm with sp^3 methine carbon at δ 87.49 ppm in HMBC spectrum, Figure (8), resulted the following fragment. Finally, the elucidated partial molecular formula of the pure compound (KTDS-2) is $C_{21}H_{22}O_5$. The real molecular formula of the pure compound (KTDS-2) is $C_{21}H_{24}O_7$. Thus, the remaining partial molecular formula is H_2O_2. There must be two hydroxyl groups. These two hydroxyl groups could be connected to the down field chemical shifts carbon at δ 136.27 ppm and δ 147.35 ppm to accomplish the complete the structure of pure compound (KTDS-2).



The Complete Structure of Pure Compound (KTDS -2)



Figure(3)^{13}CNMR Spectrum



Figure(4)DEPT Spectrum

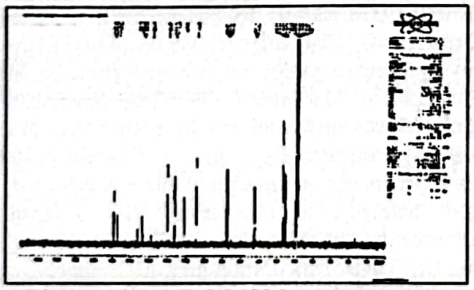


Figure (5) DQF-COSY Spectrum

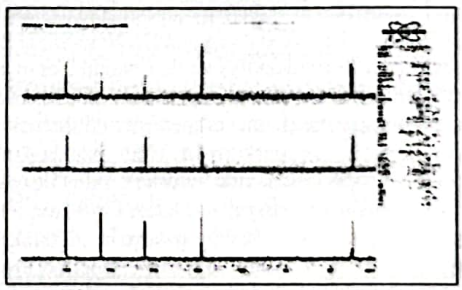


Figure (6) NOSEY Spectrum

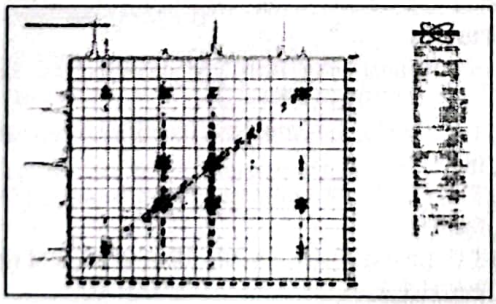


Figure (7) HSQC Spectrum

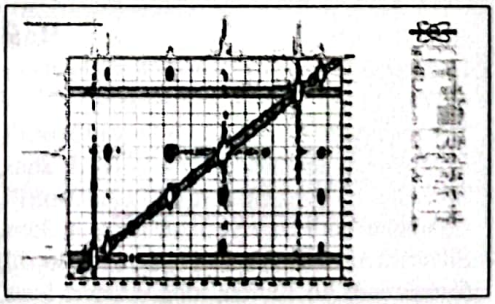


Figure (8) HMBC Spectrum

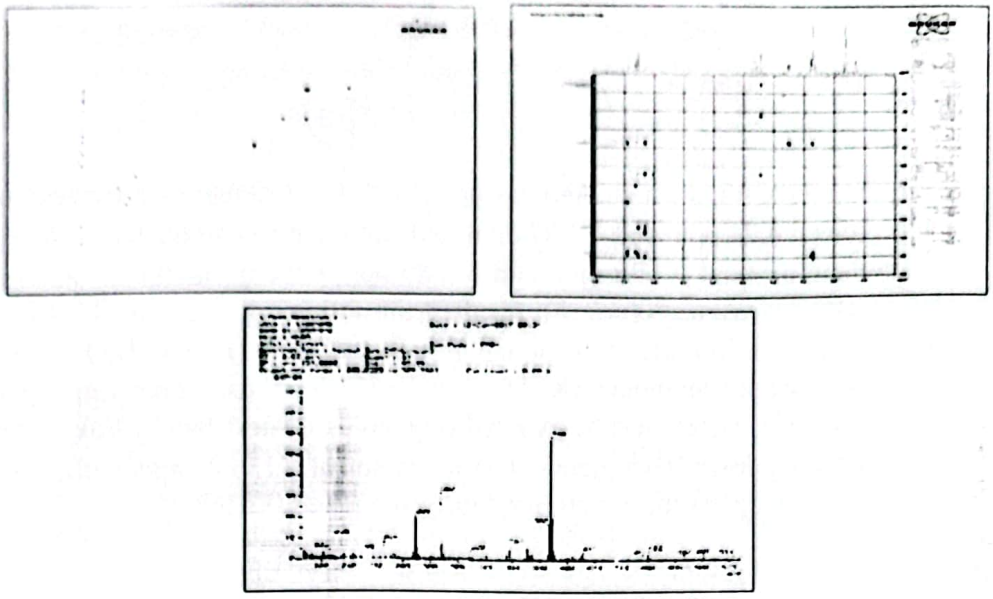


Figure (9) FAB-Mass Spectrum

Conclusion

In this study, the isolated (compound KTDS – 2) from one Myanmar indigenous medicinal plant, *Alyxia fascicularis* was used for the molecular formula determination and complete structural elucidation.

The molecular formula of the pure compound (KTDS-2) from *Alyxia fascicularis* was determined as $C_{21}H_{24}O_7$ using some spectroscopic methods. Finally, the complete structure of pure compound (KTDS-2) could be elucidated by means of spectroscopic analysis utilizing FT IR, ^{1}HNMR, ^{13}C NMR, DEPT, DQF-COSY, HSQC, HMBC, FAB-mass spectral data respectively. The molecular mass of the pure compound (KTDS-2) is 388 and is in good agreement with molecular ion peak at (m/z 411) in FAB-mass spectrum.

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Nutritional Contents Investigation and Antioxidant Activity Examination of Local Super Fruit (Nagarr-mauk)

Kyi Kyi Thet[1], Thida[2], Nila Khaing Htun[3], San San Win[4], Tin Tin Moe[5], KhinNannNyunt Swe[6]

Abstract

Red dragon fruits (Nagarr-mauk) used in this work were collected from Pyin Oo Lwin Township, Mandalay Region. The preliminary phytochemical investigation of pulp of the fruit showed the presence of some secondary metabolites such asalkaloids, glycosides, terpenes, polyphenols, phenolics, tannins, lipophenols and primary metabolites such as carbohydrates and proteins respectively. Some nutritional compositions of the pulp of red dragon fruit were studied. The minerals present in the sample were determined by using EDXRF method. The amount of potassium is the highest (0.782%)in this sample. The presence of (0.02%) oil, (0.33± 0.02%) fiber, 0.19 %of protein, (4.87± 0.11%) of reducing sugar and (0.007%) of vitamin C were explored in this work. The antioxidant activity of the sample was determined at University of Mandalay Technological University. Antioxidant activity was measured by DPPH assay. The IC_{50} value of fresh sample was found to be 2500µg/mL.

Keywords: phytochemicals, minerals, nutritional compositions, antioxidant activity, DPPH assay

Introduction

Fruits and vegetables contain numerous natural antioxidants that offer protection against chronic disease. Other than vitamins, fiber and minerals, total phenol and flavonoid compounds were found to be the most abundance antioxidants in plants particularly in the tropical fruits (Rufino*et al.*, 2010).Red dragon fruit is a great source of vitamin C and water soluble fiber (Mizrahi *et al.*, 1999) and rich in pectin (Nur Izalin *et al.*2012).The fruits often consumed fresh or make into juices, cordial, jams and ice cream (Wybraniec *et al.*, 2001). The predominant fatty acid in red dragon pulp is linoleic acid, which represents as 50.869%of the total fatty acids in the fruit, followed by oleic acid with21.55% and palmitic acid with 12.632% of the total fatty acids. This mono and polyunsaturated composition of fatty acids is paramount to health ,for as much as these acids contribute to reducing low density lipoprotein and very low density, both responsible for increased serum cholesterol.(Jeronimo MC, et al., 2015)Eating fruits during pregnancy is a good habit. The red dragon fruit juice can be an alternative treatment to deal with anemia among pregnant women. (Widyaningsih A, *et al.*, 2017)The dragon fruit helps the digestive process, prevent colon cancer and diabetes, neutralize toxic substances such as heavy metal, reduce cholesterol levels and high blood pressure and consumed regularly the dragon fruit can help against asthma and cough. (Jaafar R.A, *et al.*, 2009). Nowadays, more people are interesting to living a healthy lifestyle, and healthier food options. This study aimed to investigate some nutritional values and antioxidant activity of local dragon fruits.

Botanical Description

Family name	-	Cactaceae
Botanical name	-	*Hylocereuspolyrhizus* Haw.
English name	-	Dragon Fruit
Myanmar name	-	Nagarr-mauk.
Part of use	-	Fruits

Fig .1 Plant

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Medicinal uses

It is rich in vitamin C and fibers that help provide an overall healthy body and also helps indigestion, lower blood glucose levels in type 2 diabetes and prevent the formation of cancer-causing free radicals. Dragon fruit is rich in minerals cleans toxic ingredients thus preventing the occurrence of colon cancer. Dragon fruit helps to control cholesterol level to improve immune function (Watzl*et al.*2005).

Materials and Methods

Sample collection and preparation

The samples red dragon fruits were collected from Pyin Oo Lwin Township, Mandalay Region. The fresh pulp was cut into small piece and dried in air.

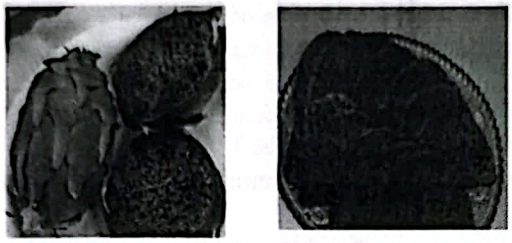


Fig .2 Fruit and Pulp

Phytochemical Screening (Harbone, 1973)

The various solvents of fruit sample were prepared to analyze the presence of certain phytochemicals. Analysis was done for alkaloids, glycosides, steroids, reducing sugars, flavonoids, terpenes, phenolic compounds, polyphenols, tannins, saponins, lipophenols and carbohydrates.

Determination of Nutritional Composition of Fruit Sample

The study of nutritional composition of fruit sample such as water content, ash, mineral, oil, crude fibre, nitrogen and protein,(by the method expressed in International Journal of Nutrition and Food sciences,2013 and AOAC, 1990.) reducing sugar(as described by O.P.Pandey, D.N.Bajpai and S.Giri, 1972) and vitamin C(as mentioned in Mohammed Sohel Chowdhury, 2016) was performed.

Table (1) Determination of Nutritional Composition of Fruit Sample

No.	Nutritional Content	Methods / Instruments
1.	Water content	Oven drying method
2.	Ash	Muffle furnace
3.	Oil	Soxhlet Apparatus
No.	**Nutritional Content**	**Methods / Instruments**
4.	Crudefibre	Muffle furnace
5.	Nitrogen and protein	Micro Kjeldahl's method
6.	Reducing sugar	Iodometric titration
7.	Vitamin C	Iodometric titration

Determination of Antioxidant Activity

Antioxidants inhibit the oxidation processes which occur under the influence of atmospheric oxygen or reactive oxygen species and are involved in the defense mechanism of the organism against the pathologies associated to the attack of free radicals (Litescu Sc *et al.*, 2011).The antioxidant activity of the fresh juice was determined by DPPH (1, 1-

diphenyl-2-picryl-hydrazyl) radical scavenging assay at Mandalay Technological University. It is the measurement of the ability of the compound to donate hydrogen to DPPH radical. In this experiment, ascorbic acid was used as standard antioxidant.

Results and Discussion

Phytochemical Constituents of Fruit Sample

Preliminary phytochemical analysis was performed in order to know different types of organic compounds present in fruit sample. These phytochemicals are known to exhibit medicinal as well as physiological activities. The results are shown in Table (2).

Table (2) Result for preliminary phytochemical screening

No	Test	Reagent used	Observation	Result
1.	Alkaloid	(i) Wagner's reagent,1%HCl	(i) Reddish brown solution	+
		(ii) Dragendorff's reagent,1 % HCl	(ii) Orange ppt	+
2.	Glycoside	10 % Lead acetate , 10 mL D.W	White ppt	+
3.	Steroid	Acetic anhydride, 10 mL EtOH Conc : H_2SO_4,	Green solution	-
4.	Reducing Sugar	Benedict's solution ,10 mLD.W	brick – red ppt	+
5.	Flavonoid	10 mL EtOH , conc:HCl , Mg and conc:H_2SO_4	Pinkcoloursolution	-
6.	Terpene	10 mL EtOH ,0.3mL acetic anhydride and 0.5mL chloroform,conc: H_2SO_4	Pink color solution	+
7.	Polyphenol	10 mL EtOH , 1% $FeCl_3$ and 0.1% K_3 [Fe (CN)$_6$	Greenish blue solution	+
8.	Phenolic compound	10 mL D.W , 10% FeCl	Greenish blue solution	+
9.	Tannin	10 mL D.W, 10 % $FeCl_3$ and dil:H_2SO_4	Yellowish brown ppt	+
10.	Saponin	10 mL D.W, $NaHCO_3$	Froth	+
11.	Lipophenol	10 mL D.W, 0.5 M KOH and NaOH	Deep color solution	+
12.	Carbohydrate	Fehling A + B solution and 10 mL EtOH	Yellow ppt	+

(+) = presence of constituents; (-) = absence constituent

According to this table, the sample contain alkaloids, glycosides, reducing sugars, terpenes, polyphenols, phenolics compounds, tannins, saponins, lipophenols and carbohydrates.

Elemental Composition

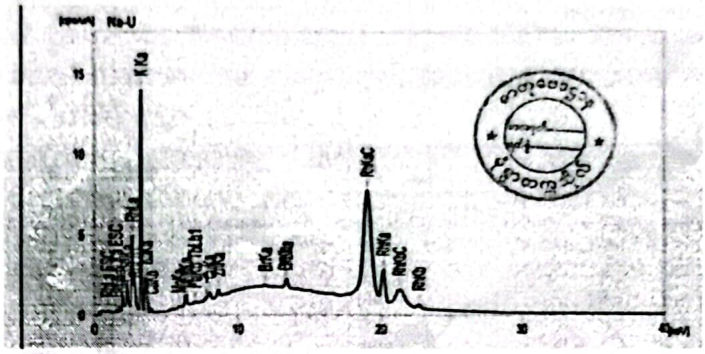
The elemental composition the pulp of the fruit was examined by EDXRF spectroscopy and the results were presented in Table (3).

Table (3) The Results of Elemental Composition

No.	Elements	Symbols	Results (%)
1.	Potassium	K	0.782
2.	Phosphorous	P	0.185
3.	Sulfur	S	0.150
4.	Calcium	Ca	0.066
5.	Iron	Fe	0.004
6.	Copper	Cu	0.002
7.	Zinc	Zn	0.001

8.	Rubidium	Rb	0.001
9.	Manganese	Mn	0.001

Fig 3. EDXRF Spectrum



According to these results, the sample contained the significant amount of potassium, phosphorous, sulfur and calcium than the others. The presence of heavy toxic metals was not detected. Based on the aspect of heavy toxic metals, eating red dragon fruit is safe for human health.

Nutritional Composition of Fruit Sample

From the experimental data, it can be observed that the sample contain many nutritional values which have benefits to human's health. The results are shown in Table (4).

Table (4) Results of Nutritional Composition of Fruit sample

No	Nutritional Compositions	Percent (%)
1	Water	88.00± 0.67
2	Ash	0.78 ± 0.01
3	Oil	0.02
4	Fiber	0.33 ± 0.02
5	Protein	0.19
6	Reducing sugar	4.87± 0.11
7	Vitamin C	0.007

Table (5) Result for Antioxidant Activity of Ascorbic acid

Tested Sample	Concentration (µg/mL)	% DPPH Radical Scavenging	IC_{50} (µg/mL)
Ascorbic acid	0.0625	41.7	0.125
	0.125	50.622	
	0.25	55.45	
	0.5	57.47	
	1	58.03	
	2	59.94	

Table (6) Result for Antioxidant Activity of fresh juice

Concentration (µg/mL)	DPPH Absorbance	Absorbance of Sample	%inhibition	IC_{50} (µg/mL)
1760	2.6761	1.483	44.53	2500
3520	2.6761	1.2539	53.14	
6930	2.6761	1.2289	54.07	
12500	2.6761	1.186	55.68	

The half maximal inhibitory concentration value for the sample (IC_{50}=2500 µg/ml) was higher than that of standard ascorbic acid (IC_{50}=0.125g/ml). Therefore, the sample has lower antioxidant activity than standard ascorbic acid.

Conclusion

The secondary metabolites alkaloids, glycosides, terpenes, polyphenols, phenolics, tannins, lipophenols and the primary metabolite carbohydrates, proteins are present. The amount of potassium is the highest (0.782%) among other minerals in this sample. Other minerals constituents such as phosphorus, sulfur, calcium and iron are also present. The nutritional compositions such as oil (0.02%), fiber (0.33± 0.02%), protein (0.19%), reducing sugar content (4.87± 0.11%) and vitamin C content (0.007%) based on the fresh sample were also detected. So, consuming dragon fruit would benefit for good health. IC_{50} value of fresh juice was found to be (2500µg/mL). By comparing the value of standard ascorbic acid (0.125µg/mL) pulp of red dragon fruit shows mild antioxidant activity.

Acknowledgements

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Investigation of Dyeing Ability on Plant Source Yarn and Animal Source Yarn Using Natural Dye

Moe Tin Khaing[1], Khin Aung Aung[2], Nan Mhway Mhway[3], Aung Ko Latt[4], Suu Suu Win[5]

Abstract

The aim of this research is to study on natural dyeing of cotton, wool and silk yarns with pigment extracted from the shocking-pink color flowers of *Bougainvillea spectabilis (Sat-Ku)*. In these studies, the effects of five different mordants, such as salt, iron, ash, vinegar and alum with pre-, together- and post- mordanting methods on cotton, wool and silk yarn samples applying aqueous medium of flower extract were examined and the results obtained were informed as a comparison. Most of tested yarn samples gave good, fair and poor rubbing and washing fastness respectively but showed very poor activity in the property of change of shade.

Keywords: *Bougainvillea spectabilis*, mordants, pre-mordanting, together-mordanting, post-mordanting methods, rubbing and washing

Introduction

The global textiles consumption is increasing by 3% per annum and nowadays it's uses are reached at around 30 million tonne. To get final products of textiles, there are many stages such as modanting, dying and washing and large amount of dyes are used in the coloration steps round about 700,000 tonnes from which releases colourants as side-waste into the environment (Rongruangkit krai and Mongkholrattanasit, 2012). The improvement of textile technology within these decades has economically upgraded the usefulness and many opportunities for the attraction of innovative finishes to people (Aberoumand, 2011). The textile industries are always needed to fulfill the satisfactions of the customer's demands including quality, variety, fastness and other technical requirements. The industries from India become to use synthetic organic dyes like direct dyes, processing dyes, reactive dyes, etc. competing with commercial inorganic dyes. Different types of chemicals present in the formulations of dyes which make the attractive shades of fabrics for the desire of market render them very complex (Mathur at al., 2005). The hazards of synthetic dye and chemicals used for dyeing have noticed as a threat to the environmental and there is an interest about the alternative preparation of dye using natural sources. Synthetic dyes are mostly produced from petrochemical source and some of synthetic dyes compost of toxic or carcinogenic amines which can affect the human health. Synthetic dyes are used as eco-friendly natural color additives on fabrics and dying of textiles based on the plant resources are gradually increased to round about 2% annually. The colors resulted from natural dyes are easier to biodegrade than the synthetic dye constituents (De Carvaiho et al., 2014).

Commercial textile producers and small industries have emphasized on the outcomes of using natural dyes for regular basis dyeing and printing of textiles to reduce the environmental pollution concerned with the disadvantages of synthetic dyes (Manta and Agarwal, 2009). The value for use of eco-friendly products instead of synthetic materials has been recognized and attracted towards consumers with the awareness on natural fibres applications. Commercial dyers and textile exporters have started interesting at the benefits of using plant resources not only for dyeing but also for printing of different textiles to get worldwide market. Though natural dyes have more effectiveness than synthetic dyes, their uses are still very uncommon, soothing and soft shades as compared to 'synthetic dyes. On the other hand, synthetic dyes can be applied easily with an economical price, but it introduces a wide range of problems like skin allergy and other harmfulness

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to human body, produce toxicity and chemical hazards during its synthesis, release undesirable, hazardous and toxic chemicals etc. The natural bio-pigments are accepted as the supplement for health, hygiene and environmental consciousness while the colours derived from minerals like lead chromate and copper sulphate etc. may cause serious health problems.

Nowadays great interests on natural dyes are due to the sources such as plants, insects, animals, and minerals whereas dyes from synthetic sources cause allergy-like symptoms or are carcinogens. Although natural dyes were utilized for a long time to color the clothes, the structures associated with the properties of natural dyes have been recognized very recently. In Myanmar, although traditional weaving is widely spread, natural dyeing is still less because the resistance and brightness of natural color on fabrics is needed to combine with advanced technology. Natural dye has some advantages over synthetic dye and application of the natural pigments in textile industry promotes consumers health protection and allows manufacturing of fully eco-friendly pigment without any synthetic mix. Therefore, there is applicable to encourage the work of natural dyeing and to do research concerning with effective production of dye from natural sources.

In this research, natural dye was extracted from the shocking pink flowers of Sat-Ku-Pann plant in aqueous medium. The color stabilities and fastness of dyed samples were measured, and their effects were organized under the title of color fastness property. Applied mordants were alum, ash, salt, iron and vinegar and pre, together and post mordanting methods were carried out in the dyeing of plant-and animal-source yarns such as cotton, wool and silk yarns.

Botanical description

Figure 1 Shocking Pink Flowers of *Bougainvillea spectabilis*

Kingdom	: Plantae
Order	: Caryohyllales
Family	: Nyctaginaceae
Genus	: *Bougainvillea spectabilis*
Part used	: Flowers
Myanmar name	: Sat-Ku-Pann
Color	: Shocking Pink

Experimental

Sample Collection

The flowers of *Bougainvillea spectabilis* were collected from Nanshae, Aungmyaetharzan Township, Mandalay in February 2015.

Sample Preparation

Collected flowers were washed with distilled water and only three calyces of each flower were taken as sample for analysis. They were cut into small pieces.

Extraction of Dye from Flower Sample

About 50 g of flower sample was placed in a beaker and 250 cm^3 of distillated water was added into this beaker. Then aqueous extract was prepared by allowing this mixture to boil on water-bath at 100°C for 30 minutes.

Determination of pH

Dye solution (20 cm^3) was placed into a beaker. The pH of dye sample solution was measured by means of pH meter after adjusting standard buffer solution of pH 4 and 7.

Dyeing with Mordant

Procedure

The three different methods of dyeing employed were pre-mordantation, together-mordantation and post-mordantation.

Pre-mordantation

Five cotton yarns were soaked into 50 cm^3 of five different 1% mordant solution containing alum, ash, salt, iron and vinegar. Then these mixtures were heated at 60°C for 45 mins on a water bath. After cooling, they were taken out and dried in air. Then each sample was put into 50 cm^3 of dyebath and heated at 90°C for 1 hour. After cooling, five dyed cotton yarn samples were dried in air.

Together-mordantation

Five cotton yarns were immersed in five baths containing five different 1% mordants and dye solutions. They were heated at 60°C for 45 minutes. After cooling, five dyed cotton yarn samples were squeezed and dried in air.

Post-mordantation

Five cotton yarns were first dyed on a water bath at 90°C for 45 minutes and then followed by mordanting in five separate baths containing different 1% mordant solutions at 60°C for 45 minutes. The mordanted cotton yarns were taken out, squeezed and dried in air.

Determination of Colour Fastness

Test for rubbing fastness was carried out in dry and wet conditions and washing fastness of dyed samples were determined by studying the change of shade and staining on other fabrics. These measurements were done at Development Centre for Textile Technology in Ministry of Industry, Yangon Region, according to International Standard Organization (I.S.O) Test no. 2 and 3.

Results and Discussion

The pink colour aqueous pigment extract was used for the study. Resulting dye solution extracted had the pH 6.8. Colour fastness of dyed yarn samples were examined according to Test no. 2 and 3 of International Standard Organization (I.S.O) and the results obtained were shown in the following Tables. For cotton yarn samples, pre-mordanting methods gave good and fair to good dry and wet rubbing fastness with salt, vinegar and alum mordants and two fair and poor to fair rubbing fastness with iron and ash mordants. Wet marks of rubbing fastness with all five mordants were also nearly the same result of dry mark. In together-mordanting, all mordants showed the boundary of fair to good responses for testing of rubbing fastness. In post-mordanting, except salt and ash with fair fastness for wet mark, vinegar mordand indicated fair to good and good rubbing fastness. Fair rubbing fastness could be observed with iron and alum mordants.

Figure 2 Dyed Cotton Yarns with five mordants by Pre, Together and Post Mordanding Methods

Table 1 Colour Fastness of Dyed Cotton Yarns Samples

Sr No.	Type of Sample	Rubbing 500 g; 100 Times		Washing Fastness of I.S.O Test No. 3; 60°C, 30 Min		
		Dry Mark	Wet Mark	Change of Shade	Cotton	P/C
Pre-mordanting						
1	Salt	4	3-4	2	4	4
2	Iron	3	2-3	1	4	4
3	Ash	3	2-3	1	4	4
4	Vinegar	4	3-4	2	4	4
5	Alum	4	3-4	2	4	4
Together- mordanting						
1	Salt	4	3-4	2	4	4
2	Iron	3-4	3-4	1	4	4
3	Ash	4	3-4	1	4	4
4	Vinegar	4	3-4	1	4	4
5	Alum	4	3-4	1	4	4
Post-mordanting						
1	Salt	3	2-3	2	4	4
2	Iron	3-4	3	1	4	4
3	Ash	3	2-3	1	4	4
4	Vinegar	4	3-4	2	4	4
5	Alum	4	3	1	4	4

P/C = Polyester and Cotton Blended

Grade. (1) Very Poor
(2) Poor
(3) Fair
(4) Good
(5) Excellent

Figure 3. Dyed Wool Yarns with five mordants by Pre, Together and Post Mordanding Methods

Similarly, in wood sample, although dry marks of rubbing fastness given by all methods were ranged from fair to good, wet marks were ranged from poor to good. Colour stabilities of all samples indicated very poor to poor change of shade in washing fastness while the staining of all wool samples with three mordanting methods on cotton were good and on multifibre were from fair to good.

Table 2 Colour Fastness of Dyed Wool Yarns Samples

Sr No.	Type of Sample	Rubbing 500 g; 100 Times		Washing Fastness of I.S.O Test No. 2; 50°C - 45 Min		
		Dry Mark	Wet Mark	Change of Shade	Cotton	P/C
Pre-mordanting						
1	Salt	3-4	3	1	4	3-4
2	Iron	3	2	1	4	3-4
3	Ash	4	3	1	4	3-4
4	Vinegar	4	3	1	4	3-4
5	Alum	4	3-4	1	4	3-4
Together- mordanting						
1	Salt	3	2-3	2	4	3-4
2	Iron	3-4	3	1	4	3-4
3	Ash	3-4	3	1	4	3-4
4	Vinegar	4	4	1	4	3-4
5	Alum	4	3-4	1	4	3-4

Sr No.	Type of Sample	Rubbing 500 g; 100 Times		Washing Fastness of I.S.O Test No. 2; 50°C - 45 Min		
		Dry Mark	Wet Mark	Change of Shade	Cotton	P/C
Post-mordanting						
1	Salt	3	2	2	4	3-4
2	Iron	3	2-3	1	4	3-4
3	Ash	3	2	1	4	3-4
4	Vinegar	3-4	2-3	1	4	3-4
5	Alum	3-4	2-3	1	4	3-4

Figure 4 Dyed Silk Yarns with five mordants by Pre, Together and Post Mordanding Methods

Table 3 Colour Fastness of Dyed Silk Yarns Samples

Sr No.	Type of Sample	Rubbing 500 g; 100 Times		Washing Fastness of I.S.O Test No. 2; 50°C - 45 Min		
		Dry Mark	Wet Mark	Change of Shade	Cotton	Multifibre
Pre-mordanting						
1	Salt	4	4	1	4	3-4
2	Iron	4	3-4	2	4	3-4
3	Ash	3-4	3	1	4	3-4
4	Vinegar	4	4	1	4	3-4
5	Alum	4	4	1	4	3-4
Together- mordanting						
1	Salt	4	4	1	4	3-4
2	Iron	4	3-4	2	4	3-4
3	Ash	4	3-4	2	4	3-4
4	Vinegar	4	4	1	4	3-4
5	Alum	4	4	1	4	3-4

Sr No.	Type of Sample	Rubbing 500 g; 100 Times		Washing Fastness of I.S.O Test No. 2; 50°C - 45 Min		
		Dry Mark	Wet Mark	Change of Shade	Cotton	Multifibre
Post-mordanting						
1	Salt	4	3-4	2	4	3-4
2	Iron	3-4	3	2	4	3-4
3	Ash	3	2	2	4	3-4
4	Vinegar	4	4	1	4	3-4
5	Alum	4	4	1	4	3-4

Multifibre: (1) Tri acetate
(2) Cotton
(3) Nylon
(4) Polyester
(5) Acrylic
(6) Wood

All dyed silk yarn samples resulted from fair to good dry mark of rubbing fastness and we mark pointed out as fair to good rubbing fastness except post-mordanting method with ash mordan which had poor fastness. Colour stabilities in washing were increased in some dyed silk samples bu they were lying in poor change of shade. Staining on cotton and multifibre could be observed a good and fair to good results.

Conclusion

The results of the present study proved that the aqueous extract from flower of *Bougainville spectabilis* distributed uniformly beautifully on the plant and animal-source yarns. Moreover, mos of the yarn samples showed separate beautiful colours with the use of respective mordants. Althoug natural dyeing on yarn samples corresponded mostly to good responses of rubbing fastness, colou stabilities were very poor when washing performed on dyed yarns. Among them, Cotton yarns wit vinegar mordant by applying together modanting method exhibited the best colour fastness and woo yarns with all mordants by pre-modanting methods showed the poor fastness property.

Acknowledgements

I owe a great deal of gratitude to Dr Aung Win, Rector, Dr Aye Aye Ko and Dr Soe Myint Aye Prorectors, University of Myitkyina for their encouragements. Then we would like to express our gratitude t Dr Ni Ni Aung, Professor and Head, Dr Nant Si Si Htay, Professor, Department of Chemistry, University o Myitkyina for their invaluable advice, kind guidance and encouragement for these results. We would like t extend our thanks to all research members for their energetic participation in this research work.

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Determination of Some Chemical Parameters of Soil Samples from Four Different Sites of Myitkyina University Campus

Nant Si Si Htay[1], Thet Su Min[2], N Khawn San[2]

Abstract

The main aim of this paper is to analyze soil from the Myitkyina University Campus, Myitkyina Township, Kachin State. The soil samples were collected from the four selected sites (Sample 1: in front of Malizup building, sample 2: behind the main building, sample 3: in front of main building, sample 4: in front of family resident) in April 2019. Some physicochemical properties such as the texture, moisture content, organic carbon content and pH were determined. The chemical components present in soil samples such as total nitrogen was determined by Kjeldahl's method, available P by UV Spectroscopy, available K, exchangeable calcium and magnesium and the trace elements in soil samples were determined by using Atomic Absorption Spectroscopy.

Keywords: Myitkyina University Campus, soil samples, some physicochemical properties, atomic absorption spectrophotoscopy

Introduction

Soil is a mixture of organic matter, minerals, gases, liquids, and organisms that together support life. Soil acts as an engineering medium, a habitat for soil organisms, a recycling system for nutrients and organic wastes, a regulator of water quality, a modifier of atmospheric composition, and a medium for plant growth, making it a critically important provider of ecosystem services (Dominati *et al*., 2010)

The soil body becomes the habitat of a variety of biological materials, viz. plants, animals and microorganism. Eventually, the dead and transformed tissues of these materials form the organic component of the soil. The organic components in combination with the mineral particles together form the soil body. Living organisms contribute to the biological activity of the soil. Thus, the soil is not a dead body, but is the seat of tremendous activity of billions and billions of soil organisms. These organisms play a major role in supporting plant life (Lynch, 1990).

Soil serves as a storage reservoir for nutrients and water needed for plant growth. These soil properties are essential to crop production. Crop production potential is greatly influenced by the physical and chemical properties of soils. These same properties also influence related activities such as tillage, erosion, drainage, and irrigation, important rate, aggregation, temperature, organic matter content, and nutrient availability(Danny, 2014). Understanding soil's properties is essential for nutrient planning and can be applied to land use decisions. Soil properties such as soil structure, depth, texture, salinity, acidity, waterlogging or compaction can limit plant growth even when the soil has adequate nutrients. Before applying fertilizer, it is necessary to consider what is actually limiting plant growth. Soil properties can be observed in the paddock as measured through soil testing. A soil's properties are largely determined by its parents material and weathering during its formation. Topography, age and agricultural practices can also affect a soil's properties (Brady and Weil, 2016). Three groups of soil properties influence plant growth:

- Physical, or the texture and structure of the soil
- Chemical, which affects both the fertility of the soil and its physical properties
- Biological or the organisms in the soil, such as bacteria, fungi, insects and earthworms (Brady and Weil, 2016)

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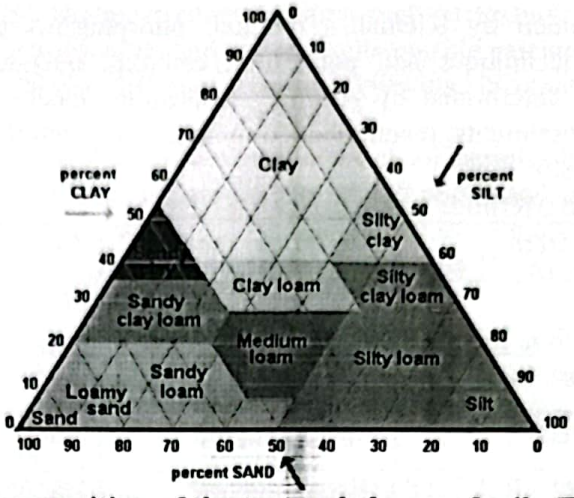

Figure 1. The composition of the textural classes of soils (Freeman, 2015)

Soils are one of the most important fundamental components which help to grow plants. It provides nutrients for plants for successful growth and better agricultural productivities. Agriculture production is based on the management and utilizing of soils toward increasing production and productivity (Danny, 2014). The research was aimed to investigate the soil parameters such as texture, moisture, pH, organic matter total nitrogen, phosphorus and exchangeable potassium ion in soil samples collected from different sites of Myitkyina University campus.

Materials and Methods

Sample collection and preparation

Four soil samples were collected from four different selected areas of Myitkyina University campus, Myitkyina, Kachin State in April 2019. Samples were broken up into small lumps and spread out in the shade for air dry. Afterwards, gravel, roots, etc. were discarded. Then the soil samples were sieved through a 2 mm sieve and were stored in plastic bags and clearly labeled.

Figure 2. Sampling Sites of Soil Sample (1) and (2)

Figure 3. Sampling Sites of Soil Sample (3) and (4)

Methods

Moisture content was determined by oven drying method, and measurement of pH was carried out by a pH meter. Organic carbon was determined by Tyurin's method, nitrogen

content was determined by Kjeldahl's method, phosphorous contents by UV-Visible Spectrophotometric techniques and potassium, calcium, magnesium, some macro and micronutrients were determined by Atomic Absorption Spectroscopy. In the analytical procedures of the experiments, recommended methods and techniques were applied (FAO, 2008 and AOAC, 1980).

Table 1. Analytical Methods and Apparatus Used

No	Analytical item	Analytical method	Apparatus used
1	pH	1:2,5 soil: water suspension method	pH meter (F-51,HORIBA)
2	Organic carbon	Tyurin's method	Analytical balance, HR-250 A
3	Textural class	Pipette method	Analytical balance, HR-250 A
4	Available P	Olsen's method	UV-Visible Spectrophotometer, Janway 6305
5	Available K	1N ammonium acetate extraction method	Atomic Absorp Spectrophotometer, Nov AA 4(
6	Total N	Kjeldahl method	Kjeldahl digestion and distilla unit
7	Exchangeable Ca, Mg	1N ammonium acetate extraction method	Atomic Absorp Spectrophotometer AA-7(SHIMADZU

Results and Discussion

Some Physicochemical properties of all Soil Samples

Table 2. Results of Physicochemical Parameters of Soil Samples

Sample name	Moisture %	Organic Carbon %	pH		Textural Type (%)			Textural class
			value	rating	sand	Silt	clay	
S -1	3.39	0.25	7.35	neutral	59.66	28.5	11.84	Sandy loam
S-2	2.35	0.11	7.31	neutral	70.18	22.74	7.08	Sandy loam
S-3	2.61	0.19	7.10	neutral	75.2	17.16	7.64	Sandy loam
S-4	3.68	0.14	7.36	neutral	65.86	25.72	8.42	Sandy loam

S1 = in front of Malizup building,
S2 = behind the main building,
S3 = in front of the main building,
S4 = in front of family residen

Table 3. Results of Physicochemical Parameters of Soil samples

Sample name	Total N (%)	Available P (ppm)		Available K (ppm)		Exchangeable Ca (ppm)		Exchangeable Mg (ppm)	
		value	rating	value	rating	Value	rating	value	rating
S-1	0.16	20.56	high	275.25	High	7.19	medium	0.32	Low
S-2	0.11	21.14	high	137.97	Low	8.73	medium	0.53	Medium
S-3	0.14	20.89	high	197.97	Medium	8.15	medium	0.39	Low
S-4	0.20	21.68	high	169.73	medium	9.18	medium	0.35	low

The physical and chemical characteristics such as texture, moisture, pH, organic carbon, total nitrogen, phosphorous and cation exchangeable calcium and magnesium were measured from the soils of four different areas of Myitkyina University campus. The resulted data are shown in Tables.

The results indicated that soil textural class of all samples S1, S2, S3 and S4 were sandy loam. Soil texture contents of sample-1 were 59.66 % sand, 28.5 % silt and 11.84 % clay and sample-2 were 70.18 % sand, 22.74 % silt and 7.08 % clay. Sample (3) and sample (4) were found to contain 75.2 % sand, 17.16 % silt and 7.64 % clay and 65.86 % sand 25.72 % silt and 8.42 % clay respectively.

According to the composition of the textural classes of soils as shown in Figure 1, sandy loam is normally made up of sand along with varying amounts of silt and clay. Sandy loam soil is preferable for gardening because this type of soil normally allows for good drainage.

The soil moisture contents of the four samples S1, S2, S3 and S4were 3.39 %, 2.35 %, 2.61 % and 3.68 %, respectively. From the results it was found that sample (4) has the highest moisture content.

The pH values of the four samples S1, S2, S3 and S4 were 7.35, 7.31, 7.10 and 7.36, respectively and were found to be neutral. Soil pH and interpretation viz., slightly acidic, medium acidic and strongly acidic values are 6, 5.5 and 5 (FAO, 2008).

The values of organic carbon content in the four samples S1, S2, S3 and S4 were 0.25 %, 011 % 0.19 % and 0.14 %, respectively. Organic matter in the soil comes from the remains of plants and animals. Organic matter contains about 58 % organic carbon (FAO, 2008).

Soil organic carbon is a measurable component of soil organic matter. Organic matter makes up just 2-10 % of most soil's mass and has an important role in the physical, chemical and biological function of agricultural soils (Hoyle, 2013). Soil organic carbon tends to be concentrated in the topsoil. Topsoil ranges from 0.5-3.0 % organic carbon for most upland soils. Soils with less than 0.5 % organic carbon are mostly limited to desert areas. Soils containing greater than 12-18 % organic carbon are generally classified as organic soil.

The values of total nitrogen contents in samples S1, S2, S3 and S4 were found to be 0.16 %, 0.11 %, 0.14 % and 0.20 %, respectively. It is found that sample (4) has the highest nitrogen content. The amount of available potassium in soil samples are shown in Table (3). The observed values are 275.25 ppm, 137.97 ppm, 197.97 ppm, and 169.73 ppm. In this work, sample (1) showed the highest available potassium content. The value of available K (ppm) < 150 is low, 150-250 is medium, 251-800 is high, and >800 is excessive.

The available phosphorus in soil samples S1,S2, S3 and S4 were found to be 20.56 ppm, 21.14 ppm, 20.89 ppm, and 21.68 ppm, respectively. The rating of available phosphorus (Olsen's test) <10 is low, 10-20 is medium, 21-40 is high, and >40 is excessive.

The values of exchangeable Ca of the four soil samples were 7.19 ppm, 8.73 ppm, 8.15ppm and 9.18 ppm. All samples are at medium exchangeable Ca (ppm) values. Exchangeable Ca <5 is low, 5-10 is medium, >10 is high.

The values of exchangeable Mg of the four soil samplesS1, S2, S3 and S4were found to be 0.32 ppm, 0.53 ppm, 0.39 ppm and 0.35 ppm respectively. The exchangeable Mg (ppm) in soil samples 1, 3 and 4 were in low rating and that in soil sample 2 was medium rating. The exchangeable Mg value of 0.3-1 ppm is assigned as low rating and that of 1-3 ppm is assigned as medium rating(FAO, 2008).

Conclusion

From the study of some physicochemical properties of soil samples from four sampling sites of Myitkyina University Campus, Myitkyina Township, the pH values of soil samples were found to be in the range of 7.10 to 7.36 which were in neutral condition. The organic carbon contents of all soil samples were found to be very low. From the

determination of N, P and K values, sample (1) and (3) were high in N and P contents and so suitable for plantation. Sample (2) was low value of N and K, and so it is unsuitable for agriculture. Treatment of biofertilizer in soil area of sample (2) is recommended for plantation. The highest total nitrogen content of sample (1) is suitable for leaf crop production. This research contributes some information for the assessment of chemical constituents of soil samples in Myitkyina University Campus.

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Antioxidant Activity of Different Extracts of Leaves of *Dregea volubilis* Banth (Gway-dauk)

Ni Ni Aung[1], Mar Mar Win[2]

Abstract

In this research work, the antioxidant activity of *Dregea volubilis* Benth in various solvent systems was carried out by using (DPPH) assay method. The sample was collected from Monywa University campus. Spectroscopic measurements were carried out by using spectrophotometer (JENWAY 6300) in the Department of Chemistry, Monywa University.

Keywords: Antioxidant activity, DPPH assay, *Dregea volubilis* Benth (Gway-dauk)

Introduction

Some people like eating the bitter taste leaves such as leaf of *Dregea volubilis* Benth (Gway-dauk), fruits of *Momordica charantia* Linn (Kyet-hin-khar) and *Oroxylum indican* Vent (Kyaung-hya). When these leaves are eaten, they are delicious and give satisfication for eaters. This is due to the effect of antioxidant activity of these leaves and fruits. These leaves of *Dregea volubilis* Benth (Gway-dauk) contain some many chemical constituents such as alkaloid, flavonoid and polyphenol. In these constituents, alkaloid and flavonoid give bitter taste and have antioxidant activity due to the presence of polyphenol and methoxy groups. So that some people use the leaves of *Dregea volubilis* Benth (Gway-dauk) for good health.

An antioxidant is a molecule that inhibits the oxidation of other molecules. Antioxidants are nutrients as well as enzymes. Oxidation reaction transfer electrons or hydrogen from a substance to an oxidizing agent. Oxidation reactions can produce free radicals. In turn, these radicals can start chain reactions. When the chain reaction occurs in a cell, it can cause damage or death to the cell. Antioxidants terminate these chain reactions by removing free radicals intermediate and inhibit other oxidation reactions.

Dregea volubilis Benth (Gway-dauk) are widely used in traditional system of medicine in most countries of the world. The leaves of Gway-dauk are used for the treatment of indigestion, dyspepsia, dysentery, ulcers, tingling and numbness and were also used in eye infections and for health improvement. It belongs to the family Asclepiadaceae. It is a twining Shrub.

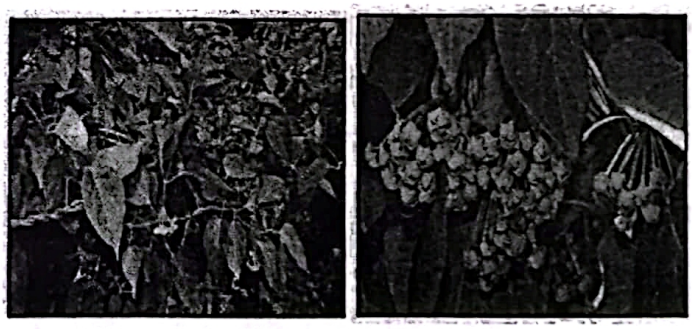

Figure 1.1 Plant and leaves of Gway-dauk

DPPH Free Radical Method: DPPH is a common abbreviation for an organic chemical compound 1,1-diphenyl-2-picryl hydrazyl (Brand-Williams, Cuvelier, & Berset, 1995). It is a dark-colored crystaline powder composed of stable free radical molecules that acts as a hydrogen radical scavenger. It is soluble in ethanol and exhibit deep violet colour in solution, and it becomes colorless or pale yellow when neutralized. DPPH is a well-known radical

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and a trap for other radicals. DPPH has two major applications, both in laboratory research one is a monitor of chemical reactions involving radicals, most notably it is a common antioxidant assay, and other is a standard of the position and intensity of electron paramagnetic resonance signals. Rate reduction of a chemical reaction upon addition of DPPH is used as an indicator of the radical nature of that reaction.

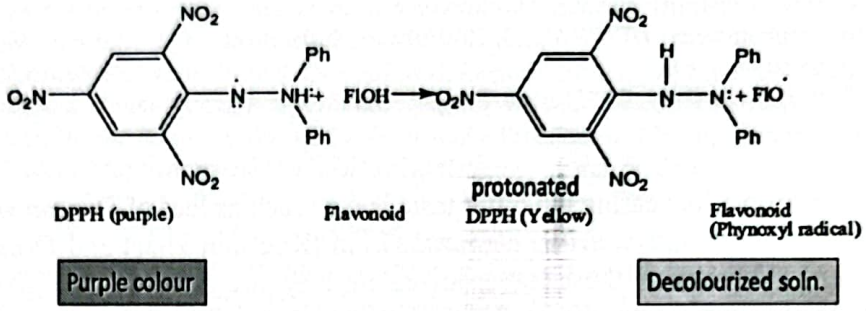

Figure 1.2 The reaction mechanism of DPPH free radical

Materials and Methods

Preparation of 60 µM DPPH Solution: 60 µM DPPH solutions were prepared in the brown colored bottle by dissolving 2.364 mg of DPPH powder in 100 mL of 95% ethanol solvent. Thorough mixing was made by using vortex mixer. This prepared solution should be used within 24 hours.

Preparation of Test Sample Solution: 95% EtOH and watery extracts of the plant samples were prepared. Stock solutions were prepared by thorough mixing of 2 mg of extract samples and 10 mL of 50% ethanol solvent. Each stock solution obtained was serially diluted with respective solvents to obtain desired concentration of 10, 5, 2.5, 1.25, 0.625 µg/mL of test sample solution.

Preparation of Control Solution: the control solution was prepared by thorough mixing of 1.5 mL of 60 µM DPPH solutions and 1.5 mL of 95% ethanol solvent with the aid of vortex mixer. This solution was allowed to stand for 30 minutes at room temperature and measured its absorbance at 517 nm.

Preparation of Blank Solution: Blank solutions were prepared by thorough mixing of 1.5 mL of each test sample solution and 1.5 mL of its respective solvent with the aid of vortex mixer. After 30 minutes, its absorbance was measured at 517 nm.

Measurement of DPPH Radical Scavenging Activity by pectrophotometric Method: 1.5 mL each of 60 µM DPPH solution and 1.5 mL each of test samples solution were thoroughly mixed by using vortex mixer. These solutions were allowed to stand at room temperature for 30 minutes. After 30 minutes, measurements of absorbance at 517 nm were made by these solutions using spectrophotometer (JENWAY 6300). All the sample solutions were tested in triplicate.

Absorbance of individual solution was measured and calculated the % inhibition by linear regressive excel program.

$$\% \text{ inhibition} = ((A_{C(0)} - A_{A(t)}) / A_{C(0)}) \times 100$$

where, $A_{C(0)}$ is the absorbance of the control at t = 0 min

$A_{A(t)}$ is the absorbance of the antioxidant at t = 30 mins

*DPPH is 2,2-diphenyl-1-picrylhydrazyl

Results and Discussion

Determinations of absorbance were carried out at wavelength 517 nm using spectrophotometer. Decrease in absorbance indicates increase in radical scavenging activity. The spectroscopic data were presented in Table (3.1).

Table 3.1 Absorbance of Crude Extracts from Gway-dauk

Extracts / Conc: (µg/mL)	Absorbance at 517 nm				
	0.625	1.250	2.500	5.000	10.000
n-hexane	0.1900	0.1706	0.1244	0.1081	0.0984
	0.1901	0.1705	0.1242	0.1082	0.0985
	0.1900	0.1706	0.1244	0.1081	0.0984
Ajinomoto	0.1451	0.1368	0.1334	0.1264	0.1234
	0.1450	0.1367	0.1332	0.1262	0.1233
	0.1451	0.1367	0.1333	0.1264	0.1233
Chloroform	0.2164	0.1506	0.1299	0.1059	0.0825
	0.2162	0.1506	0.1299	0.1057	0.0823
	0.2164	0.1505	0.1297	0.1058	0.0825
EtOAc	0.2117	0.2068	0.1298	0.1251	0.1212
	0.2116	0.2067	0.1299	0.1250	0.1213
	0.2116	0.2068	0.1298	0.1251	0.1212
Ascorbic acid	0.0851	0.0370	0.0341	0.0290	0.0201
	0.0850	0.0371	0.0340	0.0291	0.0201
	0.0851	0.0371	0.0342	0.0290	0.0202

From these results, it was found that as the concentration increased the absorbance decreased, i.e., increased in concentration increased the radical scavenging activity for all samples. Free radical scavenging activities of samples are usually expressed in term of percent. Free radical scavenging activity of extracts usually expressed in term of % inhibition was calculated. The mean % oxidative inhibition values of extracts and standards are described in Table (3.2).

In Table (3.2), $^{*}IC_{50}$ values of n-hexane extract (3.53), ethyl acetate extract (3.83), chloroform extract (2.38), Ajinomoto (3.12) and ascorbic acid (1.88) were described respectively. All are good in antioxidant activity. However, the chloroform extract showed the most effective activity. When the ajinomoto additives use in the curry, there is no effect on the antioxidant activity.

Table (3.2) Mean % Inhibition of Crude Extracts from Gway dauk and Standards in Different Concentrations and their IC_{50} Values

Extracts / Conc: (µg/mL)	Mean % Inhibition					IC_{50} (µg/mL)
	0.625	1.25	2.5	5	10	
n-hexane	67.42	63.62	56.63	36.90	28.63	3.53
Ajinomoto	54.93	53.67	50.65	49.23	45.67	3.12
Chloroform	15.67	43.77	52.61	62.89	72.89	2.38
EtOAc	67.42	65.77	63.73	30.85	28.75	3.83
Ascorbic acid	33.20	66.61	69.59	77.13	84.63	1.88

$^{*}IC_{50}$ = 50% oxidative inhibition concentration

From the average values of percent inhibition, IC_{50} values in µg/mL were calculated by computer program called linear regressive excel program. These results are tabulated in Table (3.3) and concentration versus percent inhibition was plotted as shown in Figure (3.1) and (3.2).

Table (3.3) Comparison of IC_{50} Values of Crude Extracts with Standards

Sample	IC_{50} (µg/mL)
n-hexane	3.53
Ajinomoto	3.12
Chloroform	2.38
EtOAc	3.83
Ascorbic acid	1.88

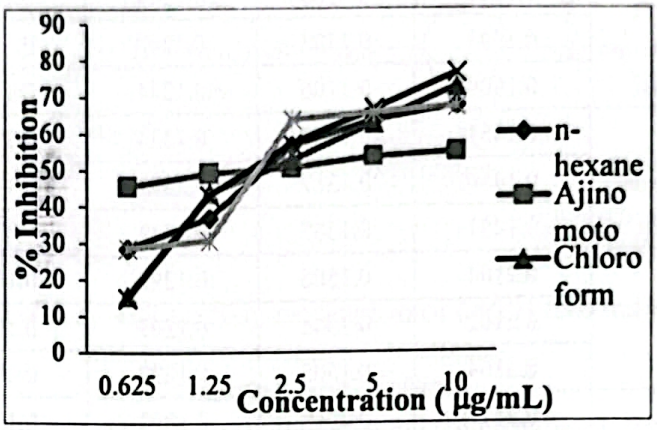

Figure 3.1 A plot of % inhibition vs concentrations of crude extracts from Gway-dauk and standards

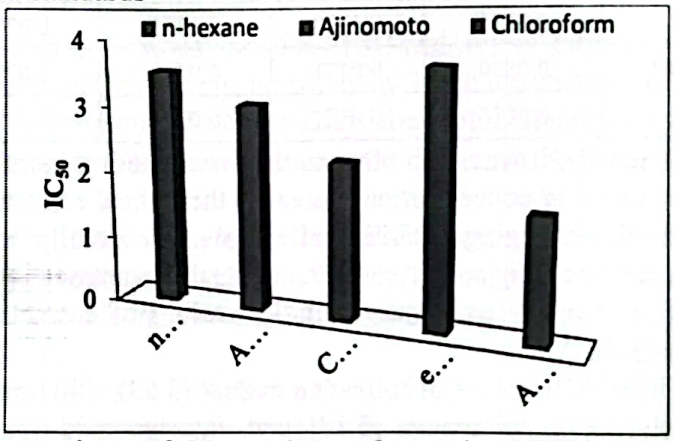

Figure 3.2 Comparison of IC_{50} values of crude extracts from Gway-dauk and standards

Conclusion

In this research work, the leaves of *Dregea volubilis* Benth (Gway-dauk) was selected to determine the antioxidant activity in the various solvent systems. IC_{50} values of the Gway-dauk in the four solvent systems were measured by DPPH assay method. All the solvent systems, the Gway-dauk give the good antioxidant activity. Among them, the antioxidant activity of Gway-dauk in the chloroform solvent system was the best. Their antioxidant activities could be due to the presence of flavonoids, polyphenols and methoxy groups. Therefore, the leaves of Gway-dauk have high benefits for human health.

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Phytochemical, Antioxidant Activity, Vitamin C Content and Mineral Compositions of *Hibiscus Sabdariffa* L. (Roselle Leave)

Nyo Nyo Win[1], Nyan Htun[2]

Abstract

The present work aims at determining the phytochemical, ash, moisture, vitamin C content, mineral compositions and antioxidant activity of *Hibiscus sabdariffa* L. (rosella leave). The phytochemical test was studied by test tube method. The ash and moisture content of leave was analyzed by AOAC method. In antioxidant activity study, ethanol extract of rosella leave was investigated with five different concentrations (25, 50, 100, 200, 400 µg/mL) by free radical scavenging assay. Mineral compositions of *Hibiscus sabdariffa* L. was determined by EDXRF method.

Keywords: Phytochemical, ash, moisture, antioxidant activity, EDXRF

Introduction

Hibiscus sabdariffa L., or commonly as Roselle or hibiscus, is a member of th Malvaceae family. Roselle contains many types of amino acid which is very important t our body and contains many important nutrients to our body such as protein, carbohydrat iron, calcium and fiber. Calyx of roselle is rich with various nutrients especially vitamin minerals and antioxidants. Vitamins found in Roselle are Vitamin B_1, Vitamin B_2, Vitami B_3 and Vitamin C. Roselle contains high level of antioxidants such as flavonoids which ar good for our heart and body. Antioxidants help to maintain the body's good health.

Reactive oxygen species (ROS) on free radicals are generated as byproducts c intermediates of aerobic metabolism and through reactions with drugs and environment toxins. The elevated cellular levels of free radicals cause damage to nucleic acid, protein and membrane lipids and have associated with many aging – related problems includin carcinogenesis and heart diseases (Sumathi, P. R, *et al*., 2009).

Many medicinal applications of the roselle plant have been developed around th world. In China it is used to treat hypertension, pyrexia and liver damage. Roselle is a annual erect shrub that takes five months from planting to harvesting; it can also be regarde as a perennial. Species grown for their fiber are tall, with fewer branches, sometimes growin to more than 3-5 m in height. Culinary varieties are many-branched, bushy, and generally l 2 m tall. Stems may be green or red, depending on the seed source.

Botanical Description of *Hibiscus sabdariffa* L. (Chin-baung-ni)

Botanical name : *Hibiscus sabdariffa* L.
Family name : Malvaceae
English name : Roselle
Myanmar name : Chin-baung-ni
Part used : Leaves

Figure (1) Leaves and plant of *Hibiscus sabdariffa* L. (Chin-baung-ni)

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Materials and Methods

Sample Collection

Roselle leaves were collected from Mandalay Region. The leaves were cut into fragments and air-dried in the shade for a few days. These fragments were used as the sample.

Preliminary Phytochemical Test of Roselle Leave

The phytochemical studies of the roselle leaves have been tested according to the standard procedure. Some of chemical compounds such as alkaloid, polyphenol, flavonoid, anthocyanins, tannin, and saponin were found in this roselle leave.

Determination of Ash, Moisture and Vitamin C

The ash and moisture content of prepared sample were determined by ashing method and oven drying method. Ascorbic acid content in roselle leave was analysed by using UV-visible spectrophotometer.

Investigation of Antioxidant Activity of Roselle Leave

The DPPH radical scavenging activity of ethanolic extracts from roselle leave was compared with ascorbic acid. DPPH radical scavenging test is based on the exchange of hydrogen atoms between the antioxidant and the stable DPPH free radical. The reduction capability of DPPH radicals was determined by the decrease in its absorbance at 517nm, which is induced by antioxidants. The significant decrease in the concentration of the DPPH radical is due to the scavenging ability of ethanolic extract of roselle leave (Sucheta, A. G., *et al.*, 2011). Determination of radical scavenging by DPPH method based on the change in absorbance of crude extracts solutions in various concentrations. Five kinds of were prepared by dilution with ethanol as solvent. Ascorbic acid was used as standard sample and ethanol was employed as control. These values are used to calculate the percentage inhibition of DPPH radical against the samples. The IC_{50} values of various extracts were calculated from the percentage inhibition at various concentrations. The results of the free radical scavenging activity of leave were assessed by DPPH was summarized by IC_{50} using method of linear regression.

Analysis of Semi Quantitative Elements

The semi-quantitative elemental analysis of *Hibiscus sabdariffa* L. (roselle leave) was performed by EDXRF method.

Results and Discussion

Ash Content and Moisture Content in Roselle Leave

Ash content and moisture content in roselle leaves were determined and the results were shown in the following Table (1).

Table (1) Ash Content and Moisture Content in Roselle

No.	Content	Value (%)
1	Ash	6.87
2	Moisture	11.09

Vitamin C Content in Roselle

Vitamin C content in roselle leave was determined by spectrophotometry using potassium chromate-diphenyl carbazide and the result was shown in the following Table (2).

Table (2) Vitamin C Content in Roselle

No.	Ascorbic acid content (mg/100 g)	Mean value
1	0.082	0.08%
2	0.080	
3	0.08	

Antioxidant Activity of Crude Extracts from *Hibiscus sabdariffa* L. (Roselle)

Antioxidant activity of ethanol extract of rosella leave was investigated with fi different concentrations (25, 50, 100, 200, 400 µg/mL) by free radical scavenging assay. IC value of *Hibiscus sabdariffa* L. and the activity of standard vitamin C were illustrated Table (3) and (4).

Table (3) % Inhibition of Various Concentration and IC_{50} Values for Standard Ascorbic Acid

Extracts	Concentration (µg/mL)	Mean Absorbance	Mean % inhibition	IC_{50} (µg/mL)
Ascorbic acid	1.25	0.221	28.71	2.23
	2.5	0.152	50.97	
	5.0	0.091	70.65	
	10.0	0.026	91.61	

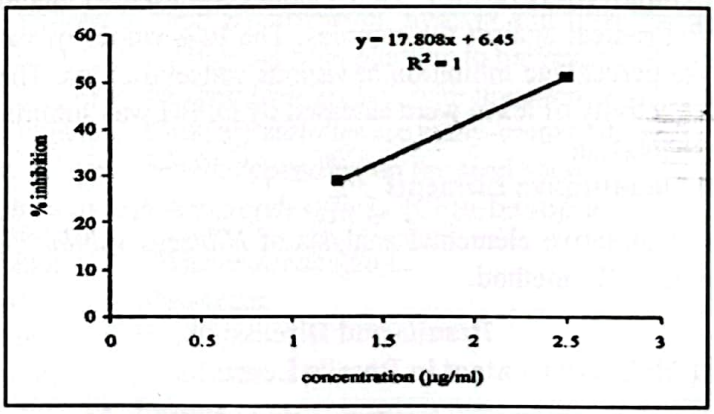

Figure (2) % Inhibition Vs Concentration (µg/mL) of Standard Ascorbic Acid

Table (4) Radical Scavenging Activity of Various Concentration of Crude Extract and IC_{50} Values (Roselle Leave)

Extracts	Concentration (µg/mL)	Mean Absorbance	Mean % inhibition	IC_{50} (µg/mL)
Ethanol extract (sample)	25	0.201	34.31	54.26
	50	0.16	48.15	
	100	0.091	69.83	
	200	0.03	89.76	
	400	0.017	94.66	

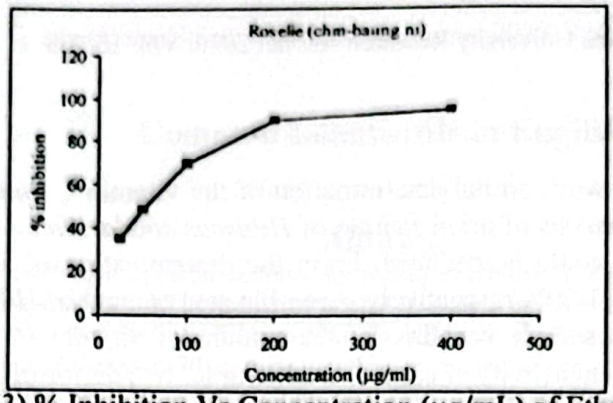

Figure (3) % Inhibition Vs Concentration (µg/mL) of Ethanol Extract Sample

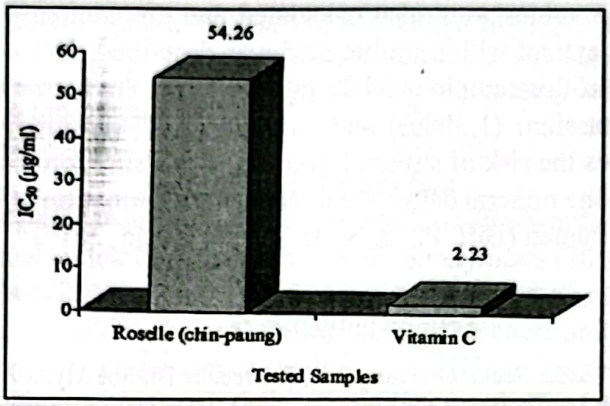

Figure (4) Bar Graph of IC_{50} Values or Standard Ascorbic Acid and Sample

Elemental Compositions of *Hibiscus sabdariffa* L. (roselle) by EDXRF

Elemental compositions of *Hibiscus sabdariffa* L. (Roselle) by EDXRF results are tabulated in Table (4) Potassium regulates acidic and alkaline level of body fluid. It is also called alkalizer. Calcium is important to bone growth and formation, blood clotting, nerve and muscle functioning. It is also called knitter. Iron is an essential mineral. It major function is to combine with protein and copper in marking hemoglobin, the component of the blood that carries oxygen from the lungs to the tissues throughout the body. Zinc is required for normal growth and development, maintenance of body tissues, help antioxidant. Sulfur is healing mineral. Silicon gives strength and support to all the tissues of body.

Manganese supports the immune system, blood sugar balance and is involved in the production of cellular energy, reproduction and bone growth. It is also called brain mineral. Chlorine is required for production of hydrochloric acid in the stomach. Phosphorus is after calcium, the second most abundant mineral in the body. It is a principal mineral of bones and teeth. It indicates that roselle contains essential nutrients for our body.

Table (5) Results of Elemental Composition by EDXRF

No.	Element	Symbols	Results (%)
1	Chlorine	Cl	0.2694
2	Potassium	K	1.308
3	Calcium	Ca	1.070
4	Silicon	Si	0.2178
5	Phosphorus	P	0.3934
6	Sulfur	S	0.0834
7	Iron	Fe	0.02651
8	Manganese	Mn	0.00904
9	Zinc	Zn	0.00269

Conclusion

From the present work on the determination of the vitamin C content, antioxidant activity and elemental analysis of dried sample of *Hibiscus sabdariffa* L. (Roselle) Leave, the following inferences could be deduced. From the determination of ash and moisture content were 6.87% and 11.09% respectively. Ascorbic acid content of *Hibiscus sabdariffa* L. was determined. This sample contains 0.08% amount of vitamin C. In addition, the determination of antioxidant activity of ethanol crude extract was performed by DPPH assay using spectrophotometry method (Jazia, S., *et al.*, 2018). Ascorbic acid was used as a standard antioxidant. IC_{50} values were also calculated and the comparison of antioxidant activity of ethanol crude extract with ascorbic acid was described. It is observed that IC_{50} values of ethanol extract of this sample is 54.26 µg/mL. In the study of elemental analysis, the high contents of potassium (1.308%) and calcium (1.07%) were observed. A high potassium intake decreases the risk of stroke, lower blood pressure, protects against loss of muscle mass, preserves bone mineral density and reduces the formation of kidney stone. So, roselles leave benefit for human (Biff, P., Deborah, J., and Clegg, 2016).

Acknowledgements

I wish to express my thanks Rector Dr. Aung Win, Pro-rectors Dr. Soe Myint Aye and Dr. Aye Aye Ko. Special thanks are extended to Professor and Head Dr. Ni Ni Aung and Professor Dr. Nant Si Si Htay Department of Chemistry, University of Myitkyina for their kind encouragement.

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Common Loanwords in English

Nang Aye Aye Thein[1]

Abstract

This research focuses on the common loanwords in English. The aim of this research is to investigate how much influence of foreign languages on English and which language is the most dominant of all languages that influence on English. In doing this, the definitions of Kemmer (2017) from Rice University, and the articles of Kroulek (2014), Liam (2016), anonymous (2016) from www.fluentu.com, and Ryan Sitzman (2019) are used as materials in the survey. Therefore, this is a kind of report research and the findings of this research highlight the dominance of foreign languages on English and which language is the most dominant of all. This research is also highly expected to make contributions to both teachers and learners who are engaging in learning and teaching English as EFL.

Keywords: loanwords

Introduction

This research has an aim to discover common loanwords in English from the papers of 4 researchers: Kroulek (2014), Liam (2016), anonymous (2016) from www.fluentu.com and Ryan Sitzman (2019). Therefore, this is simply a kind of report research. It is a small research though, it could make contribution to both teachers and learners who are teaching and learning English in classrooms as well as in real life, as knowing the languages of origin helps both of them understand their target language. Common loanwords in English highlight other cultures or languages that they have immense influences on English and why they become dominant in English.

2. Literature Review

A dictionary meaning of a loanword is a word taken into one language from another. Kemmer (2016) states that loanwords are words adopted by the speakers of one language from a different language or the source language. She also stated that a loanword can also be called a borrowing. Borrowing refers to the process of speakers adopting words from a source language. Borrowing is a sequence of cultural contact between two languages communities and it can go in both directions between the two languages in contact, but there is often an asymmetry. It means that more words go from one side to the other. Due to this, the source language community has some advantage of power, prestige, and wealth that makes the objects and ideas it brings desirable and useful to the borrowing language community. According to Kemmer (2016), the Germanic tribes in the first few century A.D. adopted numerous loanwords from Latin as they adopted new products via trade with the Romans. Few Germanic words, on the other hand, pass into Latin.

Kavtaria (2011) stated that the English language has a great number of words, many of the words are based on Greek and Latin roots. A great deal of the terminology of science and medicine and indeed much of the vocabulary of higher education is based Latin and Greek roots. These roots are dependable and unchanging and serve as the key to understanding the vocabulary of English and many of the modern European languages. Those words were borrowed in different periods and for different purposes.

According to Wikipedia, a loanword is a word adopted from one language (the donor language) and incorporated into another language without translation.

According to Richard Nordquist (2019), a loanword is a word imported into one language from another language. These words are also called a borrowed or a borrowing. He also says that a borrowed word won't ever be returned to the donor language.

According to the article from mentalfloss.com, the English language lives a good loan word. Those words and phrases are lifted directly from another language. This article

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says that some English words are used all the time without realizing that they are foreign words.

3. Research Methodology

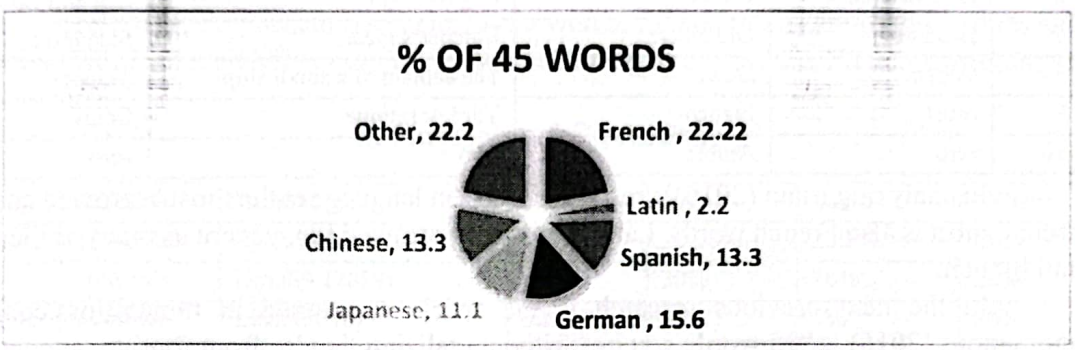
As this research is a kind of report one, only quantitative research method is applied in collecting data as well as in analyzing data. In describing the origin of languages in the table, only the impressive languages are mentioned and the rarely found are mentioned as others.

3.1 Data Collection & Data Analysis

In the first research that is used in the survey is Ryan Sitzman (2019)'s "4 common English words that came from other languages. The common words collected from Ryan's research are as follows:

Sr	Loanwords	Source Language	Meaning	English
1	ballet	French	Dance	Ballet
2	cafe	French	Coffee	Café
3	croissant	French/ Latin	Grow	Croissant
4	entrepreneur	French/ Latin	Director	Entrepreneur
5	faux pas	French/ Latin	False step	Faux pas
6	genre	French	A kind	Genre
7	hors d'oeuvre	French	Outside the work	Hors d'oeuvre
8	lingerie	French	Linen	Lingerie
9	renaissance	Latin	Re -, back, again	Renaissance
10	rendezvous	French	Present yourselves	Rendezvous
11	delicatessen	German	Foods for sale	Delicatessen
12	Fest	German	Festival	Fest
13	Gesundheit	German	Health	Gesundheit
14	kindergarten	German	Children's garden	kindergarten
15	waltz	German	revolve	dance
16	rucksack	German	back sack	backpack
17	glitch	US	Man function	small problem
18	klutz	Yiddish	Wooden block	person who always things
19	spiel	German	game	long speech persuaded sb
20	schmooze	Yiddish	converse	chat
21	guerrilla	Spanish	war	small group of soldiers
22	macho	Spanish	war	aggressive man
23	patio	Spanish	Inner courtyard	flat hard area outside/ b house
24	plaza	Spanish	place	small shopping centre
25	pinata	Spanish	toy with candy	party game
26	siesta	Spanish	Sixth hour	nap
27	karaoke	Japanese	empty orchestra	type of entertainment
28	karate	Japanese	empty hand	fight with hands & fe weapons
29	ninja	Japanese	Spy	Ninja
30	origami	Japanese	Folding paper	Origami
31	tsunami	Japanese	Harbor wave	Tsunami
32	chocolate	French	Food made from cacao seeds	Chocolate
33	moccasin	American Indian	A flat shoe	Moccasin
34	dim sum	Chinese	Food wrapped in sheets of dough	Dim sum
35	gung-ho	Chinese	Work together	Gung-ho
36	kung fu	Chinese	System of fighting without weapons	Kung fu
37	tofu	Chinese	Beans	Tofu

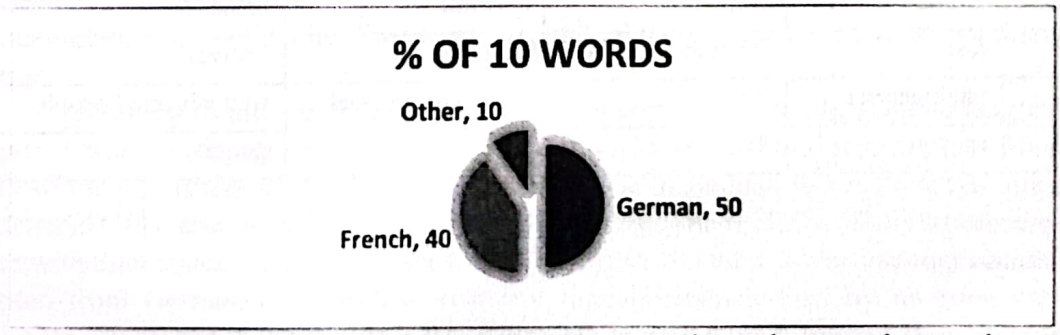
Sr	Loanwords	Source Language	Meaning	English
38	typhoon	Chinese	Big wind	Typhoon
39	yin and yang	Chinese	Moon and sun	Moon and sun
40	babushka	Russian	Grandmother	Grandmother
41	bossa nova	Portuguese	Popular music	Bossa nova
42	moped	Swedish	Pedal cycle	Motorcycle
43	paparazzi	Italian	A photographer who follows famous people	Paparazzi
44	sheikh	Arabic	An Arab prince or leader	head
45	taekwondo	Korean	System of fighting without weapons	taekwondo



In analyzing the data from Ager (2012)'s research, French words are the most impressive among all languages and the second most common words are of German. Chinese, Spanish, and Japanese words are also found as common, yet they are not used as much as French and German.

In collecting data, the four previous researches are used as materials in the survey. First of all, the research of Kroulek (2014) "10 surprising words the English language borrowed" has been found out as follows:

Sr	Loanwords	Source Language	Meaning	English
1	leg	Old Norse	One of the part of body	Leg
2	skin	Old Norse	Peel	Skin
3	sky	Old Norse	Clouds	Sky
4	they, their and them	Old Norse	Norminative masculine plural	They, their, them
5	science	Old French/ French	Know	Science
6	war	Old North French	Worse	War
7	person	Latin	Human being	Person
8	cockroach	Spanish	A large brown insect	Cockroach
9	very	Old French	Real/ true	Very
10	alcohol	Arabic	Drinks such as beer, wine	alcohol



In analyzing Kroulek's research, the German words are borrowed more than other languages and French words are the second most borrowed by English language. Spanish,

Arabic, and Latin words are also borrowed but they are not distinctive like German or French.

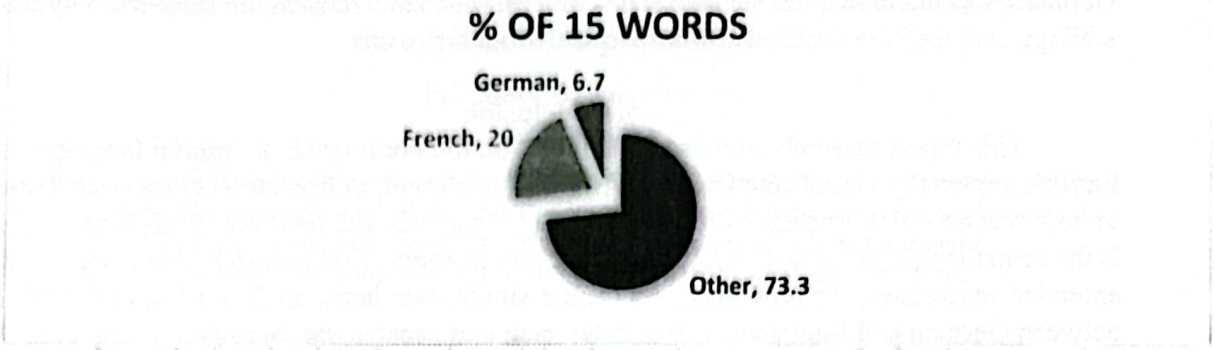
Secondly, the research of Latin (2016) "10 common English words borrowed from other languages" is analysed and found out as follows;

Sr	Loanwords	Source Language	Meaning	English
1	they/ their	Old Norse	Norminative masculine	Plural/ they/ their
2	person	French	Human being	Person
3	very	French	Real	Very
4	dollar	Dutch	Coin	Dollar
5	war	Old French	Worse	War
6	leg and skin	Old Norse	Leg and skin	Leg and skin
7	slaughter	Old Norse	Butcher's meat	Slaughter
8	skipper	Dutch	The captain of a small ship	Skipper
9	court	French	Yard or retinue	Court
10	zero	Arabic	zero	zero

In analyzing Liam (2016)'s research, German language is the most borrowed and the second most is also French words. Latin words are borrowed too, yet not as many as German and French.

In the next previous research is the article mentioned in mentalfloss.com by anonymous (2016) is "15 words you use without realizing they're from foreign languages". According to this article, the findings show as follows:

Sr	Loanwords	Source Language	Meaning	English
1	cul-de-sac	French	bottom of the sack	dead-end street
2	chowder	French	stew pot	thick soup with fish & vege
3	mosquito	Spanish	little fly	biting insect
4	avatar	Sanskrit Hindi	manifestation of god	picture of person or animal
5	kowtow	Chinese	bow of respect	pay too much respect to sb
6	Tsunami	Japanese	harbor wave	extremely large wave by ear
7	tattoo	Polynesian	Inked	Picture or design marked permanently on skin
8	lemon	Arabic	Kind of lime	yellow citrus fruit
9	sherbet	Turkish	drink/ syrup	fruity frozen dessert/Sweet
10	aficionado	Spanish	become fond of	person who like sth very mu
11	Hoi polloi	Greek	the many	the many
12	prairie	French	meadow	meadow
13	fest	German	festival	festival
14	intelligentsia	Russian	urban professionals	well educated people
15	canyon	Spanish	tube	gorge



In analyzing the data from the article, the total percentage of other languages is the most though, it includes a salad bowl of languages: Chinese once, Japanese once, Arabic once, Greek once, Polynesian once, etc. Of 15 words, French words are found 3 times and a German word is found only once. Therefore, according to this article, French words are very common.

4. Findings and Discussion

Sr	Research	Researcher	German	French	Latin	Others
1	45 words	Ryan Sitzman (2019)	15.56%	22.22%	2.22%	60%
2	10 words	Kroulek (2014)	40%	30%	10%	20%
3	10 words	Liam (2016)	30%	40%	0%	30%
4	15 words	Anonymous (2016)	6.67%	20%	0%	73.33%
Total			92.23%	112.22%	12.22%	183.33%

From the data collected and analysis of the 4 researches on common loanwords in English, the findings show that the very impressive languages which greatly influences on English is French and German. Chinese, Italian, Greek, Latin, Spanish, Arabic, Korean, Russian words are frequently found a lot in English. However, they are not as much as French and German words. Of these two languages, French words are found very commonly in English more than German words. In analyzing the reasons why French words are the commonest in English and why German words follow as the second influential language on English, it is said that according to Ager (2012), the main reason of French's influence on English is because of politics. In 1066, the French-speaking Normans who come from the Northern France invaded England. During the Norman French was the dominant language, English was rarely used in writing and started to change in many ways. This change is known as the transformation from Old English to Middle English. At the same time Norman French became Anglo-Norman as it was itself affected by English. Then more than 10,000 French words are flowing into English words which are associated with government, law, art, literature, food, and many other aspects of life. Moreover, the pronunciation of English changed to some extent under the influence of French, and English Grammar took on a few French structures. That's why, French words, undoubtedly, become the most dominant on English.

According to the article from thetranslationpeople.com (2009), English language is peppered with words and expressions from all around the globe and it states that from the study of the publishers of the Oxford dictionary, 25% of English words have the origin of French and Old German have a quarter of English words. The findings of this report research agree with their statements. Then Jesse Lund (2016) mentioned in her article that vocabulary adopted from German into English in recent time is characterized by its great variety. Paultobin (2019) states in his article that if English is your mother tongue, then that makes

German your uncle tongue. He also states that English and German are long-last linguistic siblings, and they are descended from the same root language.

5. Conclusion

This report research intends to shed light on the dominance of foreign languages on English, especially French and German. Although it is small, this research gives contribution to both teachers and learners who are engaging in teaching and learning English as English is the target language for both English teacher and learners. This research also suggests that extended researches can be done more on the similarities between English and French or between German and English or between German and French, etc. because in analyzing the data, it is found that there are a lot of identical words between English and German. For example, Ball, bus, August, April, and so on.

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Exploring Female Conversational Styles in "Pride and Prejudice," through gender point of view

Pri Lum[1], Bawm Hkaw[2]

Abstract

This paper is an attempt to explore the conversational styles of a female character, Elizabeth in " Pride and Prejudice" by Jane Austen. Utterances of Elizabeth are categorized using Tannen's differences theory (1990) and examined how much the Genderlect model can explain the conversational styles of female characters. Based on the different categories, this study discusses gender and explains how the social identities – class, social relations, religion and age – are governing female conversational styles in fiction beyond Tannen's difference theory. This research presentation will provide systematic ways of literary appreciation for ELT pedagogy.

1. Introduction

Tannen (1990) states that language is the chief medium by which people comprehend themselves and the outside world. As human beings can be divided into male and female, language is also gendered.

Tannen (1990) argues that language is the reflection of the profound and complicated consciousness about gender that is embedded in and hidden behind a language. The relationship between gender and language is a major topic in recent years.

Tannen (1990) states that people have different conversational styles. So when speakers from different parts of the country or of different ethnic or class background talk to each other, it is likely that their words will not be understood exactly as they are meant.

Baron (1986) believed women's speech to be the main carrier of linguistic tradition, as it was the women's task to teach children to speak properly, though paradoxically-women's ways of speaking were considered as a rather inferior counterpart of men's speech. The explanations of the differences were mythological, sociological, or biological, depending on the viewpoint of the time.

Baron (1986) says that the creation of woman from Adam's rib in the biblical myth is largely contributed to female language being considered as less perfect, which was reflected among other things in the belief that all feminine gender forms were derived from masculine forms. So there are many researchers conducted on language and gender and this study appears to study as the primary reason for investigating the ways in which genders are reflected in language through examination of utterances by female characters in "Pride and Prejudice" by Jane Austen.

This research aims to explore conversational styles of Elizabeth, one of the female characters in "Pride and Prejudice" by Jane Austen through gender point of view.

The objectives are:

1) To find out the conversational styles of Elizabeth in "Pride and Prejudice"
2) To categorize Elizabeth's utterances in terms of Tannen's differences theory (1990).
3) To analyse the conversational styles of Elizabeth according to their class, gender, social relation, religion, age that are governing the ways of women's talk in the fiction.
4) This research centered on the following research questions:
5) How can the conversational styles of Elizabeth, one of the women characters in "Pride and Prejudice" by Jane Austen be explained using Tannen's differences theory (1990)?

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6) How can class, gender, social relation, religion and age effect the female's conversational styles have found in fiction?

The area of the research is gender, language and social identities through analyzing of females' conversational styles in "Pride and Prejudice" by Jane Austen.

This research is limited to study meaningful chunks of utterances by Elizabeth which can give an indication of language and gender displayed differently which represent their social identities.

This study is organized into five chapters. Chapter one is introduction. Chapter two is Literature Review which discusses on some examples of Tannen's difference theory (1990). Chapter three presents research methodology which includes data collection and data interpretation of six binary oppositions of females' conversational styles by Tannen's difference theory through social identities: class, gender, social relation, religion and age. Chapter four presents findings and discussion. Chapter five is the conclusion of the study.

2. Literature Review

This chapter presents the review of the theory ,references and researches which related to this study .This chapter consists of theoretical background and related researches.

2.1 Theoretical background

This section discusses Tannen's difference theory (1990) which related to the study. Language and gender are research interdisciplinary that studies varieties of speech in terms of gender, language and their relation. Gender in the linguistic field has different context with sex. West and Zimmerman (1987) claims that "gender is not something we are born with, and not something we have, but something we do".

Talbot (2010) states that gender is learned behavior and it is constructed in society. It means that gender is not merely talking about the physical but also involves the whole display of psychological, social and cultural differences between men and women.

Tannen's difference theory (1990) focuses on themes that describe the ideas of men and women conversations. This research discusses the role of women in 19th century of England as it was an era of male-entered and women's social status was very low. The law prescribed that women could not own the property and family was the most suitable place for women and marriage was a shortcut to own a family.

2.1.2 Difference theory or Genderlect theory

"Difference theory" by Tannen (1990) is generally summarized into six binary oppositions. They are Status Vs Support, Advice Vs understanding, Information Vs feelings, Orders Vs proposals, Conflict Vs compromise, and Independence Vs intimacy.

1. Status Vs Support

Tannen (1990) states that, for men, "the world is a competitive place" in which conversation and speech are used "to build status", whereas for women "the world is a network of connections", and that they use language "to seek and offer support" (Tannen,1990).

2. Advice Vs understanding

Tannen (1990) states that women seek comfort and sympathy for their problems, whilst men will seek a solution to the problem.

3. Information Vs feelings

Tannen (1990) suggests that men's conversation is message-oriented, based upon communicating information. For women, conversation is much more important for building relationships and strengthening social link.

4. Orders Vs proposals

Tannen (1990) states that men will use direct imperatives ("close the door", "switch on the light") when speaking to others. Women encourage the use of superpolite forms, however ("let's", "would you mind if ….?").

5. Conflict Vs compromise

Tannen (1990) asserts that most women avoid conflict in language at all costs, and instead attempts to resolve disagreements without any direct confrontation, to maintain positive connection and rapport. Men, on the other hand, are more likely to use confrontation as a way of resolving differences and thereby negotiating status.

6. Independence Vs intimacy

Tannen (1990) asserts that in general men favour independence, while women are more likely to seek intimacy. He states that women, seeing the world as a network of connections and relationships, view intimacy as key to achieve consensus and avoiding the appearance of superiority, whereas men, who are more likely to view the world in terms of status.

3. Research Methodology

This research is a discourse analysis of the female conversational styles of Elizabeth in "Pride and Prejudice" in the framework of difference theory. It is a qualitative-quantitative research. In this research, utterances of Elizabeth are categorized in terms of Tannen's (1990) difference theory. Then it explains the occurrences of the different categories of female conversations that do not adhere to difference theory by their social identities- class, gender, social relations and age.

This chapter also contains a description of the materials and methods employed in the present research as well as procedures for data collection, data analysis and data interpretation.

3.1 Data Collection Procedure

The procedure of collecting data is the following steps: All conversations from (chapter 1 to chapter 61) uttered by Elizabeth are enlisted and categorized them in terms of Tannen's difference theory (1990) of six binary oppositions: 1)Status Vs Support 2) Advice Vs Understanding 3)Information Vs feelings 4) Orders Vs Proposals 5) Conflict Vs Compromise 6) Independence Vs Intimacy. Then, all categorized utterances are tabulated into each table.

The sources of data are utterances made by Elizabeth in "Pride and Prejudice". The following table shows data collection of language.

Sr. No	Chapter No	Page No	Line No	Speeches	Interlocutor		Gender											
							Female conversational style Tannen's difference theory (1990)											
					Speaker	Hearer	Status	Support	Advice	Understanding	Information	Feelings	Orders	Proposals	Conflict	Compromise	Independence	
							M	F	M	F	M	F	M	F	M	F	M	
1	2	10	10	"But you forget, mama,' that we shall meet him at the assemblies, and that Mrs. Long has promised to introduce him."	Elizabeth	Mrs. Bennet								Â				
2	3	15	82	"I certainly shall not.	Elizabeth	Mrs. Bennet						Â						
3	3	15	82	You know how I detest it, unless I am particularly acquainted with my partner.	Elizabeth	Mrs. Bennet		Â										
4	3	15	82	. At such an assembly as this, it would be insupportable.	Elizabeth	Mrs. Bennet								Â				
5	4	19	7	"He is also handsome, which a young man ought likewise to be if he possibly can.	Elizabeth	Jane		Â										
6	4	19	7	His character is thereby complete."	Elizabeth	Jane					Â							
7	4	19	7	"Did not you? I did for you.	[illegible]	Jane										Â		

8	4	19	7	But that is one great difference between us.	Elizabeth	Jane		Â										
10	4	19	7	No thanks to his gallantry for that.	Elizabeth	Jane											Â	
925	60	401	87	"You are all to come to Pemberley at Christmas. Yours, etc."	Elizabeth	Lydia						Â						
				Total			23	223	43	28	44	150	8	183	5	159	12	47	925

Sample Table for conversational styles found in Elizabeth's Utterances in terms difference theory by Tannen(1990)

3.2 Data Analysis

The conversational styles of female characters in "Pride and Prejudice" by Jane Austen from chapter1to 61 are analyzed in terms of difference theory by Tannen (1990): (1) Status Vs Support, (2) Advice Vs Understanding, (3) Information Vs feelings, (4) Orders Vs Proposals, (5) Conflict Vs Compromise, (6) Independence Vs Intimacy as shown in Table.

The frequencies of different conversational styles of Elizabeth in "Pride and Prejudice" in terms of difference theory by Tannen (1990) are shown in the following tables.

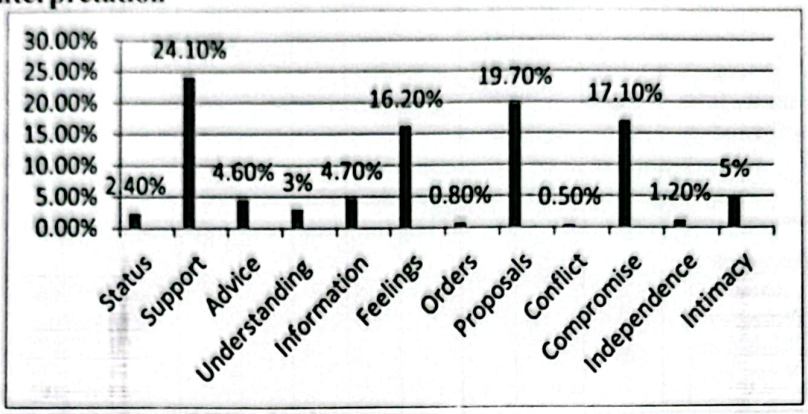
Table (1): Frequency of Females' Conversational Styles (Tannen, 1990)
Elizabeth

No.	Gender	Females' Conversational Styles Tannen's difference theory (1990)	Frequency	Percentage
1	M	Status	23	2.4%
	F	Support	223	24.1%
2	M	Advice	43	4.6%
	F	Understanding	28	3%
3	M	Information	44	4.7%
	F	Feelings	150	16.2%
4	M	Orders	8	0.8%
	F	Proposals	183	19.7%
5	M	Conflict	5	0.5%
	F	Compromise	159	17.1%
6	M	Independence	12	1.2%
	F	Intimacy	47	5%
Total			925	100%

The above-mentioned table describes the total frequency of six binary oppositions of female conversational styles. There are totally 925 speeches, whereas status is 23, support is 223, advice is 43, understanding is 28, information is 44, feelings is 150, 8 in orders, 183 in proposals, 5 in conflict,159 in compromise, 12 in independence, 47 in intimacy out of total frequency respectively. But it is found that 23 in status, 8 in orders, 44 in information and 5 in conflict in male conversational styles. It is found that 2.4% in status, 24.1% in support,

4.6% in advice, 3% in understanding, 4.7% in information, 16.2% in feelings, 0.8% in orders, 19.7% in proposals, 0.5% in conflict, 17.1% in compromise, 1.2% in independence, and 5% in intimacy respectively.

3.3. Data Interpretation



Data Interpretation of Elizabeth

The above bar chart shows the total percentage of six binary oppositions of conversational styles found in utterances of Elizabeth. The most found percentage of conversational style is support shown in 24.1%, whereas the least found percentage is 0.5% in conflict (M) and 0.8%.in order for male. The second mostly found in percentage is 19.7% in proposals, and compromise is 17.1%, feeling is 16.2%.

4. Findings and discussion

In this research, the Elizabeth's utterances in the novel "Pride and Prejudice by Jane Austen are first categorized in terms of six binary oppositions : "Status vs Support", "Advice vs Understandings", " Information vs feelings", "Orders vs proposals" , "Conflict vs Compromise ", "Independence vs Intimacy" (Tannen ,1990). In these binary pairs of oppositions, the first part of every pair is restricted to men, and the second part is to female according to Tannen (1990), women make connection, seek or offer comfort build the relationship, encourage the of super polite forms and avoid conflict and to maintain positive connection and rapport, on the other hand, men are direct imperative, communicating information, are direct imperative, like order and like to use confrontation as a way of resolving differences .In this chapter, it will explain the occurrences of the different types of conversational styles that do not agree with the binary oppositions of difference theory by intersecting with social identities-class, gender, social relations, religion and age with primary laws on females conversations.

Tannen's difference theory is also proved through the female conversational styles in the novel. It says that women use rapport talk to establish meaningful connection with others. And women usually use support, understanding, feelings, proposal, compromise and intimacy in their styles of communicating. After analyzing the conversational styles of female characters in "Pride and Prejudice" by Jane Austen, there are six binary oppositions of female conversational styles found in their utterances. They are support, understanding, feelings, proposals, compromise, and intimacy. It is found that there are 925 utterances that made by Elizabeth. Here are some examples of six binary oppositions of female's conversational styles.

(1) Status Vs Support

For women, talking is often a way to gain confirmation and support for their ideas. Women see the world as a "network of connections seeking support and consensus. From the data, it is found that support is 24.1% out of 925 utterances.

Example: "You need not be frightened..... I have heard you say that you know them."

(2) Advice Vs Understanding

Women seek comfort and sympathy for their problems. This study finds that 3% or 28 speeches of understanding. And 43 speeches or 4.6% found in advice for men.

Example: To Jane herself, there could be no possibility.....he will probably never reach.

(3) Information Vs Feelings

For women, conversation is much more important for building relationships and strengthening social links. There are 150 utterances or 16.2% that is found in the data that use conversations which emphasize on feelings. For information, 44 utterances or 4.7% is found in the data.

Example: "My fingers, do not move over this instrument in the masterly manner which I see so many women's do."

(4) Orders Vs Proposals

Women encourage the use of super polite forms. In the data it is found 183 utterances or 19.7% out of 925 speeches exists in the data. And it is also found that orders for men in 8 utterances or 0.8% as given in examples.

Example: "You mean to frighten me, Mr. Darcy, by coming in all this state to hear me?"

(5) Conflict Vs Compromise

Women avoid conflict in language at all costs and instead attempt to resolve disagreements without any direct confrontation to maintain positive connection and rapport. In the data, it is found that 159 utterances or 17.1% used forms of communication are valid ways of creating involvement and forming bonds. And on the other hand, 5 utterance or 0.5% is found in conflict for men as given in example.

Example: "Did Mr. Darcy give you reasons for this interference."

(6) Independence Vs Intimacy

Women are more likely to seek intimacy. Women like to demonstrate that they have to consult with their partner, as this is seemed to be proof of the intimacy of the relationship. It is found that 47 utterances or 5% of intimacy in the data. And it is also found 1.2% or 12 utterances in independence for men.

Example "Your cousin will give you a very pretty notion of me and teach you not to believe a word I say."

5. Conclusion

This study focuses on exploring conversational styles by female character, Elizabeth, in the novel: "Pride and Prejudice" to reflect the significance of revealing language, gender and social identities. In order to prove the role of female, conversational styles of the independent heroine, Elizabeth, has been analyzed. After analyzing all the utterances of Elizabeth by using Tannen's difference theory, it is found that Austen designed her female character, Elizabeth, as an independent young lady who is intelligent, lively and charming. Austen's style of producing her novels differs from her contemporaries since she reflects her female characters with an identity in society.

Jane Austen's novel is "social satires" which emphasize how male-dominated societies underestimate the power of femininity. After analyzing the utterances that express language used by Elizabeth in "Pride and Prejudice", it can be concluded that the female character dominantly used support, understanding, feelings, proposal ,compromise and intimacy but she also used status, advice, information, order, conflict and independence for men in some extent.

This research has concluded describing how the differences of language between men and women characters in "Pride and Prejudice" by Jane Austen can be explained by

Tannen's difference theory (1990). In addition, this research also reveals that how social identities, gender, race and class can explain the conversational styles of women's character beyond Tannen's differences theory.

This research provides clear explanation of the theory on gender and social identities. Not only that, the obtained data which consists of examples from the novel are also provided the readers understand more of it. This research also presents the different utterances indicated different meaning and purposes. People use different language styles that depends on their role in society and how they act and face their society issue reflects their use of language. And also, as this research only focuses on females' character, but other researches can be tried on discussing further by analyzing all the different characters in the novel", Pride and Prejudice".

Acknowledgements

We would like to express our genuine gratitude to Dr. Aung Win, Rector of Myitkyina University, for giving permission to conduct this research. We also deeply thank Dr. Nang Aye Aye Thein, Professor and Head of English Department of Myitkyina University for encouraging us to carry out this research. We wish to acknowledge our colleagues from the English Department, Myitkyina University.

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Lithostratigraphy and Micropaleontological Biostratigraphy of Okhmintaung Formation in Shwezettaw Area, Ngape-Minbu Townships, Magway Division

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Abstract

This research focuses on the lithostratigraphy and micro-biostratigraphy implication of the Okhmintaung Formation in a part of Minbu Sedimentary Basin. The Okhmintaung Formation in the study area with a thickness of 485 meters consists mainly of sandstone with shale and fossiliferous conglomerate. According to the lithostratigraphic investigations, the Okhmintaung Formation in the study area is subdivided into eighteen units. Micropaleontological study of this formation has led to the recognition 5 families, 6 genera and 6 species of benthic foraminifera. In this research, two biozones have been recognized by distribution of benthic foraminifera in the Okhmintaung Formation. These identifications can be interpreted as delta, tidal flat and estuarine depositional environments. The evidences of micropaleontological biostratigraphy and paleoenvironmental analysis reflect that Okhmintaung Formation is likely to be petroleum reservoir of other formations in Minbu basin.

Keywords: Lithostratigraphy, Biostratigraphy, Okhmintaung Formation, Oligocene

Introduction

The study area is located in Ngape and Minbu Townships, Magway Division. This area is situated between latitudes 20°03' to 20°08'N and longitudes 94° 30' N to 94° 36' E. It is bounded by horizontal grids 175 to 268 and vertical grids 568 to 674 and 2094 (12) of UTM maps of Myanmar Survey Department (Fig.1). The total coverage of the area is approximately 30 square miles (62 km^2). This area belongs to the western part of the Inner-Myanmar Tertiary basin. The present area occupies a small segment of the western outcrops in Minbu Tertiary Basin, the Central Cenozoic Belt (Bender, 1983). As this study area is situated on the western limb of the Minbu syncline, the strata are monocline and generally dipping towards the east (Fig.2). The regional trend of the strata is NNW-SSE, direction, paralleling with the major tectonic structures. Some cross-faults are trending nearly E-W also present. Geological map of the study area is shown in (Fig.3). The Shwezettaw area is composed of the Tertiary Strata. The Eocene-Oligocene Succession is molassic in nature and generally dipping towards the northeast with low to moderate dip amounts.

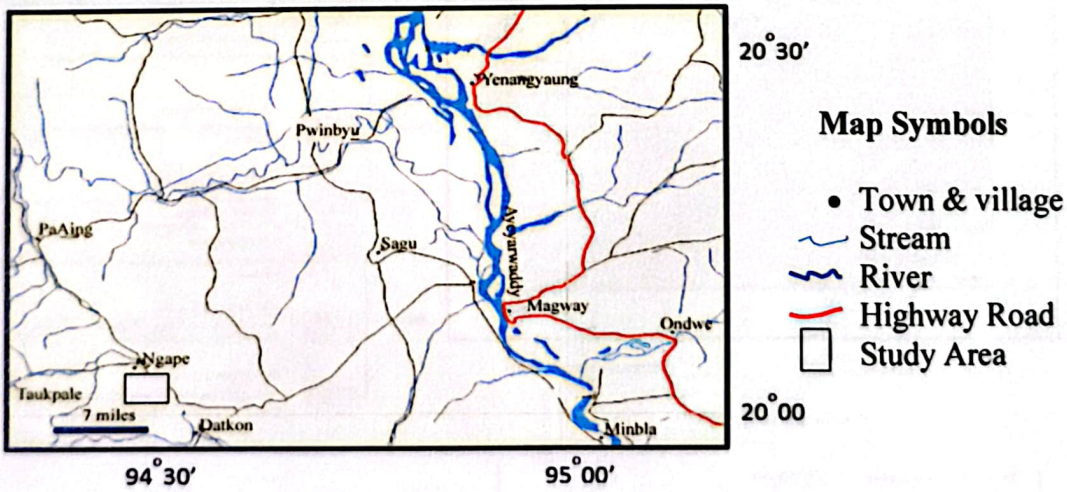

Fig. 1 Location map of the study area.

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According to Theobald (1874), in Oligocene Epoch, a sedimentary cycle which is composed of the Shwezettaw, Padaung and Okhmintaung Formations are called as Lower Pegu Group. The type section of Okhmintaung Formation is located in the Okhmintaung Ridge (19° 30'N to 94° 84' E), NNW of Thayet Township. The Okhmintaung Formation is a thick sandstone with shale and conglomerate strata as a part of Lower Pegu Group which is deposited in Inner-Myanmar Tertiary basin. The Okhmintaung Formation in the studied section has a thickness of 485 meters. The main objectives of this paper are to describe and interpret the lithostratigraphy and micropaleontological biostratigraphy of the Okhmintaung Formation in the study area in order to understand the geological evolution of the area during this time interval and at the same time be economically be reasonable.

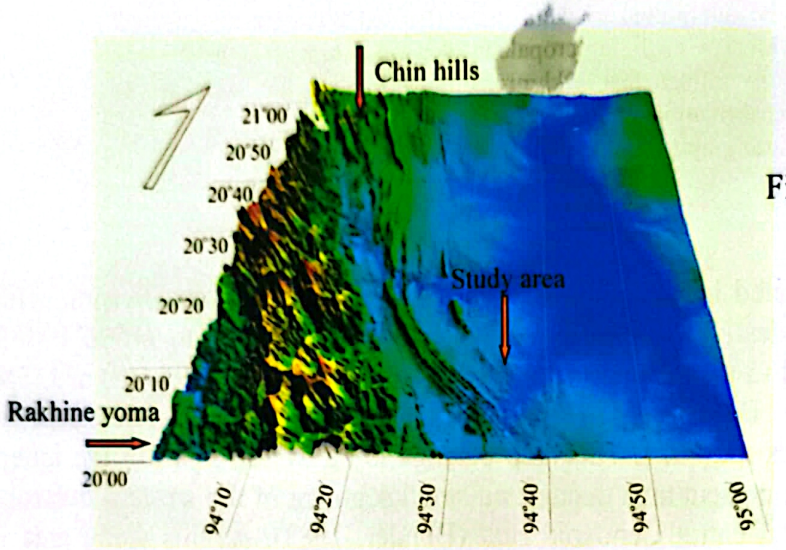

Fig. 2 3D image of the study area and its environs

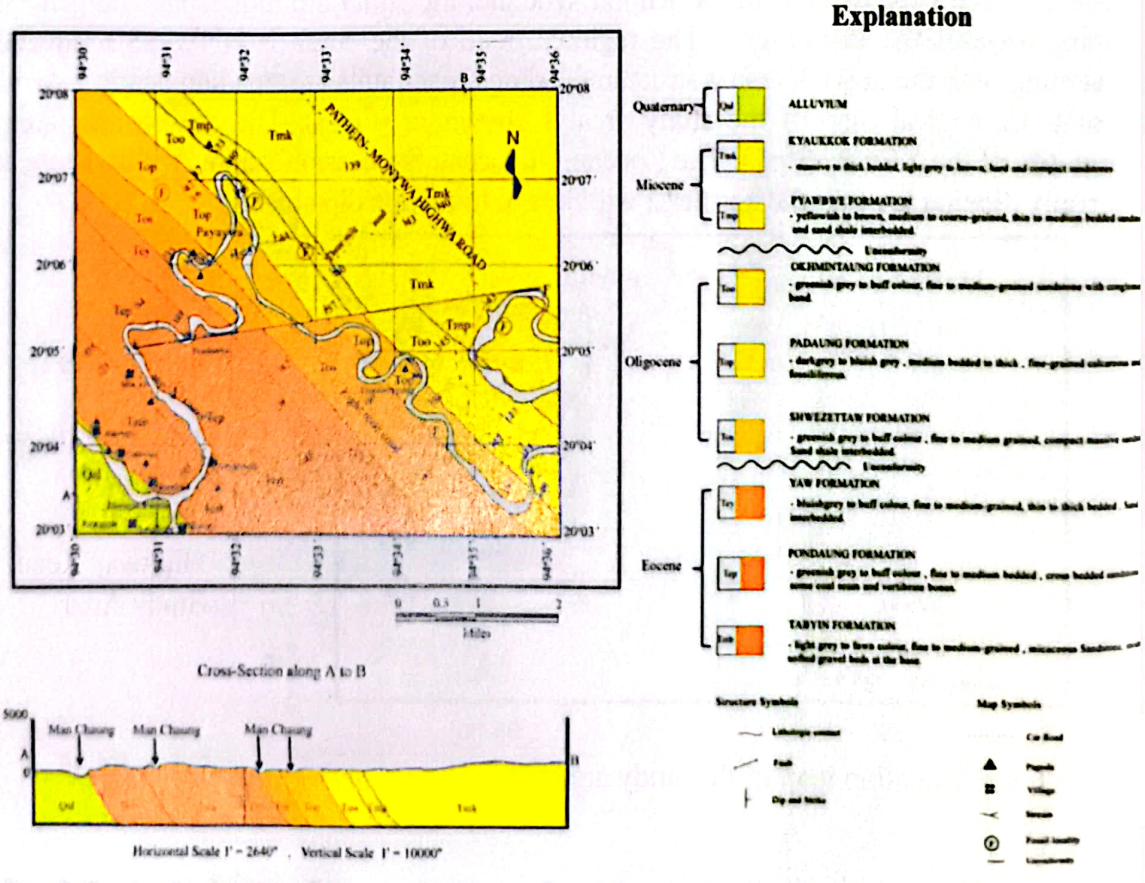

Fig. 3 Geological map of the study area (after MaungMaung, 1994).

Materials and Methods

The best stratigraphic sections of Okhmintaung Formation in the study area are selected and systematic sampling was done on the basis of lithological and facies changes.The study carried out for achieving the desired goals and objectives included two stages: field studies and laboratory studies.

1) Field studies: First an investigation of the geological evidence was done together with a choice of the best three sections of the Okhmintaung Formation in the study area (Figs.4 and 5) and then 150 samples were taken of the total thickness of 485 meters basis on the facies and lithologic changes.
2) Laboratory studies: Microscopic thin sections were prepared and studied with a polarized microscope for the identification of large benthic foraminifera and other skeleton components . The supraspecific classification of foraminifera mainly followed and named by Peter and Willem (2014), Le Roy (1939), Sharaf *et al* 2014) and EWA (2018). Also Pictures were taken of typical samples. Through the studying final reports and thin sections; identification of microfossils and photography and their distribution in stratigraphy column and displaying detected zones have been done.

Results

The Okhmintaung Formation outcrops with 485 m thickness in the study area, and consists of yellowish-brown to light-grey, fine to medium-grained, thick to massively-bedded sandstones with grey, laminated to thin-bedded shales and fossiliferous conglomerates. Biogenic components are dominated by benthic foraminifera, pelecypoda and gastropoda. The Okhmintaung Formation overlies the Padaung Formation and is overlain by Pyawbwe Formation.

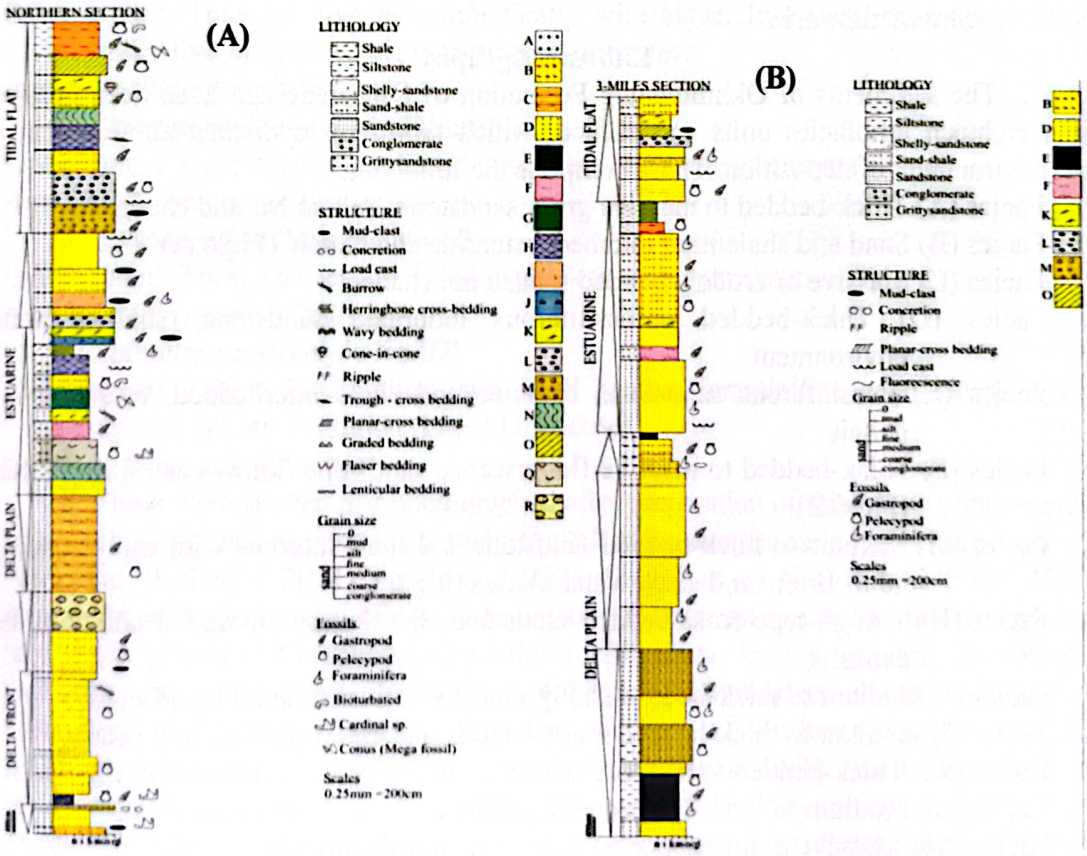

Fig.4 (A & B) Detailed columnar sections of Okhmintaung Formation

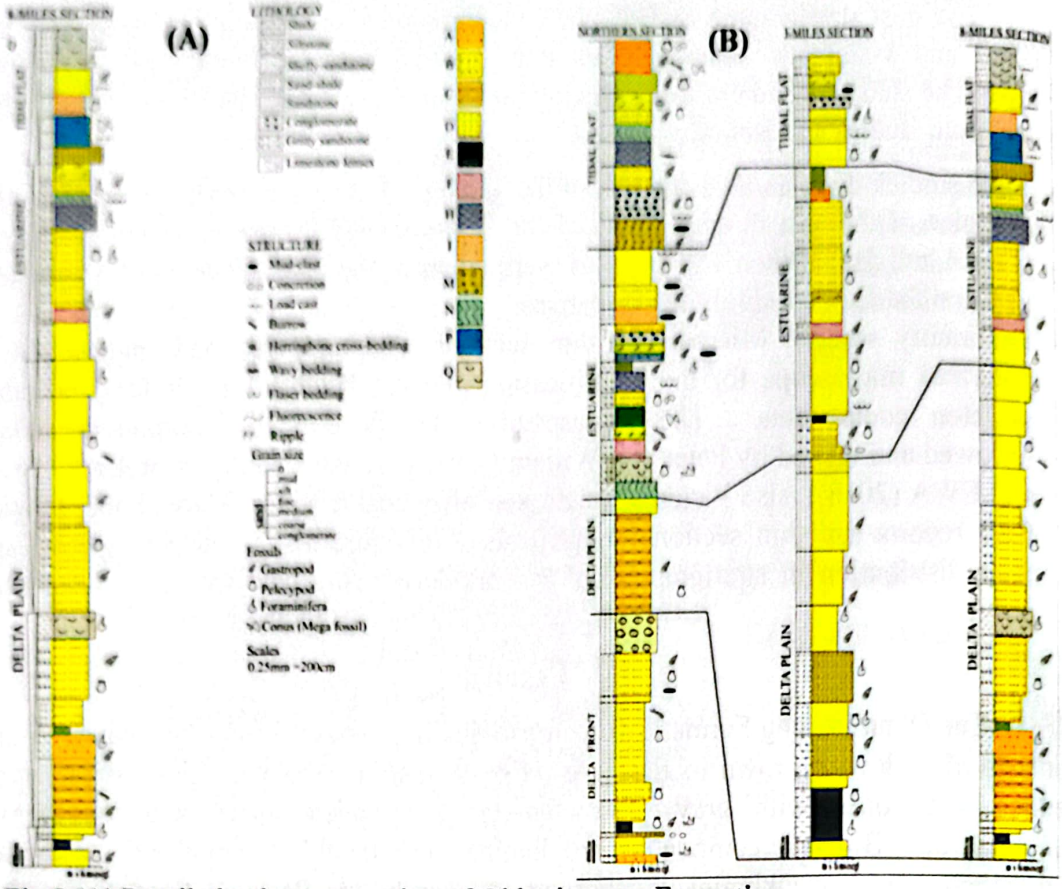

Fig.5 (A) Detailed columnar section of Okhmintaung Formation
(B) A stratigraphic correlation of the Late Oligocene Okhmintaung Formation in the Shwezettaw area

Lithostratigraphy

The sediments of Okhmintaung Formation of Oligocene age have been grouped into eighteen lithofacies units and each of which represents a distinct environment or subenvironment of deposition. These comprise the following:

Facies (A) Thick-bedded to massive gritty sandstone, deltaic bar and channel
Facies (B) Sand and shale/mud interbed, estuarine and deltaic (Fig.6.A)
Facies (C) Massive or crudely bedded sandstone, channel
Facies (D) Thick-bedded unfossiliferous indurated sandstone, shallow water environment
Facies (E) Fossiliferous sandstone, siltstone and shale interbedded, estuarine and deltaic
Facies (F) Thick-bedded to massive fluorescence sandstone (known as oil trap), delta (Fig.6.B)
Facies (G) Medium to thick-bedded sandstone and shale interbed with wavy bedding, tidal current and slack water phases (Fig.6.C)
Facies (H) Trough-type cross-bedded sandstone, distributary mouth bar and point bar deposits
Facies (I) Medium to thick-bedded shelly sandstone, tidal channel lag (Fig.6.D)
Facies (J) Medium to thick-bedded graded-sandstone, intertidal flats and beaches
Facies (K), Thick-bedded to massive sandstone with ripples, downstream-migrating
Facies (L), Medium to thick-bedded clay pebble conglomerate, channel-lag
Facies (M), Massive grain-supported conglomerate, channel

Facies (N), Medium-bedded sandstone with herringbone cross-bedding, estuarine and tidal

Facies (O), Planar cross-stratified sandstone, tidal channel

Facies (P), Limestone lenses within silty and mud interbed, warm, shelf-mud environment

Facies (Q), Massive or thick-bedded sandstone with bifurcated flaser bedding, channel and tidal flat environment

Facies (R), Thick-bedded sandstone with lenticular bedding, subtidal and intertidal zone

Each lithofacies represents an individual depositional event. Therefore, lithofacies may be grouped into four lithofacies associations as Delta plain association, Delta front association, Estuarine association and Tidal-flat association of Okhmintaung Formation.

Micropaleontological Biostratigraphy

According to the studied microfauna, Okhmintaung Formations are very rich in terms of fossil contents which can be utilized in determining the age and identifying the sedimentary environment. Recently, a total of thirty Okhmintaung Formation samples were collected and analyzed for micropaleontology. Of them, six samples were examined for microfossil analysis (Fig. 7). The result can be described as follow.

1. ***Heterostegina (Vlerkina)*** **(Sample No. F_1)**

Environment: They may live in deeper offshore marine.
Age: Late Oligocene (Chattian).

2. ***Rotalia beccarii koeboeensis*** **(Sample No. C4)**

Environment: Shallow, marginal marine environment exposed to salinity fluctuations.
Age: Late Oligocene (Chattian).

3. ***Lepidocyclina delicate*** **(Sample No. F2m)**

Environment: They too live in symbiotically with algae. In Recent seas, large forams generally live in shallow, clear, nutrient poor water.
Age: Late Oligocene (Chattian).

4. ***Miogypsinoides dehaarti*** **(Sample No.A8)**

Environment: these species are found in shallow marine environment.
Age: Late Oligocene (Chattian).

5. ***Discocyclina*** **(Sample No.E1)**

Environment: These species are found in shallow to deep marine.
Age: Late Oligocene (Chattian).

6. ***Spiroclypeus*** **(Sample No.B2)**

Environment: Pelagic Foraminifera and small benthic foraminifera calm, deep, offshore setting with aphotic condition (Latest Oligocene).
Age: Late Oligocene (Chattian).

These were studied and photographed after preparation of thin section and segments and labelling. For the purpose of the study, the following sources and articles have been used; Peter and Willem (2014), Le Roy (1939), Sharaf *et al* (2014) and EWA (2018). Micropaleontological study of the Okhmintaung Formation has led to the recognition 5 families, 6 genera and 6 species of benthic foraminifera. In this research, two biozones have been recognized by distribution of benthic foraminifera in the Okhmintaung Formation. In the depositional environment, the bulk of sediment consists of skeletal fragments produced by different types of organisms with particular ecological requirements (MeteuVicens et al., 2008). Oligocene shore lines are characterized by the re-establishment of shallow water marine benthic communities during transgression and regression.

Planktonic foraminifera are rare in Okhmintaung Formation and so making correlation with the planktonic zonation difficult. Therefore, biostratigraphic zonation is mainly based on the benthic foraminifera. In the study area, Okhmintaung Formation is mainly composed of sandstones. These sandstones contain *Heterostegina (Vlerkina)*, *Rotalia beccarii koeboeensis*, *Lepidocyclina delicate*, *Miogypsinoides dehaarti*, *Dicocyclina* and *Spiroclypeus*. Based on the type of distribution and paleoecological condition, the faunas were grouped into two zones.

The lower sandstones of the formation containing *Heterostegina (Vlerkina)* and *Rotalia beccarii koeboeensis* with some planktonic fossil fragments represent deeper offshore environment. They are recognized by biostratigraphic zone 1. The age of these microfossils is recognized as earlier in latest Chattian. It is considered that the fauna is determined to stay or live in shallow marine especially near shore line. Rotalia Species and related foraminifera in Okhmintaung sandstones are considered to be deposited under strong brackish water having a salinity fluctuation.

Fig.6 (A) Sand and shale/mud interbedded, thinly interlayered bedding show (rhythmites show estuarine and deltaic environment. (N 20° 06' 29" & E 94° 32' 12")

(B) Light grey to yellowish, medium to thickly-bedded, medium-grained sandstone with fluorescence nature in the middle part. The progradation of a delta produced extensive sandy body. They are also known found important oil trap.
(N 20° 03' 52" & E 94° 35' 47")

(C) Bluish grey, fine-grained, medium to thick-bedded, compact and micaceous sand stone in the lower part, indicate the delta front environment.
(N 20° 06' 51" – E 94°31' 32")

(D) Compact and fossiliferous, medium to thick-bedded sandstone in the upper part of the formation indicate the channel lag environment. (N 20° 07' 32" – E 94°31' 31")

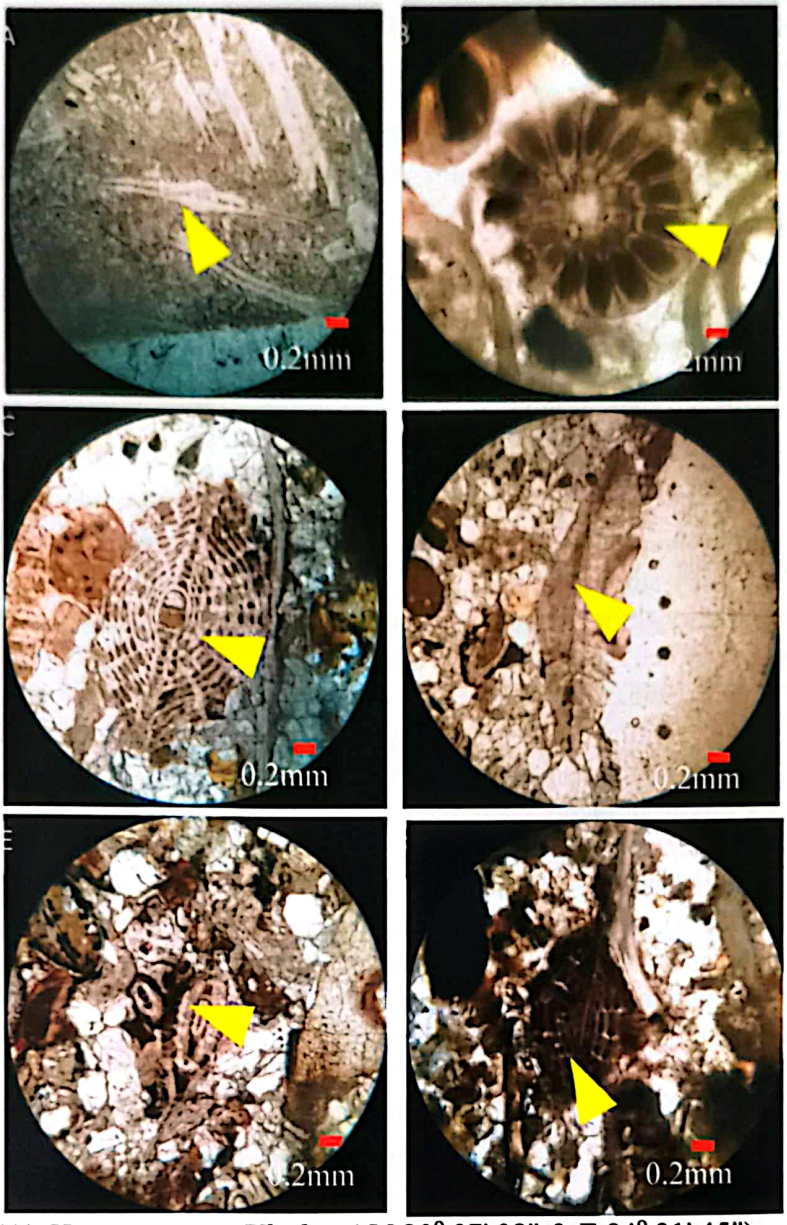

Fig.7 (A) *Heterostegina (Vlerkina)*(N 20° 07' 08" & E 94° 31' 45")
(B) *Rotalia beccarii koeboeensis* (N 20° 06' 21" & E 94° 32' 38")
(C) *Lepidocyclina delicate* (N 20° 07' 32" & E 94° 31' 30")
(D) *Miogypsinoides dehaarti* (N 20° 07' 05" & E 94° 31' 41")
(E)*Discocyclina* (N 20° 06' 19" & E 94° 31' 09")
(F) *Spiroclypeus* (N 20° 04' 20" & E 94° 35' 04")

The sandstones in the upper portion of the formation contain *Lepidocyclina delicate, Miogypsinoides dehaarti, Dicocyclina* and *Spiroclypeus*. They are characterized by Biostratigraphic zone 2. The large benthic foraminifera may indicate shallow, well-illuminated, warm, oligotrophic waters with suitable substrate and normal marine salinity (Roozpeykar, 2016). They may be latest Chattian in age.

The paleoenvironmental setting is interpreted as a shallow marine to deeper offshore environment in the aphotic zone dominated by pelagic and smaller benthic foraminifera, to low-energy, turbid and low light conditions characterized by large and flat *Heterostegina (Vlerkina), Rotalia beccarii koeboeensis, Lepidocyclina delicate, Miogypsinoides dehaarti, Dicocyclina* and *Spiroclypeus* (Roozpeykar, 2016). The

biostratigraphy of the Okhmintaung Formation in Shwezettaw area is shown in the following table.

Table 1 Biostratigraphic Zones of the Okhmintaung Formation, Shwezettaw area.

Epoch	Geological age	Biostratigraphic zone	Distribution
Oligocene	Chattian	*Lepidocyclina delicate, Miogypsinoides dehaarti, Dicocyclina* and *Spiroclypeus*	Upper portion
		Heterostegina (Vlerkina), Rotalia beccarii koeboeensis	Lower portion

Paleoenvironmental Interpretation

The environmental interpretation of the study area is identified on the basis of primary sedimentary structures, textures and biogenic sedimentary structures, vertical and lateral facies relationships and micropaleontological biostratigraphy. The present study follows Ingram (1954), Van Straaten, 1954, Potter (1959), Compton (1962), Hantzschel 1963a; Coleman, 1966, Campell, 1967, Matter, 1967, Singh, 1969, Reading, 1978, Reineck & Singh, 1980, Miall, 1984, Raymond, 1995, Tucker (2001). The depositional facies and facies relationships of these strata has already been described. The identification of the lithofacies association of the late Oligocene Okhmintaung Formation reflects the development of a strand plain system which consisted of four major depositional environments as the delta front, delta plain, tidal flat and estuarine environments (Fig.8). Based on evidences of the above mentioned fauna, the study area may be regarded as a part of marine near to the shore. They reflect a marine transgression and regression in Oligocene. Through this fluctuation in sea level can be reconstructed by initially inferring the paleobathymetry.

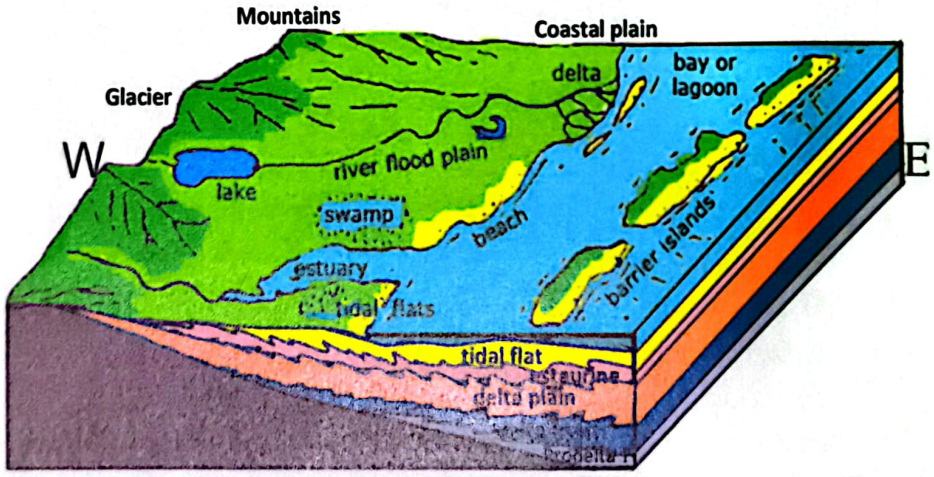

Fig. 8 Clastic depositional environments occurring Okhmintaung Formation in Shwezettaw area. (Modified online source)

Conclusion

According to the lithostratigraphic investigations, the Okhmintaung Formation in the study area is subdivided into eighteen units. Micropaleontological study of this formation has led to the recognition 5 families, 6 genera and 6 species of benthic foraminifera. In this research, two biozones have been recognized by distribution of benthic foraminifera in the Okhmintaung Formation. The identification of the lithofacies association of the late Oligocene Okhmintaung Formation reflects the development of a strand plain system which consisted of four major depositional environments as the delt

front, delta plain, tidal flat and estuarine environments. The depositional sequences depending on whether they form part of transgression, regression or a high stand of sea can be used to surmise the disposition of likely reservoir and cap facies and thereby giving directions for a successful exploration campaign. The evidences of micropaleontological biostratigraphy and paleoenvironmental analysis reflect that Okhmintaung Formation is likely to be petroleum reservoir of other formations in Minbu basin.

Acknowledgements

I would like to express my sincere gratitude to Dr. Aung Win, Pro-rector, Myitkyina University for his kind permission to take this present research work. I am grateful to Dr. Myint Oo, Professor and Head, Department of Geology, Myitkyina University for his critic and advice on the present manuscript. Dr. Maung Maung, Principal, Myingyan Degree College for his valuable suggestion, critism, fruitful discussion and supervision to prepare this paper.

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Analysis on the Trend of Temperature and Rainfall of Myitkyina

Aye Aye Moe[1]

Abstract

This research is the study on analysis on the trend of temperature and rainfall of Myitkyina. It is the capital city of Kachin State in Myanmar. The study area 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 25900 acres or 40.47 square miles, spreading on the west bank of Ayeyarwady. The researcher has studied temperature and rainfall for 40 years (1979-2018) meteorological data. All data were analyzed by using geographical, regression, GIS (Geographic Information System), statistical, inductive and deductive methods. According to Koppen's classification, Myitkyina has a generally humid subtropical climate (Cwa). The result shows that the average mean temperature and annual rainfall are increased about 0.0261° F and 0.3325 inch every year during the 40 year's period.

Keywords: temperature, rainfall, Cwa.

Introduction

In this research, analysis on the trend of temperature and rainfall of Myitkyina is studied. Climate is general pattern of weather conditions for a region over a long period of time (at least 30 years)[Geography Dictionary]. The purposes of this research are to study temperature and rainfall in Myitkyina and to analyze and examine which temperature and rainfall effects on climatic conditions or factors. The result shows that temperature and rainfall have been changing from time to time.

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 25900 acres or 40.47 square miles, spreading on the west bank of the Ayeyarwady. The Ayeyarwady bounds by the town in the east and the south. On the west of Myitkyina, Namkwi creek is flowing through the western part with north-south direction (Figure 1). According to 2018 Census, the highest population density of Myitkyina was found in Minyat Ward with a population density of 30329 persons per square mile. The smallest number of population density was found in Panmati Ward with a population density of 1009 person per square mile. The total population and density of Myitkyina were 188849 persons and 4666 per square mile. (Table 1)

Materials and Methods

Before 2019, there were many studies related to regional geography and physical geography of Myitkyina. Most of books of the thesis related to Myitkyina were submitted for the Degree of Master of Arts in Department of Geography, Myitkyina University. This study is based on analysis of secondary data gathered UTM (Universal Transverse Mercator), General Administration Department, Meteorology and Hydrology Department, Immigration and National Registration Department, Land Management and Registration Department. Data on temperature and rainfall of Myitkyina (from 1979 to 2018) are collected from Meteorology and Hydrology Department, Myitkyina. These data bases are analyzed by using GIS, regression method, graphical method, deductive method and inductive method. By its latitude, Myitkyina falls in the Subtropical Zone. Therefore, the temperature is not low as it is located in the transition zone between the Tropical Zone and the Temperate Zone. Besides, Myitkyina is situated about (600) miles north far from Gulf of Moattama (Mortaban) Andaman Sea, and the climate resembles as congenital climate. As the Myitkyina is surrounded by high mountains, monsoon rain receives more than that of the central Myanmar which is situated in the southern of the town. Therefore, the Myitkyina receives the warm and wet climatic condition (Zaw Htet, 2011).

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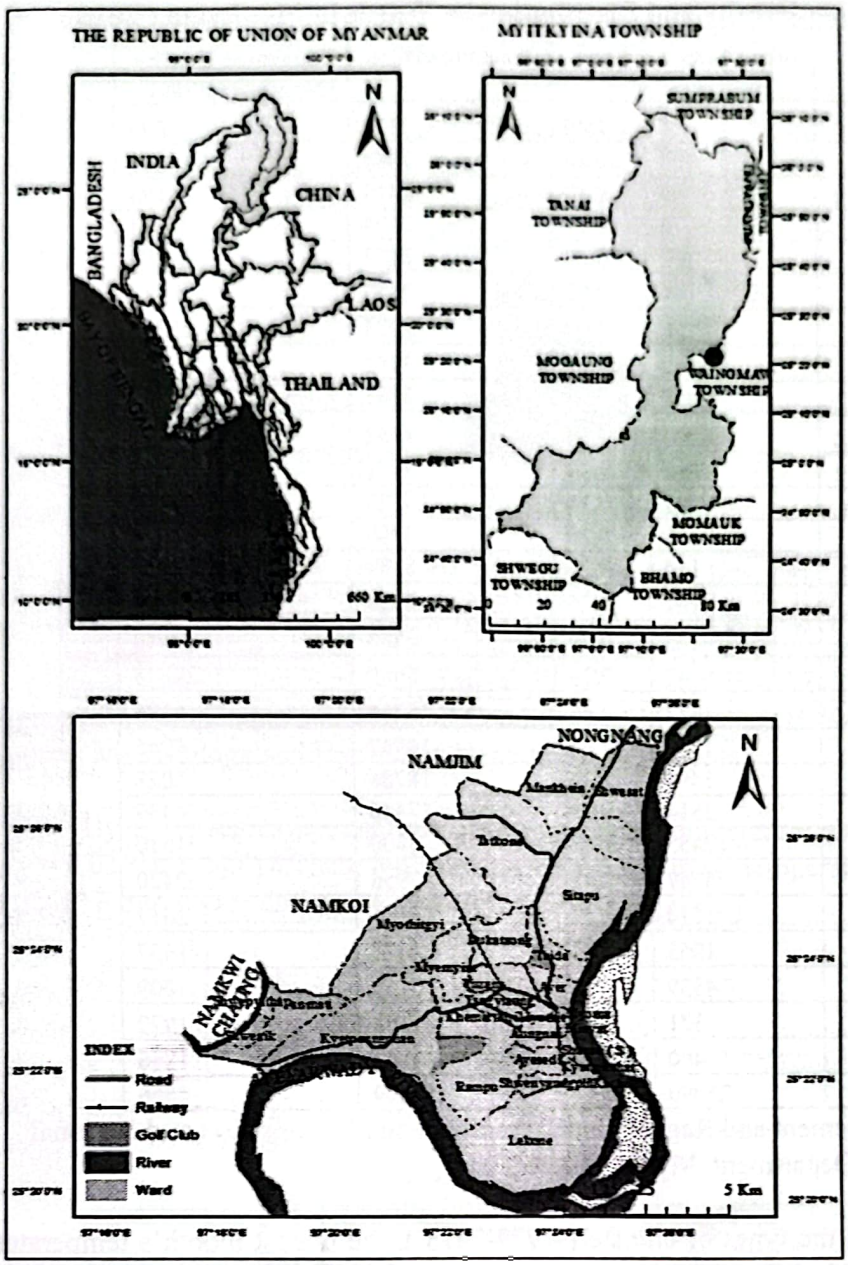


Figure (1) Location of Myitkyina
Source: UTM Map No.2597_07.

Result and Discussion

According to the 1979-2018 Meteorological data of Myitkyina, in the study area, the hottest month is May with the temperature of 95.85°F and the coldest month is January with the temperature of 48.73°F. The average maximum temperature is 89.63°F, the average minimum temperature is 64.11°F and the average mean temperature is 76.83°F. The average annual rainfall is 93.4 inches. 22 years is higher than the average annual rainfall. During the 40-year's period, 1988 had the heaviest amount of rainfall amounting to (114.66) inches and 2006 had the least amount of rainfall amounting to (65.7) inches. During the 40-year's period from 1979 to 2018, 2014 had the hottest month of April amounting to 104°F and 1985 had the coldest month of January amounting to 40.12°F. Regarding the distribution of rainfall, the average heaviest rainfall in June is (22.27) inches and the average lowest rainfall in January is 0.5 inch. (Figure 2)

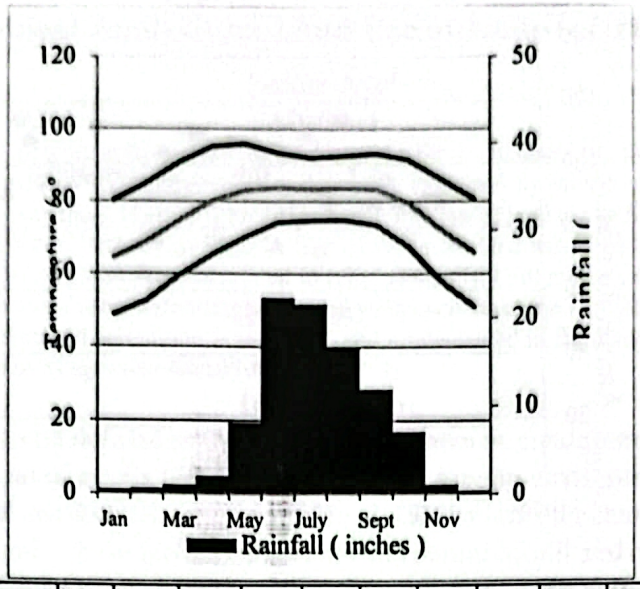
Table (1) Population Density and Distribution by Wards in Myitkyina (2018)

No	Wards	Area (Acres)	Sq.m	Total Population	Population Density (per square mile)
1	Ayer	314	0.49	3335	6806
2	Kachinsu	100	0.16	2667	16669
3	Shansu (North)	66	0.10	2419	24190
4	Shansu (Sorth)	70	0.11	2395	21773
5	Myoma	62	0.10	2179	21790
6	Minyat	44	0.07	2123	30329
7	Myothit	56	0.09	2273	25256
8	Thida	240	0.38	3542	9321
9	Dukataung	352	0.55	6765	12300
10	Shwenaungpin	203	0.32	8302	25944
11	Khemarthiri	212	0.33	7071	21427
12	Yuzana	201	0.31	5523	17816
13	Myemyint	161	0.25	4980	19920
14	Yangyiaung	154	0.24	5383	22429
15	Kyungpintha	157	0.25	5554	22216
16	Ayesedi	125	0.20	5888	29440
17	Aungnan	147	0.23	5669	24648
18	Sitapru	1577	2.46	15216	6185
19	Myothitkyi	1559	2.44	16947	6945
20	Rampu	1495	2.34	18786	8028
21	Lekone	2514	3.93	17446	4439
22	Mankhein	2455	3.84	5800	1510
23	Tatkone	4747	7.42	17956	2420
24	Shwesat	1614	2.52	6596	2617
25	Kyetpaungchan	1965	3.07	4472	1457
26	Panmati	4539	7.09	7156	1009
27	Shweaik	371	0.58	1144	1972
28	Shwepyitha	400	0.68	1262	1856
	Total	25900	40.47	188849	4666

Source: Land Management and Registration Department and Immigration and National Registration Department, Myitkyina.

In classifying the types of climate (1979-2018), the hottest month's temperature exceeds 50°F, the coldest month's temperature exceeds 26.6°F, it receives summer rainfall and total annual precipitation is 93.4 inches. According to Koppen's classification (with the formula, r > or < 0.44t -3, Myitkyina has a generally humid subtropical climate (Cwa).

According to Koppen's classification, the researcher examines every 30-year of average mean temperature and average monthly rainfall, Myitkyina generally suffers eight frequencies of Cwa types of climate. But the study area gets three frequency of tropical monsoon type of climate (Am).



	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Avg/Total
Max Temp(° F)	80.16	84.92	90.70	95.09	95.85	93.25	91.93	92.46	93.08	91.37	86.00	80.71	89.63
Mean Temp(° F)	64.37	68.78	74.66	80.15	82.94	83.67	83.28	83.61	83.28	79.43	71.98	65.84	76.83
Min Temp(° F)	48.73	52.64	59.38	65.20	70.03	74.09	74.64	74.77	73.47	67.48	57.92	50.98	64.11
Rainfall (inches)	0.50	0.71	1.05	2.08	8.13	22.27	21.55	16.67	11.90	7.06	1.12	0.38	93.40

Figure (2) Temperature and Rainfall Conditions of Myitkyina (1979-2018)
Source: Meteorology and Hydrology Department, Myitkyina.

By using regression analysis of average mean temperature, the regression equation is y = 0.0261x + 24.618.These indicate that the average mean temperature is increased about 0.0261° F every year during the 40 year's period. (Figure 3)

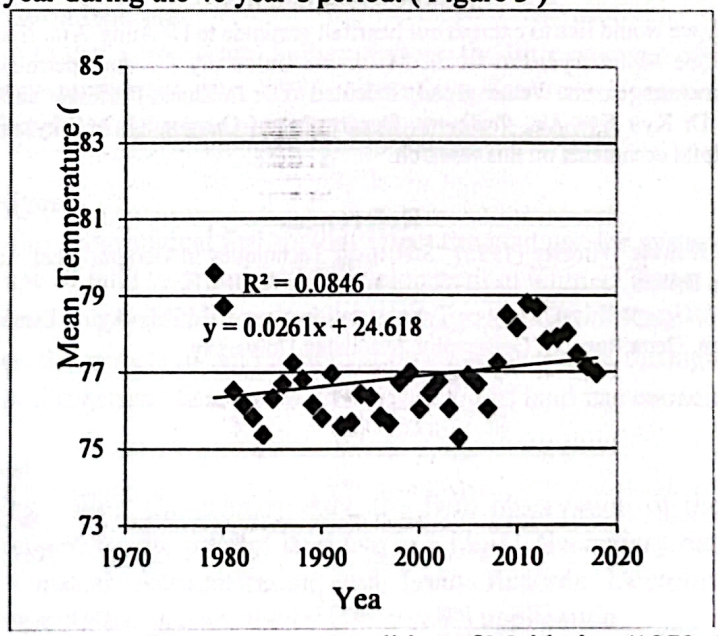


Figure (3) Mean Temperature Condition of Myitkyina (1979- 2018)
Source: Meteorology and Hydrology Department, Myitkyina.

By using regression analysis of average annual rainfall, the regression equation is y = 0.3325x + 86.538.These indicate that the average annual rainfall is increased about 0.3325 inch every year during the 40 year's period. (Figure 4)

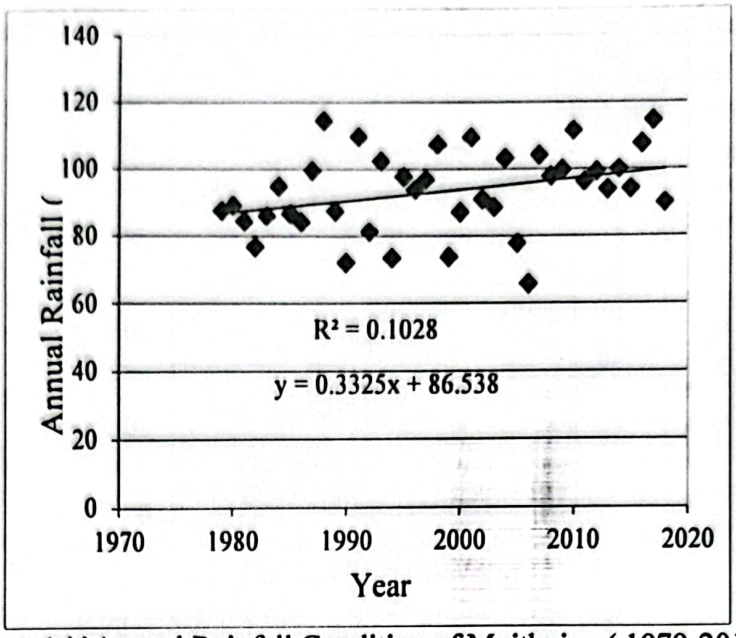


Figure (4)Annual Rainfall Condition of Myitkyina (1979-2018)
Source: Meteorology and Hydrology Department, Myitkyina.

Conclusion

According to Koppen's classification, Myitkyina has a generally humid subtropical climate (Cwa). This study reveals that the average mean temperature and annual rainfall are increased about 0.0261° F and 0.3325 inch every year during the 40 year's period. According to this research, temperature and rainfall are still changing from time to time by human being.

Acknowledgements

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

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Geographical Analysis on Land Use of Khin-U Urban Area

Sandar Aye[1]

Abstract

This paper is an attempt to analyse the land use of Khin-U. In analysing the land use of Khin-U, the primary data and secondary data were examined by means of quantitative and qualitative method. There is little difference in the type of land use of Khin-U. There were eight types of land use in Khin-U. In examining the land use zones of Khin-U, it was known that the land use was related to relief and soils. Furthermore, soil condition favour for the sustainable agriculture and good yield even the climate is drought in some years. If mechanized agriculture is promoted and implemented in the study area, it will be developed in its agricultural land use.

Introduction

"Land use can be defined as the use of land by man as conditioned by environmental factor and by the state of man's technical knowledge. Among environmental factors which change land use, soil erosion, climate, wind, fire, deforestation, and changes in water supply are of great importance. These factors can change the nature of soil and hence land use. With the advancement of scientific and technological knowledge many new implements as well as methods are developed and by applying them to land, change in land use is the result". Land use mainly deals with the problems related to the society and the region as a whole rather than a private farmer. Land use is mainly related to the optimum use of the limited land between the alternative major types of land use.

In Khin-U, the major types of land use are as follows;

(1) Residential land use
(2) Commercial land use
(3) Industrial land use
(4) Institutional land use and
(5) Transportation land use

According to the physical and human factors, the little changes of land use in Khin-U Town was more prominent after 1988. Nowadays, land use is more effective for the operation of regional development planning in the entire township.

Aim and Objectives

- To study the geographical factors that affect the land use for systematic growth and efficient use of land to promote the development in Khin-U Town.
- To examine the physical bases and social characteristics of Khin-U Town
- To provide the variety of land uses in appropriate locations throughout the town
- To present the general land use with the relation of land use capacity

Data and Method

After being collect the primary data, the field observation of the study area was processed and mapped by the present land use in Khin-U. Secondary data are the data of collected from General Administration and Land Records Department. Method of geographical representation is obtained by GIS and RS application.

Study Area

Khin-U Town proper is located approximately at the intersection point of 22° 46′ and 22° 47′ N latitude and 95° 37′, 95° 38′ E longitude. It is built up of 11.66 square mile or 7,471 acres. The Khin-U Town proper is surrounded on the west by Kanthaya village tract,

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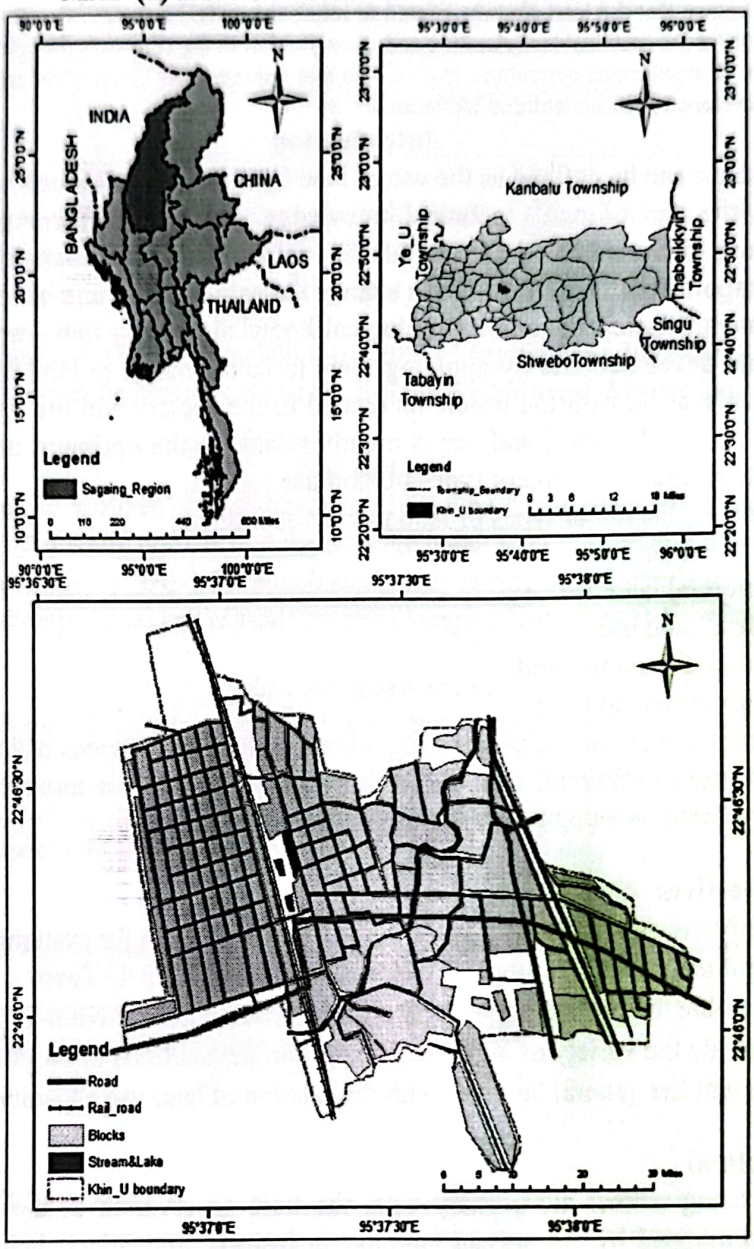
on the east by Magyidon village tract, on the north by Kunding village tract and on the south by Laungshay village tract. The shape of Khin-U is rectangular shape. Generally, the relief structure of Khin-U Town proper is built up of plain as a smooth surface of the drum. Therefore, most of land use of Khin-U Town proper can be found as the agricultural land. Khin-U Town is rich in land and water resources.

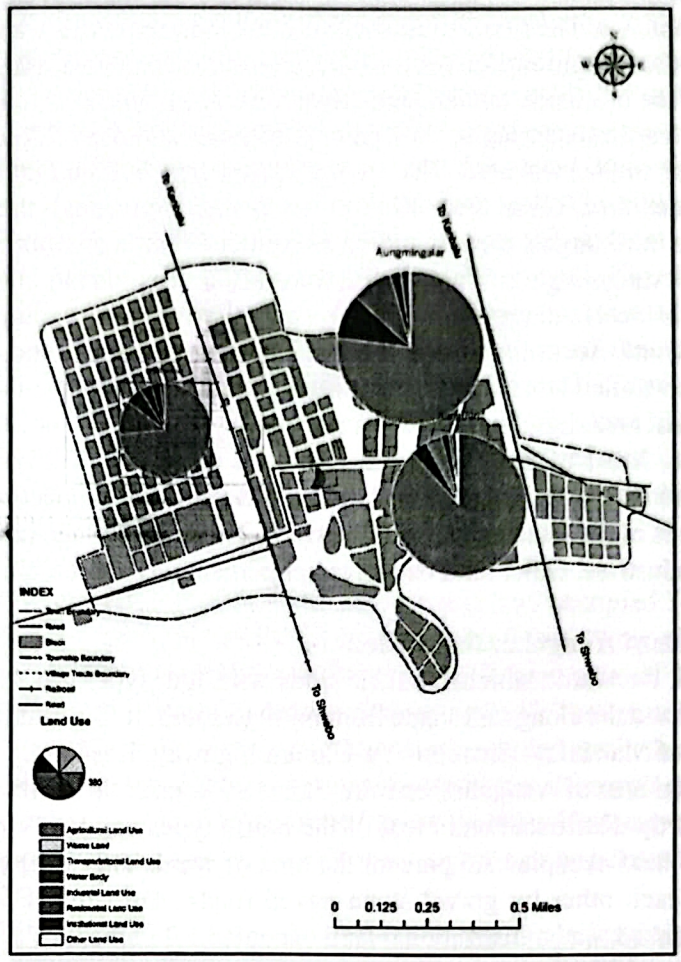
MAP (1) LOCATION MAP OF KHIN-U TOWN



Land Use Pattern of Khin-U Urban Area

Khin-U Town proper is formed by the confederation of four wards. In Khin-U Town proper eight types of land use pattern are found. But the land use pattern of each ward varies in land use types. Among the wards, Aungmingalar Ward has the largest number of land use types with eight types of land use. Aungthiri Ward and Myakanthar Ward have seven types of land use in the urban area. The smallest number of land use types is found in the Aungchanthar Ward. The land use patterns the wards within Khin-U Town proper in 2017 are shown in Table (1) and Map (1).

MAP 2. LAND USE PATTERNS IN URBAN AREA (2017)



Source : Based on Table (4.1).

Table (1) Land Use Pattern of Khin-U (2017)

No	Ward	Area (Acres) by Type of Land use								Total Area Acres
		Agricultural land use	Cultivable waste land	Transportational land use	Water body Area	Industrial land use	Residential land use	Institutional land use	Other	
1	Aungmingalar	2,476	6	61	314	2	285	75	77	3,296
2	Aungchanthar	-	-	19	-	-	31	1	2	53
3	Aungthiri	2,586	-	114	119	24	57	23	24	2,947
4	Myakanthar	862	4	49	70	15	137	38	-	1,175
	Total	5,924	10	243	503	41	510	137	103	7,471

Source: Compiled by Researcher based on Appendix (1)

Land Use Pattern of Aungmingalar Ward

The land use pattern of Aungmingalar Ward is different from the other wards. It has eight types of land use. The shape of this ward is "S" shape according to the extended urban area. Although the Aungmingalar ward is located in the urban area, it occupies agricultural land because of the originally demarcated urban area. Agricultural land is the largest area of Aungmingalar Ward accounting to 75.1 percent of total land use of Aungmingalar ward as this ward is close to the rural area. The second largest type is found under water body with 9.5 percent of total area. Canal from Karbo Dam is passing through the eastern part of the urban area. The third largest area is studied as residential area amounting to 8.7 percent of total land use of Aungmingalar Ward. There were 110 households in this ward. Most of the residential area is located along the Shwebo - Ye U highway in the south eastern part of the Aungmingalar Ward. According to the sandwich land use of agriculture, most of the house types are bamboo walled house type. Institutional land has the fourth largest areas with 2.3 percent of the total area. Land use under transportation land is only occupied by 1.8 percent of the total area. Most of the streets are found as gravelled. Cultivable wasteland and industrial land are the second smallest and the smallest land use respectively. Industrial land occupies two acres of the total land area of the ward. There are cottage industries and making of rice and oil industries. Other land occupies 2.3 percent of the total area of the ward.

Land use pattern of Aungchanthar Ward

In Kin-U, the wards which use their lands with four types are Aungchanthar Ward. The area is small and the elongated shape from north to south. It is located is in the downtown area by the side of Mandalay- Shwebo- Ye-U main highway. Residential lands occupy 58.5 percent of the total area of Aungchather ward. It has 95 households in this ward. Most of the residents are evenly distributed and most of the house types can be found as brick houses. Transportational land occupies 9.5 percent the area of ward. The ward within the town are connected with each other by gravel stone paved roads, earth roads and the main trunk gravelled stone paved roads. Institutional land occupies 1.9 percent of the area of ward. On these lands there are Government offices, a market and Revenue Department. Other land occupies 3.8 percent of the total land area.

Land use pattern of Aungthiri Ward

In Khin-U, the ward with seven types of land use is found. Agricultural land occupies 88.4 percent of the total area and they occupy the largest land area. As this ward is close to the village tracts, most of the lands are used as agricultural lands. This area is included in the extended area as urban land. Under water lands occupy 4.0 percent of the total area of the ward. Under water land area is utilized as the irrigation cannel and some are found as natural streams. Transportational land occupies 3.9 percent because of locating side of the road leading Mandalay. Within the ward there are gravel paved road and a few earth roads. Residential lands occupy 1.9 percent of the total land area of the ward. There are about 140 households living in this ward. Most of residents are concentrated around the ward boundary as the institutional lands of pagodas are located at the centre of the ward. Institutional lands occupy 0.8 percent of the total land area of the ward. In these lands there are government offices and State High school, People's Police Station and Myanmar Electric Power Enterprise office are found. Pagoda and Monasteries are found such as Lawka-marazein Pagoda, Myaytu, Hlaythar, Tamartaw and Kyaongthit monastery. Industrial land is utilized by small scale of rice and oil mills. They occupy 0.8 percent of the area of these wards. There is rice mill, oil mill and workshops as well as other cottage industries. Other land occupies 0.8 percent of the total area of this ward. There are also found store shops in this ward.

Land use pattern of Myakanthar Ward

In this ward where there are 7 types of the land use. It lies on the western tip of Khin-U. Agricultural lands are occupied by 73.4 percent of the total area. Agricultural lands are found lying adjacent and close to the village tracts. Residential land occupies 11.7 percent of the total land area of the ward. There are about 76 households living in this ward. This ward is found with even distributed residents. Southern most part is covered by institutional land. Water bodies occupy 5.9 percent of the total area of the ward. Industrial Land occupies 1.3 percent of the total area of the ward. There are Rice mill, Oil mill and other cottage industries in these wards. Cultivable waste lands occupy 0.3 percent of the land area. Transportation land occupies 4.2 percent of the area of the ward. The road which passes through the ward is the only gravel-paved road. The remaining branch roads are mostly earth roads. Institutional land occupies 3.2 percent of the total are of the ward. Most of the government offices are found in the ward. Khin-U General Hospital, Land Record Department, Forest Department, Commerce Office, Agriculture Department, City Development Committee, Rail Station, Co-operation, food and breweries shops are found along side of the Khin-U motor car roads. There are also store shops in this ward.

Findings and Result

In examining the land use of Khin-U, agricultural land occupied 79.3 percent of the land area. Agricultural land uses are found in Aungthiri Ward, Aungmingalar Ward and Myakanthar Ward. In 2017, Aungthiri Ward has the largest area of agricultural lands occupied by 44 percent of the total agricultural lands of Khin-U. The existence of agricultural lands located adjacent village tracts of Laungshay were included put in the town's land. The second largest land use type of Khin-U is residential land use. According to 2017 data, 6.8 percent of Khin-U area was used for residential lands. In Khin-U, Aungmingalar Ward has the largest area of residential lands with the largest number of populations. In Khin-U, the house types are different.

In Khin-U, the land use type with the least area is the industrial land. The area of industrial land is only 0.03 percent of the total area. Aungthiri Ward has the largest area of industrial land which is occupied by 58.5percent of the total industrial lands in the Khin-U.

In Aungmingalar Ward, there are eight types of land use and agricultural land use is the largest because the main economy of this ward is agriculture and it is near to the agricultural field. Aungthiri Ward and Myakanthar Ward have seven types of land use. In the land use pattern of Aungthiri Ward agricultural land occupies 88.4 percent. In Myakanthar ward, agricultural land use is also the largest and residential area is the second largest. Aungchanthar Ward has only four type of land use and it may be the centre of commercial area in downtown area. With respect to the main economic activity in these wards, as there are no lands which are used specially for the economic activities, the economic activities are carried on only at the homes of the settlers of the ward.

In examining the land use zones of Khin-U, it was known that the land use was related to relief and soils. According to those lands use of Khin-U is distinguished by the agricultural land use type. The elevation of the study is not more than 600 and the surface condition is suitable for the agriculture. Furthermore, geology and soil conditions favour for the sustainable agriculture and good yield even the climate is drought in some years. It is due to the surface water flowing from the watershed of northern Myanmar. If mechanized agriculture is promoted and implemented in the study area.

Acknowledgement

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Political Awakening of Kachin State (1920-1945)

Kyaw Swe Nyunt[1]

Abstract

This paper has tried to express the result of the rigorous examination of events and episodes, occurred in Kachin territory in the past eighty years. Moreover, this paper describes how the political awakening of Kachin State came to emerge. It presents about the flowering of Kachin literature, how Kachin newspapers were published and how the experience of war veterans in World War I and the contact with the AFPFL government, all made the peoples in Kachin State awaken politically and got the freedom minded political thought.

Keywords: Literature, Newspaper, War veterans, AFPAL Governments

Introduction

British practiced varied and diverse forms of divided and rule administration in Burma (Myanmar). In the actual implementation of divide and rule, they changed and transformed it to suit the conditions and status of the nationals. In the area where civilized people lived, the existing feudal lords were permitted to govern as before creating proxy administration by permitting feudalism grown for a long time, British made the national people deaf and dumb in the political awareness. At that time, though, there were nationalist movement by such organization of YMBA, GCBA and Labor Strike in the Myanmar proper, their influence, consequences and repercussion can be felt only to the Mogaung region, never reached for beyond, to the north such as Myitkyina and Bhamo. It was the result of British policy of divide and rule. British were always trying to divide a wedge between the national peoples. For instance, when a Christmas festival held in Bhamo on 23 December 1925 some Kachin women wore Myanmar costume, for which Bhamo Deputy Commissioner told that Kachin women that they should wear their Kachin national dress.[2] Such intervention can be seen as an act of instigation and discrimination. In 1907, British introduced Upper Myanmar and Arakan Hills Frontier Crossing and Disturbed District Regulation. Though, it was enacted to prevent the spread of rebellion in region to another, it also effectively forbade the communication and transportation between regions, thereby created obstacles to the development of knowledge and understanding among the peoples. Thus, we can see, Upper Myanmar and Arakan Hills Frontier Crossing and Disturbed District Regulation as a kind of stumbling block to barricade the spread of political awakening of Myanmar proper to the Hilly regions.

Circumstances that caused political awakening of Kachin nationals were (a) the arrival of missionaries (b) the emergence and blooming of Kachin Literature and opening of Kachin School; (c) The return of First World War, war veterans to their native Kachin land: and (d) serve oppressions on the part of the British. In the process of political awaking of Kachin peoples, we find various missionaries in various times played a major role. As we all know world powers usually practiced what widely known policy of three M to colonize an area or country the 3Ms: Missionary, Merchant and Military, the missionary plays a crucial role in paving the way for later steps of colonization of a country. They carried out the spread of Christian faith, and socio-economic development by means of educational activities, social activities and giving away material support. Christian missionaries in Kachin territory had carried out all these activities. They made animist Kachins convert to Christianity. They also educated these backward peoples. Thanks to their educational activities, once illiterate peoples of Kachin became literate. The most outstanding work of their educational activities is the invention of Kachin literature for the Kachins who did not have their own literature before.

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[2] Jinghpaw Shi Lai Ka (Kachin News), Vol. XII, No.2, 1926

For this great accomplishment and achievement, the peoples of Kachin owe a great debt to the once missionaries. As soon as the introduction of Kachin literature, the horizon of the Kachin peoples wide and their vision became high. Politico-socio-economic knowledge and awareness became wide.

Nevertheless, different race and different faith caused to occur different opinion vision in politics, creating political schism. The conversion of Kachins from animism to Christianity made the similarity of faith between the ruler and the ruled: the British and the Kachin: but the schism between the majority Buddhist Myanmar and minority Christian Kachin. Whatever the consequences of the missionaries in Myanmar may be, the peoples of Kachin became awaken politically, economically and socially through their newfound and acquired asset of Kachin literature. Till 1895, Kachins had never had their own literature. Therefore, Kachin servicemen in the British army had to wear bronze rings by which they had to draw their salaries by sealing with their Bronze rings. The fine for the loss of bronze rings was about one mat (25 pyas).[3]

After the introduction of Kachin Literature, a series of missionary schools appeared here and there in Kachin territory but most of them are found clustered in Myitkyina, Bhamo and Nankham regions. In 1897 missionary George J. Geis in Myitkyina opened a school, in Lana Wara Bun village, Bhamo district by Labans La and in 1899, a school in Bhamo by Daw La Bya Lu.[4] But in all their schools, Kachin Literature could not be used in teaching till 1907. Only in that year, Kachin readers in Kachin Language came into emergence by the hard cooperative work of J.F. Ingram and U Maran Lanaung, a teacher in Bhamo Teachers Training School.[5] In 1916, Kachin Readers were printed and published.[6] Only after that schools in Kachin region were able to teach by Kachin Language. From that time on word, Kachin nationals became interested in school and more and more educated persons appeared. Then, they realized that it is impossible to drive out the British militarily.

Number of schools and students enrollment grew year by year since the opening of the schools. In government both English and Kachin Languages taught schools subjects. Opening of schools and gradual development of education notwithstanding, these vividly show that there are very little Literatures and educated persons compared to the total population of Kachin region. It, in other words, means illiteracy prevails throughout the region, which forms a hindrance to the development of socio-economy and political awakening of the nationals in Kachin territory.

Civilian education apart, there also existed military education in Kachin region. At one point, Kachin soldiers in British army learned Kachin Language by inviting Saya Naw Taung to teach them. When more Kachin soldiers came out to learn the Kachin Language, British planned Myanmar Military Education to fulfill and satisfy her soldiers' desire of Learning in the year 1912. In the month of June in that same year, soldiers began to learn Kachin Language by the Burma Military Education plan.[7] After two years, in August 1914 Jinghpaw Shi Lai Ka (Kachin news)[8] began to appear and went on publish till the year 1932. It was monthly newspaper. The first editor-in-chief of Jinghpaw Shi Lai Ka was George J. Geis and reporter who wrote in Kachin language was Seng Li and Shalum Naw.[9] The Newspaper mentioned news of Christian churches, profiles of missionaries, First World War news, Burmese news, Kachin territory news on Kachin soldiers and news on

[3] Myitung Sut Nau, ***Ja hte lung Seng Jubilee*** (Record of Gold and jade), Hanson Memorial Press, Myitkyina, 1977, p.94 (Henceforth: Sut Nau, 1977)

[4] Marip Aung Hla, ***Jinghpaw Laika Labau Kadon*** (History of Kachin Literature), Hanson Memorial Press, Myitkyina, 1995, p. ii (Henceforth: Aung Hla, 1955)

[5] Tegenfeldt, G. Herman. ***A century of Growth South Pasadena***, California, William Carey Library, 1954, p.118 (Henceforth: Tegenfeldt, 1954)

[6] Sut Nau, 1977, 7

[7] Sut Nau, 1977, 94-95

administration education communication etc. The impact of Jinghpaw Shi Lai Ka is immense. Before the emergence of it, Kachin nationals, it seems, do not concern with the politics and the then political awaking and movement of Myanmar proper.

Only after the appearance of Jinhpaw Shi Lai Ka, Kachin nationals began to awaken. They began to analyze themselves and began to overcome the narrow sense of ethnicity. They now take interest in Kachin regional politics and Myanmar national politics. Due to the intercourse and exchange of culture, ideas, ideology between Kachin region and Myanmar proper and the outside world, the politico-socioeconomic knowledge and vision of Kachins changed and developed thanks to the introduction of literature, the opening of schools and the publication of Jinghpaw Shi Lai Ka.

The gesture of opening of schools set a side, British oppressed Kachin nationals with various means of which one was by introducing many oppressive laws. While the Diarchy administration brought about some changes and development in the Myanmar proper; there was no administrative change in the Kachin Hill Tracts. Though, Duwas and Highland chief were responsible for the administration in conformity with the Kachin Hills Tribe Regulations, they were being put under the control of Deputy Commissioner mostly emphasized to keep and enforce law and order. Kachin Hill Tribe Regulation was very oppressive for the Kachin nationals. The Regulation described to take action against someone who were in a position to oppose the government or held to belligerent attitude or carried out hostile activities by the following ways:

"Detain all or any members of the tribe, clan or village, detain or confiscate their property and debar members of the tribe, clan or village from access into territory outside the hill-tract and prohibit all other persons from entering the hill tracts."[10]

In the execution of this Regulation, Deputy Commissioner was fully responsible, and we find that the D.C fervently implemented it, only, not for the interest of Kachins, but for imperialist British. The D.C appointed or dismissed or punished Local headmen according to his will. The harshest oppressive measure of the Regulation was that one cannot build a resident house or small village without the prior consent or approval of D.C,[11] which clearly exhibit the extent of the oppressive nature of Regulation and how much it violates the fundamental rights of men to live freely anywhere he likes. By forbidding the free movement and free living of Kachins British tried and prevented the awaking of this people politically, socially and economically.

We have seen that Kachin Hills Tribe Regulation was enacted in the year 1897, roughly at the end of the pacification of Myanmar from 1885 to 1895. We know that this Regulation was very oppressive in nature. Nevertheless, above all these measures and activities wakened once peaceful and tranquil dim-witted peoples of Kachins.

Their waking was much accelerated by the holding of conventions, arrange by Kachin Baptist Kachin missionaries. The missionaries regularly hold Baptist convention conferences since 1910 mostly in Bhamo, Mytkyina and Namhkan. These convention conferences gave the Kachins opportunity to culture the friendship and intimacy among them, to hold discussion and exchange views on various matters, to find out a common opinion, to seek a common ground and to forge a unified platform on various matters, say, such as political, economic and social. In this way, Kachin nationals were able to form an All Kachins Unity Organization (AKUO) (Pawng Yawng Jinghpaw Hpung) on 29 March 1923 at Namsan, northern Shan State.

• Jinghpaw Shi LaiKa has three pages. One page contains two Coloum. In December 1932, It has forty pages.

• Jinghpaw Shi LaiKa, August 1914

The principal purpose of AKUO was to open more government schools in the Hill Tract regions and to raise, funds[12] for the development of the region of a whole. Though it takes a pretext of to open schools, the AKUO in fact is a precursor political organization. As the Viceroy Sir Harcourt Butler sensed in the true intension of the AUKO, he invited Kachin Duwas to Rangoon. Therefore, a fifty-six Kachin Duwas members of AKUO led by Seinlun Duwa Panmu Zau Tu left for Rangoon on 21 December 1924.[13]

In the month of July 1926, War veteran Kachin nationals established a Book Club (B.C) in Bhamo. British government did not permit to call it a club. They noticed that if club members wanted to call it a club, the club would be taxable. Therefore, senior members of the club advised to call it servicemen's mess. An admission fee for a member was one Kyat and a monthly fee was about four Kyats. Non-war veteran members of the club were Woodbury and Subaru Major Gawlu Gam. The club ordered such periodicals of Rangoon Gazette, Taria (Thuriya) and Bandola.[14] Apart from AKUO in about 1920, Kachin Youths Organization (Jinghpaw Ma Ram Hpung) was formed in Bhamo. The KYO was very popular that in the year 1927 it spread not only to Myitkyina but also up to hill tract regions of Kachin, recruiting members of up to 2000. The objective of KYO was to forge a national unity among the national people of the region.[15]

The awaking of Kachins was so great that they were able to form Kachin Trade Union Association (KTUA) (Jinghpaw Myit Hpawm Hpaga Hpung) on 15 December 1927 in Bhamo. The first Manger of KTUA was a pensioner Chyinghpaw Gam, Subadar Major (retired) who won the O.B.E (Order of British Empire).[16]
We have seen that all four important organizations of KYO (1920), AKUO (1923), B.C (1926) and KTUA (1927) are formed within a mere time span of one decade. Therefore, we are to understand that the awaking of Kachins, politically, economically and socially is so rapid and so great. In the awaking of Kachin, war veterans play a crucial role. Kachin nationals had served in the Burma Military Police (BMP) formed in Bhamo in 1898. In 1914, BMP was transferred to Pyinoolwin where in 1916; it was reorganized into a Kachin company in the 85th Burma Rifles.[17] Kachins were found to serve not only in the Burma Military but also at the front lines in various battlefields of First World War. On 16 July 1917, Jamedar Kanje Naw got an order to serve in the Mesopotamia battlefield for which he left Kachin region on 31 July 1917.[18] Likewise, Nau Nan and Balu Gam from 2/ 20 Burma Rifles came along with Major C.M. Enrigue to serve in the Borneo island Battlefield.[19]

We find that Militarily service in abroad made the Kachins earned international exposure, which transformed them militarily, politically, and organizationally well weathered men. Such internationally experienced war veterans Kachins were great help in educating their fellow Kachin nationals and in boosting up of patriotism and in stimulating the nationalism and national movement. The rise of patriotism and nationalism caused to understand the nationals of Kachin territory that a national unity is essential for the liberation of themselves and their region and the whole country. In this way, we find that war veteran nationals formed a driving force in the political awaking and political movement of Kachin territory.

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[12] Section (19) Kaschin Hill tribes Regulation
[13] The Kachin Hill Manual, Rangoon, Government Printing and Stationery,1959,p.6 (Henceforth: Kachin Hill Manual, 1959)
[14] Sut Nau, 1977, 87-88
[15] Jinghpaw Shi Laika , Vol XI , No.7, December 1924
[16] Jinghpaw Shi Laika, Vol. XIV, No.4, November 1929
[17] Jinghpaw Shi Laika, Vol. XIV, No.4, November 1929

After the First World War, Burmese anti-imperialist movement gained momentum. In the month of January 1919, the Samghas of Bahan on the Shwedagon pagoda established a Sangha Organization known as Sanghathamaggi. The organizer of this influential organization was the Venerable U Nageinda.[20] After the formation of Sanghathamaggi, more and more Dhamma preachers who expounded political matters gradually emerged. Sanghathamaggi organizations were also popped up in various parts of upper Myanmar. Soon, by the new rules of GCBA adopted on 12 June 1924, ranges of nationalist organizations were formed, which had a hierarchy of village and word, circle, township and district organization. Information of these organizations, the central executive Sayadaws from Sanghathmaggi took responsibility. Of these Sayadaws, Thetpan Sayadaw was assigned to form nationalist organization in the district of Katha, Bhamo and Myitkyina.[21] We find that Sanghathamaggi was in opposition to Diarchy. In the case of affiliation and non-affiliation, it favored the affiliation. When the 91 Department Administration was granted, Sanghathamaggi tended toward winning over Hluttaw Deputy in the election.

In the year 1936, Ye-U GCBA went on soliciting to win in the election of 91 Department administrations. Prince Makkhaya, a member of Ye-U GCBA, left for Tagaung, Shwegu and Mohnyin to canvass for the election 7 September 1936.[22] Ye-U GCBA prepared to compete for a total of 87 constituencies with 104 candidates, of these were included candidate for Kachin region which were town headman U Sein Ok for west Katha, Land Lord U Ba Yin for Nanma (Myitkyina), timber trader U Nyi for Bhamo and rice mill owner U Thi for Bhamo constituencies respectively.[23]

In the year 1931-32, under the aegis of YMBA Saya Tin a Grammar School was opened in central ward, Mogaung. Thanks to activities of this Grammar school, number of youths who became interested in the politics and national cause grew more and more as the time elapsed. These youths, as a result, became awakened politically. In the political awaking of Mogaung region to newspaper of the News Light of Myanmar and Thuriya were significant.

When U San Ni from the Parrot film Company donated books to the whole country, Mogaung received its share. We can say that there is some kinds of literary movement in Mogaung region for the peoples of have access to various books kept in various associations, especially by the help of Youth Readers Association. We also can understand that the literary movement would make the people got political, economic and social knowledge and visions.

Therefore, in about 193334, by the urge of these politico-socio-economic knowledge and national spirits, the people of Mogaung region formed Dobama Asiayone with the Chairmanship of U Po Choke (Younger brother of Mogaung town headman U Po Chon). Like the formation of political economic and social association and organization, Mogaung people did not forget to hold the ceremony that took national level. Therefore, in the year 1936, a National Day celebration was able to hold which was master of ceremony by U Aung Kyin (Aleyat) and in the next year's celebration; U Peik Sein was master of ceremony.[24]

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[20] Jinghpaw Shi Laika, Vol. XIV, No.7, February 1928

[21] Bawk La, Marang, ***Biography of Sama Duwa Sinwa Naw***, Rangoon, Nay Yi Yi Press,1980, p. 45 (Henceforth: Bawk La, 1980)

[22] Jinghpaw Shi Laika, Vol. IV,No.2, June 1918

[23] Jinghpaw Shi Laika, Vol.XII, No.1, August 1925

[24] Dean A.Minix, Sandra M.Hawley: ***Global Politics***: west/wads worth Publishing company, America, 1998, p. 16

[25] Lay Maung, ***Myanmar Naingnganye Thamaing*** (Myanmar Political History), Vol.I, Rangoon, Sarpaybeikman Press, 1973, p.177 (Henceforth: Lay Maung, 1973 a)

[26] Han Tin, Sagain, ***Myanmar Naingngan Record***, Vol. II, Rangoon, Public's powers 1967, pp.149-159

In the 1300 Revolution, Young Monks Association appealed the whole country to donate cash and kinds to support the Oil Field Workers Strike (OFWS). Mogaung peoples responded well to be appeal, which was attested by the fact that police collected the list of donors who donated cash and kinds to the fund for OFWS.[25]

In the month of June 1930, a political row broke out in Myanmar over the matters of affiliation or non-affiliation to India by the report of Simon Commission. The dispute of affiliation or non-affiliation made headlines in the press of Myanmar at that time. Newspapers of, at that time were mostly found party newspapers, which divided themselves into newspaper into newspaper for affiliation and newspaper for non-affiliation. Newspapers for affiliation were Deedok, Daungsetkyan, Bandola, Mawriya, Myanmar zaya and Wunthanu, while that of newspapers for nonaffilication were Nawyahta, Mahawthahta, Myanmar Yuwa, Myanmar a Lin and Thuriya. Thuriya newspaper strongly advocated for the non-affiliation. The begin-to-awaken Kachin nationals stood for the no affiliation. Accordingly, they read Thuriya newspaper most.[26] By the Diarchy administration, Kachin territory was divided into Part Two on 2 January 1923. Populated areas of Bhamo, Myitkyina and Katha were put under the division of Part II and these areas were placed under the administration of constituent Assembly. The Hill Tracts regions of Part I constituted the Frontier Areas Administration. Then, British pursued a policy of racial segregation. Thus, Kachins, who lived in the villages of mostly Myanmar peoples, were being taxed two times than the Myanmar peoples. And in the case of Myanmar and Shan peoples the reverse was true.[27] This act of double taxation might be the result of British desire, as they did not want the unity of Shan-Myanmar and Kachin and the spread of political awaking and political movements of Myanmar proper to Kachin Hill tracts. Nevertheless, Kachin nationals became awaken like those people of Myanmar proper that if arm struggle did not favor, unity among the diverse people was essential for the political means and political movement.

Sama Duwa Sinwa Naw who later became the paramount leader of Kachins, came to Mogaung for education in 1929, after rejecting the British offered position of chief of Duwas in Sama region. The mentor of Sama Duwa was the Venerable Sayadaw U Thuriya, Alekyaung, Mogaung. Sinwa Naw read extensively by ordering books from the towns of Myanmar proper. He held talks on books criticism at the resident of Mogaung town headman U Po Chon. These books criticism talks later change into anti-imperialist nationalist publish lectures.[28]

By the facts it is safe to say that the pioneer politician who sowed the seed of politics firmly was no other than Sinwa Naw. On March 1936, Sama Duwa Sinwa Naw founded the Peoples' Economic and Cultural Development Organization (PECDO) at Mayan village with the following persons: Padip La Taung, Kareng La, Nlum Zau Neng, Marip Naw, Marip Gum, Shadan Ja Naw, Lahre Shawg, Shadan Naw Grawng, Sharaw La, Lajurg Gam and Lahtaw La.[29] On 8 February 1938, the Headquarters of PECDO was opened at Lweliyan midway between Mogaung and Namati.[30]

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[25] Kyaw Swe, *Sangha Samaggi Thamaing* (History of Monk Union) M.A. thesis Mandalay University Mandalay 1988, p.120 (Henceforth: Kyaw Swe, 1988).

[26] Personal interview with U Paik Kaung aged 91 at his resident Aungnan ward, Myitkyina, 17 December 2004

[27] *History of the Dobama Asiayone*, Vol. I & II , Rangoon, Sapaybeikman Press,1976, p.246 (Henceforth: Dobama Asiayone, 1976)

In the year 1935, Township Education Officer U Maran Robin led a group of twenty-three Kachins who met the Viceroy where they asked more freedom for Kachin nationals, to release Kachin political prisoners and to promote Kachin soldiers according to their ability and capability.[31] Like the political awaking and movement in Myitkyina district, Kachin Youths in Bhamo district and northern Shan State were found politically awakening. In the year 1938, Shan, Myanmar and Kachin Youths came to coalesce at a place called Hkuphyat in northern Shan State where with consensus they formed Kachin Youths Organization (Pawng Yawng Ram Rawt). Kachin Youths of Lahtaw Gam, La Hkan and Usin La carried out political instigation throughout the region of northern Shan State where at every place they arrived, they had established small units of Pawng Yawng Ram Rawt, opening the headquarter at Hsenwi.[32]

Myanmar felt the wave of Second World War on 8 December 1941. Japanese Air force bombed Rangoon on the days of 23 and 25 December 1941. British forces were enabling to resist the Japanese offensive. Therefore, British hurriedly withdrew from Myanmar to India by various routes. One among them was the route from Myitkyina via Sampabra bum, Putao and Hukawng valley to India. In their way back, British took the Thakin political prisoners along with them and sent Thakins to various prisons in Upper Myanmar. In this way, Thakin political prisoners were a massed in the prison of Katha, Bhamo and Myitkyina. Oil Field Strike leaders of Thakin Po Hla Gyi and Thakin Ba Hein were being sent to Bhamo prison.[33] The arrival of Thakin political prisoners in Kachin territory opened a chapter in the political process of the awakening of Kachins. After the complete withdrawal of British the administration of Myanmar's prison came almost collapsed paving the way for the release of Thakin political prisoners. These political prisoners carried out vigorous political campaign leading to the profound change of the way the political awakening process occurred. More and more Kachin, Myanmar and Shan nationals in Kachin territory became awakened and involved in various political movements and campaign.

In 1942 Japanese forces occupied Myitkyina and released Thakin political prisoners from the jail. With the help of these Thakin, Municipal administration was introduced under the charge of U Hla Tin. During the period of Japanese occupation, Dobama poor party (Dobamasingyetha Party) was formed in Myitkyina with Thakin Net Pe in the Chairman, Thakin Ko Lay as secretary and Thakin Tun Sein as executive member. Also, servants' corps was instituted with U Sein as chief and Ko Avid (a) Thakin Tin Myint as assistance chief.[34] Dobamasinyetha Asiayon had formed many branches and said that they had undergone military training. We understand that most of nationals became believed in the policy and politic of the Asiayon and gave support to the effort of Thakins. In July 1942, East Asia Youths Organization (EAYO) was formed in Bhamo.[35] In the same year Thakin Than Myaing established New Bhamo Developing Association.[36] EAYO had carried out a series of activities in order to educate and upgrade the national people. They tried to raise the moral and morale of the people.

[31] Personal interview with Nan Zein Htwe Wa aged 79 at his resident Myemyint (ii), Myitkyina 6 August 2004.
[32] Kachin Hill Manual, 1959, 147
[33] Bauk La, 1980, 38-40
[34] Bauk La, 1980, 47
[35] Naw Awn. H. ***Wunpawng Labau Ginshi*** (Kachin History), Typing Manuscript, 1983, p.133 [36] Bauk La, 1980, 44 [37] M.Roi Nau, ***The Role of Kachin tribes in struggle for Independence***, M.A.,thesis, Rangoon University, 1991, p.37 (Henceforth: Roi Nau, 1991)
[38] One O One, Kyaw Win Maung, ***Thakin Net Fe who never surrender to the imperialist***, Rangoon, Bhamo Press, January, 1999, p. 2. (Henceforth: Kyaw Win Maung, 1999)

It is noteworthy to describe that during the anti-Fascist resistance, resistant forces of Kachin territory that is Kachin Levies and Rangers did not have any contact with the resistant forces of Burma proper, especially with the AFPFL. Kachin resistant forces are found to operate their operations on their own and wages resistant war against the Japanese with the help of the British forces and American forces. Having contact only with the mainstream resistant movement of AFPFL notwithstanding, Kachin resistant forces had successfully waged the anti- Japanese resistant war in their Kachin territory. In this regard, we have to recognize the vim and vigor of Kachin nationals in the struggle to awaken them and to go on against the Japanese. After the successful driving out of Japanese from the Kachin territory at the end of Second World War, all Kachin Youths Vigilant Association (Pawng Yawng Ram Rawt Hpung - (P.Y.R.Hp) was established under the leadership of U La Htoi at the place known as Nyaung Kaung - Si Lum mountain in the present Momauk township. It consisted of about fifteen members of Japanese war refugee youths and veterans of Kachin Ranger. The major function of the Association was to open the eyes of youths politically by opening youth training courses. The P.Y.R.Hp was also founded at the Balawngkawng ward in Bhamo under the auspices of U Zau Awng.[37] After the war, Kachins had tried to reestablish the economy of their territory. One such economic rehabilitation activity was the formation of Kachin United Company (Jinghpaw Hpaga Hpung). It was formed it Mayan village. Mogaung Township under the management of U Karing La. Duwa Zau Rip runs the Company as Manager. The Company bought war material remains and resold them to the public at reasonable prices. After a long time, the company was moved from Mayan to Myoma ward, Myitkyina. Though they got a parcel of Land to open the Company, being not having residential ground forthe Kachin nationals who worked for the Company, U Karens La and Duwa Zau Rip applied to Myitkyina District Commissioner Mr. Peter Murray for residential land. The District Commissioner did not grant any residential land; beside he threatens to move the company to other area. Nevertheless, U Karing La and Duwa Zau Rip did not give in and decided to proceed on to the British Superior Officers.[38]

In this way, some loss of Kachin nationals in the Japanese resistance set aside, the resistance brought about the emergence of energetic and vigorous Kachin Youths who took part in the independence struggle in cooperation with the Myanmar proper based on their experiences of politic, military and international exposure gained while in abroad during the Japanese resistance. To prevent the rise of nationalist sentiment and patriotism, British tried to gird the political awakening of nationals in the Kachin territory.

In précis, as we have seen, the political awakening of Kachin territory had significantly more developed during the short period of Japanese occupation, exactly fifteen month[39] for Kachin territory, then the periods of Myanmar monarchy and early British Colonial rule. We find that the leaders who led the political awakening of Kachin territory were educated youths and some youths who had contact with Myanmar proper. The raisons détre of the political awakening of Kachin territory, what we find are: the publication of Kachin newspaper in 1914, military duties of nationals in abroad in First World War, severe suppression by practicing the scorched earth policy on the part of the British, the holding of convention Conferences by missionaries, the establishment of All Kachins Unity Organization (AKUO), Kachin Youths Soliditary Organization (KYSO), Kachin Trade Union Association (KTUA) and Kachin United Company, the spread of

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[37] Kyaw Win Maung, 1999, 24

[38] Oway Daily, Vol I, No.9 , August 1943

[39] Oway Daily, Vol. I, No.8 , August 1943

[40] Roi Nau, 1991, 53-54

[41] Personal interview with Duwa Zau Rip, at his resident, Sitapu Myitkyina, 22 December 1999

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References

Primary Source

[illegible]

Master Thesis

[illegible]

Books in Myanmar

[illegible]

List of Interviewees

Name	Age	Status	Address
Daw Ban Htwey	85	Teahcher(Retd.) (U Drang Tan's wife)	Shansu South. Near KBC, Myitkyina.
Bawk La, Maran	67	Lawyer	Kachinsu , Myitkyina
Lu Taung, Daw	80	(U La Wamli's wife)	Yuzana , Myitkyina.
Pait Kaung, U.	91	Ex.AFPFL	Aung Nan , Myitkyina
Pait Sein, U	89	Ex. AFPFL	Hkemathiri,. Myitkyina.
Sama Chyaung Hpa Naw.	62	(Sinwa Naw's son)	Ayar.55. Myitkyina.
Zau Rip, Duwa	80	Kachin Politician	Sitapu, Myitkyina.

Compulsory Disputes Settlement Mechanisms Under the Law of the Sea

Yee Yee Htay[1]

Abstract

This paper presents about compulsory disputes settlement mechanisms under the law of the sea. Maritime disputes arises from the delimitation of maritime boundaries, the exercise of rights and duties of coastal States and other international actors in maritime zones of national jurisdiction, the activities in the Deep Seabed (the Area) and High Seas.(Ngugen, 2005) If the peaceful means cannot be reached, the disputes may be resorted by the compulsory dispute settlements, which are settled the International Court of Justice, the International Tribunal for the Law of the Sea, Arbitral Tribunal and Special Arbitral Tribunal. Besides, it described that ITLOS gets the most popular mechanism for settling disputes in calculating percentage by the Authority bodies. Because in the ITLOS there includes very extensive experience maritime affairs, without delaying, not costing too much. Moreover, it also includes not only States but also entities can stand before the ITLOS, examining seabed disputes and prompt release cases, third States and entities intervening the interpretation of UNCLOS and other international agreements which confers jurisdiction on the Tribunal, examining the urgency disputes by special chamber and following the judgments of the ITLOS. Therefore, the ITLOS is the most reliable tribunal in settling maritime disputes.

Keywords: ICJ, ITLOS, Arbitral Tribunal, Maritime Disputes.

Introduction

Disputes are an inevitable part of international relations. An international dispute may be defined as a specific disagreement concerning a matter of fact, law or policy in which a claim or assertion of one party is met with refusal, counterclaim or denial by another. Maritime disputes are a sub-category of international disputes. Some disputes arise out of a direct violation of one State's rights by another. The United Nations Convention on the Law of the Sea 1982 was adopted on 10 December 1982 and was recognized as universal legal documents on the seas. It contains 320 Articles and 9 annexes. As at October 2018, there are 168 States parties to its. The violation of the provisions of this Convention or disputes concerning the interpretation or application of this Convention may be settled by dispute settlement procedures under Part XV of this Convention. States Parties may opt the appropriate dispute settlement organs from among the International Court of Justice (ICJ), the International Tribunal for the Law of the Sea (ITLOS) (Annex VI), Arbitral Tribunal (Annex VII) and Special Arbitral Tribunal (Annex VIII).

Aims & Objectives

Aims: The main aim of this paper is to analyze the advantages and disadvantages relating to the International Court of Justice, the International Tribunal for the Law of the Sea, Arbitral Tribunal and Special Arbitral Tribunal in settling of maritime disputes. This paper uses the literature reviews and studies maritime cases.

Objectives:

- to enable dispute settlement mechanisms to have a real and strong impact on maritime disputes,
- to assess the ways in which the judicial process can contribute to the developing the legal order of the oceans and
- to find out the best means for international maritime disputes in proper ways.
- to express a realistic hope that the actual role of dispute settlement mechanisms will improve in the future.

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International Court of Justice

The International Court of Justice (ICJ) was created in 1945. Article 92 of the United Nations Charter describes the ICJ as the principal judicial organ of the United Nations, with the Statute of the ICJ being an integral part of the Charter. The seat of the Court is in the Hague (Netherlands).

Composition

Article 2 of the Statute of ICJ provides that The Court shall be compose of a body of independent judges, elected regardless of their nationality from among persons of high moral character, who possess the qualifications required in their respective countries for appointment to the highest judicial offices, or are jurisconsults of recognized competence in international law. Under Article 3 of this Statute, the Court shall consist of fifteen members, no two of whom may be nationals of the same State. Article 8 of this Statute provides that the General Assembly and the Security Council shall proceed independently of one another to elect the members of the Court. Moreover, Article 13 of this Statute provides that the members of the Court shall be elected for nine years and may be re-elected. In practice election of judges is based upon a degree of "equitable geographical distribution". The ICJ has always included judges of the nationality of the permanent members of the Security Council (France, Russia, China, the United Kingdom and the United States), with the exception at the moment of China. (The International Court of Justice, 1979). Article 31 of the Statute of the International Court of Justice 1945 sets out a procedure whereby *ad hoc* judges sit on contentious cases before the court.

Procedure

Article 40 of Statute of ICJ provides that the procedural rules concerning the conduct of cases before the court are instituted either by the notification of the special agreement or by a written application addressed to the Registrar. The procedure shall consist of two parts: written and oral.

Article 53 of the Statute of the International Court of Justice 1945 provides that whenever one of the parties does not appear before the Court, or fails to defend its case, the other party may call upon the Court to decide in favour of its claim. The Court must, before doing so, satisfy itself, not only that it has jurisdiction in accordance with Article 36 and 37, but also that the claim is well founded in fact and law.

Article 79(2) of Rules of the Court, 1978 provides that any objection by the respondent to the jurisdiction of the Court or to the admissibility of the application, or other objection the decision upon which is requested before any further proceeding on the merits, shall be made in writing as soon as possible, and not later than three months after the delivery of the memorial. Moreover, the powers of the court to allow a State to intervene in a case are set out in Article 62 and 63 of the Statute of the International Court of Justice 1945. Article 62 authorizes a State to make a request to intervene if it considers that it has 'an interest of a legal nature' which may be affected by the decision in the case.

As far as enforcement of the judgments of the ICJ is concerned, Article 94 of the UN Charter provides each member of the United Nations undertakes to comply with the decision of the International Court of Justice in any case to which it is a party. If any party to case fails to perform the obligations incumbent upon it under a judgment render by the Court, the other party may have recourse to the Security Council, which may, if it deems necessary, make recommendations or decide upon measures to be taken to give effect to the judgment. In order to give effect to the decisions of the Court provides that Article 41 and Article 42 of Charter of the United Nations. However, such enforcement is subject to the veto power of the five permanent members of the Council.

which the United States used in the Nicaragua case. Article 55 provides that all questions shall be decided by a majority of the judges present. Article 60 of this Statute provides that the judgment is final and without appeal. The official languages of the Court shall be French and English.

It can be seen that the rules of procedure assists for the expanding of Statute of ICJ. As permanent members with the veto power, the influence of the permanent members in the Security Council can tremendously impact the enforcement of the ICJ decisions.

Applicable Law

Matters before the International Court of Justice are decided in accordance with Article 38 (1) of Statute of the International Court of Justice.

Jurisdiction

The International Court of Justice has jurisdiction in two types of cases. It decides contentious cases and it gives advisory opinions on legal questions asked by international organizations. (Hamid Abdul Ghafur @ Khin Maung Sein , 2011).

Article 34 of Statute of the International Court of Justice provides that only States may be parties in cases before the Court. Article 65 of the Statute of the International Court of Justice provides that the Court may give an advisory opinion on any legal question at the request of whatever body may be authorized by or in accordance with the Charter United Nations to make such request.

Article 36 of Statute of the International Court of Justice provides that the jurisdiction of the Court comprises all cases which the parties refer to it and all matters specially provided for in the Charter of the United Nations or in treaties and conventions in force. The States parties to the present Statute may at any time declare that they recognize as compulsory *ipso facto* and without special agreement, in relation to any other State accepting the same obligation, the jurisdiction of the Court in all legal disputes. It can be seen that the jurisdiction of the Court is founded upon the consent of the parties. The compulsory jurisdiction of the ICJ is optional.

From 1948 to 2018 list of maritime cases decided by ICJ

SI No	Name & Issues of Cases	Date of Application	Date of Judgment	ICJ's Decision
1	Corfu Channel Case (Albania v. the United Kingdom). -Sovereignty in territorial sea; innocent passage of warship	On 25 March 1948	On 15 December 1949	Agreement on decision
2	Fisheries Jurisdiction Case (United Kingdom v. Norway) -Straight baselines	On 28 September 1949	On 18 December 1951	Agreement on decision
3	North Sea Continental Shelf (Federal Republic of Germany/ Denmark & Netherlands -Delimitation; continental shelf; adjacent States; equidistance method	On 2 February 1967	On 20 February 1969	Agreement on decision
4	Fisheries Jurisdiction Case (Federal Republic of Germany v. Iceland) -Extension by coastal State of fisheries jurisdiction	On 26 May 1972	On 25 July 1974	Not Agreement on decision

Sl No	Name & Issues of Cases	Date of Application	Date of Judgment	ICJ's Decision
5	Fisheries Jurisdiction Case (United Kingdom v. Iceland) -Extension by coastal State of fisheries jurisdiction	On 14 April 1972	On 17 August 1974	Not Agreement on decision
6	Aegean Sea Continental Shelf (Greece v. Turkey). -delimitation of the continental shelf	On 10 August 1976	On 19 December 1978	Agreement on decision
7	The Continental Shelf Case, Tunisia v. Libyan Arab Jamahiriya. -delimitation of the continental shelf	On 10 June 1977	On 24 February 1982	Agreement on decision
8	Canada v. United States of America -Delimitation of the Maritime Boundary in the Gulf of Maine Area.	On 20 January 1982	On 12 October 1984	Agreement on decision
9	Continental Shelf Case, Libyan Arab Jamahiriya v. Malta. -delimitation; continental shelf	On 26 July 1982	On June 1985	Suspend
10	Guinea-Bissau v. Senegal, -Maritime Delimitation Dispute	On 23 August 1989	On 12 March 1991	No Agreement on decision
11	Denmark v. Norway. - Maritime Delimitation in the Area between Greenland and Jan Mayen	On 16 August 1988	On 14 June 1993	Agreement on decision
12	Libyan Arab Jamahiriya v. Chad, -Territorial Dispute	On 31 August 1990	On 3 February 1994	Agreement on decision
13	Fisheries Jurisdiction Case, Spain v. Canada. -violation of Canadian coastal fisheries protection Act	On 28 March 1995	On 4 December 1998	No Jurisdiction
14	Qatar v. Bahrian, -Maritime Delimitation and Territorial Dispute	On 8 July 1991	On 16 March 2001	Agreement on decision
15	Cameroon v. Nigeria, -Maritime delimitation Dispute.	On 29 March 1996	On 10 October 2002	Agreement on decision
16	El Salvador v. Honduras, -Island & Maritime Frontier Dispute	On 11 December 1986	On 11 September 1992	Agreement on decision
17	Nicaragua v. Honduras, -Territorial & Maritime Dispute in the Carribbean Sea	On 8 December 1999	On 8 October 2007	Agreement on decision
18	Romania v. Ukraine, -Maritime Delimitation in the Black Sea	On 16 September 2004	On 3 February 2009	Agreement on decision
19	Nicaragua v. Columbia -Territorial & Maritime Dispute	On 6 December 2001	On 19 November 2016	Suspend
20	Australia & New Zealand v. Japan, -Whaling in the Antarctic	On 31 May 2010	On 31 March 2014	Agreement on decision
21	Peru v. Chile - Maritime Delimitation Dispute	On 16 January 2008	On 27 January 2014	Agreement on decision

Sl No	Name & Issues of Cases	Date of Application	Date of Judgment	ICJ's Decision
22	Bolivia v. Chile -Territory and maritime delimitation in the western Caribbean	On 24 April 2013	On 1 October 2018	Suspend
23	Costa Rica v. Nicaragua -violation of the 1858 treaty	On 29 September 2005	On 13 July 2009	Agreement on decision
24	Somalia v. Kenya - Maritime delimitation Boundary).	On 28 August 2014	On 2 February 2018	Suspend

Since it received its first case in 1948, a total of 24 maritime cases have been filed. On these, 16 have been decided, 3 were not agreement on decision, 4 were suspending and one is removal. Of the 16 cases that have been resolved, thirteen were delimitation cases, one deal with innocent passage of warships, one relates to fishing case and one is navigation and related rights on the lower course of Nicaragua's San Juan River. Above mentioned, the ICJ has no jurisdiction on the provisional measures, prompt release of vessels and crews and seabed disputes.

The International Tribunal for the Law of the Sea

The International Tribunal for the Law of the Sea (ITLOS) is an international judicial body established by the United Nations Convention on the Law of the Sea 1982. The seat of the Tribunal shall be in Hamburg of Germany. (Anderson, 2008).

Composition

Article 2 of the Annex VI of the Statute of the ITLOS provides that the Tribunal shall be composed of a body of 21 independent members, elected from among persons enjoying the highest reputation for fairness and integrity and recognized competence in the field of the law of the sea. Article 2 of the Annex VI of the Statute of the ITLOS provides that in the Tribunal as a whole the representation of the principal legal systems of the world and equitable geographical distribution shall be assured. Article 5, of the Annex VI of the Statute of ITLOS provides that the members of the Tribunal shall be elected for nine years and may be re-elected. Article 12 of the Annex of the Statute of ITLOS provides that the Tribunal shall elect its President and Vice-President for three years; they may be re-elected.

The International Tribunal for the Law of the Sea has formed two chambers such as Seabed Disputes Chamber and Special Chamber. Furthermore, a special chamber was established on 20 December 2000 in accordance with Section 5 Part XI of this Convention and Article 15 of the ITLOS Statute.

Procedure

Procedurals arrangements are straightforward and in general resemble those of the Statute of the International Court of Justice. (Merrills, 2017).

Disputes are to be submitted to the Tribunal, depending on the case, either by notification of a special agreement, or by written application, addressed to the Registrar. (Dixon, McCorquodale, Williams, 2016).

Under Article 49 of Annex VI of the Statute of ITLOS, the Tribunal and its Seabed Disputes Chamber have the power to prescribe provisional measures. If the Tribunal is not in session or a sufficient number of its members is not available to constitute a quorum, the provisional measures can be prescribed by the chamber of summary procedure. Such measures are subject to review and revision by the Tribunal.

States Parties not party to a dispute but which consider that they have an interest of a legal nature which may be affected by the decision in any dispute may submit a request to the Tribunal to be permitted to intervene. Furthermore, under Article 102 of the Rules of the Tribunal, the Tribunal shall hear the State Party or entity other than a State Party seeking to intervene and the parties before deciding. The proceedings before the Tribunal shall be conducted without unnecessary delay or expense.

Decisions of the Tribunal are final and shall be complied with by all the parties to the dispute. However, decisions will not have a binding force except between the parties in respect of the particular dispute. (Dixon, McCorquodale, Williams, 2016).

The procedures of ITLOS play a main role for the Tribunal that mentions the frame of a proceeding arriving at before the Tribunal.

Applicable Law

The Tribunal will apply the provisions of the United Nations Convention on the Law of the Sea and other rules of international law not incompatible with the Convention in deciding disputes submitted to it. (Dixon, McCorquodale, Williams, 2016).

Jurisdiction

The jurisdiction of the Tribunal comprises all disputes and all applications submitted to it in accordance with the United Nations Convention on the Law of the Sea and all matters specifically provided for in any other agreement which confers jurisdiction on the Tribunal. (Shaw, 2017).

The Tribunal has exclusive jurisdiction, through its Seabed Disputes Chamber, with respect to disputes relating to activities in the international seabed Areas. These matters include disputes between State Parties concerning the interpretation or application of the provisions of the Convention, concerning the deep seabed Area; and disputes between States Parties or a contractor and the international Seabed Authority. (Dixon, McCorquodale, Williams, 2016).

The Tribunal, through its Seabed Disputes Chamber, has jurisdiction to provide advisory opinions at the request of the Assembly or the Council of the International Seabed Authority on legal questions arising within the scope of their activities. (Dixon, McCorquodale, Williams, 2016).

The Tribunal has special jurisdiction in matters calling for provisional measures. Failing agreement between parties to a dispute within two weeks of the request by either party for provisional measures, the Tribunal or with respect to activities in the Area, the Seabed Disputes Chamber, may prescribe, modify or revoke provisional measures. (Dixon, McCorquodale, Williams, 2016).

Where the authorities of a States party have detained a vessel flying the flag of another State Party and it is alleged that the detaining State has not complied with the provisions of the Convention for the prompt release of the vessel or its crew upon the posting of a reasonable bond or other financial security, the question of release from detention may be submitted to the Tribunal, failing agreement between the Parties within ten days from the time of detention. (Dixon, McCorquodale, Williams, 2016).

The Tribunal has jurisdiction to deal with disputes (contentious jurisdiction) and legal questions (advisory jurisdiction) submitted to it. The Tribunal has jurisdiction over all disputes concerning the interpretation or application of the Convention subject to the provisions of Article 297 and to the declarations made in accordance with Article 298 of the Convention.

It can be noted that the competence of the Tribunal very expands in the sphere of the law of the sea. The jurisdiction recognized by the tribunal is binding and not subject to the consent of the States Parties.

From 1997 to 2018 List of maritime cases decided by ITLOS

Sl No	Name and Issues of Cases	Date of Application	Date of Judgment	ITLOS's Decision
1	The M/V Saiga case No.1 (Saint Vincent and the Grenadines v. Guinea) -custom jurisdiction in EEZ; use of force; Prompt Release.	On 13 November 1997	On 4 December 1997	Not Agreement on decision
2	The M/V Saiga case No.2 (Saint Vincent and the Grenadines v. Guinea) -reparation - Provisional Measures.	On 13 January 1998	On March 1998	Agreement on decision
3&4	Southern Bluefin Tuna cases (New Zealand v Japan, Australia v Japan), -Fisheries conservation and management -Provisional Measures	On 3 July 1999	On 27 August 1999	Agreement on decision
5	The Camouco case (Panama v. France) - reasonableness of and criteria for a bond; form of bond -Prompt Release.	On 17 January 2000	On 7 February 2000	Agreement on decision
6	The Mont Confurco case (Seychelles v. France) -reasonableness of the bond -Prompt Release.	On 27 November 2000	On 18 December 2000	Agreement on decision
7	Case concerning the Conservation and Sustainable exploitation of Swordfish Stocks in the South-Eastern Pacific Ocean (Chile/European Union)	On 28 May 2010	On 7 October 2011	Removal
8	The Grand Prince case (Belize v. France) -illegal fishing in EEZ -Prompt Release	On 21 March 2001	On 20 April 2001	Agreement on decision
9	The Chaisiri Reefer 2 case (Panama v. Yemen) -violation of fishery laws -Prompt Release.	On 3 July 2001	On 13 July 2001	Removal
10	The MOX Plant case (Ireland v. United Kingdom) -jurisdiction - Provisional Measures.	On 9 November 2001	On 3 December 2001	Agreement on decision
11	The Volga case (Russian Federation v. Australia) -form of the bond -Prompt Release.	On 2 December 2002	On 23 January 2002	Agreement on decision

Sl No	Name and Issues of Cases	Date of Application	Date of Judgment	ITLOS's Decision
12	Case concerning Land Reclamation by Singapore in and around the Straits of Johor (Malaysia v. Singapore) - interference with the navigation and marine environmental degradation in the Straits of Johor. -Provisional Measures.	On 9 November 2001	On 3 December 2001	Agreement on decision
13	The Juno Trader case (Saint Vincent and the Grenadines v. Guinea-Bissau) -form of bond - Prompt Release.	On 18 November 2004	On 18 December 2004	Agreement on decision
14	The Hoshinmaru case (Japan v. Russian Federation) -infringement of national fisheries legislation in EEZ. -Prompt Release.	On 6 July 2007	On 6 August 2007	Agreement on decision
15	The Tomimaru case (Japan v. Russian Federation) -infringement of national fisheries legislation in EEZ. - Prompt Release	On 6 July 2007	On 6 August 2007	Agreement on decision
16	Responsibilities and obligations of States sponsoring persons and entities with respect to activities in the Area -Request for Advisory Opinion submitted to the Seabed Disputes Chamber	On 6 May 2010	On 1 February 2011	Agreement on decision
17	The ARA Libertad case (Argentina v. Ghana) -Challenged legality of detention by Ghana of Argentinian warship. -Provisional measures	On 29 & 30 November 2012	On 25 December 2012	Agreement on decision
18	The M/V Louisa case (Saint Vincent and the Grenadines v. Kingdom of Spain) - Challenge to arrest of vessels & crew by Spain for violation of laws on underwater cultural heritage.	On 23 November 2010	On 23 December 2010	Removal
19	The Arctic Sunrise case (Kingdom of the Netherlands v. Russian Federation) -Challenge legality of arrest and detention of Greenpeace ship and demonstrators. -Provisional Measures	On 4 October 2013	On 22 November 2013	Agreement on decision
20	The M/V Virginia G case (Panama/Guinea-Bissau) -Challenge to arrest of Panamanian vessels carrying out fueling operations for fishing vessels in EEZ of Guinea-Bissau.	On 2 November 2012	On 21 December 2012	Suspend
21	(Bangladesh/ Myanmar). -Dispute concerning delimitation of the maritime boundary between Bangladesh and Myanmar in the Bay of Bengal	On 5 September 2011	On 14 March 2012	Agreement on decision

SI No	Name and Issues of Cases	Date of Application	Date of Judgment	ITLOS's Decision
22	Request for an Advisory Opinions submitted by the Sub-Regional Fisheries Commission (SRFC), a regional fisheries organization comprised of seven West-African States. -illegal, unreported, and unregulated (IUU) fishing	On 5 October 2015	On 2 April 2015	Agreement on decision
23	The Enrica Lexie Incident (Italy v. India) -Provisional Measures, Challenge to arrest of Italian military armed guards on Italian ship who accidently killed Indian fisherman in EEZ of India.	On 21 July 2015	On 24 August 2015	Agreement on decision
24	(Ghana/Coted'voire). -Dispute concerning delimitation of the maritime boundary between Ghana and Cote d'voire in the Atlantic Ocean	On 3 December 2014	On 25 April 2017	Agreement on decision
25	The M/V Norstar case (Panama v. Italy) -Challenge to arrest of Panamanian vessel oil supply vessel in EEZ of Italy.	On 17 December 2015	On 19 September 2016	Suspend

Since it received its first case in 1997, a total of 25 cases have been filed. Of these, 19 have been decided, one was not agreement on decision, two were suspending, and three are removal. Of the 19 cases that have been resolved, eight were prompt release cases, seven involved provisional measures, two deals with a maritime boundary disputes, and two involved a request for an advisory opinion. Therefore, the records to show that ITLOS has jurisdiction on a variety maritime matter.

Arbitral Tribunal and Special Arbitral Tribunal

Arbitration was defined by the International Law Commission as "a procedure for the settlement of disputes between States by a binding award on the basis of law and as a result of an undertaking voluntarily accepted". (Hamid, Abdul Ghafur @ Khin Maung Sein, 2011). Special arbitral tribunal is one of the binding methods of settlement. (Merrills, 2017).

Composition

Under Article 3, Annex VII of UNCLOS, Arbitral Tribunals are to be composed of five members, one chosen by each of the parties and the other three members chosen jointly by the parties, from a penal to which each State party to the Convention may nominate four people. If the disputants cannot agree upon the three jointly chosen arbitrators, these are to be appointed by the President of the International Tribunal for the Law of the Sea. Arbitrators must have some experience in maritime affairs, but not necessarily in the Law of the Sea.

Article 2, Annex VIII of UNCLOS, Special arbitral tribunals under Annex VIII of the UNCLOS may be established to deal with four categories of specialized disputes: (1) fisheries; (2) environmental protection; (3) marine scientific research; and (4) navigation (including pollution and dumping from ships). States parties to the Convention may nominate two experts in the relevant field to each of four lists, each list dealing with one of these categories and maintained respectively by the FAO,UNEP, IOC and IMO. Each party to the dispute may choose two arbitrators for each case, preferably from the appropriate list. The President of the arbitral tribunal is

chosen by agreement between the parties, failing which the Secretary General of the United Nations is to make the appointment.

Procedures and Jurisdiction

Subject to the provisions of Part XV, any party to a dispute may submit the dispute to the arbitral procedure provided for in Annex VII by written notification addressed to the other party or parties to the dispute.

Then, an arbitral tribunal constituted under Article 3 of this Annex shall function in accordance with this Annex and the other provisions of this Convention. Unless the parties to the dispute otherwise agree, the arbitral tribunal shall determine its own procedure, assuring to each party a full opportunity to be heard and to present its case. The parties to the dispute shall facilitate the work of the arbitral tribunal and, in particular, in accordance with their law and using all means at their disposal, shall: (a) provide it with all relevant documents, facilities and function; and (b) enable it when necessary to call witnesses or experts and the receive their evidence and to visit the localities to which the case relates.' Decisions of the arbitral tribunal shall be taken by a majority vote of its members.

From 1989 to 2018 list of maritime cases decided by Arbitral Tribunal

SI No	Name & Issues of Cases	Date of Application	Date of Judgment	Arbitration's Decision
1	Australia and New Zealand v. Japan (Southern Bluefin Tuna Arbitration) -Fisheries conservation and management; jurisdiction and admissibility	On 30 March 1989	On 10 June 1992	Removal
2	Eritrea v. Yemen Maritime delimitation	On 3 October 1996	On 17 December 1999	Agreement on decision
3	Ireland v. UK (Mox Plant Arbitration) -Marine environment, jurisdiction, admissibility; prescription of provisional measures	On 25 October 2001	On 24 June 2003	Suspend
4	Malaysia v. Singapore (Land Reclamation Arbitration)	On 4 July 2003	On 1 September 2005	Suspend
5	Barbados v. Trinidad and Tobago -Maritime Delimitation Arbitration	On 16 February 2004	On 11 April 2006	Agreement on decision
6	Guyana v. Suriname -Maritime Delimitation Arbitration.	On 24 February 2004	On 17 September 2007	Agreement on decision
7	Bangladesh v. India -Bay of Bengal Maritime Boundary Arbitration	On 8 October 2009	On 7 July 2014	Not Agreement on decision
8	Argentine v. Ghana -ARA Libertad Arbitration)	On 29 October 2012	On 11 November 2013	Suspend
9	Philippines v. China -South China Sea	On 22 January 2013	On 12 July 2016	Not agreement on decision

SI No	Name & Issues of Cases	Date of Application	Date of Judgment	Arbitration's Decision
10	Ukraine v. the Russian Redration -Dispute concerning Coastal State Rights in the Black Sea, Sea of Azov, and Kerch)	On 16 September 2016	On 31 August 2018	Suspend
11	Bering Sea (Fur Seal) Arbitration (United States v. United Kingdom) -Seal fisheries; jurisdiction; high seas	On 29 February 1892	On 15 August 1893	Agreement on decision
12	North Atlantic Coast Fisheries Arbitration (United Kingdom v. United States of America) -Fisheries; bays; high seas	On 27 January 1909	On 7 September 1910	Agreement on decision

It received its first case in 1989, a total of 15 cases have been filed. Of these, 6 have been decided, two was not agreement on decision, six were suspended and one was removal. Of the 6 cases that have been resolved, two were fishing cases and four deals with a maritime boundary dispute.

Thus, the records to show that Arbitral Tribunal has jurisdiction on a variety maritime matter. But, has no more successful mean than the Court or Tribunal.

According to the Article 1, Annex VIII of the United Nations Convention on the Law of the Sea 1982, subject to Part XV, any party to a dispute concerning the interpretation or application of the Articles of this Convention relating to (1) fisheries, (2) protection and preservation of the marine environment (3) marine scientific research or (4) navigation including pollution from vessels and by dumping may submit the dispute to the special arbitral procedure provided for in this Annex by written notification addressed to the other party or parties to the dispute. The job of a special arbitral tribunal will normally be adjudication. Its functions can be broadened to include inquiry, fact-finding and conciliation. (Merrills, 2017).

Accordingly, special arbitration differs from the Arbitration (Annex VII) in exercising the functions and powers upon any dispute. States are not obliged to use special arbitration for the specified disputes but may still utilize Annex VII arbitration, ITLOS or ICJ. To date, an Annex VIII tribunal has not been utilized.

Table1. Comparing on Judgments of International Court of Justice, International Tribunal for the Law of the Sea, Arbitral Tribunal and Special Arbitral Tribunal.

	Cases	Agreement on decision	Not Agreement on decision	Suspend	Removal	% Agreement on decision
ICJ	24	16	3	4	1	66%
ITLOS	25	19	1	2	3	80%
Arbitral Tribunal	15	6	2	6	1	40%
Special Arbitral Tribunal	-	-	-	-	-	-

Note: calculation based on the judgments of the respective Court and Tribunals in settling maritime disputes.

Conclusion

Apart from their specificities in terms of composition, jurisdiction, procedures and rules of the Court and Tribunals, although the ICJ has managed to do reasonably well, there are still areas for improvement and efficiency in order to ensure maximum performance. Therefore, it is still considered ICJ as a failure or remain skeptical as regards to its future.

Thus, it should reform concerning the problems such as (1) the removal of judges from the permanent member States; (2) the abolishment of Article 31 of the ICJ Statute; (3) the acceptance of the compulsory jurisdiction of the Court; (4) the expanding jurisdiction *ratione personae*; and (5) the provision the time-limits in proceedings before the ICJ if it is to be equipped to effectively handle the evolving of legal issues confronting the global community. ITLOS has shown its ability to play a major role in the development of international law, particularly in the field of maritime disputes.

Because of (1) the composition of the Tribunal with 21 Judges specialized in the field of the Law of the Sea; (2) demanding special expertise; (3) including not only States but also entities can stand before the ITLOS; (5) examining seabed disputes and prompt release; (6) third States and entities intervening the interpretation of UNCLOS and other international agreements which confers jurisdiction on the Tribunal; (7) examining the urgency disputes by special chamber; and (8) without delaying and not costing too much; and (9) following the judgments of the ITLOS. The Arbitral Tribunal has not more successful mean than the Court or Tribunal, especially in the field of the maritime disputes. Today, States has not utilized Special Arbitral Tribunal. According to the mentioned above and table 1 shows calculation percent based on the judgments of the respective Court and Tribunals in settling maritime disputes, the ITLOS is the most reliable tribunal in settling maritime disputes.

Acknowledgement

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Some Application of Conformal Mapping

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Abstract

The concepts of conformal mapping are introduced. And then basic theory of conformal mapping and some of its applications in physical problems are also discussed.

Introduction

Conformal mapping is an important transformation used in complex analysis. It has many applications in different physical problem. If the function is harmonic then the transformation of such functions of conformal mapping is also harmonic. If the physical problem can be represented by complex functions then it can be transferred to a problem with much more convenient geometry by a conformal mapping.

Conformal Mapping

A conformal map is a function which preserves the angles. Conformal map preserves both angles and shape of infinitesimal small figures but not necessarily their size. More formally, a map

$$w = f(z) \tag{1}$$

is called conformal at z_0 if it preserves oriented angles between curves through z_0, as well as their orientation, that is direction.

An important family of examples of conformal maps comes from complex analysis. If U is an open subset of the complex plane, then a function $f:U \to C$ is conformal if and only if it is holomorphic and its derivative is everywhere non-zero on U. If f is a antiholomorphic, it still preserve angles, but it reverses their orientation. The Riemann mapping theorem, states that any nonempty open simply connected proper subset of C admits a bijective conformal map to the open unit disk in complex plane C if U is a simply connected open subset in complex plane C, which is not all of C, then there exists a bijective. $f:U \to D$, where $D = \{z \in C : |z| < 1\}$. As f is a bijective map it is conf

Basic Theory

Let us consider a function

$$w = f(z) \tag{2}$$

where $z = x + iy$ and $w = u + iv$. We find that $dz = dx + idy$, and $dw = du + idv$,

$$|dz|^2 = dx^2 + dy^2, \tag{3}$$

and

$$|dw|^2 = du^2 + dv^2. \tag{4}$$

Then the square of the length element in xy-plane is

$$ds^2 = dx^2 + dy^2 \tag{5}$$

and square of the length element in uv-plane is

$$dS^2 = du^2 + dv^2. \tag{6}$$

From equations (3), (4), (5), (6) we find that,

$$dS/ds = |dw/dz| \tag{7}$$

is the ratio of arc length of two planes remains essentially constant in the neighborhood of each point in z plane provided w(z) is analytic and have a nonzero or finite slope at that point. This implies the linear dimensions in two planes are proportional and the net

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result of this transformation is to change the dimension in equal proportions and rotate each infinitesimal area in the neighborhood of that point. Thus the angle is preserved although shape in a large scale will not be preserved in general as the value of $|dw/dz|$ will vary considerably at different points in the plane. Due to this property such transformations are called conformal.

Theorem

Assume that f(z) is analytic and not constant in a domain D of the complex z plane. For any point $z \in D$ for which $f'(z) \neq 0$, this mapping is conformal, that is, it preserves the angle between two differentiable arcs.

Example

Let D be the rectangular region in the z plane bounded by $x = 0$, $y = 0$, $x = 2$ and $y = 1$. The image of D under the transformation $w = (1+i)z + (1 + 2i)$ is given by the rectangular region D of the w plane bounded by $u + v = 3$, $u - v = -1$, $u + v = 7$ and $u - v = -3$.

If $w = u + iv$, where $u, v \in R$, then $u = x - y + 1$, $v = x + y + 2$. Thus the points a, b, c, and d are mapped to the points (0, 3), (1, 2), (3, 4), and (2, 5), respectively. The line $x = 0$ is mapped to $u = -y + 1$, $v = y + 2$, or $u + v = 3$; similarly, for the other sides of the rectangle (Figure 1). The rectangle D is translated by $(1 + 2i)$, rotated by an angle $\frac{\pi}{4}$ in the counterclockwise direction, and dilated by a factor $\sqrt{2}$. In general, a linear transformation $f(z) = \alpha z + \beta$, translates by β, rotates by $\arg \alpha$, and dilates by $|\alpha|$. Because $f(z) = \alpha \neq 0$, a linear transformation is always conformal.

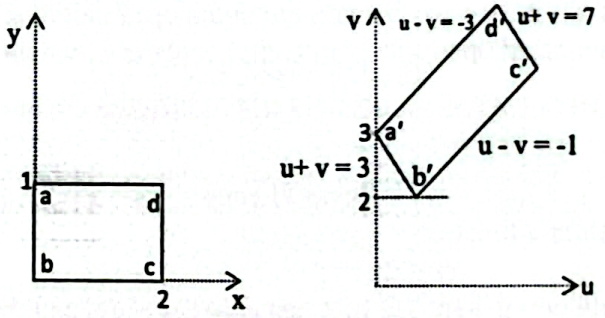

Figure 1

The below theorem related to inverse mapping, is an important property of conformal mapping as it states that inverse mapping also preserves the angle.

Theorem

Assume that f(z) is analytic at z_0 and that $f'(z) \neq 0$. Then f(z) is univalent in the neighborhood of z_0. More precisely, f has a unique analytic inverse F in the neighborhood of $w_0 = f(z_0)$; that is, if z is sufficiently near z_0, then $z = F(w)$, where $w = f(z)$. Similarly, if w is sufficiently near w_0 and $z = F(w)$, then $w = f(z)$. Furthermore, $f'(z)F'(w) = 1$, which implies that the inverse map is conformal. This uniqueness and conformal property of inverse mapping allows us to map the solution obtained in w-plane to z-plane.

Critical Points

If $f'(z_0) = 0$, then the analytic transformation f(z) ceases to be conformal. Such a point is called a critical point of f. Because critical points are zeroes of the analytic function f', they are isolated.

Applications

The Stream Function

Let $V = p(x,y) + iq(x,y)$ be the velocity vector. Let $\phi(x,y)$ be velocity potential, then $V = \phi_x + i\phi_y = (\phi_x, \phi_y) = \text{grad}\,\phi$. Let ψ be harmonic conjugate of ϕ. Then the curve $\psi(x, y) = c$ is called streamline. $\psi(x, y)$ is called stream function. The analytic function $F(z) = \phi(x, y) + i\psi(x, y)$ is called complex potential.

By Cauchy-Riemann conditions for analytic functions,

$$\phi_x = \psi_y,\ \phi_y = -\psi_x, \text{we have } F'(z) = \phi_x + i\psi_x = \phi_x - i\phi_y = \bar{V}.$$

Hence $V = \overline{F'(z)}$.

The speed $|V| = |\phi_x + i\phi_y| = |F'(z)| = |\overline{F'(z)}|$.

Example

Let the complex potential be $F(z) = Az$, where A is a positive real constant. Then $\phi(x,y) = Ax$, $\psi(x,y) = Ay$. The stream lines $\psi(x,y) = c$ are horizontal lines $y = \frac{c}{A}$.

The velocity $= V = \overline{F'(z)} = \bar{A} = A$.

The speed $= |V| = |\overline{F'(z)}| = |\bar{A}| = |A| = A$.

Here a point (x_0, y_0) at which $\psi(x,y) = 0$ is any point on the x axis. If the point (x_0, y_0) is taken as the origin, then $\psi(x,y)$ is the rate of flow across any contour drawn from the origin to the point(x, y). The flow is uniform and to the right. It can be interpreted as the uniform flow in the upper half plane bounded by the x axis, which is a streamline or as the uniform flow between two parallel lines $y = y_1$ and $y = y_2$.

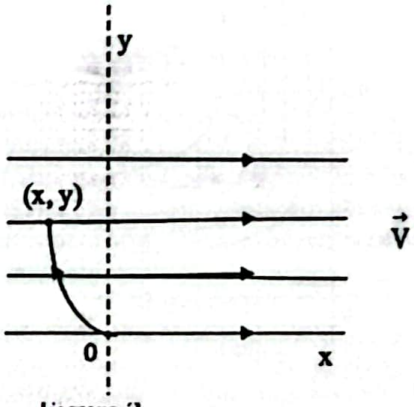

Figure 2

Flows Around A Corner and Around A Cylinder

Let ϕ be velocity potential and ψ be stream functions in uv-plane, that is $\phi = \phi(u,v)$ and $\psi = \psi(u,v)$. Then ϕ and ψ are harmonic functions in domain D_w in uv-plane. Suppose D_w is the image of D_z in xy-plane under the transformation $w = f(z) = u(x,y) + iv(x,y)$, where f(z) is analytic.

$$\phi_{uu} + \phi_{vv} = 0,$$

$$\psi_{uu} + \psi_{vv} = 0.$$

Substituting the values of u(x, y) and v(x, y) is $\phi(u,v)$ and $\psi(u,v)$, we obtain the harmonic functions, $\phi[u(x,y), v(x,y)]$ and $\psi[u(x,y), v(x,y)]$ is in D_z inxy-plane.

Let $F(w) = \phi(u,v) + i\psi(u,v)$ be the complex potential in uv-plane. Then $F[f(z)] = \phi[u(x,y), v(x,y)] + i\psi[u(x,y), v(x,y)]$ is a complex potential in xy-plalne.

Example

Let $F(w) = Aw = A(u + iv)$, where $A > 0$, be a complex potential in uv-plane. Consider the transformation $w = f(z) = z^2 = (x + iy)^2 = x^2 - y^2 + i2xy$. Thus $u = x^2 - y^2$, $v = 2xy$. This transformation maps the first quadrant in xy-plane to the upper half plane in uv-plane, since $x > 0$, $y > 0$, $v = 2xy > 0$. It maps the y-axis to negative u-axis and the x-axis to the positive u-axis in uv-plane.

If $x = 0$, then $u = -y^2 \le 0$, $v = 0$,

If $y = 0$, then $u = x^2 \ge 0$, $v = 0$.

Going back to $F(w) = Aw = A(x+iy)$ and $w = z^2 = (x + iy)^2$, we obtain the complex potential in xy-plane as $F(z^2) = A(x^2 - y^2) + i2Axy$.

Velocity potential and stream function in xy-plane are $\phi = A(x^2 - y^2)$ and $\psi = 2Axy$. The stream function $\psi(x,y) = 2Axy$ is harmonic and zero when $x = 0$ or $y = 0$. The streamlines $2Axy = c$ are hyperbolas for each c.

Velocity of fluid $V = \overline{2Az} = 2A(x - iy)$.

Speed $|V| = 2A\sqrt{x^2 + y^2}$.

It represents the flow of liquid around the corner as in Figure 3.

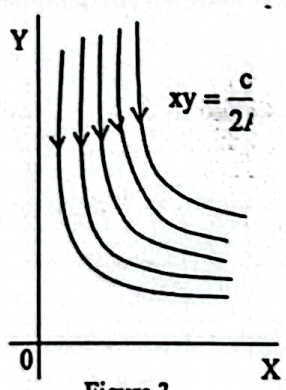

Figure 3

Example

Let a long circular cylinder of unit radius be placed in a large body of fluid flowing with a uniform velocity, the axis of the cylinder being perpendicular to the direction of flow. To determine the steady flow around the cylinder, we represent the cylinder by the circle $x^2 + y^2 = 1$.

The complex potential involved in this problem is $F = Aw$ in the uv-plane, and the transformation $w = F(z) = z + \frac{1}{z}$, hence $F(f(z)) = A(z + \frac{1}{z})$. By the results given above the velocity of liquid will be $V = \overline{F'(z)} = A(1 - \frac{1}{\bar{z}^2})$ since $F'(z) = A(1 - \frac{1}{z^2})$.

Expression F in polar coordinates, $z = r(\cos\theta + i\sin\theta)$.

$$F(z) = A(r(\cos\theta + i\sin\theta)) + \frac{1}{r(\cos\theta + i\sin\theta)} \times \frac{(\cos\theta - i\sin\theta)}{(\cos\theta - i\sin\theta)}$$

$$= A(r(\cos\theta + i\sin\theta)) + \frac{1}{r}(\cos\theta - i\sin\theta).$$

Therefore $\phi = A(r + \frac{1}{r})\cos\theta$, $\psi = A(r - \frac{1}{r})\sin\theta$.

Stream function $\psi = A(r - \frac{1}{r})\sin\theta$.

The streamlines $A(r - \frac{1}{r})\sin\theta = c$ are symmetric to the y-axis and have asymptotes parallel to the x-axis. When $c = 0$, the streamline consists of the circle $r = 1$ and the parts of the x-axis exterior to the circle.

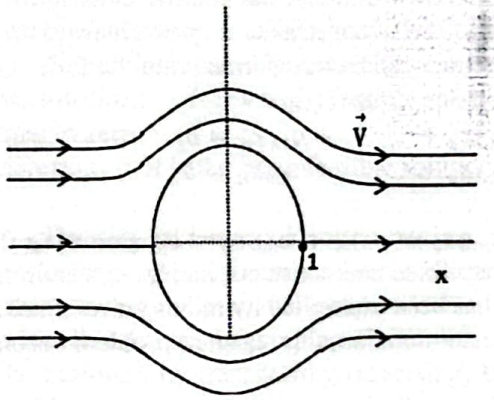

Figure 4

Conclusion

The conformal mapping that can be used for practical applications such as fluid flows around a corner and around a cylinder problem.

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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 Ko and Dr Soe Myint Aye,Pro-Rectors, University of Myitkyina, whose permission to me to carry out my present research. I also thank to Dr Daw Win Sein, Professor and Head, Department of Mathematics, University of Myitkyina , for her encouragement. Finally, I would like particular to thank Dr Nang Bawk, Professor, Department of Mathematics, University of Myitkyina, for her assistance and helpful suggestions.

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Applications of the Dual Simplex Method in Linear Programming

Hla Hla Win[1]

Abstract

In this paper, some important definitions of linear programming and standard linear programming model were described. And then, the dual simplex method was also studied. Finally, the linear programming problems were solved by using the dual simplex method.

Keywords: standard linear programming, duality in linear programming and the dual simplex method.

Introduction

A linear programming (LP) problem is a mathematical program in which the objective function is linear in the unknown and the constraints consist of linear equalities and linear inequalities. The exact form of these constraints may differ from one problem to another, but as shown below, any linear program can be transformed into the following standard form:

Minimize $c_1x_2 + c_2x_2 + \ldots + c_nx_n$

Subject to $a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n = b_1$

$a_{21}x_1 + x_{22}x_2 + \ldots + a_{2n}x_n = b_2$

$\ldots\ldots\ldots\ldots\ldots$

$a_{m1}x_1 + a_{m2}x_2 + \ldots + a_{mn}x_n = b_m$ and $x_1 \geq 0, x_2 \geq 0, \ldots, x_n \geq 0,$

where the b_i's, c_j's and a_{ij}'s are fixed real constants, and the x_j's are real numbers to be determined. Each equation has been multiplied by minus unity, if necessary, so that each $b_i \geq 0$.

In more compact vector notation, this standard problem becomes

Minimize $\underline{c}\,\underline{x}$

Subject to $A\underline{x} = \underline{b}$ and $\underline{x} \geq \underline{0}$,

here $\underline{x}$ is an n-dimensional column vector, $\underline{c}$ is an n-dimensional row vector, A is an $m \times n$matrix and $\underline{b}$is an m-dimensional column vector. The vector inequality $\underline{x} \geq 0$ means that each component of $\underline{x}$ is nonnegative.

A is called **coefficient matrix**, $\underline{x}$ is the **decision vector**, $\underline{b}$ is the **requirement vector**, $\underline{c}$ is the **cost (price or profit) vector** of the (LP) problem.

The new positive variables introduced to convert the " less than or equal to" inequalities to equalities are called **slack variables.**

The new positive variables adjoined to convert a "greater than or equal to" inequalities to equalities are called **surplus variables.**

Some Important Definitions in Linear Programming

Consider the general linear programming problem involving **n variables** and **m constraints** $(m \leq n)$:

Determine the values of variables $x_1, x_2, \ldots x_n$ which

Maximize $z = c_1x_2 + c_2x_2 + \ldots + c_nx_n$ (1)

Subject to $a_{11}x_1 + x_{12}x_2 + \ldots + a_{1n}x_n \leq b_1$

$a_{21}x_1 + x_{22}x_2 + \ldots + a_{2n}x_n \leq b_2$

$\vdots$ (2)

$a_{m1}x_1 + a_{m2}x_2 + \ldots + a_{mn}x_n \leq b_m$

and $x_1 \geq 0, x_2 \geq 0, \ldots, x_3 \geq 0.$ (3)

Introducing slack variables $x_{n+1}, x_{n+2}, \ldots x_{n+m}$ in the constraints it can be put in the following standard form:

Maximize $z = c_1x_1 + c_2x_2 + \ldots + c_nx_n$

Subject to $a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n + x_{n+1} = b_1$

$a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n + x_{n+2} = b_2$

$\vdots$

$a_{m1}x_1 + a_{m2}x_2 + \ldots + a_{mn}x_n + x_{n+m} = b_n,$

where $x_1, x_2, \ldots, x_n, x_{n+1}, x_{n+2}, \ldots, x_{n+m} \geq 0.$

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1. **Solution:** A set of variables $\{x_1, x_2, \ldots, x_{n+m}\}$ is called a **solution** to (LP) problem if it satisfies the constraints (2).

2. **Feasible solution:** A set of variables $\{x_1, x_2, \ldots, x_{n+m}\}$ is called a **feasible solution** to (LP) problem if it satisfies the constraints (2) as well as non-negativity restrictions (3).

3. **Basic solution:** A solution obtained by setting any n variables equal to zero and solving for remaining m variables (provided the determinant of the coefficients of these m variables is non-zero) is called a **basic solution.** These m variables (some of them may be zero are called basic variables and the remaining n variables that have been put equal to zero each are called non-basic variables. The number of basic solutions thus obtained will at most be ${}^{m+n}C_m = \frac{(m+n)!}{m!\,n!}$ which is the number of combinations of m+n things taken m at a time.

4. **Basic feasible solution:** It is a basic solution that also satisfies the non-negativity restrictions (3). All variables in a basic feasible are ≥ 0.

5. **Non-degenerate basic feasible solution:** It is a basic feasible solution in which all the m basic variables are positive (> 0) and the remaining n variables are zero each.

6. **Degenerate basic feasible solution:** It is a basic feasible solution in which one or more of the m basic variables are equal to zero.

7. **Optimal basic feasible solution:** It is the basic feasible solution that also optimizes the objective function (1).

Duality in Linear Programming

Every (LP) problem (linear program) there is a related unique (LP) problem involving the same data which also describes the original problem (program).

The given original program is called the primal program (P).

This program can be rewritten by transporting (reversing) the rows and columns of the algebraic statement of the problem. Inverting the program in this way results in dual program (D). The variables of the dual program (problem) are known as dual variables or shadow prices of the various resources.

When the primal program (P) are converted to the dual program (D), the following points are clear:

(1) If the primal contains n variables and m constraints, the dual will contain m variables and n constraints.

(2) The maximization problem in the primal becomes the minimization problem in the dual and vice versa.

(3) The maximization problem has ($\leq$)constraints while the minimization problem has ($\geq$)constraints.

(4) Constraints of $\leq$ type in the primal become $\geq$ type in the dual and vice versa.

(5) The coefficient matrix of the constraints of the dual is the transpose of the primal.

(6) A new set of variables appear in the dual.

(7) The constants $c_1, c_2, \ldots, c_n$ in the objective function of the primal appear in the constraints of the dual.

(8) The constants $b_1, b_2, \ldots, b_m$ in the constraints of the primal appear in the objective function of the dual.

(9) The variables in both problems are non-negative.

Example

Consider the problem

Maximize $z = c_1x_1 + c_2x_2$

Subject to $a_{11}x_1 + a_{12}x_2 = b_1$

$a_{21}x_1 + a_{22}x_2 \leq b_1,$

and $x_1 \geq 0,\ x_2 \geq 0.$

The first constraint of equality form can be expressed as

$a_{11}x_1 + a_{12}x_2 \leq b_1$ and $a_{11}x_1 + a_{12}x_2 \geq b_1$

or $a_{11}x_1 + a_{12}x_2 \leq b_1$

$-a_{11}x_1 - a_{12}x_2 \leq -b_1.$

Let y_1', y_1'' and y_2 be the dual variables associated with the first, second and third constraints. Then the dual problem is

Minimize $W = b_1(y_1' - y_1'') + b_2y_2$

Subject to $a_{11}(y_1' - y_1'') + a_{21}y_2 \geq c_1$

$a_{12}(y_1' - y_1'') + a_{22}y_2 \geq c_2$

and $y_1', y_1'', y_2 \geq 0$.

Put $y_1' - y_1'' = y_1$, the dual problem becomes

Minimize $W = b_1y_1 + b_2y_2$

Subject to $a_{11}y_1 + a_{21}y_2 \geq c_1$

$a_{12}y_1 + a_{22}y_2 \geq c_2$

and y_1 unrestricted in sign, $y_2 \geq 0$.

The Dual Simplex Method

The dual simplex method is to solve an (LP) problem consists of the following steps.

Step 1. Convert the problem into maximization problem if it is initially in the minimization form.

Step 2. Convert ≥ type constraints, if any, into ≤ type by multiplying both sides of such constraints by –1.

Step 3. Convert the inequality constraints into equalities by addition of slack variables and obtain the initial solution. Express the above information in the form of a table known as the dual simplex table.

Step 4. Look at the elements in the bottom row.

(a) If all elements in the bottom row are either negative or zero and all b_i are non-negative, the solution obtained above is the optimal basic feasible solution.

(b) If all elements in the bottom row are either negative or zero and at least one b_i is negative, then proceed to step 5.

(c) If any indicator in the bottom row is positive, the method fails.

Step 5. Select the row that contains the most negative b_i. This row is called the key row or the pivot row. The corresponding basic variable leaves the basis. This is called dual feasibility condition.

Step 6. Look at the elements of the key row.

(a) If all elements are non-negative, the problem does not have a feasible solution.

(b) If at least one element is negative, find the ratios of the corresponding elements of the bottom row to these elements. Ignore the ratios associated with positive or zero elements of the key row. Choose the smallest of these ratios. The corresponding column is the key column and the associated variable is the entering variables. This is called dual optimality condition. Mark the key element or the pivot element.

Step 7. Make the key element unity. Perform the row operations and repeat iterations until either an optimal feasible solution is obtained in a finite number of steps or there is an indication of the non-existence of a feasible solution.

Example

A person wants to decide the constituents of a diet which will fulfill his daily requirements of proteins, fats and carbohydrates at the minimum cost. The choice is to be made from four different types of foods. The yields per unit of these foods are given in table (3).

Table (3)

Food Type	yield per unit			cost per unit
	Proteins	Fats	Carbohydrates	Rs
1	3	2	6	45
2	4	2	4	40
3	8	7	7	85
4	6	5	4	65
Minimum requirement	800	200	700	

Let x_1, x_2, x_3 and x_4 denote the number of units of food of type 1, 2, 3 and 4 respectively.
A linear programming problem for this problem can be constructed as follows:

Minimize $Z = 45x_1 + 40x_2 + 85x_3 + 65x_4$

Subject to
$3x_1 + 4x_2 + 8x_3 + 6x_4 \geq 800$
$2x_1 + 2x_2 + 7x_3 + 5x_4 \geq 200$
$6x_1 + 4x_2 + 7x_3 + 4x_3 \geq 700$

and $x_1, x_2, x_3, x_4 \geq 0.$

Maximize $Z' = -Z = -45x_1 - 40x_2 - 85x_3 - 65x_4$

Subject to
$-3x_1 - 4x_2 - 8x_3 - 6x_4 \geq -800$
$-2x_1 - 2x_2 - 7x_3 - 5x_4 \geq -200$
$-6x_1 - 4x_2 - 7x_3 - 4x_4 \geq -700$

and $x_1, x_2, x_3, x_4 \geq 0.$

Maximize $Z' = -Z = -45x_1 - 40x_2 - 85x_3 - 65x_4 + 0x_5 + 0x_6 + 0x_7$

Subject to
$-3x_1 - 4x_2 - 8x_3 - 6x_4 + x_5 = -800$
$-2x_1 - 2x_2 - 7x_3 - 5x_4 + x_6 = -200$
$-6x_1 - 4x_2 - 7x_3 - 4x_4 + x_7 = -700$

and $x_1, x_2, x_3, x_4, x_5, x_6, x_7 \geq 0.$

Putting $x_1 = x_2 = x_3 = x_4 = 0$, the initial basic solution is $x_5 = -800$, $x_6 = -200$, $x_7 = -700$. Since x_4, x_5, x_6 are negative solution in infeasible. The above information is expressed in table (3), called starting dual simplex table.

Table (4)

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	b
x_5	–3	–4	–8	–6	1	0	0	-800
x_6	–2	–2	–7	–5	0	1	0	-200
x_7	–6	–4	–7	–4	0	0	1	-700
$c_j - z_j$	–45	–40	–85	–65	0	0	0	0

Table (5)

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	b
x_2	3/4	1	2	3/2	$-\frac{1}{4}$	0	0	200
x_6	–2	0	–3	–2	$-\frac{1}{2}$	1	0	200
x_7	–3	0	1	2	–1	0	1	100
$c_j - z_j$	–15	0	–5	–5	–10	0	0	800

As all the elements in the bottom row are negative or zero and all b_i are positive, the solution given by table (5) is

$x_1 = 0,\ x_2 = 200,\ x_3 = 0,\ x_4 = 0$

Maximize $Z' = -45(0) - 40(200) - 85(0) - 65(0) = -800$

Minimize $Z = 8000.$

Example

A computer manufacturing company has two assembly plants, plant A and plants B, and two distribution outlets, outlet I and outlet II. Plant A can assemble at most 700 computers a month, and plant B can assemble at most 900 computers a month. Outlet I must have at least 500 computers a month, and outlet II must have at least 1000 computers a month. Transportation costs for shipping one computer from each plant to each outlet are as follows: $6 from plant A to outlet I; $5 from plant A to outlet II; $4 from plant B to outlet I; $8 from plant B to outlet II.To find a shipping schedule that will minimize the total cost of shipping the computers from the assembly plants to the distribution outlets.

Let x_1 = number of computers shipped from plant A to outlet I
Let x_2 = number of computers shipped from plant A to outlet II
Let x_3 = number of computers shipped from plant B to outlet I
Let x_4 = number of computers shipped from plant B to outlet IIThe (LP) problem is

Maximize $Z = 6x_1 + 5x_2 + 4x_3 + 8x_4$
Subject to $x_1 + x_2 \le 700$
$x_3 + x_4 \le 900$
$x_1 + x_3 \ge 500$
$x_1 + x_3 \ge 1000,$
and $x_1, x_2, x_3, x_4 \ge 0$
Maximize $Z' = -6x_1 - 5x_2 - 4x_3 - 8x_4$
Subject to $x_1 + x_2 \le 700$
$x_3 + x_4 \le 900$
$-x_1 - x_3 \le -500$
$-x_2 - x_4 \le -1000,$
and $x_1, x_2, x_3, x_4 \ge 0.$

The (LP) model in standard form is

Maximize $Z' = -6x_1 - 5x_2 - 4x_3 - 8x_4 + 0x_5 + 0x_6 + 0x_7 + 0x_8$
Subject to $x_1 + x_2 + x_5 = 700$
$x_3 + x_4 + x_6 = 900$
$-x_1 - x_3 + x_7 = -500$
$-x_2 - x_4 + x_8 = -1000,$
and $x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8 \ge 0$

Table (6)

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	b
x_5	1	1	0	0	1	0	0	0	700
x_6	0	0	1	1	0	1	0	0	900
x_7	−1	0	−1	0	0	0	1	0	−500
x_8	0	−1	0	−1	0	0	0	1	−1000
$c_j - z_j$	−6	−5	−4	−8	0	0	0	0	0

Table (7)

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	b
x_5	1	0	0	−1	1	0	0	1	−300
x_6	0	0	1	1	0	1	0	0	900
x_7	−1	0	−1	0	0	0	1	0	−500
x_2	0	1	0	1	0	0	0	−1	1000
$c_j - z_j$	−6	0	−4	−3	0	0	0	−5	5000

Table (8)

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	b
x_5	1	0	0	−1	1	0	0	1	−300
x_6	0	0	0	1	0	1	0	0	900
x_3	1	0	1	0	0	0	−1	0	500
x_2	0	1	0	1	0	0	0	−1	1000
$c_j - z_j$	−2	0	0	−3	0	0	−4	−5	7000

Table (9)

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	b
x_4	−1	0	0	1	−1	0	0	−1	300
x_6	1	0	0	0	1	1	0	1	600
x_3	1	0	1	0	0	0	−1	0	500
x_2	1	1	0	0	1	0	0	0	700
$c_j - z_j$	−5	0	0	0	−3	0	−4	−8	7900

As all the elements in the bottom row are negative or zero and all b_i are positive, the solution given by Table (7) is $x_1 = 0, x_2 = 700, x_3 = 500$ and $x_4 = 0$.

Maximize $Z' = -6(0) - 5(700) - 4(500) - 8(300) = -7900$

Minimize $Z = 7900$

The total cost of shipping the computers from the assembly plants to the distribution outlets is 7900.

Conclusion

Every linear program (LP) can be transformed into the standard form by using slack and surplus variables. The given original program is called the primal program (P). This program can be rewritten by transporting (reversing) the rows and columns of the algebraic statement of the problem. Inverting the program in this way results in dual program (D). Every linear program can be solved by using the dual simplex method.

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Some Applications from Complex Numbers

Hkawng Nan[1], Khon Mai[2]

Abstract

In this paper, a complex number is presented in Cartesian form. And then, this complex number is also represented by the Polar form. Moreover, the complex numbers are discussed by the fundamental law such as addition, subtraction, multiplication and division. Finally, the applications of complex numbers are discussed.

Introduction

The complex numbers are two parts of real and imaginary part as $z = x + iy$, where x, y are real numbers and $i = \sqrt{-1}$. There are also existed the properties of real numbers.

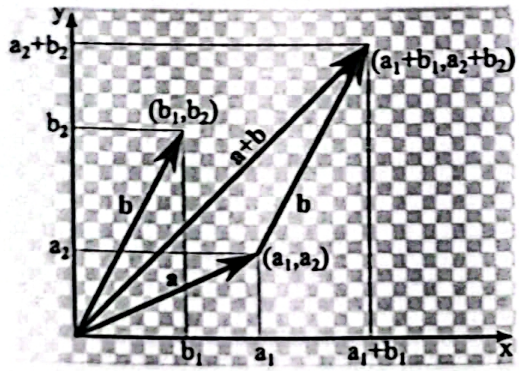
The Basic Concept of Complex Numbers

In this section, we shall use small letters, a, b, c, ..., to denote real numbers. Such numbers possess the following properties.

1. There exist unique real numbers p, q such that
   (i) $a+ b = p$,
   (ii) $ab= q$.
2. The associative law holds for both addition and multiplication,
   (i) $(a + b) + c = a + (b + c)$,
   (ii) $(ab)c = a(bc)$.
3. The commutative law holds for both addition and multiplication,
   (i) $a+ b =b+ a$,
   (ii) $ab=ba$.
4. The distributive law holds,
   $a(b + c) =ab+ ac$.
5. There exists
   (i) an identity number $e = 1$, such that $ae=ea= a$.
   (ii) a null number, 0 which has the property that $a.0 = 0.a = 0$.

It is pertinent to ask whether, in fact, there are numbers other than real numbers which have the same properties. Consider numbers defined by pairs of real numbers, these new numbers being denoted by capital letters A, B, C, ... Thus we write $A = (a, b)$, $B = (c, d)$, $C = (e, f)$, where a, b, c, d, e, f are real numbers. In order to include real number in our system the number pair $(a, 0)$ is defined to mean the real number a. We next define the operations addition and multiplication. Thus (i) $A+ B = (a, b) + (c, d) = (a + c, b + d) = P$.

(ii) $AB = (a, b)(c, d) = (ac - bd, ad + bc) = Q$.



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Then clearly that the numbers P, Q belong to our new system of numbers since they are defined in each case, by a pair of real numbers.

We show that from these definitions, by using the laws for real numbers, that (1) the associative, (2) the commutative and (3) the distributive laws hold for the new system.

(1) (i) $(A + B) + C = (a + c, b + d) + (e, f) = (a + c + e, b + d + f)$

$=[a + (c + e), b + (d + f)]$

$=A + (B + C)$.

(ii) $(AB)C = (ac - bd, ad + bc)(e, f)$

$= (ace - bde - adf - bcf, acf - bdf + ade + bce)$.

$A(BC) = (a, b)(ce - df, cf + de) = (ace - adf - bcf - bde, acf + ade + bce - bdf)$

$= (ace - bde - adf - bcf, acf - bdf + ade + bce)$

$= (AB)C$.

(2) (i) $A + B = (a, b) + (c, d) = (a + c, b + d)$

$= (c + a, d + b)$

$= B + A$.

(ii) $AB = (a, b)(c, d) = (ac - bd, ad + bc)$

$= (ca - db, da + cb) \quad = BA$.

(3) $A(B + C) = (a, b)(c + e, d + f) = (ac + ae - bd - bf, ad + af + bc + be)$

$= [(ac - bd) + (ae - bf), (ad + bc) + (af + be)]$

$= (ae - bd, ad + bc) + (ae - bf, af + be)$

$= AB + AC$.

Now we consider the identity element E. It must possess the property that

$EA = AE = A$.

We write $E = (g, h)$.

Then $EA = (g, h)(a, b) = (ga - hb, gb + ah)$.

Since $EA = A = (a, b)$, we have $ga - hb = a$, $gb + ah = b$. By solving these two equations for g and h, we find that $g = 1$, $h = 0$ provided a and b are not both zero. Thus $E = (1, 0)$.

Since the real number a has been defined to be $(a, 0)$, we see that $E = 1$.

If $a = 0$ and $b = 0$, then A becomes the null element $0 = (0, 0)$. This satisfies the condition $A.0 = 0$. $A = 0$. Thus $(a, b)(0, 0) = (a.0 - b.0, a.0 + b.0) = (0, 0)$.

We consider that the number $E_1 = (0,1)$. We prove that it is not a real number.

Byusing the notation for indices, $E_1 . E_1 = E_1^2 = (0,1)(0,1) = (-1,0) = -1$.

Thus E_1 cannot be real for the square of a real number must be positive. We take $E_1 A = AE_1$, where $A = (a,0) = a$, a real number.

$aE_1 = (a,0)(0,1) = (0,a)$, which is not a real number.

$E_1^2 a = E_1 (aE_1) = (0,1)(0,a) = (-a,0) = -a$.

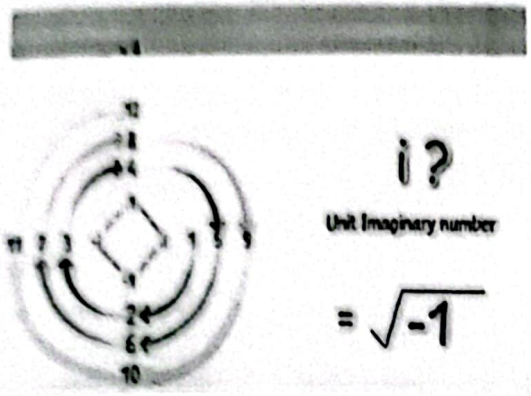
$E_1^3 a = E_1 (E_1^2 a) = (0,1)(-a,0) = (0,-a)$, which is not a real number.

$E_1^4 a = E_1 (E_1^3, a) = (0,1)(0,-a) = (a,0) = a$.

Thus the combined multiplication of a real number by E_1 changes real into complex, then into real with changed sign, then into complex, the fourth application producing the original real number. This suggests that it will be advantageous to have a special symbol to denote $E_1 = (0,1)$. The letter i or j is that usually used. Thus

$E_1^2 = E_1 . E_1 = i.i = -1$, $E_1^3 = E_1 . E_1^2 = i(-1) = -i$.

$E_1^4 = E_1 (E_1^3) = i(-i) = -i^2 = +1$.



i chart

i $\sqrt{-1}$	i^2 -1	i^3 $-i$	i^4 1
i^5 $\sqrt{-1}$	i^6 -1	i^7 $-i$	i^8 1
i^9 $\sqrt{-1}$	i^{10} -1	i^{11} $-i$	i^{12} 1
i^{13} $\sqrt{-1}$	i^{14} -1	i^{15} $-i$	i^{16} 1
i^{17} $\sqrt{-1}$	i^{18} -1	i^{19} $-i$	i^{20} 1
i^{21} $\sqrt{-1}$	i^{22} -1	i^{23} $-i$	i^{24} 1
i^{25} $\sqrt{-1}$	i^{26} -1	i^{27} $-i$	i^{28} 1
i^{29} $\sqrt{-1}$	i^{30} -1	i^{31} $-i$	i^{32} 1
i^{33} $\sqrt{-1}$	i^{34} -1	i^{35} $-i$	i^{36} 1
i^{35} $\sqrt{-1}$	i^{36} -1	i^{37} $-i$	i^{40} 1

Do you see the pattern?

The introduction of the identity element E enables division to be carried out.

Thus provided A is not (0, 0), the reciprocal of A is A^{-1}, where $AA^{-1}=E$.

We write $A=(a,b), A^{-1}=(c,d)$, where a, b are not both zero.

Then $(a,b)(c,d)=(1,0)$, that is, $(ac-bd,\ ad+bc)=(1,0)$.

Hence $ac-bd=1, ad+bc=0$. By solving these equations for c, d, we find that

$$c=a/(a^2+b^2),\ d=-b/(a^2+b^2).$$

Thus A^{-1} is $[a/(a^2+b^2), -b/(a^2+b^2)]$.

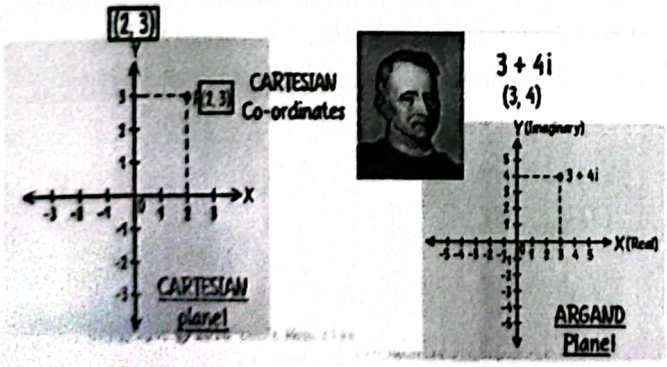
Then if $B=(e,f)$, $\dfrac{B}{A}=BA^{-1}$

$$\frac{B}{A}=(e,f)\left(\frac{a}{a^2+b^2},\frac{-b}{a^2+b^2}\right)$$

$$=\left(\frac{ae+bf}{a^2+b^2},\frac{-be+af}{a^2+b^2}\right).$$

We can readily change our "number pair" into that used in the previous section. Write $Z=(x,y)=(x,0)+(0,y)$, in accordance with the rule for addition. Now (x, 0) is the real number x.

Also $(0,y)=E_1y=iy$. Thus $Z=x+iy$.



Complex Numbers Argand Plane

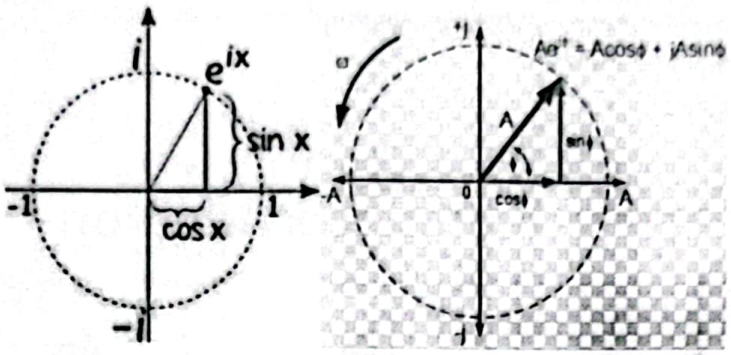
Alternative Form for a Complex Number

Consider the complex number $z=x+iy$.

Let r, θ be two real quantities defined by $x=r\cos\theta,\ y=r\sin\theta$.

Then $z=r(\cos\theta+i\sin\theta)$,

$x^2+y^2=r^2(\cos^2\theta+\sin^2\theta)=r^2$, that is, $r=\pm\sqrt{(x^2+y^2)}$.



Again by division, $\tan\theta=\frac{y}{x}$.

Thus $\theta=\tan^{-1}\frac{y}{x}$.

In order to make r unique, it is taken to be the positive square root of x^2+y^2.

We choose θ, $\cos\theta=\frac{x}{r}$, $\sin\theta=\frac{y}{r}$. $-\pi<\theta\leq\pi$, this is one andonly one angle defined by these equations. This angle is called the principal value.

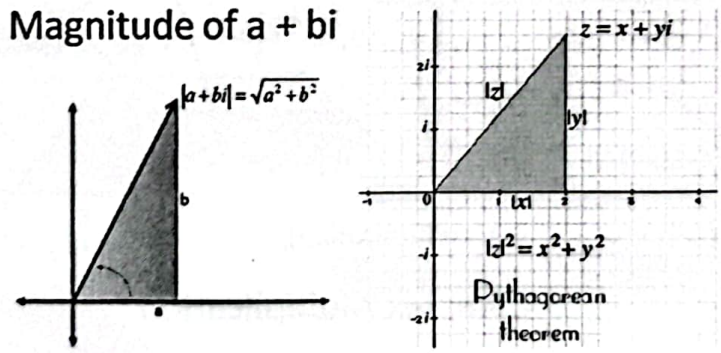
Since $\cos(\theta+2n\pi)=\cos\theta$, $\sin(\theta+2n\pi)=\sin\theta$, where n is a positive or negative integer, there are an infinite number of angles satisfying the equations

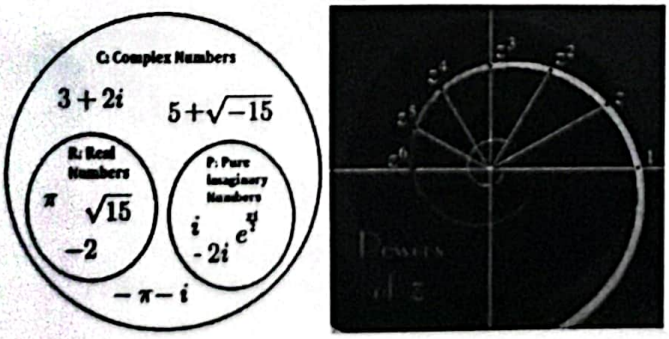
$$\cos\theta=x/\sqrt{(x^2+y^2)}, \qquad \sin\theta=y/\sqrt{(x^2+y^2)}.$$

The principal value is the simplest value and the other only differ from it by multiples of 2π.

The real number r is defined to be the modulus and the number θ the amplitude of z.

Thus $r=|z|=\sqrt{(x^2+y^2)}$, $\theta=\text{amp.}z$.





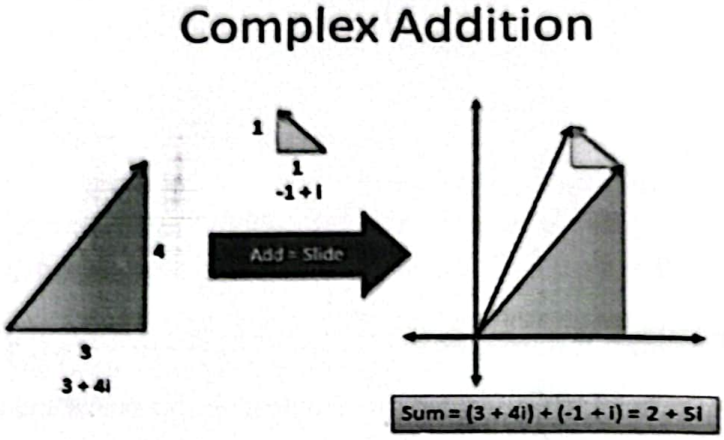
Fundamental Laws

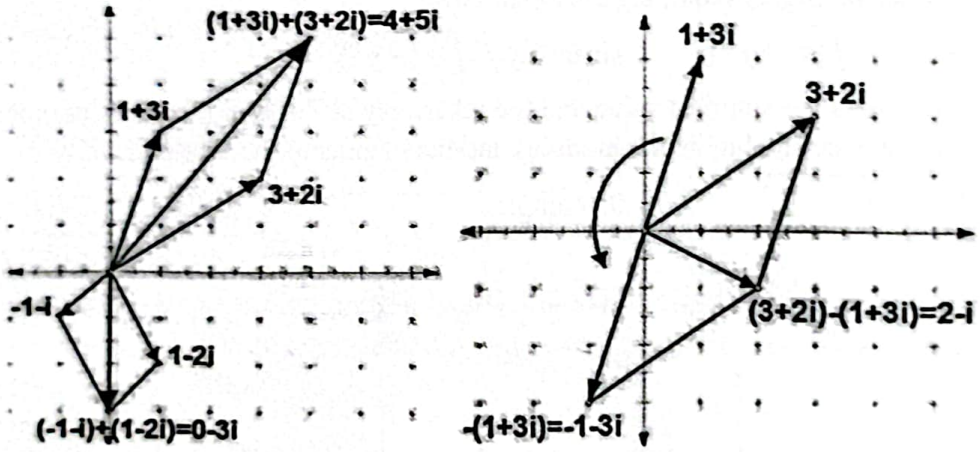
We consider the elementary operations of algebra as applied to complex numbers.

Let $z_1 = x_1 + iy_1$ and $z_2 = x_2 + iy_2$ be two complex numbers, where x_1, x_2, y_1, y_2 are reals. Then the fundamental laws are as follows,

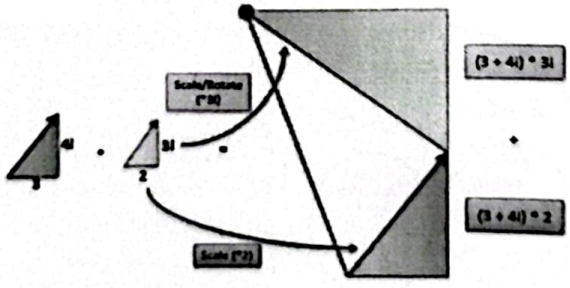
$z_1 + z_2 = (x_1 + x_2) + i(y_1 + y_2)$ (addition),

$z_1 - z_2 = (x_1 - x_2) + i(y_1 - y_2)$ (subtraction),

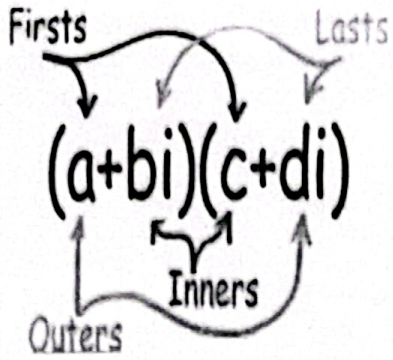


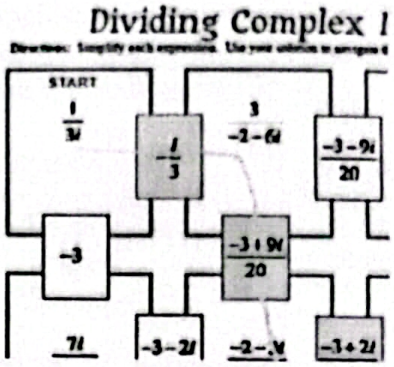


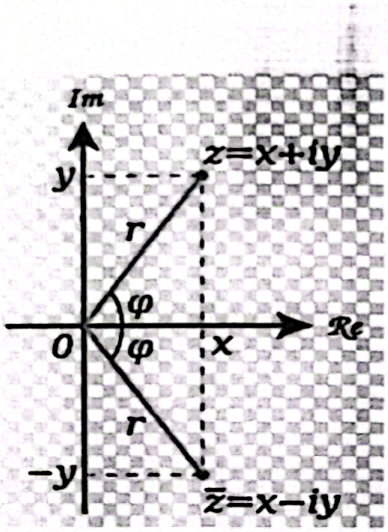
$z_1 z_2 = (x_1 x_2 - y_1 y_2) + i(x_1 y_2 + x_2 y_1)$ (multiplication),

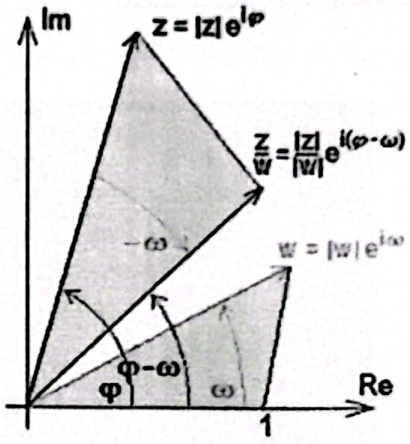


$$\frac{z_1}{z_2} = \frac{x_1 x_2 + y_1 y_2}{x_1^2 + y_1^2} + i\frac{x_2 y_1 - x_1 y_2}{x_2^2 + y_2^2}$$ (division).

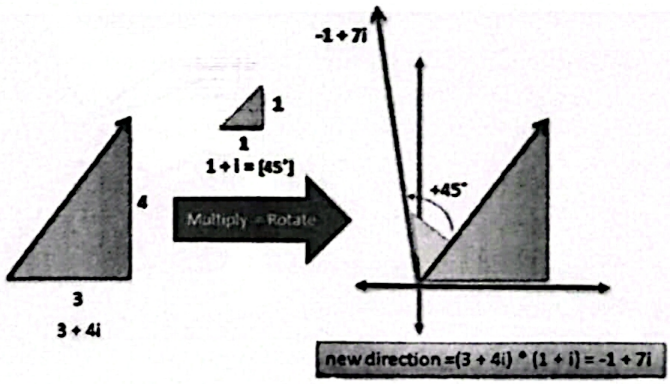


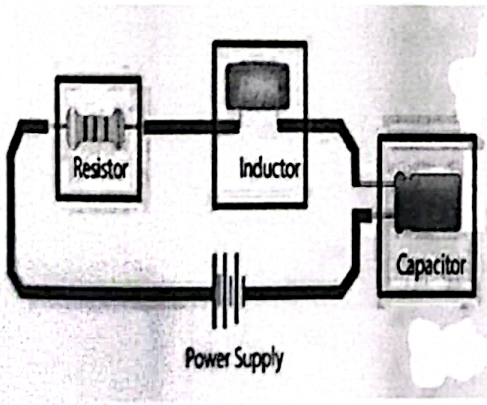


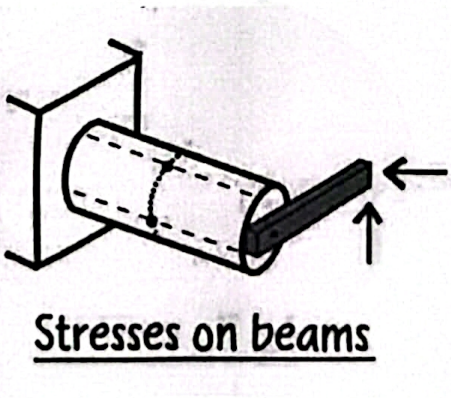


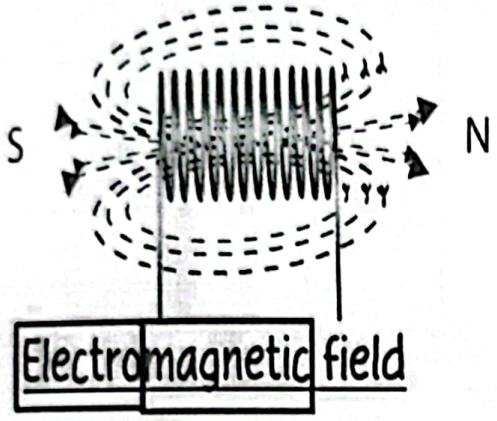


Applying Complex Numbers

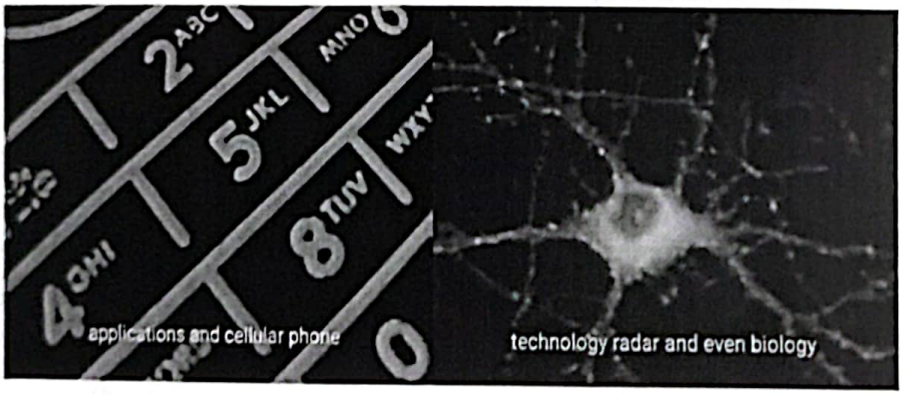


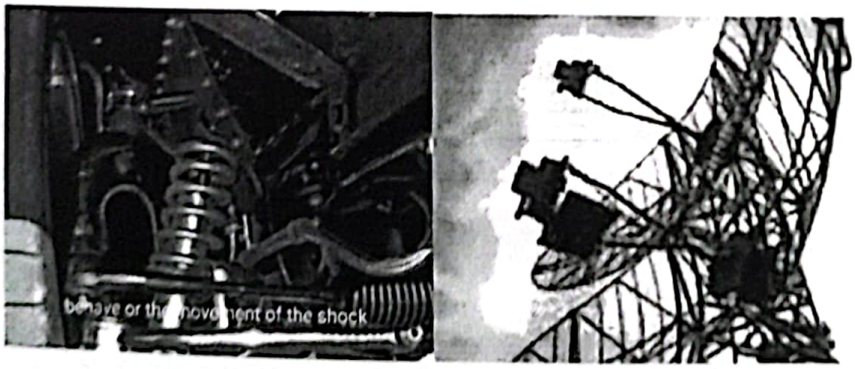





S
N
Electromagnetic field

REAL 3D
For 3d movies Engineers use imaginary


applications and cellular phone
technology radar and even biology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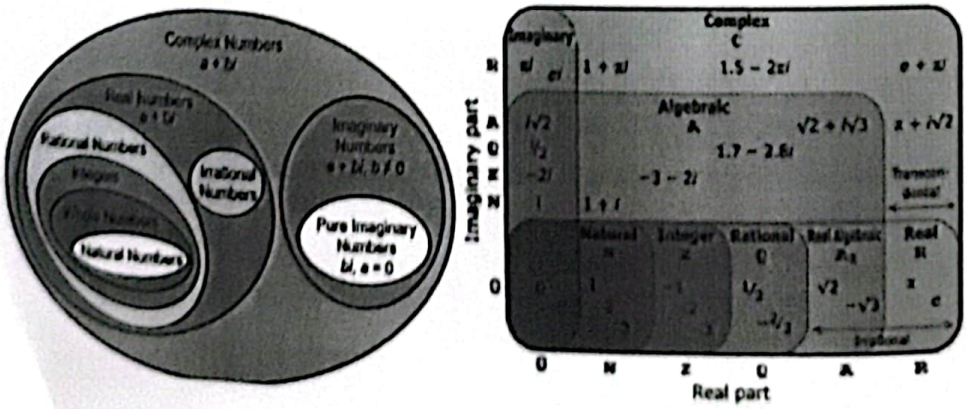
Complex Numbers
Real Numbers
Rational Numbers
Irrational Numbers
Natural Numbers
Imaginary Numbers
Pure Imaginary Numbers
Complex
Imaginary part
Real part
Algebraic
Rational
Real

Conclusion

The elementary operations of algebra as applied to complex numbers. We can find some applications of complex numbers are used in electromagnetic field, 3d movies, cellular phone, technology radar, even biology and behave or the movement of the shock.

Acknowledgements

I would like to express special thanks to Dr Aung Win, Rector, Dr Aye Aye Ko, Pro-Rector and Dr Soe Myint Aye, Pro-Rector, Myitkyina University for their kind permission to carry out this research work. I am grateful to Professor Dr Daw Win Sein, Head of Department and professor, Dr Nang Bauk, Department of Mathematics, University of Myitkyina for their helpful advice and continuous encouragement.

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Construction of Three-Factor Personality Inventory (TFI)

Sann Moe San[1]

Abstract

The purpose of this study was to develop the Three-Factor Personality Inventory (TFI) in Myanmar version to be used in examining and predicting job performance of managers by reducing two dimensions, Agreeableness and Openness to experience which are considered unrelated to job performance of individuals working in the managerial role, from the original Big Five Personality Inventory (BFI) developed by John & Srivastava (1999). The TFI consists of 25 items covering three factors namely: Conscientiousness, Extraversion, and Neuroticism. The questionnaire was administered to 247 managers working in Yangon, Mandalay, Myitkyina, and Hpakan for carrying out an item analysis. The results of the item analysis showed that all the items on each dimension were significantly reliable at $p < .001$ level. It was found that the internal consistency coefficient (Cronbach's Alpha values) of the subscales were .62 for Extraversion, .71 for Conscientiousness, and .59 for Neuroticism, respectively. Hence, the value of the reliability coefficients for all dimensions of the TFI Myanmar version were adequate to warrant a safe application.

Keywords: Neuroticism, Extraversion, Conscientiousness, Item Analysis, Reliability Analysis

Introduction

McCrae and Costa (1990) as cited in McCrae, Costa, Del Pilar, Rolland, & Parker (1998), stated that the Five Factor Model (FFM) is an organization of personality traits, and traits in turn are dimensions of individual differences in tendencies to show consistent patterns of thoughts, feelings, and actions. McCrae further defines traits as "endogenous basic tendencies that, within a cultural context, give rise to habits, attitudes, skills, beliefs, and other characteristic adaptations". Thus traits are relatively stable or enduring individual differences in thoughts, feelings and behaviors (Church, 2001). Different theorists sometimes gave different names to the underlying five factors. However, the creation of the NEO-Personality Inventory (NEO-PI) by Costa and McCrae went some way in bringing about consensus as to the labels attached to the five factors; Neuroticism, Extraversion, Conscientiousness, Openness to Experience, and Agreeableness (Church, 2001).

Neuroticism is a fundamental personality trait in the study of psychology, manifested by characteristics of anxiety, moodiness, worry, envy and jealousy. Individuals who score high on neuroticism are more likely than the average to experience such feelings as anxiety, anger, envy, guilt, and depressed mood. They respond more poorly to environmental stress, and are more likely to interpret ordinary situations as threatening, and minor frustrations as hopelessly difficult. They are often self-conscious and shy, and they may have trouble controlling urges and delaying gratification (Sharma & Sharma, 2015).

According to Eysenck's (1967) theory of personality, neuroticism is associated with increased reactivity of the limbic system and a low tolerance for stress or aversive stimuli. Indeed, neurotics show greater distress and depressive symptomology following stressful life events, such as unemployment (Creed, Muller, & Machin, 2001), spousal caregiving (Gallant & Connell, 2003), and breast cancer surgery (Millar, Purushotham, McLatchie, George, & Murrary, 2005).

In general, there are at least three basic characteristics of extraversion that make it important to study. First, extraversion has emerged as one of the fundamental dimensions of personality (Costa & McCrae, 1992a; Digman, 1990; Eysenck & Himmelweit, 1947; Goldberg, 1990; Norman, 1963). As such, extraversion has the potential to explain the covariation of a wide variety of behaviors, which is one of the central concerns for the field of personality (Funder, 1991). Second, extraversion predicts effective functioning and well-being

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across a wide variety of domains (Ozer & Benet-Martinez, 2006) from cognitive performance (Matthews, 1992) and social endeavors (Eaton & Funder, 2003) to social economic status (Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007). Third, extraversion predicts risk and also resilience for different forms of psychopathology (Trull & Sher, 1994; Widiger, 2005).

It has even been proposed that extraversion is at its core the tendency to experience positive affect (Watson & Clark, 1997), and there is some evidence to support this claim. The covariation of extraversion components is accounted for by positive affect; once positive affect is removed, the other components of extraversion do not correlate with each other. A similar finding reported recently is that extraversion facets reflecting reward sensitivity load on a higher order extraversion factor that accounts for the correlations between the other facets of extraversion (Lucas & Baird, 2004). Not only does trait extraversion predict trait positive affect, but both traits predict similar outcomes, such as social activity, leadership, and number of friends (Watson & Clark, 1997).

Conscientiousness, one of five domains in the Big Five taxonomy of personality, has been defined as "the tendency to be organized, responsible, and hardworking" (American Psychological Association, 2007) and as "the propensity to follow socially prescribed norms for impulse control, to be goal directed, to plan, and to be able to delay gratification and to follow norms and rules."

Conscientiousness refers to goal-directed behavior. High conscientiousness refers to a person who focuses intensely on his/her goals and exhibits the self-discipline associated with such focus. Low conscientiousness refers to one who is disorganized and distracted. Of the Big Five personality traits, only conscientiousness has consistently been associated with academic achievement (Noftle & Robins, 2007; O'Connor & Paunonen, 2007).

Construction of the Three-Factor Personality Inventory (TFI)

The Big Five Personality Inventory (BFI) was originally developed by John and Srivastava (1999). It consists of five factors namely Neuroticism, Extraversion, Conscientiousness, Openness to Experience, and Agreeableness (Church, 2001). For the purpose of using the personality inventory in the process of personnel selection, particularly managerial rank, only three dimensions of personality –Neuroticism, Extraversion and Conscientiousness– are needed to be measured. Since the Agreeableness dimension mainly concerns with an individual's social and friendship life and Openness to experience dimension chiefly relates to an individual's curiosity and tendency to learn new things, those two dimensions are seemingly unrelated to an individual's performance in the context of working with subordinates as a manager. That's why these two dimensions were intentionally omitted in the construction of TFI Myanmar version. Neuroticism, Extraversion, and Conscientiousness were measured with 25 items from the BFI personality Inventory. This description was adapted into Myanmar against the original version to ensure the conceptual equivalence of the Myanmar version to the original version. Participants responded on a 5-point scale ranging from strongly disagree (1) to strongly agree (5). Examples of items are as follows: "I see myself as someone who is talkative (extraversion)", "I see myself as someone who is a reliable worker (conscientiousness)" and " I see myself as someone who is depressed, blue (neuroticism)".

Item Analysis of the Myanmar version of the Personality Inventory

Method

Participants

A group of 247 subjects used for the item analysis included managers in Yangon, Mandalay, Myitkyina, and Hpakan.

Procedure

To conduct an item analysis for the 25-item of the TFI Myanmar version, their responses were scored by using the scoring keys for each subject. The total scores for each subscale were obtained and arranged in descending order. Out of these, the 27 percent of high-scoring individuals and the 27 percent of low-scoring individuals were used in item analysis. Then, the Chi-square method was used to find out whether or not there were any significant differences between the two groups on each item. This Chi-square (χ^2) was computed by using the formula as follow: $\chi^2 = \sum \frac{(O - E)^2}{E}$

Results and Discussion

Results of the item analysis for each subscale of the TFI Myanmar version were shown in Table 1, 2 and 3. According to the result, all of the items on each scale were significant at .001 level, except for item 17. Owing to a lack of variance, this item was deleted in the study. This study showed that the 24-item TFI Myanmar version is an appropriate measure for the Myanmar cultural setting.

Table 1 *Showing Significant Differences between High-Scoring Group and Low-Scoring Group (Item Analysis for Extraversion)*

Scale Item	Statement	χ^2 Value	Significant Level
1	I see myself as someone who is talkative.	73.93	.001
2	I see myself as someone who is reserved.	99.37	.001
3	I see myself as someone who is full of energy.	35.10	.001
4	I see myself as someone who generates a lot of enthusiasm.	42.14	.001
5	I see myself as someone who tends to be quiet.	78.80	.001
6	I see myself as someone who has and assertive personality.	36.38	.001
7	I see myself as someone who is sometimes shy, inhibited.	22.37	.001
8	I see myself as someone who is outgoing, sociable.	37.39	.001

Table 2 *Showing Significant Differences between High-Scoring Group and Low-Scoring Group (Item Analysis for Conscientiousness)*

Scale Item	Statement	χ^2 Value	Significant Level
9	I see myself as someone does a thorough job.	52.84	.001
10	I see myself as someone who can be somewhat careless.	61.24	.001
11	I see myself as someone who is a reliable worker.	43.58	.001
12	I see myself as someone who tends to be disorganized.	90.21	.001
13	I see myself as someone who tends to be lazy.	52.69	.001
14	I see myself as someone who perseveres until the task is finish.	36.20	.001
15	I see myself as someone who does things efficiently.	56.30	.001
16	I see myself as someone who make plans and follows through with them.	56.27	.001
17	I see myself as someone who is easily distracted.	6.62	ns

Table 3 *Showing Significant Differences between High-Scoring Group and Low-Scoring Group (Item Analysis for Neuroticism)*

Scale Item	Statement	χ^2 Value	Significant Level
18	I see myself as someone who is depressed, blue.	62.48	.001
19	I see myself as someone who is relaxed, handles stress well.	30.47	.001
20	I see myself as someone who can be tense.	61.78	.001
21	I see myself as someone who worries a lot.	74.62	.001
22	I see myself as someone who is emotionally stable, not easily upset.	36.85	.001
23	I see myself as someone who can be moody.	60.56	.001
24	I see myself as someone who remains calm in tense situations.	29.01	.001
25	I see myself as someone who gets nervous easily.	55.22	.001

Reliability Evaluation of the TFI

Method

Participants

Questionnaires were distributed and participants were asked to fill out anonymously and the questionnaires were collected.

Procedure

In order to examine internal consistency reliability of the TFI Myanmar version, the data was entered onto a database in the Statistical Package for the Social Science (SPSS 15.0 version). Then, coefficient alpha available in SPSS was used to calculate the internal consistency reliability.

Results and Discussion

The reliability coefficient of the Extraversion, Conscientiousness and Neuroticism were found to be .62, .71 and .59 respectively (see Table 4). As shown in Table 4, the alphas for the Extraversion and Neuroticism were lower but adequate for scale with fewer than 10 items. So, it is obvious that the values of reliability coefficient for these scales are high enough to warrant a safe application.

Table 4 *Internal Consistency Reliability Coefficient (Cronbach's Alpha) for TFI Myanmar Version*

No	Test	Alpha
1	Extraversion	.62
2	Conscientiousness	.71
3	Neuroticism	.59

Summary and Conclusion

This study aimed at developing the TFI Myanmar version of by reducing two dimensions from the Big Five Personality Inventory (BFI) originally developed by John & Srivastava (1999). The TFI Myanmar version consists of three factors namely Neuroticism, Extraversion, Conscientiousness. A total number of 247 managers were recruited in the data collection to carry out an item analysis.

According to the result of item analysis, all the items on each subscale were significantly reliable at .001 level, expect for item 17. Owing to a lack of variance, the item No. 17 was deleted. The reliability coefficients were found to be .62 for Extraversion, .71 for Conscientiousness and .59 for Neuroticism, according to the results of reliability analysis.

So, it is obvious that the values of reliability coefficient for the TFI Myanmar version are high enough to warrant a safe application. Moreover, these subscales showed that the 24-item TFI Myanmar version is an appropriate measure in Myanmar cultural setting.

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Expatiation of Mammalian Fauna in Inkhibum National Park, Kachin State

Aung Lu[1]

Abstract

The report of expatiation of mammalian fauna in Inkhibum National Park, Kachin State was conducted from March 2018 to February 2019 in survey sites of Ubyit, Alam, Dumgan, Lungga Zup, Aung Myin Thar, Ching Khrang and Tang Hpare near Inkhibum National Park, Kachin State to record mammalian fauna around Inkhibum National Park and to determine species composition of different mammal orders recorded in the study area. In this study a total of 54 species of mammals under 41 genera, 16 families and seven orders were recorded. Among them, the largest number of recorded species composition is under order Carnivora (35.93%) while the order Scandentia is the least number of species (1.85%). According to analysis, there was no significant difference between the number of recorded mammal species ($p > 0.05$, $t = -.74$) among the study sites. In the present study, according to IUCN Red List, five species including Sunda pangolin (*Manis javanica*), Chinese pangolin (*M. pentadactyla*), Black Bear (*Ursus thibetanus*), Large spotted Civet (*Viverra megaspila*) and Hog deer (*Axis porcinus*) were regarded critically endangered while four species belonging Assamese Macaque (*Macaca assamesis*), Dhole (*Cuon alpines*), Asian Golden Cat (*Catopuma temminckii*) and Chinese Serow (*Copricarnis milneedwardsii*) as near threatened. Besides, ten species consisting Asian slow loris (*Nycticebus bengalensis*), Stump-tailed Macaque (*Macaca arctoides*), Sun Bear (*Helarctos malayanus*), Hog Badger (*Arctonyx collaris*), Binturong (*Arctictis binturong*), Clouded Leopard (*Neofelis nebulosa*), Leopard (*Panthra pardus*), Sambar deer (*Rusa unicolor*), Guar (*Bos frontalis*) and Chinese Goral (*Naemorhedus griseus*) represented vulnerable species.

1. Introduction

Myanmar is one of the largest land areas in South East Asia and contains many globally important species and ecosystems. There are more than 300 mammal species in Myanmar. Hunting wildlife for food rather than habitat loss appeared to be the most significant threat to the conservation of biological diversity in the tropics over the next 15 - 25 years (Robinson and Bennett, 1999; Robinson et al., 1999; Wilkie and Carpenter, 1999). Fortunately, the use of forearm is strictly prohibited by law and the defacto protection afforded according to strong religious belief is a sort of blessing to lowing assets in Myanmar. Nevertheless, illegal trade in the wildlife across the border appeared as a lucrative bread earning errand. Some species have been hunted in rural area over a long time.

Inkhibum National Park appeared as a safe haven providing places to take refuge, for roosting and opportunities for foraging for various wildlife species. However, there is no proper study on the diversity and distribution of fauna, so that there is an urgent need to record the natural assets before some will be lost forever, even before being discovered.

The target area is considered as an important resource by community around protected area. However, some rural people depend on wild animals for food, traditional medicines and tree for fuel that are some of the drivers of forest degradation and habitat loss for wild animals.

2. Goals and Objectives

Richness of fauna and flora in this area is important for wildlife ecology. However, as there is no detail study on wild animals in this area, it is an essential to study and record wildlife from the study area (Ubyit, Alam, Dumgan, Lungga Zup, Aung Myin Thar, Ching Khrang and Tang Phare villages) in order to maintain equilibrium to the ecosystem.

The main objectives are

- to record mammalian fauna around Inkhibum National Park
- to determine the species composition of different mammalian orders recorded

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3. Methodology

a. Study area

The present study was conducted in Inkhibum National Park, Myitkyina Township, Kachin State. It is approximately far from Myitkyina about 17.609 kilometres (11miles) and located North to South between 25.787465°N 97.45670° E and 25.54100 N 97.43639 E and East to West between 25.66921° N 97.34203° E and bordered by the villages of Ubyit, Alam, Dumgan, Lungga Zup, Aung Myin Thar, Ching Khrang and Tang Hpre in the eastern side of the Inkhibum National Park along the Ayeyawady River (Plate 1). The types of climate found in Myitkyina Township are subtropical humid type of climate and humid cold temperate type of climate. The types of forest can be classified into hill forests, evergreen forest and mixed deciduous forest, bamboo grooves, shrubs, scrubs, streams and tributaries of Ayeyawady traversed the Park according to Economic Geography of Myitkyina Township (Ja Hkam, 1992). (Plate 1)

b. Study period

The study period commenced from March 2018 to February 2019.

c. Data collection

Data collection was based on interview surveys which were conducted twice a month by using a structure of questionnaires to hunters and villagers who live in the villages of Ubyit, Alam, Dumgan, Lungga Zup, Aung Myin Thar, Ching Khrang and Tang Hpare during the study period. Photographic records were taken on some collected specimens and some from the wild.

d. Identification

Identification of the species was based on Bats of the Indian Subcontinent by Bates and Harrison (1997) and A Field Guide to The Mammals of Thailand and Southeast Asia by Francis (2008) respectively.

e. Data Analysis

Student's t-test was used to compare the numbers of species among the study sites using SPSS software (version 11.5).

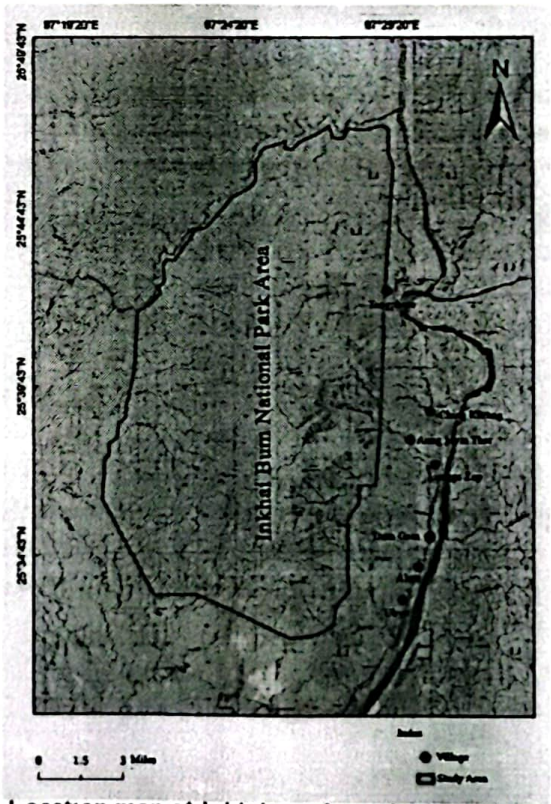


Plate 1. Location map of Inkhibum Area showing the study sites

Source: Google Earth

4. Results

During the study period, from March 2018 to February 2019, surveys were conducted in survey sites, Ubyit, Alam, Dumgan, Lungga Zup, Aung Myin Thar, Ching Khrang and Tang Hpare. During this study, a total of 54 species of mammals under 41 genera, 16 families and seven orders were recorded through interview surveys from the villagers and hunters in the study sites. Among the recorded species, only one species of order Scandentia (1.85%), 14 species of Chiroptera (25.93%), two species of Pholidota (3.70%) and Rodentia (3.70%), five species of Primates (9.26%), 35 species of Canivora (35.19%) and 11 species of Artiodcatyla (20.37%) were recorded respectively (Table 1, 3, Fig 1 and Plate 2, 3, 4 and 5).

In the present study, Northern Treeshew (*Tupaia belangeri*) collected from Aung Myin Thar Village. Among the bat species, five species of fruit bats including Leschenault's Rousette (*Rousettus leschenaulti*), Short-nosed fruit bat (*Cynopterus sphinx*), Lesser Dog-faced fruit bat (*C. brachyotis*), Dawn bat (*Eonycteries spelaea*) and Hill long-tongued fruit bat (*Macroglossus sobrinus*), and nine species of insectivorous bats consisting Rufous Horseshoe bat (*Rhinolophus rouxii*), Peter's Horseshoe bat (*R. coelophyllus*), Least horseshoe bat (*R. pusillus*), Blyth's Horseshoe bat (*R. lepidus*), Pearson's horseshoe bat (*R. pearsonii*), Dobson's horseshoe bat (*R. yunanensis*), Andersen's leaf-nosed bat (*Hipposideros larvatus*), Hardwicke's forest bat (*H. pomona*) and Sunda pangolin bat (*Kerivoula hardwickii*) were recorded from Inkhibum around Tang Phare Village. In Primates, a Rhesus macaque (*Macaca mulatta*) and a Stump-tailed Macaque (*M. arctoides*) were recorded from Tang Phare Village, two young Assamese Macaques (*M. assamesis*) recorded from Alam Village. In carnivore, a Hog Badger (*Arctonyx collaris*) collected from Ubyit Village, a tail of Small Indian Civet from Tang Phare Village and each of Masked Palm Civet (*Paguma larvata*) from Aung Myin Thar and Tang Phare Village. In Artiodactyla, Eurasian wild pig (*Sus scrofa*) collected from Tang Phare Village, flesh from Aung Myin Thar, skulls and fangs from Ubyit and Tang Phare Village, a skull with antler of Leaf Deer (*Mutiacus putaoensis*) from Ubyit Village, skulls and antlers of Red deer (*M. muntjak*) and Sambar Deer (*Rusa unicolor*) from Alam, Aung Myin Thar and Tang Phare Villages, Skulls and antlers of Guar (*Bos frontalis*) and Chinese Serow (*Capricarnis milneedwardsii*) from Ubyit, Alam and Aung Myin Thar Villages and an antler of Chinese Goral (*Naemorhedus griseus*) from Alam Village respectively. In Rodentia, Malayan porcupine (*Hystrix brachyura*) was recorded from the hunters in Tang Phare village and Brush tailed porcupine (*Atherurus macrourus*) from Ubyit and Aung Myin Thar, tails in Aung Myin Thar village (Table.2).

According to comparison analysis on numbers of species among the study sites (Ubyit, Alam, Dumgan, Lungga Zup, Aung Myin Thar, Ching Khrang and Tang Hpare), there was no significant difference between the number recorded mammal species ($P > 0.05$, $t = -0.739$) among the study sites (Appendix I).

Table 1. The Mammal species recorded from Inkhibum National Park Area according to interview during study period between March 2018 and Feburary 2019

Sr. No	Order	Family	Scientific Name	Common Name	Myanmar Name	From collection	Encountered	IUCN Status
1	Scandentia	Tupaiidae	*Tupaia belangeri*	Northern Treeshew	Thit - Swe	+	+	LC
2	Chiroptera	Pteropodidae	*Rousettus leschenaulti*	Leschenault's Rousette		+	+	LC
3			*Cynopterus sphinx*	Short-nosed fruit bat		+	+	LC
4			*Cynopterus brachyotis*	Lesser Dog-faced fruit bat		+	+	LC
5			*Eonycteries spelaea*	Dawn bat		+	+	LC
6			*Macroglossus sobrinus*	Hill long-tongued fruit bat		+	+	LC
7		Rhinolophidae	*Rhinolophus rouxii*	Rufous Horseshoe bat		+	+	LC
8			*Rhinolophus coelophyllus*	Peter's Horseshoe bat		+	+	LC

Sr No	Order	Family	Scientific Name	Common Name	Myanmar Name	From collection	Encountered	IUCN Status
9			*Rhinolophus pusillus*	Least horseshoe bat		+	+	LC
10			*Rhinolophus lepidus*	Blyth's Horseshoe bat		+	+	LC
11			*Rhinolophus pearsoni*	Pearson's horseshoe bat		+	+	LC
12			*Rhinolophus yunanansis*	Dobson's horseshoe bat		+	+	LC
13		Hipposideridae	*Hipposideros larvatus*	Horsefield's leaf-nosed bat		+	+	LC
14			*Hipposideros pomona*	Andersen's leaf-nosed bat		+	+	LC
15			*Kerivoula harkwickii*	Hardwicke's forest bat		+	+	LC
16	Pholidota	Manidae	*Manis javanica*	Sunda pangolin	Malay Thin-Khwe-Chat	+		EN
17			*Manis pentadactyla*	Chinese pangolin	Ta-yope Thin-khwe-Chat	+		EN
18	Primates	Lorisidae	*Nycticebus bengalensis*	Asian slow loris	Myauk-Maung-Ma	+		VU
19		Cercopithecidae	*Macaca mulatta*	Rhesus macaque	Myauk-Sat	+	+	LC
21			*Macaca arctoides*	Stump-tailed Macaque	Myawk-Mi-Toh	+	+	VU
20			*Macaca assamesis*	Assamese Macaque	Ar-Than-Myawk	+	+	NT
22			*Hoolock hoolock*	Hoolock Gibbon	Myet-khon-phyu-Mywak-Loi-Kyaw	+		-
23	Carnivora	Carnidae	*Canisa urenus*	Golden jackal	Khwe-Ah	+		LC
24			*Cuon alpinus*	Dhole	Taw-Khwe	+		NT
25		Ursidae	*Ursus thibetanus*	Asian Black Bear	Wet-Wun-Gi	+		EN
26			*Helarctos malayanus*	Sun Bear	Malay-Wet-Wun	+		VU
27		Mustelidae	*Martes flavigula*	Yellow-Throated Marten	Sat-kha-lawk Nge	+		LC
28			*Melogale personata*	Large-Throat Ferret-Badger		+		-
29			*Arctonyx collaris*	Hog Badger	Khwe-thu Wet-thu	+	+	VU
30		Viverridae	*Viverricula indica*	Small Indian civet	Kyaung-Ka-Doe	+	+	LC
31			*Viverra megaspila*	Large spotted Civet		+		EN
32			*Viverra zibetha*	Large Indian Civet	Kyaung-Myin-Kywet	+		LC
33			*Paguma larvata*	Masked Palm Civet	Kyaung-Wun-Na-Ga	+	+	LC
34			*Paradoxurus hermaphroditus*	Common Civet	Kyaung-Wun-Paik	+		-
35			*Prionodon pardicolar*	Spotted Ling Sang	Lin-Sang Pyawk	+		LC
36			*Prionodon linsang*	Banded Lin Sang	Lin-Sang Kyar	+		LC

S No	Order	Family	Scientific Name	Common Name	Myanmar Name	From collection	Encountered	IUCN Status
37			*Arctictis binturong*	Binturong	Wun-Kyaung	+		VU
38			*Neofelis nebulosa*	Clouded Leopard	Thit-Tat-Kyar/Inn-Kyar	+		VU
39			*Panthra pardus*	Leopard	Kya-Thit	+		VU
40			*Felis chaus*	Jungle Cat	Taw-Kyaung	+		LC
41			*Catopuma temminckii*	Asian Golden Cat	Kyar-Min	+		NT
42	Artiodactyla	Suidae	*Sus scrofa*	Eurasian wild pig	Taw-Wet	+	+	LC
43		Cervidae	*Muntiacus putaoensis*	Leaf dear	Phat-Gi	+	Skull /Antler	DD
44			*Muntiacus muntjak*	Red deer	Gi	+	+ Skull /Antler	LC
45			*Axis porcinus*	Hog deer	Da-Yel	+		EN
46			*Rusa unicolor*	Sambar deer	Sat	+	Skull /Antler	VU
47		Bovidae	*Bos frontalis*	Guar	Pyaung	+	Skull /Antler	VU
48			*Capricarnis milneedwardsii*	Chinese Serow	Taung-Seik	+	Skull /Antler	NT
49			*Naemorhedus griseus*	Chinese Goral	Taung-Seik-Ni	+	Antler	VU
50		Sciuridae	*Petaurista petaurista*	Red Giant Flying Squirrel	Shu-Pyan	+		LC
51			*Petaurista philippensis*	Indian Giant Flying Squirrel	Shu-Pyan	+		LC
52			*Callosciurus erythreus*	Pallas's squirrel	Shint-nga-paw	+		LC
53	Rodentia	Hystricidae	*Hystrix brachyura*	Malayan porcupine	Phyu-kaung Gyi	+	+	LC
54			*Atherurus macrourus*	Brush tailed porcupine	Phyu-Mee-Phwar	+	+	LC

Table 2. Occurrence of Mammal species recorded from study sites during study period between March 2018 and February 2019

Sr No	Scientific Name	Common Name	SI	SII	SIII	SIV	SV	SVI	SVII
1	*Tupaia belangeri*	Northern Treeshew					+		
2	*Rousettus leschenaulti*	Leschenault's Rousette							+
3	*Cynopterus sphinx*	Short-nosed fruit bat							+
4	*Cynopterus brachyotis*	Lesser Dog-faced fruit bat							+
5	*Eonycteries spelaea*	Dawn bat							+
6	*Macroglossus sobrinus*	Hill long-tongued fruit bat							+
7	*Rhinolophus rouxii*	Rufous Horseshoe bat							+
8	*Rhinolophus coelophyllus*	Peter's Horseshoe bat							+
9	*Rhinolophus pusillus*	Least horseshoe bat							+
10	*Rhinolophus lepidus*	Blyth's Horseshoe bat							+
11	*Rhinolophus pearsonii*	Pearson's horseshoe bat							+
12	*Rhinolophus yunanensis*	Dobson's horseshoe bat							+
13	*Hipposideros larvatus*	Horsefield's leaf-nosed bat							+

Sr No	Scientific Name	Common Name	SI	SII	SIII	SIV	SV	SVI	SVII
14.	*Hipposideros pomona*	Andersen's leaf-nosed bat							+
15.	*Kerivoula hardwickii*	Hardwicke's forest bat							+
16.	*Macaca mulatta*	Rhesus macaque							+
17.	*Macaca arctoides*	Stump-tailed Macaque							+
18.	*Macaca assamesis*	Assamese Macaque		+					
19.	*Arctonyx collaris*	Hog Badger	+						
20.	*Viverricula indica*	Small Indian civet							+
21.	*Paguma larvata*	Masked Palm Civet					+		+
22.	*Sus scrofa*	Eurasian wild pig	+	+					+
23.	*Mutiacus putaoensis*	Leaf Dear	+						
24.	*Muntiacus muntjak*	Red Deer	+				+		+
25.	*Rusa unicolor*	Sambar Deer		+			+		
26.	*Bos frontalis*	Guar	+	+			+		
27.	*Capricarnis milneedwardsii*	Chinese Serow	+	+			+		+
28.	*Naemorhedus griseus*	Chinese Goral		+					
29.	*Hystrix brachyuran*	Malayan Porcupine					+		+
30.	*Atherurus macrourus*	Brush Tailed Porcupine					+		
Total Numbers of Species			6	6	-	-	8	-	22

SI = Ubyit SII = Alam SIII = Dumgan SIV = Lungga Zup SV = Aung Myin Thar
SVI = Ching Khrang SVII = Tang Phare

Table 3. Numbers of species composition recorded from the study sites during study period

Sr. No	Class	Order	Family	Genera	Species	Percentage (%)
1.	Mammalia	Scandentia	1	1	1	1.85
2.		Chiroptera	3	7	14	25.93
3.		Pholidota	1	1	2	3.70
4.		Primates	2	3	5	9.26
5.		Carnivora	4	17	19	35.19
6.		Artiodactyla	4	10	11	20.37
7.		Rodentia	1	2	2	3.70
Total Numbers			16	41	54	

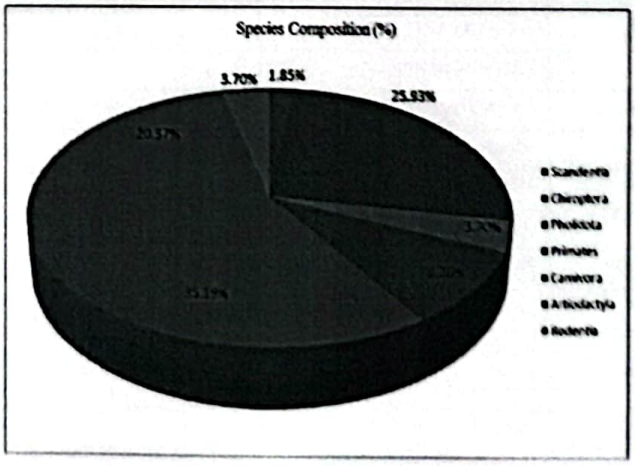


Figure 1 Relation species composition of different mammalian orders recorded during study period from March 2018 to February 2019

A *Tupaia belangeri*

B *Rousettus leschenaulti*

C *Cynopterus sphinx*

D *Cynopterus brachyoti*

E *Eonycteries spelaea*

F *Macroglossus sobrinus*

G . *Rhinolophus rouxii*

H *Rhinolophus coelophyllus*

I *Rhinolophus pusillus*

K *Rhinolophus pearsini*

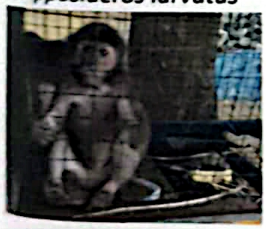
Plate 2 Recorded Species of Order Scandentia and Chiroptera

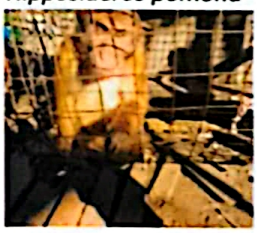
A *Hipposideros larvatus*

B *Hipposideros pomona*

C *Kerivoula harkwickii*

D *Macaca mulatta*


E *Macaca arctoides*


F *Macaca assamensis*

G *Macaca assamensis*

H Tail of *Viverricula indica*

I *Paguma larvata*

J *Paguma larvata*

K Jaw of *Sus scrofa*

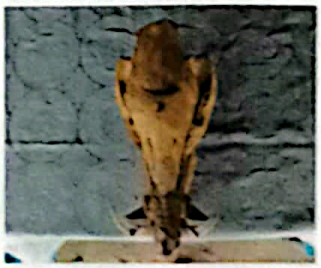
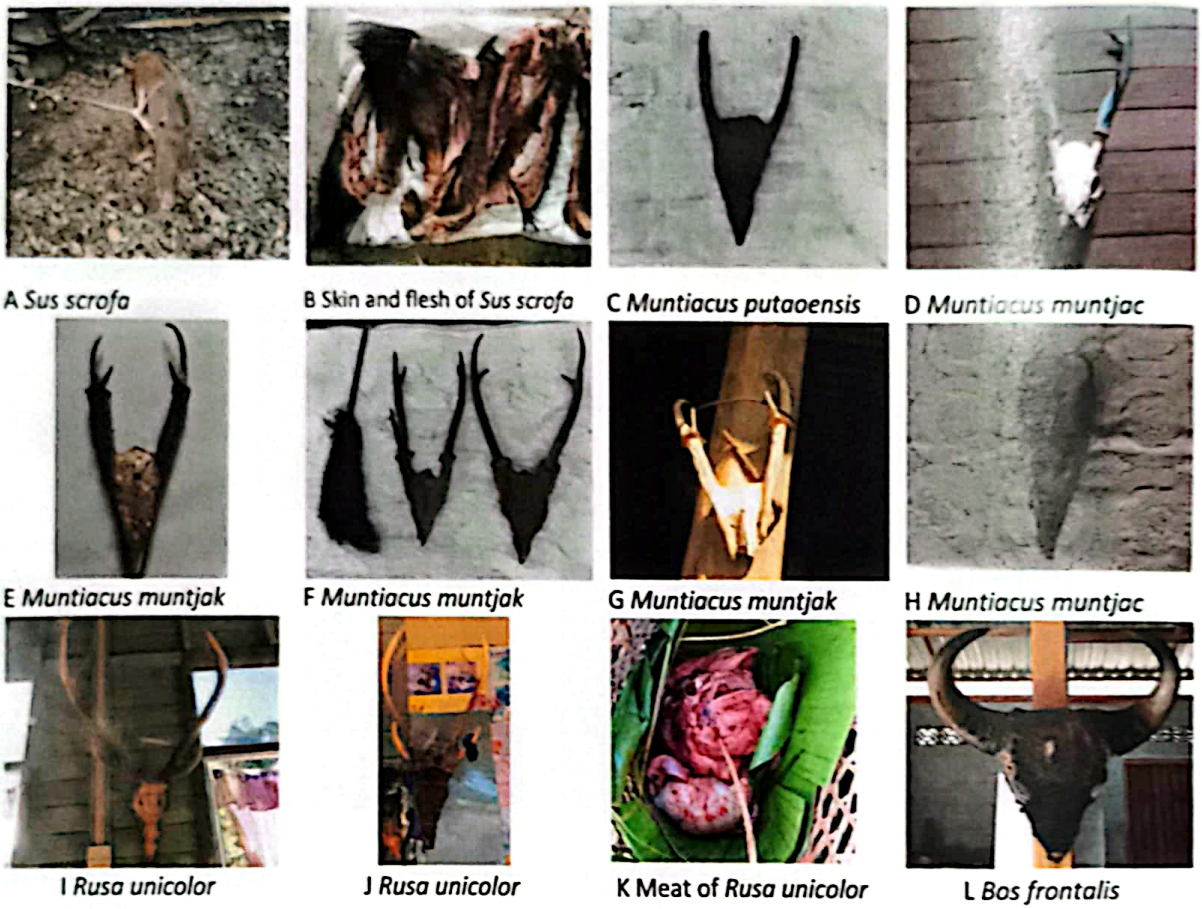

L Skull and Fang of *Sus scrofa*

Plate 3 Recorded Species of Order Chiroptera, Primates, Carnivora and Artiodactyla



A *Sus scrofa* B Skin and flesh of *Sus scrofa* C *Muntiacus putaoensis* D *Muntiacus muntjac*

E *Muntiacus muntjak* F *Muntiacus muntjak* G *Muntiacus muntjak* H *Muntiacus muntjac*

I *Rusa unicolor* J *Rusa unicolor* K Meat of *Rusa unicolor* L *Bos frontalis*

Plate 4 Recorded Species of Order Artiodactyla

A *Bos frontalis* B *Bos frontalis* C *Bos frontalis* D *Capricarnis milneedwadsii*

E *Capricarnis milneedwadsii* F *Capricarnis milneedwadsii* with hunters G *Capricarnis milneedwadsii* H *Nemorhaedus griseus*

I *Hystrix brachyuran* J *Hystrix brachyura* K *Atherurus macrourus* L *Atherurus macrourus*

Plate 5 Recorded Species of Order Artiodactyla

Discussion

The current survey on fauna expedition in Inkhibum National Park, Kachin State focusing on terrestrial vertebrates was conducted from March 2018 to February 2019. Previously, a total of 17 species of bats was recorded from Myitsone Area, Myitkyina Township, Kachin State (Aung Lu, 2012). Besides, the pre-survey reported of (43) mammal species were recorded by Forest Department, Fauna and Flora International and Biodiversity and Nature Conservation Association in 2013. Moreover, Hpaw Bwe (2016) worked on the seasonal occurrence and species composition of some mammals in Myitkyina environs, reported 39 species of small mammals from Inkhibum Mountain area. During the study, the numbers of 54 species of seven orders confirmed to the class Mammalia. Among them, the largest number of recorded species composition is under order Carnivora (35.93%) while the order Scandentia is the least number of species (1.85%).

According to IUCN Red List, five species including Sunda pangolin (*Manis javanica*), Chinese pangolin (*M. pentadactyla*), Black Bear (*Ursus thibetanus*), Large spotted Civet (*Viverra megaspila*) and Hog deer (*Axis porcinus*) were regarded critically endangered while four species belonging Assamese Macaque (*Macaca assamesis*), Dhole (*Cuon alpines*), Asian Golden Cat (*Catopuma temminckii*) and Chinese Serow (*Copricarnis milneedwardsii*) as near threatened. Besides, ten species consisting Asian slow loris (*Nycticebus bengalensis*), Stump-tailed Macaque (*M. arctoides*), Sun Bear (*Helarctos malayanus*), Hog Badger (*Arctonyx collaris*), Binturong (*Arctictis binturong*), Clouded Leopard (*Neofelis nebulosa*), Leopard (*Panthra pardus*), Sambar deer (*Rusa unicolor*), Guar (*Bos frontalis*) and Chinese Goral (*Naemorhedus griseus*) represented vulnerable species.

The result indicated that most of the local people go after big and small mammalian gave both for consumption and medicinal purpose and as well as supplementary income through local market and the trade across the border. In the present study area, Inkhibum National Park, with full complement of natural resources could create roosting sites and foraging sites for various species of wild animals. According to the interview information gathered from local people and local hunters, it was known that illegal trade and hunting, logging for their livelihoods were going in earnest. Most people accepted that wild animals play an important role in maintaining the ecosystem. Human activities, however, lead to habitat loss leading to decline in the population and number of species. Thus, there is a need not only to maintain the sustainability of flora and fauna but also all the natural asserts as well, that thrive habitat of the Kachin State.

6. Conclusion

The study area is considered as an important resource by community around protected area. There is a need to sustain the wild flora and fauna in Inkhaibum Wildlife National Park. This is the report of the project, however, need to be extended and in more detail study and record of wildlife in order to get the true information from the study area.

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Occurrence of Some Dragonfly Species in Myitkyina University Campus

Aye Aye Ko[1], Tin Tin Moe[2] and Khin Pyae Pyae Thaw Thar[3]

Abstract

Dragonfly species were collected from in Myitkyina University Campus. The study period was conducted from January to December 2018. There were three study sites; drainage areas (site 1), bare ground (site 2) and shrubs (Site 3). A total of 13 species of 12 genera belonging to three subfamilies under Family Gomphidae, Libellulidae and Aeshnidae from Order Odonata were recorded during the study period. Species composition and habitat preference of collected species were studied. The recorded dragonfly species were given supported by scaled photographs. The maximum number of dragonfly species were recorded in wet season while the minimum number in hot season. Among the study sites; the bare ground was the lowest collected species whereas the highest species from drainage area. The collected dragonfly species were recorded in tabulation and graphic presentation.

Keywords: Dragonfly species, habitat, species composition

Introduction

A dragonfly is belonging to Class Insecta and Order Odonata. Dragonflies and damselflies are resembling which are similar in structure while different holding the wing. At rest, dragonflies are held flat and away from the body however damselflies hold the wings folded above the abdomen. Dragonflies are able to move quickly and easily while damselflies have slowly flight. Many Dragonflies have metallic or bright colors by structure and wing pattern. Dragonflies feed mainly on small invertebrates throughout the lifecycle. In turn, it may be significant prey items of fish, birds and other invertebrates including spiders and coleopterans. The life cycle consists of a long larval phase and a short adult phase. The eggs are laid either by inserting them in aquatic plants or on the water surface.

Not only are dragonflies essentially benign to humans, they actually are pretty helpful for cutting down on insects that are not quite so harmless, on the other hand. Mosquitoes are one such example of dragonfly prey. In tropical regions, two to three generations of dragonflies may mate and lay eggs each year. In temperate regions, usually only one generation mates and lays eggs. For dragonflies living in temperate regions, mating and egg lying typically occurs in mid to late summer (Nelson,*et.al.*,2000).

When dragonflies hatch, they are called nymphs. Dragonfly nymphs are voracious predators that have no resemblance to their adult forms. They molt (shed their skin) up to 12 times, depending on the species, and can spend as long as four years as nymphs. Dragonflies living in tropical regions spend less time in the nymph form while dragonflies living in temperate regions will spend longer as nymphs as the onset of winter delays maturation. Dragonfly nymphs are aquatic, living in drainage areas and marshes until emerging to molt for one final time. During the final molting, the nymph's skin splits and the nymph emerges as an adult dragonfly. After the final molt from nymph to adult, occurring in late spring or early summer in temperate regions and at any time of the year in tropical regions, most dragonfly species spend the next month fully maturing (Wikipedia, 2019). Economically they are of great importance in destroying noxious flies and mosquitoes, as well as the smaller moths which are regarded as pests (Fraser, 1933).

Therefore, the present work is conducted to record the dragonflies of Myitkyina University Campus which has not been surveyed by previous workers. The information given in this work is also to serve as a basic tool forwards the functional as well as ecological aspects.

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[3] Assistant Lecturer, Department of Zoology, University of Myitkyina

The objectives of this research works were focused as followings;

- To record the occurrence of dragonfly species in the study area
- To examine the species composition of dragonflies from the study area
- To study the habitat of dragonflies in Myitkyina University Campus

Materials and Methods

Study area

The collected specimens were taken from Myitkyina University Campus in Kachin State. The study area is situated between North Latitude 25° 25′ 1.19′′N and East Longitude 97° 24′ 23.99′′ E. The width of study area is measured about 89.35 hectare. Three study sites were chosen in the Campus; near drainage area (site1), bare ground (site 2) and shrub and herb (site 3) (Plate. I).

Study period

The study period lasted from January to December 2018.

Specimen collection

The specimens were collected from different habitats such as bare ground, shrub and drainage area. The collection of dragonflies was made between 07:00 to 09:00(morning) and 15:00 to 17:00 (afternoon). The collection was made every week during the study period. Most specimens were collected by using hand net. The hand net was made with the handle of plastic pipe, a wire rim and a cloth bag. The handle is light and strong. It is about 100-120 cm long. The rim is made of a stiff wire, bent and fitted into the grooves and holes at the end of handle. The rim is attached to the handle by means of wire. The net rim has a diameter of about 50-75 cm wide. The bag is about twice as long as the diameter of the rim and tapered at the opposite end. The net has a sufficiently open mesh so that dragonfly can be seen through it.

Preparing the collected specimen

Specimens were killed in an ordinary cyanide bottle and put into triangular paper packets or envelops. The specimens were taken the measurements and photographs. The specimen was pinned and kept on the soft tissue. They were pinned upper side of the thorax, below the base of wings. Specimens were mounted in the store-boxes with labeled for identification.

Identification and recording data

The identification and classification of the collected dragonfly species were based on Fraser (1933, 1934 and 1936). The finding data was analysed by tabulation and graphic presentation.

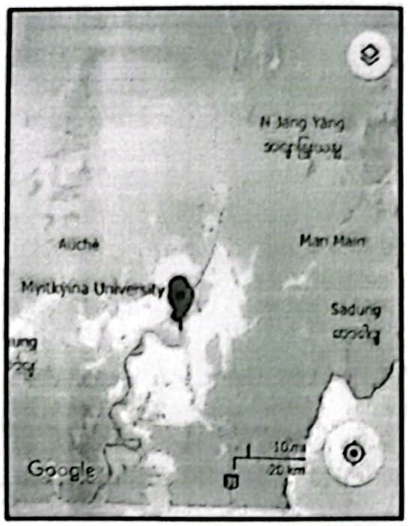


Fig.1. Map of study area (Source: Google earth, 2019)

A. Drainage Area B. Bareground C. Shrub and herb Area

Plate. I. Different study sites from the study area

Results

Distinguished morphological characters of an adult dragonfly

Adult dragonflies are characterized by large, multifaceted eyes, two pairs of strong, transparent wings, sometimes with coloured patches, and an elongated body. An adult dragonfly has three distinct segments, the head, thorax, and abdomen as in all insects. It has a chitinous exoskeleton of hard plates held together with flexible membranes. The head is large with very short antennae. It is dominated by the two compound eyes, which cover most of its surface. Also, they have three simple eyes or ocelli. The mouthparts are adapted for biting with a toothed jaw; the flap-like labrum, at the front of the mouth, can be shot rapidly forward to catch prey.

The thorax consists of three segments as in all insects. The prothorax is small and is flattened dorsally into a shield-like disc which has two transverse ridges. The mesothorax and metathorax are fused into a rigid, box-like structure. The thorax bears two pairs of wings and three pairs of legs. The wings are long, veined, and membranous, narrower at the tip and wider at the base. The hindwings are broader than the forewings and the venation is different at the base. The leading edge of each wing has a node where other veins join the marginal vein, and the wing is able to flex at this point. In most large species of dragonflies, the wings of females are shorter and broader than those of males. The legs are rarely used for walking, but are used to catch and hold prey, for perching, and for climbing on plants. Each has two short basal joints, two long joints, and a three-jointed foot, armed with a pair of claws. The long leg joints bear rows of spines, and in males, one row of spines on each front leg.

The abdomen is long and slender and consists of 10 segments. There are three terminal appendages on segment 10. The second and third segments are enlarged, and in males, on the

underside of the second segment has a cleft. In females, the genital opening is on the underside of the eighth segment and is covered by a simple flap (Fig.1).

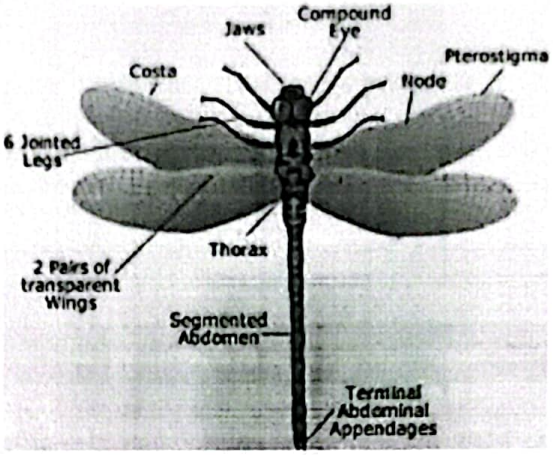


Fig.2. Diagrammatic structure of an adult dragonfly (After animalcorner.co.UK)

Recorded dragonfly species from Myitkyina University Campus

(According to Fraser (1933, 1934 and 1936)

Phylum - Arthropoda
Class - Insecta
Sub Class - Pterygota
Division - Exopterygota
Order - Odonata
Sub Order - Anisoptera
Family - Gomphidae
Sub Family - Gomphinae
Genus - *Mesogomphus* Forster, 1906
Species - *M. lineatus* (Selys, 1850)
Common name- Lined hooktail
Family - Aeshnidae
Genus - *Anax* Leach, 1815
Species - *A. guttatus* (Burmeister, 1839)
Common name- Lesser green emperor
Family - Libellulidae
Sub family - Corduliinae
Genus - *Epophthalmia* Burmeister, 1839
Species - *E. frontalis frontalis* Selys, 1871
Common name- Nail
Sub family - Libellulinae
Genus - *Zygonyx* Selys-Hagen, 1867
Species - *Z. iris mildredae* Fraser, 1926
Common name- Emerald cascader
Genus - *Brachydiplax* Braver, 1868
Species - *B. chalybea* Braver, 1868
Common name- Yellow patched lieutenant
Genus - Tholymis Hagen, 1867
Species - *T. tillarga* (Febricius, 1798)
Common name- Old world twister
Genus - *Orthetrum* Newman, 1832

Species - *O. Sabina* (Drury, 1770)
Common name- Slender skimmer
Species - *O. glaucum* (Braver, 1865)
Common name- Blue marsh hawk
Genus - *Diplacodes* Kirby, 1889
Species - *D. trivialis* (Rambur, 1842)
Common name- Blue ground skimmer
Genus - *Rhyothemis* Hagen, 1867
Species - *R. phyllis phyllis* (Sulzer, 1776)
Common name- Yellow stripped flutterer
Genus - *Trithemis* Braver, 1868
Species - *T. festiva* (Rambur, 1842)
Common name- Black stream glider
Genus - *Neurothemis* Braver, 1867
Species - *N. tullia* (Drury, 1773)
Common name- Pied paddy skimmer
Genus - *Potamarcha* Karsch, 1890
Species - *P. obscura* (Rambur, 1842)
Common name- Swamp watcher

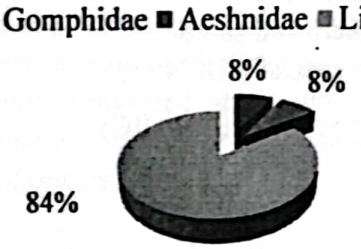


Fig.3. Percentage on the species composition of recorded dragonflies by families during the study period

Distinctive morphological characters of recorded dragonfly species

Mesogomphus lineatus (Selys,1850) (Plate. IIA)

Sex - Male
Length Body 31-33mm
Fore wing 24-26mm
Hind wing 21-24mm
Head - Labium pale yellow; labrum, face and frons sandy yellow; vesicle and occiput yellow, a narrow transverse dark brown streak separating them.
Thorax - Sandy yellow, marked with blackish brown
Legs - Yellow, marked with black; a stripe on inner side of all femora
Wings - Hyaline; costa yellow as far as pterostigma, which is pale reddish-brown heavily bordered with black on the costal.
Abdomen - Yellow mark with black. Segment one with the sides broadly yellow and a large dorsal apical spot of the same color; two with a subdorsal black line on each side enclosing a dorsal bilobed yellow spot; three to seven with broad black apical rings, black on the dorsum, an irregular spot of the same color on the mid-dorsum, more evident on segment eight than nine; ten sandy yellow, with the basal half or two thirds of the dorsum black.
Anal appendages - Dull sandy yellow

Habitat - Drainage area
Conservation status- Nil

Anax guttatus (Burmeister, 1839) (Plate.IIB)

Sex - Male
Body length 53 -58 mm
Fore wing 53 - 57mm
Hind wing 51 - 53mm
Head - Labium and labrum bright ochreous; face and frons bright greenish yellow; occiput bright yellow; eyes blue during life.
Thorax - pale green
Legs - Black, proximal ends of femora dark reddish brown, flexor and inner surface of anterior femora citron-yellow.
Wings - Hyaline, hind wing with a patch of amber-yellow lying between discoidal cell and posterior border of wing; discoidal cell of fore-wing very narrow and more elongate than hind wing.
Abdomen - Bright ochreous, marked with orange and azure blue; segments one, two and three pale green on lower parts of sides and turquoise-blue on dorsum; segments four to seven with bright orange laterally and irregular reddish brown stripe on mid-dorsum and continue up to segment eight to nine; segment ten is entirely yellow.
Anal appendages - Dark reddish brown
Habitat - Bare ground, herb and shrub
Conservation status- Least concern species (IUCN, 2017)

Epophthalmia frontalis frontalis Selys, 1871 (Plate.IIC)

Sex - Male
Length body 45-49mm
Fore wing 43-47mm
Hind wing 42-45mm
Head - Labium and labrum are reddish brown, with two small citron yellow spots at base of labrum; frons and vesicle dark metallic green, marked on each side in front with a triangular yellow spot with a rounded yellow spot.
Thorax - Dark reddish – brown
Legs - Blackish-brown
Wings - Hyaline, pterostigma blackish brown,
Abdomen - Black, changing to dark reddish brown at the terminal segments, ringed with bright ochreous; segment eight with a broad basal triangle of yellow; segment 10 is almost entirely yellow
Anal appendages - Dark ochreous; inferior decidedly longer than superior, triangular, narrow, curved slightly upwards.
Habitat - Drainage area, bare ground, herb and shrub
Conservation status- Least concern species (IUCN, 2010)

Zygonyx iris mildredae Fraser, 1926 (Plate.IID)

Sex - Male
Body length 31-35mm
Fore wing 45-47mm
Hind wing 42-44mm
Head - Labium bright citron –yellow , lateral lobes narrowly bordered with black; labrum black; lower border of frons dull yellow, laterally yellow; occiput dark brown centered

ith bright yellow; vesicle dark metallic blue; eyes dark reddish-brown above, paler laterally nd below.
horax - Dark metallic greenish-blue; beneath yellow
egs - Black
Wings - Much longer than theabdomen; hyaline and without a small dark brown spot at xtreme base of hindwing, pterostigma black.
bdomen - Black, with mid-dorsal carina finely yellow on segments one, two to seven; egments one to two with ayellow stripe tapering apically on the latter segments.
nal appendages - Black, long and slender; the apices of superiors more tapered.
abitat - Bare ground, herb and shrub
onservation status- Least concern species (IUCN, 2010)

rachydiplax chalybea Braver, 1868 (Plate.IIE)

ex - Male
ody length 21- 25mm
ore wing 30-31mm
ind wing 28-31mm
Head - Labium, labrum, face and anterior surface of frons palest ochre; frons above and esicle metallic blue; occiput black with a geminate spot behind yellow.
Thorax - Ochreous, pruinosed white on dorsum
Legs - Black, coxae and trochanters ferruginous.
Wings - Hyaline, bases of all tinted burnt – brown and extending nearly to tornus in hind wing; pterostigma yellow between thick black nervures.
Abdomen - Black on dorsum, pruinosed nearly white; segments one to three yellow and ferruginous on dorsum and laterally, sutures finely black; segments four and five with black spots on dorsum; remaining segments all black.
Anal appendages - Black
Habitat - Bare ground, herb and shrub
Conservation status- - Least concern species (IUCN, 2010)

Tholymis tillarga (Fabricius, 1798) (Plate.IIF)

Sex Male
Body length 30 - 32mm
Fore wing 33-35mm
Hind wing 32 -35mm
Head - Labium, labrum and face and vesicle ochreous; eyes brown capped with reddish, olivaceous below; occiput dark ochreous.
Thorax - Golden-yellow with a bright reddish suffusion on dorsum
Legs - Long, robust, coloured ochreous
Wings - Hyaline, with a broad fan-shaped, smoky golden-brown fascia extending from node to base of hindwing, very deep in colour at node and somewhat longitudinally striated, paling towards base and posterior border of wing; pterostigma reddish-brown between dark nervures; membrane blackish-brown.
Abdomen - Bright rust-red, especially on dorsum, paler at sides of basal segments
Anal appendages - Reddish, superior as long as segments nine and ten taken together, long, slim, acuminate at apex.
Habitat Drainage area, herb and shrub
Conservation status- - Least concern species (IUCN, 2016)

Orthetrum sabina (Drury, 1770)(Plate.IIG)

Sex - Male
Body length 30 - 33mm
Fore wing 33-35mm
Hind wing 32 -35mm
Head - Labium yellow, middle lobe brownish to black ;labrum, face and frons yellowish; frons very deeply notched so as to form two triangular facets in front; vesicle black tipped with yellow; occiput ochreous; eyes greenish during life.
Thorax - Greenish-yellow, marked with black; sutures all finely black.
Legs - Black, anterior femora yellow on inner surface, and a fine stripe of same on flexor surface of the other two pairs.
Wings - Hyaline; pterostigma black with middle ochreous; membrane dark brown; hind-wing tinted with amber- yellow.
Abdomen - Greenish- yellow, marked with black. Apical borders and jugal sutures of segments one to three all finely black. Segments four to six with a broad oval dorsal black spot. Segments seven to nine black; ten with base broadly, apical border finely black and with two small black baso- dorsal points. Segments one to three enormously swollen dorso-ventrally as well as laterally; segments four to six very narrow , cylindrical; segments seven to nine all dilated but compressed laterally ; segment ten very small.
Anal appendages - As long as segment nine , creamy –white in colour, with a row of very small black teeth or spines below superiors.
Habitat - Drainage area, bare ground, herb and shrub
Conservation status- - Least concern species (IUCN, 2013)

Orthetrum glaucum (Braver, 1865) (Plate.IIH)

Sex - Male
Body length 28-30mm
Fore wing 30-32mm
Hind wing 28-31mm
Head - Labium, labrum , face and frons uniform glossy black; vesicle and occiput black; eyes dark green, capped with reddish-brown.
Thorax - Pruinosed dark dullnbluewitha very thin pruinesence
Legs - Black, femora paler on extensor surface
Wings - Hyaline, with extreme base tinted with dark amber-yellow, the whole wing enfumed palely and evenly with brown; pterostigma dark ochreous between thick black nervures.
Abdomen - Ventro-dorsally dilated at segments one to three, then very slim and width to the end, pruinosed pale dirty blue from segments one to apical end of segment eight, black for the remainder.
Anal appendages - Black
Habitat - Drainage area, bare ground, herb and shrub
Conservation status- Least concern species (IUCN, 2009)

Diplacodes trivialis (Rambur, 1842)(Plate.II I)

Sex - Male
Body length 20 - 22mm
Fore wing 21 -23mm
Hind wing 22 - 23mm

- Labium, labrum and bases of mandibles creamy-yellow; face, frons and vesicle azure-blue, with a fine black line at base of frons; eyes reddish-brown above, pale bluish yellowish below.

- Greenish-yellow with sutures finely black, the area between mid-dorsal carina humeral sutures violaceous-brown speckled with minute dots, this latter area and the black kings becoming pruinosed in adult.

- Greenish- yellow, marked with black in subadults, black marked with yellow in

- Hyaline; uncoloured for a minute yellow point in cubital space of hindwing.

- Segments one to three greenish –yellow, with the sutures finely black, mid-dorsal subdorsal stripes extending from jugal-suturee on segment two, expanding broadly at apical ders of segments two and three ; all these markings more or less obscured by blue escence in adults, remaining segments black, pruinosed densely in old adults, but with dorsal yellow stripes on segments four to seven.

appendages - Bright yellow.

- Drainage area, bare ground, herb and shrub

servation status- - Least concern species (IUCN, 2010)

themis phyllis phyllis (Sulzer, 1776)(Plate.IIJ)

- Male

y length 20 - 22mm

wing 35-40mm

wing 35-40mm

- Labium pale whitish-yellow, middle lobe black; labrum black; frons and vesicle dark metallic green; occiput black; eyes dark reddish-brown above.

- Dark metallic green

- Black.

- Palely tinted throughout with yellow, all apices blackish-brown to within one or cells of perostigma; a black nodal spot variable in size. This spot absent or reduced in hind-ing, at the base of which are two very broad black fasciae with dark metallic blue reflex nding distally to apex. The two fasciae lying enclosed in a large opaque chrome-yellow spot ich separates the two fasciae and extends distally for the same distance. Membrane very pale own; pterostigma blackish brown.

domen - All segments black.

al appendages - Long, slim, slightly sinuous.

itat - Drainage area

servation status- - Least concern species (IUCN, 2017)

themis festiva (Rambur, 1842) (Plate.IIK)

- Male

y length 23- 27 mm

wing 30-32mm

wing 28-31mm

- Labium blackish –brown; labrum black with base brown; frons drak brown in t, metallic violet above, as well as vesicle; occiput dark brown; eyes dark brown above with ple reflex, bluish-grey laterally and beneath.

- Black, coated with a thin purplish pruinescence.

- Black

Wings - Hyaline, with a dark opaque brown mark at base of hind wing, slightly variable in extent, dark rays in subcostal and cubital spaces which is dark with paler attached border; pterostigma black.
Abdomen - Black, segments one to three with a thin bluish pruinescence
Anal appendages - Black.
Habitat - Drainage area, bareground
Conservation status- - Least concern species (IUCN, 2009)

Neurothemis tullia (Drury, 1773) (Plate.IIL)

Sex - Female
Body length 15 – 20 mm
Fore wing 20 - 22mm
Hind wing 20 – 23 mm
Head - Labium creamy-white; labrum, face and frons greenish-yellow; vesicle olivaceous brown; occiput olivaceous, with a bright citron- yellow geminate spot behind; eyes pale brown above, plae olivaceous laterally and beneath.
Thorax - Greenish-yellow, with a bright yellow stripe; this stripe broadly bordered with blackish-brown throughout.
Legs - Yellow on extensor surface
Wings - Base of wings, to as far as two or three cells distal of node, bright amber-yellow; subcostal space from base of wing to node blackish-brown, broadening at node blackish-brown, broadening at node into a very large blackish –brown spot which traverses wings nearly to posterior border, variably round, oval or triangular in shape in fore-wing, irregular or curved like a sickle in the hind; apices of all wings broadly opaque blackish-brown to as far proximal as inner end of pterostigma; the area between these two opaque areas with pale yellow reticulation.
Abdomen - Bright yellow, with a broad black stripe extending from segment one to the end, black beneath, the two black areas confluent at segment seven or eight to enclose a narrow yellow stripe which tapers from base of abdomen to segment seven, the black stripes expanding at apical ends of segments so as to constrict the dorsal yellow and finally, by confluence over dorsum, to enclose yellow spots on segment eight and nine; segment ten bright yellow.
Anal appendages - Bright yellow, shortly conical.
Habitat - Drainage area, herb and shrub
Conservation status- - Least concern species (IUCN, 2009)

Potamarcha obscura (Rambur, 1842)(Plate.IIM)

Sex - Male
Body length 25-30mm
Fore wing 30-32mm
Hind wing 28-31mm
Head - Labium yellow; labrum yellow narrowly bordered with black; face and frons olivaceous- yellow, frons in adults steely black; occiput variably yellow to reddish-brown.
Thorax - In adults black, but this pruinosed more or less densely and appearing dark violaceous or blackish-blue; in subadults yellow markings showing obscurely through the pruinoscence.
Legs - Reddish-brown towards base of femora.
Wings - Hyaline, with extreme apices tipped with brown, subadults have the coastal area of both wings tinted with pale yellow; pterostigma dark reddish-brown.
Abdomen - Very variable in colouring according to age of individuals, completely pruinosed in old adults, especially on the basal three segments. Remaining segments coloured

low with medial and subdorsal black stripe bordered by subdorsal and lateral yellow lines
segments one to eight.
al appendages - Black
bitat - Drainage area, bare ground, herb and shrub
nservation status- - Least concern species (IUCN, 2017)

Mesogomphus lineatus

B. *Anax guttatus*

C. *Epophthalmia frontalis frontalis*

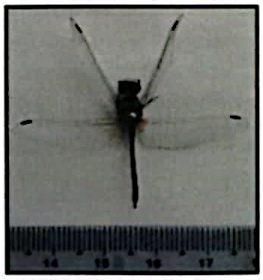
Zygonyx iris mildredae

E. *Brachydiplax chalybea*

F. *Tholymis tillarga*

Orthetrum sabina

H. *Orthetrum glaucum*

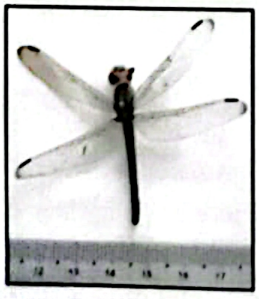


I. *Diplacodes trivialis*

Neurothemis phyllis phyllis

K. *Neurothemis tullia*

L. *Trithemis festiva*



M. *Potamarcha obscura*

Recorded dragonfly species from the study area during the study period

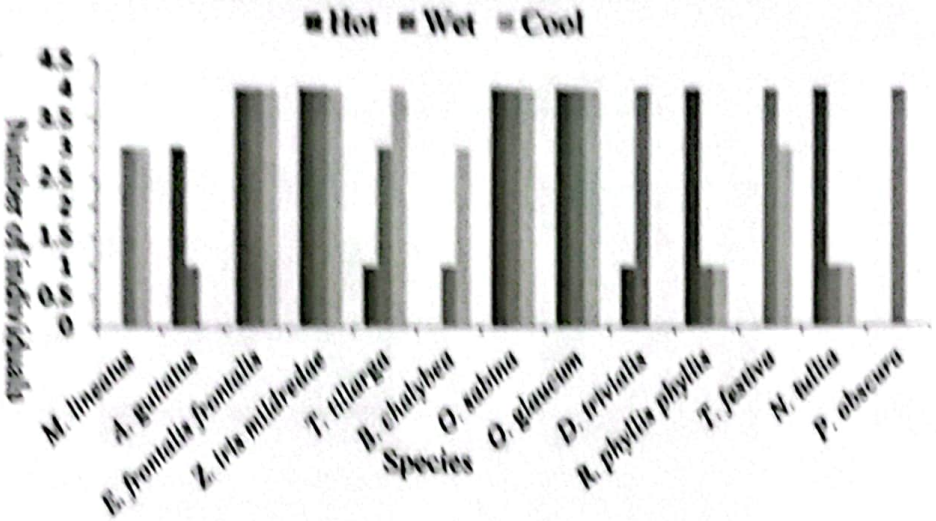


Fig.4. Seasonal occurrence of collected dragonflies from the study area during the study period

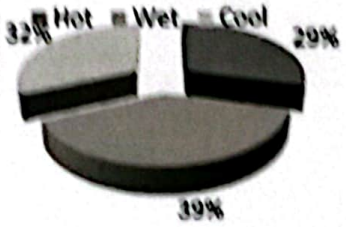


Fig.5. Percentage on the seasonal occurrence of dragonfly species from the study area

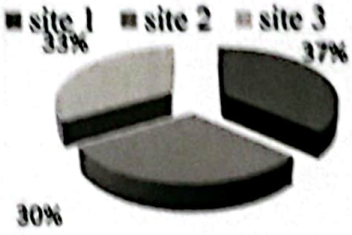


Fig.6. Percentage of collected dragonflies in different habitats during the study period

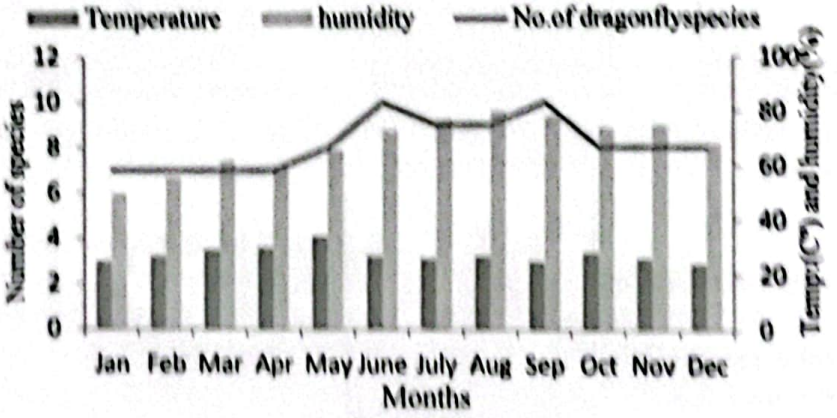


Fig.7. Monthly recorded temperature, humidity and dragonfly species from the study area

Discussion

Among the most beautiful and attractive of all insects are all phrases that recent accounts ve used to describe dragonflies. They are aquatic insects which belong to the insect Order donata. The 'true' dragonflies are large robust species. Adults are characterized by having similar hind and fore wings which, at rest, are held out flat (Nelson, *et.al.*,2000).

The occurrences of dragonflies and damselflies were observed in previous researchers om India and Myanmar. Fraser (1933-1936) stated that the total of 537 species of dragonflies d damselflies in India. Khin Soe Yee (2000) studied that 46 species of suborder Zygoptera and isoptera from Taungoo Area. Kay Thi Khaing (2008) recorded that 25 species, 19 genera, two milies of dragonflies were collected from the Bago environs. Nar Chein (2016) observed that species of dragonflies belonging to 15 genera of three families was also recorded from Kyaing ng Area.

In the present study, a total of 13 species of 12 genera from three families of dragonfly re recorded from Myitkyina University Campus during the study period. Out of 13 species, recorded dragonfly was found male except *Neurothemis tullia* which was collected only male during the study period.

According to data, the largest number of dragonfly species were recorded to be in wet ason especially in the months of June and September while the lowest in hot season especially the months of February, March and April.

Fraser (1933-1936) also stated that the best months for collecting are May, June and September to the first half of November, that is, during the months which precede and follow the south-west monsoon. Due to the findings, the months of June and September were recorded be low temperature and high humidity whereas the months of March and April were recorded be high temperature and low humidity.

Among the habitats, the highest species of dragonflies were recorded were found in site where mostly the drainage area including shrub area. Following the site 3 has the largest shrub ea while the site 2 was found the least number of dragonfly species due to small shrub and rge bareground which without canopy in it.

Fraser (1933-1936) also observed dragonflies may also be put in deep jungle, especially the neighbourhood of streams or marshes adjoining forest. In addition, dragonflies are at home very shallow pond, a frequent garden pond inhabitant. He also stated the large number of prey sects in shrub area help the dragonflies flies long distances, so prey is readily available when e dragonflies stop to rest and feed. Therefore, the present study was recorded to be the most undant dragonfly species were recorded in drainage and shrub area from Site 1 and 3 whereas e least in bareground area from site 2.

Out of 13 species, *Mesogomphus lineatus*, *Anax guttatus, Zygonyx iris mildredae, Trithemis festiva, Neurothemis tullia, Diplacodes trivialis* and *Potamarcha obscura* were also found in Kyaing Tone area while not recorded in Bago and Taungoo environs. The dragonfly species of Kyaing Tone and Myitkyina area were similar. It was assumed that these areas are near mountainous area and almost the same climatic condition. In addition, all collected species were observed as the categories of least concern species described by International Union of Conservation of Nature Red List of Threatened Species except *M. lineatus* (IUCN, 2009-2017).

Schlager (2004) described that the adults mostly occurred aquatic environment. He also pointed out that the dragonflies have aquatic larvae, which generally rely on good water quality. Consequently, they can be used to make rapid assessments of water quality and indicate a healthy ecosystem and the biological control of mosquitoes.

Conclusion

Dragonflies are well-known insects, and many people appreciate their striking colors and equilibristic flight. Most species are found in the tropics. Many species have small ranges and are specific to certain habitats such as alpine mountain bogs or desert wadis. Dragonflies are frequently used as indicators of environmental health. Their sensitivity to habitat quality and their amphibious life cycle make dragonflies well suited for evaluating environmental changes. Therefore, their existing will be useful and beneficial in controlling mosquitoes and other small insects in this campus.

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မင်းသုဝဏ်၏ ဇာတ်လမ်းကဗျာဖန်တီးပုံ

စန္ဒာရှိန် [၁]

ဇာတမ်းအကျဉ်း

ဤဆောင်းပါးသည် မြန်မာကဗျာလာခေတ်ကဗျာကဏ္ဍမှ မင်းသုဝဏ်၏ ဇာတ်လမ်းကဗျာ ဖန်တီးပုံကို လေ့လာတင်ပြထားသော ဆောင်းပါးဖြစ်ပါသည်။ ဤသို့လေ့လာ တင်ပြရာတွင် ဘဲလက်(ballad)ခေါ် ဇာတ်လမ်းကဗျာများဖွင့်ဆိုမှု သဘောတရားများကို အခြေခံ၍ မင်းသုဝဏ်၏ ဖိုးမောင်လာပြီ၊ သူမှာတမ်း၊ မင်းရဲကျော်စွာ ကဗျာတို့ကို အလေ့လာခံအဖြစ် သတ်မှတ်ပါသည်။ မြန်မာကဗျာဆရာ မင်းသုဝဏ်၏ ဇာတ်လမ်းကဗျာဖန်တီးပုံကို သိရှိစေရန် ရည်ရွယ်ပါသည်။ ဤစာတမ်းတွင် အကြောင်းအရာ ဝိုင်းဖန်တီးပုံ၊ အရေးအဖွဲ့ဝိုင်းဖန်တီးပုံ ဟူ၍ ဝိုင်းခြားလေ့လာပါသည်။ အကြောင်းအရာဝိုင်းဖန်တီးပုံတွင် ဇာတ်ကွက်တစ်ကွက် ခြင်းဖန်တီးပုံ၊ ဇာတ်ဆောင်ပြောစကားများဖြင့်ဖန်တီးပုံ၊ လွှမ်းဆွေးဖွယ်အခြေအနေ ဖြင့်ဖန်တီးပုံတို့ဖြစ်ပြီး အရေးအဖွဲ့ဝိုင်း ဖန်တီးပုံတွင် စကားအသုံးအနှုန်းဖန်တီးပုံ၊ ဝါကျဖန်တီးပုံ၊ ထပ်ကျော့ရေးဖွဲ့ ဖန်တီးပုံဟူ၍ လေ့လာတင်ပြထားပါသည်။ ဇာတ်လမ်းကဗျာ လေ့လာလိုသူများအတွက် အထောက်အကူရရှိမည်ဖြစ်ပါသည်။

သော့ချက်စကားလုံးများ ဘဲလက်၊ ဇာတ်လမ်းကဗျာ။

၁ နိဒါန်း

ခေတ်အဆက်ဆက် ကဗျာစာဆိုတို့သည် ကဗျာလင်္ကာတို့ကိုဖွဲ့ဆိုရာတွင် အကြောင်းအရာထူးခြား လေးနက်သော် ကဗျာပုံသဏ္ဌာန်ဆန်းသစ်အောင် အားထုတ်ဆောင်ရွက်ခဲ့ကြသည်။ ယင်းသို့ကဗျာသစ်၊ စာသစ်များ မွေးဖွားလာသော် အားထုတ်ဆောင်ရွက်သူများတွင် မင်းသုဝဏ်သည်လည်း တစ်ဦးအပါအဝင်ဖြစ်သည်။

မင်းသုဝဏ်သည် ခေတ်စမ်းစာဆိုတစ်ဦးလည်း ဖြစ်သည်။ ခေတ်စမ်းခေတ်တွင် ဘဲလက်ခေါ် ဇာတ်လမ်းကဗျာ သဏ္ဌာန်သစ်တစ်ရပ်ကို မင်းသုဝဏ်က စတင်ဖွဲ့ဆိုခဲ့သည်။ မင်းသုဝဏ်သည်ဥရောပ ဘဲလက်ကဗျာတို့ကို ရှေးဦးစွာမြန်မာ ပြန်ဆိုခဲ့သည်။ ထို့နောက် အနောက်တိုင်း ဥရောပ ဘဲလက်ကဗျာသဘောကိုအခြေခံ၍ ကိုယ်ပိုင်စိတ်ကူးသစ် ဖြင့်သစ်တို့ဖြင့် ဇာတ်လမ်းဇာတ်ကွက်ပါသည့် ဇာတ်လမ်းကဗျာများကို ရေးဖွဲ့ပါသည်။ မင်းသုဝဏ်၏ ဇာတ်လမ်းကဗျာ များအနက် ၁၉၆၂-ခု ဒီဇင်ဘာလတွင်ရေးဖွဲ့ခဲ့သော 'ဖိုးမောင်လာပြီ'ကဗျာ၊ ၁၉၆၃-ခု ဖေဖော်ဝါရီလတွင် 'သူမှာတမ်း' ကဗျာ၊ ၁၉၆၈-ခုဧပြီနှစ်ဝါရီလတွင် 'မင်းရဲကျော်စွာ' ကဗျာတို့သည်အထင်ရှားဆုံး ဖြစ်ပါသည်။ ယင်းဇာတ်လမ်းကဗျာ သုံးပုဒ်ကို အခြေခံ၍ မင်းသုဝဏ်၏ဇာတ်လမ်းကဗျာဖန်တီးပုံကို တင်ပြမည်ဖြစ်ပါသည်။ အနောက်တိုင်း ဘဲလက်ကဗျာများသည် ဇာတ်လမ်းဖြစ်ရပ်တစ်ခု ဇာတ်ကွက်တစ်ကွက်ဖြင့် တင်ပြပါသည်။ ဇာတ်လမ်းအဖြစ်အပျက်ကို ဖော်ဆောင်ရာတွင် ဇာတ်ဆောင်တို့ အပြန်အလှန်ပြောခန်းများဖြင့်တင်ပြသည်။ လွှမ်းဆွေးဖွယ်ရာကောင်းသည့် အခြေအနေများဖြင့် ဖွဲ့ဆို သည်။ ဇာတ်ကြောင်းပြောပုံရိုးရှင်းပြီး သုံးနှုန်းသော ဝေါဟာရမှာလည်း ရိုးရိုးရှင်းရှင်း ဖြစ်သည်။ ဇာတ်ကွက်အတွင်း အသုံးများကို ထပ်ခါထပ်ခါကျော့ဖွဲ့လေ့ရှိသည်။ မင်းသုဝဏ်၏ဇာတ်လမ်း ကဗျာများတွင်လည်း အဆိုပါသဘော သက်ရောက်မှုများဖြင့် ရေးဖွဲ့ဖန်တီးကြောင်း တွေ့ရသည်။

၂ ဇာတ်လမ်းကဗျာဟူသည်

မြန်မာကဗျာသမိုင်းတွင် ဇာတ်လမ်းကဗျာ(ခေါ်)ဇာတ်ကြောင်းပြောကဗျာကို ခေတ်စမ်းစာဆို မင်းသုဝဏ်က စတင်ရေးဖွဲ့ဖန်တီးခဲ့ပါသည်။ ဘဲလက် ကဗျာဟုခေါ်ပါသည်။ ခရီးဆောင် အင်္ဂလိပ်-မြန်မာ အဘိဓာန်တွင် ဘဲလက်ကို-

> ဇာတ်လမ်းကဗျာ
>
> မလေးလေးတွဲ့တွဲ့ဆိုရသည့် အချစ်သီချင်းဟုအနက်ဖွင့်ဆိုထားပါသည်။

ဘဲလက်ကဗျာကို ပင်ဂွင်းစာပေသီအိုရီနှင့် စာပေသုံးဝေါဟာရအဘိဓာန်တွင်-ဇာတ်လမ်းပါသောသီချင်းဖြစ်ပြီး၊ ရေးတွင် နောက်ခံတေးဂီတအဖြစ် တီးမှုတ်ပါသည်။ ဘဲလက်သည် ရုတ်ချည်းအစပြုရသော ဂီတနှင့်အက ဖြစ်သည်။ ဘဲလက်တွင်သုံးနှုန်းသောဝေါဟာရမှာ ရိုးရိုးရှင်းရှင်းပင်ဖြစ်သည်။ ဘဲလက်တွင် လှုပ်ရှားမှုများ၊ အပြန်အလှန်စကားပြောခန်း

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[၁] တိုက်ပါမောက္ခ၊ ဒေါက်တာ၊ မြန်မာစာဌာန၊ မြစ်ကြီးနားတက္ကသိုလ်

များကို တစ်ဆက်တည်းပြလေ့ရှိသည်။ အများအားဖြင့် အဆွေးဇာတ်များ သာဖြစ်သည်။ ဘဲလက်ကိုဆိုရာကရာ၌ ထပ်ခါထပ်ခါကျော့ လျက်ရှိသည်

ဟုလည်းကောင်း၊

ဆရာမကြီးဒေါ်ခင်မျိုးချစ်ကလည်း-

အများအားဖြင့်ရိုးရာပုံပြင်များကို သီဆိုဖွဲ့နွဲ့ထားသည့် အမျိုးအစားများဖြစ်သည် ဟုလည်းကောင်း၊ အချို့ဘဲလက်များမှာ လှို့ဝှက်သည်းဖိဝိညာဉ်လောကမှ နတ်၊ ဖုတ်၊ ပြိတ္တာ၊ တစ္ဆေများကို ဇာတ်ဆောင်အဖြစ်ထည့်ကာ ဖွဲ့ဆိုထားသည် ဟုလည်းကောင်း၊ "အချို့ဘဲလက်သီချင်းများမှာ နယ်မြေအရပ်ရပ်တွင် တွေ့ရသည့် တောတောင်ရေမြေအဆန်းတကြယ် ရှာခင်းများနှင့်ပတ်သက်သည့် ပုံပြင်များကို ဖွဲ့ဆိုထားသည်" ဟု လည်းကောင်း၊ ဘဲလက်သီချင်းများသည် အဆွေးစိတ်ကူး ပုံပြင်များကိုချည်း ဖွဲ့ဆိုထားသည်မဟုတ်ဘဲ ကျားကျားလျားလျား ယောကျ်ားတို့၏ လုပ်ငန်းဆောင်တာ အမဲလိုက်ခြင်း၊ ဝေးရေးလံရေးပြခြင်းစသည့် အမူကိစ္စများကိုလည်း ဖွဲ့ဆိုထားကြသေးသည်

ဟုလည်းကောင်း၊

မမိုးမြေကလည်း-

ဘဲလက်ကဗျာ၏သဘောမှာဇာတ်ကြောင်းပြောကဗျာဖြစ်၍ ဇာတ်လမ်းပါသည်။ ပြဇာတ်၏ဇာတ်ကွက် တစ်ကွက်ကဲ့သို့ တင်ပြရေးဖွဲ့လေ့ရှိသည်။ ယင်းဇာတ်ကွက်သည် ကြေကွဲစရာအကြောင်းအရာ ဖြစ်တတ်သည်။ ကျေးလက်တောရွာသုံး ဘဲလက်ကဗျာနှင့် စာပေဘဲလက်ကဗျာ ဟူ၍ နှစ်မျိုးရှိသည်။ ကျေးလက်ဘဲလက်ကဗျာများသည် အနောက်နိုင်ငံများတွင်ရှေးအကျဆုံး စာပေအဖွဲ့ပုံစံတစ်ခုဖြစ်ပြီး အညတရများအကြောင်းကို ဖွဲ့ဆိုလေ့ရှိသည်။ မျိုးဆက်တစ်ဆက်မှ တစ်ဆက်သို့ နှုတ်ဖြင့်လက်ဆင့်ကမ်းခဲ့သည်။ စာဟောကဗျာများဟုလည်း ဆိုကြသည်

ဟုလည်းကောင်း ဖွင့်ဆိုထားပါသည်။

အထက်ပါဖွင့်ဆိုထားချက်များအရ ဘဲလက်သည် ဇာတ်လမ်းရှည်ကြီးမဟုတ်ဘဲ ဇာတ်ကွက် တစ်ကွက်တည်းသာ ဖြစ်သည်။ ထိုဇာတ်ကွက်ကိုဖော်ဆောင်ရာတွင်လည်း အချိုးနိဒါန်းပျိုးသည့်သဘော မပါဝင်ဘဲ ချက်ချင်းအစပြုရသည်။ အများအားဖြင့် အလွမ်းအဆွေးသဘောကို ဖွဲ့လေ့ရှိသော်လည်း အကြောင်းအရာမျိုးစုံကို ဖွဲ့နိုင်သည်။ သဘာဝလွန်ဖြစ်ရပ်များကိုလည်း ဖွဲ့နိုင်သည်။ ဇာတ်ကွက်ကို ဖွံ့ဖြိုးအောင်ပြုရာတွင် ဇာတ်ဆောင်တို့၏ပြောစကားတို့ဖြင့် ဖော်ဆောင်ရသည်။ ဇာတ်ဆောင်တို့၏ ပြောစကားတို့ကိုလည်းကောင်း၊ ဇာတ်ဝင်အဖြစ်အပျက်တို့ကိုလည်းကောင်း ထပ်ခါထပ်ခါကျော့သည့် သဘောလည်း ပါဝင်ပါသည်။

၂။ မင်းသုဝဏ်၏အတ္ထုပ္ပတ္တိအကျဉ်း

မင်းသုဝဏ်ကို ၁၉၀၉-ခုနှစ် ဖေဖော်ဝါရီလ(၁၀)ရက်နေ့တွင် ဖခင်ဦးလွမ်းပင် မိခင်ဒေါ်မိတို့က ရန်ကုန်တိုင်း ကွမ်းခြံကုန်းမြို့၌ ဖွားမြင်သည်။ အမည်ရင်းမှာ ဦးဝန်ဖြစ်သည်။ မွေးချင်း(၇)ယောက်အနက် ဒုတိယမြောက်ဖြစ်သည်။ ကွမ်းခြံကုန်းမြို့ ရွှေကျင်ကျောင်း၊ အင်္ဂလိပ်-မြန်မာ(၂)ဘာသာသင် အမျိုးသားအလယ်တန်းကျောင်း၊ ရန်ကုန်မြို့ ခရစ်ယာန် သာသနာပြုစိန်ဂျန်းအထက်တန်းကျောင်းများ၌ ပညာသင်ခဲ့သည်။ ၁၉၃၅ ခုနှစ်တွင် ရန်ကုန်တက္ကသိုလ်မှ မဟာဝိဇ္ဇာဘွဲ့ကို ရယူသည်။ ၁၉၃၆ တွင် အင်္ဂလန်ပြည် အောက်စဖို့တက္ကသိုလ်သို့သွား၍ အရှေ့တိုင်းဘာသာစကားများတွင် အထွေထွေဘာသာဗေဒကို ဆက်လက်သင်ယူရာ၊ ၁၉၃၈ခုနှစ်တွင် ဘီလစ်ဘွဲ့ရသည်။ ထို့နောက် လန်ဒန်တက္ကသိုလ် အရှေ့တိုင်းဘာသာရပ်များကျောင်းသို့ကူးပြောင်း ပညာသင်ယူသည်။ အမေရိကန်ပြည် နယူးဟေဗင်မြို့ ယေးတက္ကသိုလ်တွင်လည်း အထွေထွေဘာသာဗေဒပညာ သင်ယူဖူးသည်။

မင်းသုဝဏ်သည် ၁၉၃၃-၁၉၃၅တွင် ရန်ကုန်တက္ကသိုလ် အချိန်ပိုင်း မြန်မာစာနည်းပြ၊ (၁၉၃၅-၃၆)တွင် အချိန်ပြည့်နည်းပြ၊ (၁၉၃၉-၄၂)တွင် လက်ထောက်ကထိက၊ (၁၉၄၂-၄၅)တွင် ဂျပန်ခေတ် မြန်မာနိုင်ငံပညာတံခွန်အသင်း အဘိဓာန်ဌာနစာတည်း၊ (၁၉၄၅-၄၆)တွင် အရေးပေါ် တက္ကသိုလ် မြန်မာစာ လက်ထောက်ကထိက၊ (၁၉၄၆-၅၃)တွင် ရန်ကုန်

[illegible] မြန်မာစာ ကထိကတာဝန်တို့ကို ထမ်းဆောင်ခဲ့သည်။ ထို့နောက် တက္ကသိုလ်များ အုပ်ချုပ်ရေးရုံး ဘာသာပြန်နှင့် [illegible]လက်ဝေရေးဌာန၏ ဌာနမှူး၊ တက္ကသိုလ်မြန်မာစာအဘိဓာန်၏ စာတည်းမှူးအဖြစ် ဆောင်ရွက်ခဲ့ဖူးသည်။ ရန်ကုန် [illegible] မြန်မာစာဌာန ပါမောက္ခအဖြစ်လည်း ဆောင်ရွက်သည်။ ၁၉၆၈တွင် အငြိမ်းစားယူသည်။

မင်းသုဝဏ်သည် ခေတ်စမ်းစာပေ၊ ခေတ်စမ်းကဗျာကိုတည်ထောင်ခဲ့သူတစ်ဦးအဖြစ် ထင်ရှား သည်။ ကဗျာကို [illegible]သုနှစ်ခန့်တွင် စတင်ရေးသားသည်။ ကဗျာအပြင် ဝတ္ထုတို၊ ပုံပြင်၊အစမ်းစာ (ရသစာတမ်း)၊ မှတ်တမ်း၊ အတ္ထုပ္ပတ္တိ၊ [illegible]လွှဲ၊ စာပေသဘောတရားနည်းနာ၊ စာပေဝေဖန်ရေး၊ သတ်ပုံရေးထုံး၊ ဝေါဟာရအဖွင့်၊ အဘိဓာန်၊ ယဉ်ကျေးမှု [illegible]ဆောင်းပါးများ၊ ဝေဖန်စာများရေးသား သည်။ ၂၀၀၄ခုနှစ် ဩဂုတ်လ ၁၅ရက်နေ့တွင် ကွယ်လွန်ခဲ့သည်။

[illegible]သုဝဏ်၏ စာတ်လမ်းကဗျာဖန်တီးပုံ

မင်းသုဝဏ်သည် မြန်မာစာပေ၊ မြန်မာ့ယဉ်ကျေးမှု၊ မြန်မာဘာသာစကားဟူသော နယ်ပယ်များကို ဘက်စုံတောင့်စုံ [illegible]လာခဲ့သူ စာဆိုကြီးဖြစ်ပါသည်။ ထို့ပြင် မြန်မာကဗျာလောကအတွက် ဧာတ်လမ်းကဗျာ ကဗျာပုံသဏ္ဌာန်သစ်ကို [illegible]ခဲ့သည်။ မင်းသုဝဏ်၏ဧာတ်လမ်းကဗျာများ အနက်ထင်ရှားသော ကဗျာသုံးပုဒ်မှာ'ဖိုးမောင်လာပြီ'၊ 'သူ့မှာတမ်း'၊ [illegible]ကျော်ဇော' ကဗျာတို့ဖြစ်ပါသည်။ ယင်းကဗျာ သုံးပုဒ်မှာ အကြောင်းအရာအရလည်းကောင်း၊ ရေးဖွဲ့ပုံအရလည်းကောင်း [illegible]ထင်ခံရသော ကဗျာများ ဖြစ်ပါသည်။

[illegible]အကြောင်းအရာပိုင်းဖန်တီးပုံ

မြန်မာကဗျာသမိုင်းတွင် ၁၉၃၀-ဝန်းကျင်၌ ခေတ်စမ်းစာဆိုတို့သည် မြန်မာစာပေဖွံ့ဖြိုးရေးအတွက် အကြောင်း [illegible]ခံအဖြစ်ကိုရေးဖွဲ့ပြီး မြန်မာစာပေ၏ နယ်နိမိတ်ကိုချဲ့ထွင်ခဲ့ကြသည်။ ခေတ်စမ်းစာဆို မင်းသုဝဏ်သည်လည်း အနောက် [illegible]သောလက်ကဗျာပုံစံကိုအခြေခံကာ အတွေးသစ်များဖြင့်ဧာတ်လမ်း ကဗျာပုံသဏ္ဌာန်သစ်ကို ရေးဖွဲ့ခဲ့ပါသည်။

[illegible]။ စာတ်တွက်တစ်ကွက်ဖြင့်ဖန်တီးပုံ

စာတ်လမ်းကဗျာသည် ဧာတ်လမ်းရှည်ကြီးမဟုတ်ဘဲ ဧာတ်ကွက်တစ်ကွက်ကိုအခြေခံ၍ ဧာတ်လမ်းဆင် ဖွဲ့ဆိုပါ [illegible]ည်။ မင်းသုဝဏ်၏ဧာတ်လမ်းကဗျာသုံးပုဒ်လုံးတွင် ထိုသဘောမျိုးတွေ့ရပါသည်။

'ဖိုးမောင်လာပြီ' ကဗျာတွင် ရွာကလေးကိုငါးရှာကျွေးနေသော ကျေးတောသားတံငါသည်ဖိုးမောင် သည် ငါးရှာပြီး [illegible]အပြန် မိမိရွာကို စားပြေးရန်မှ အသက်စွန့်ကာကွယ်သွားသည့်အဖြစ်အပျက်ကို ဧာတ်ကွက်ဆင်ဖွဲ့ဆိုထားသည်။ [illegible]အစတွင် ဖိုးမောင်ငါးရှာပြီး ရွာသို့ပြန်လာလျှင် လူအသွားအလာ ကင်းမဲ့သော လူခြေတိတ်ချိန်မျိုးမှပြန်လာလေ့ရှိပုံ၊ [illegible]ကောင်ချောင်းမှာ ငါးရှာပြီးပြန်လာသော ဖိုးမောင် အသံကြားလျှင် ကင်းသမားက ရွာတံခါးမ မလွယ်ပေါက်ကို ဖွင့်ပေး [illegible]ပုံ၊ ငါးရှာပြီးပြန်လာသော ဖိုးမောင်၏အသွင်ကို-

[illegible]ကိုင် အုပ်ဆောင်း၊ ဝဲတက်ချောင်းနှင့်၊

[illegible]ကိုယ်ကိုင်း၊ ငါးပလိုင်းကို၊

[illegible]ကိုင်ပြီးလျှင်၊ ရွာသို့ဝင်သည်၊

[illegible] တစ္ဆေလား

[illegible]ကွယ် ပင်ပန်းစွာလုပ်ကိုင်ရသူဖြစ်ပုံ၊ တစ္ဆေမကြောမြွေမကြောက်ဘဲ ညမှောင်မှောင်တွင် ဖိုးမောင်ငါးရှာကျွေးပုံ၊ [illegible]ကိုကို ဦးစွာဖော်ပြပါသည်။

[illegible]ကာ ဆောင်းတစ်ညတွင် ဇီးကွက်အော်သံ၊ တောက်တဲ့ကြော်သံတို့နှင့်အတူ ဂုတ်ကျားဟောင်၍ ဖိုးမောင် [illegible]ဖြစ်ခဲ့ကြောင်းလည်း ယခင်လို တံခါးမဖွင့်ခိုင်းပုံ၊ ရွာသားများကို မောင်းကိုထု လူများစုပြီး ရွာကိုစားပြအန္တရာယ်မှ [illegible]ကယ်ရန် အော်ဟစ်သတိပေးပုံ၊ ဖိုးမောင်၏စကားမဆုံးမီ သေနတ်သံများပဲ့တင်ထပ်ကာ စားပြလက်ချက်ဖြင့် ဖိုးမောင်

သေဆုံးသွားပုံကို ဇာတ်ကွက်ဆင်ဖွဲ့ဆိုထားသည်။ မိမိရွာကို စားပြအန္တရာယ်မှလွတ်မြောက်အောင် အသက်စွန့် ကာကွယ်သွားသော ဖိုးမောင် အကြောင်းဖြစ်ရပ်တစ်ခုကို ဇာတ်လမ်းဆင်ရေးဖွဲ့ထားခြင်းဖြစ်သည်။

'သူ့မှာတမ်း'ကဗျာသည် ပြောက်ကျားတပ်သားလေးတစ်ဦး၏ တိုင်းပြည်ချစ်စိတ်ကို ဖော်ပြလိုပါသည်။ ဖက်ဆစ် ဂျပန်တို့ကိုတော်လှန်ရင်း ဂျပန်တို့မြုပ်ထားခဲ့သော ဗုံးထိမှန်၍ သေလုနီးပါး ဝေဒနာခံစားနေရသော ပြောက်ကျားတပ်သား နှင့် ရွာသူရွာသားများအပြန်အလှန်မေးကြဖြေကြပုံ ဇာတ်ကွက်ဖြင့် ဇာတ်လမ်းဆင် ရေးဖွဲ့ပါသည်။ ရွာသားများ၏ ပထမ အမေးစကားသည် ချစ်သူအတွက်ဖြစ်ပြီး၊ ပြောက်ကျားတပ်သားလေးက ချစ်သူအပေါ်ခွင့်လွှတ်ပုံ၊ ဒုတိယအမေးစကားသည် မိဘများအတွက်ဖြစ်ပြီး မိဘအားရှိခိုးကန်တော့ခဲ့ပုံ၊ တတိယအမေးစကားသည် တိုင်းပြည်အတွက်ဖြစ်ပြီး၊ တိုင်းပြည် အတွက် မိမိအသက်ကိုပင် စွန့်လွှတ်ထားပါသော်လည်း မိမိသေရမည်ထက် တိုင်းပြည်လွတ်လပ်ရေးမရမီ လမ်းခုလတ်မှာ ကိုယ်လွတ်ရှောင်ခွာပြီး ချစ်သောတိုင်းပြည်နှင့်ခွဲခွာရသည့်အတွက် တိုင်းပြည်ကိုအားနာမိပါကြောင်းဖြေကြား၍ ပြောက် ကျားတပ်သားလေး၏ တိုင်းပြည်ချစ်စိတ်ကိုဖော်ညွှန်းပုံ၊ ဤသို့ မေးကြဖြေကြပုံ ဇာတ်ကွက်အဖြစ်အပျက် တစ်ခုကိုအခြေခံ ကာ ဇာတ်လမ်းကဗျာရေးဖွဲ့ပါသည်။

'မင်းရဲကျော်စွာ'ကဗျာတွင် ဒလတိုက်ပွဲ၌ မင်းရဲကျော်စွာ ဒဏ်ရာသည်းထန်စွာရပြီး မွန်တို့၏ လက်တွင်းသို့ ကျရောက်ခဲ့သည့် စိတ်ဝင်စားဖွယ် ဇာတ်ကွက်လေးတစ်ကွက်ကို အသက်ဝင်လာအောင် ပုံဖော်ရေးဖွဲ့ထားပါသည်။ မင်းရဲ ကျော်စွာကဗျာတွင် ရန်သူကိုထိမထင်သည့် ရဲရဲတောက်မြန်မာ သူရဲကောင်းတစ်ဦး၏စိတ်ဓာတ်ကို တင်ပြလိုခြင်းဖြစ်သည်။ မင်းရဲကျော်စွာ ဒဏ်ရာပြင်းထန်စွာရပြီး ရာဇာဓိရာဇ်လက်သို့ပါလာသောအခါ ရာဇာဓိရာဇ်က တိုင်းပြည်တစ်ဝက်ယူ၍ မင်းပြုပါဟု ဖိတ်ခေါ်သည်ကို မင်းရဲကျော်စွာက 'တိုင်းပြည်မဲ့သူမဟုတ်ပါ' ဟု ငြင်းပယ်သည်။ တစ်ဖန်သမီးတော်နှင့် ထီးနန်း အတူစံပါဟု ဖိတ်ခေါ်သည်ကို မင်းရဲကျော်စွာက 'မယားမဲ့သူမဟုတ်ပါ' ဟုငြင်းပယ်သည်။ တစ်ဖန် သားအဖြစ် အမွေဆက်ခံ ပါဟုဖိတ်ခေါ်သည်ကို 'ဖခင်မဲ့သူမဟုတ်ပါ' ဟုငြင်းပယ်သည်။ နောက်ဆုံး ဆေးဝါးကုသပြီး နေကောင်းလျှင် တိုင်းပြည်ပြန်ပါ ဟုဆိုသည်ကို 'သေခြင်းမဲ့သူမဟုတ်ပါ' ဟုငြင်းပယ်သည်။ မင်းသုဝဏ်သည် ရာဇာဓိရာဇ်နှင့် မင်းရဲကျော်စွာတို့ အချီအချ ပြောကြဟန်ဖြစ်ရပ်တစ်ခုကို ဇာတ်ကွက်ဆင်၍ ဇာတ်လမ်းကဗျာဖန်တီးခဲ့သည်။

မင်းသုဝဏ်၏ ဇာတ်လမ်းကဗျာသုံးပုဒ်လုံးတွင် အဖြစ်အပျက်တစ်ခုကိုအခြေခံ၍ ဇာတ်ကွက်ဆင်ကာ ဇာတ်လမ်း ကဗျာ အဖြစ်ဖန်တီးခဲ့သည်။ ယင်းကဗျာသုံးပုဒ်လုံးသည် ဦးတည်ချက်ကောင်းမွန်သည်။ ဇာတ်လမ်းဇာတ်ကွက် ရိုးရိုး ရှင်းရှင်းဖြင့် စွဲငြိဖွယ်ကောင်းအောင် ပုံဖော်နိုင်သည်။

၃၊ ၁၊ ၂။ ဇာတ်ဆောင်ပြောစကားများဖြင့်ဖန်တီးပုံ

ဇာတ်လမ်းကဗျာများတွင် ဇာတ်ကွက်ကိုဖွဲ့ဖြိုးအောင်ပြုရာ၌ ဇာတ်ဆောင်တို့၏ပြောစကားများ၊ ဇာတ်ဆောင် အချင်းချင်းအပြန်အလှန်ပြောစကားတို့ဖြင့် ဖန်တီးပုံဖော်လေ့ရှိသည်။ မင်းသုဝဏ်သည် ဇာတ်လမ်းကဗျာ(၃)ပုဒ်လုံးတွင် ဇာတ်ကွက်ဇာတ်လမ်းအတွင်းရှိ ဇာတ်ဆောင်တို့၏ ပြောစကားများဖြင့် ဖန်တီးထားသည်ကို တွေ့ရပါသည်။

'ဖိုးမောင်လာပြီ'ကဗျာတွင် တစ္ဆေမကြောက် မြွေမကြောက်ဘဲ ငါးရှာထွက်ရသော ဖိုးမောင်၏ အပန်းကြီးလှသော ဘဝ၊ အရေးကြုံသောအခါ မိမိအသက်ကိုပဓာနမထားဘဲ ရပ်ရွာအကျိုးအတွက် အသက်စွန့်ရဲသော ဖိုးမောင်၏ စိတ်ဓာတ်ကို ဖော်ပြလိုသည်။ မင်းသုဝဏ်သည် ရပ်ရွာအကျိုးကို ဖိုးမောင်အသက်စွန့်ဆောင်ရွက်သွားပုံပေါ်လွင်စေရန် ပြောစကားဖြင့် ပုံဖော်ပါသည်။ ဖိုးမောင်ငါးရှာပြီး ပြန်လာသော ဆောင်းတစ်ညတွင်ဂုတ်ကျားဟောင်၍ ဖိုးမောင်လာချိန် ဖြစ်သော်လည်း ယခင်လိုတံခါး မဖွင့်ခိုင်းဘဲ ရွာထဲရှိရွာသူရွာသားများကို-

မောင်းကိုထုပါ။ လူစုပါဟေ့

ရွာကိုဘေးမှ ကာကွယ်ကြလော့

ဓားပြ ငါ့အားဖမ်း၍ထား

စသော်ဆောင်ဖိုးမောင်ပြောစကားသံဖြင့် ဖွဲ့ဆိုပါသည်။ စားပြအန္တရာယ်ကျရောက်နေပြီဖြစ်ကြောင်း ကျေးရွာရှိရွာသူ ရွာသားများကို အော်ဟစ်သတိပေးနေသော ဖိုးမောင်၏အသံကို ကြားယောင်လာစေ သည်။ ဖိုးမောင်၏ရဲရင့်မှု၊ အနစ်နာခံမှု၊ အကျိုးလိုလားမှုတို့ ပေါ်လွင်စေပါသည်။

'သူမှာတမ်း'ကဗျာတွင် ပြောက်ကျားစစ်သားကလေးနှင့်ရွာသူရွာသားများ အပြန်အလှန်မေးကြ ဖြေကြပုံဖြင့် ဇာတ်လမ်းကို ပုံဖော်ပါသည်။ ဇာတ်ဆောင်အချင်းချင်းအပြန်အလှန်ပြောစကားများဖြင့် ပုံဖော်ရာတွင် ရွာသားများက-

အောင်ပြောက်ကျား၊ ချစ်သူအားကို၊ ဘာများမှာခဲ့လိုသနည်း

ရွာသားကျားတပ်သားလေးက

ကြောင်မြတ်၊ မိသတ်မှတ်ကို၊ ခွင့်လွှတ်ခဲ့ကြောင်းပြောပါလေ

ကြားပါသည်။ ထိုမှတစ်ဆင့်တက်၍-

အောင်ပြောက်ကျား၊ မိဘအားကို၊ ဘာများမှာခဲ့လိုသနည်း

အမြန်ရာ ပြောက်ကျားတပ်သားလေးက

ညီမိခင်၊ မွေးဖခင်ကို ဦးတင်ခဲ့ကြောင်းပြောပါလေ

ကြားပါသည်။ ထို့နောက်တစ်ဆင့်တက်၍-

အောင်ပြောက်ကျား၊ တိုင်းပြည်အားကို၊ ဘာများမှာခဲ့လိုသနည်း

ရွာသားများက မေးသောအခါ-

ဦးတ်တတ်၊ လမ်းခုလတ်တွင်၊

ညီသွတ်ရှောင်ခွာ၊ ခွဲရပါ၍

အားခဲ့ကြောင်း ပြောပါလေ

၍ မှာကြားခဲ့ပါသည်။ ရွာသူရွာသားများနှင့် ပြောက်ကျားတပ်သားလေးတို့ အပြန်အလှန် အမေးအဖြေစကားများဖြင့် ဆက်စပ်ဇာတ်လမ်းကို ဖြစ်ထွန်းစေပါသည်။ ပြောက်ကျားတပ်သားလေး၏ နောက်ဆုံးအမှာစကားမှာ ထူးခြားလေးနက်ပါသည်။ တိုင်းပြည်အတွက် မိမိအသက် ကိုပင်စွန့်လွှတ်ရ တော့မည့် ပြောက်ကျားတပ်သားလေးက မိမိသေရမည်ထက် ဝမ်းသာလပ်ရေးခရီးမဆုံးမီ လမ်းခုလတ်မှာ ယခုလိုကိုယ်လွှတ်ရှောင်ခွာပြီး တိုင်းပြည်နှင့်ခွဲခွာရသည့်အတွက် တိုင်းပြည်ကို အားမိပါကြောင်းမှာကြားစကားဖြင့် ပြောက်ကျားတပ်သားလေး၏ တိုင်းပြည်ချစ်စိတ်မျိုးချစ်စိတ်ကို ဖော်ဆောင်ပါသည်။

'မင်းရဲကျော်စွာ' ကဗျာတွင် ရာဇာဓိရာဇ်နှင့်မင်းရဲကျော်စွာတို့ အပြန်အလှန်တွေ့ဆုံပြောဆိုသည့်အခန်းကို မင်းသုခစိတ်ကူးဖြင့်ကဗျာဖွဲ့ဆိုရာ၌ အပြန်အလှန်ပြောစကားများဖြင့် ဇာတ်လမ်းအသွင် ဖန်တီးတင်ပြခဲ့ပါသည်။ ရာဇာ ဓိရာဇ်၏ခေါ်ဘကြီးတော်နှင့် မင်းရဲကျော်စွာခေါ်တူတော်တို့ အပြန်အလှန် ပြောကြဟန်ကို-

ဦးလေးကျော်၊ ပြည်ကိုဝက်၍

ဖခင်ကြီးမင်းမူ၊ ငါ၏တူဟု

ဦးမင်းက ဖိတ်ခေါ်သည်

ဦးတော်ရဲ့၊ ကျေးဇူးငဲ့လည်း

ပြည်မဲ့သူ မဟုတ်ပါတဲ့

ကြည်းကောင်း

သမီးတော်နှင့်၊ ဥကောင်ဖွင့်၍
အသင့်မင်းမူ၊ ငါ၏တူဟု
နိုင်သူမင်းက ဖိတ်ခေါ်သည်
ဘကြီးတော်ရဲ့၊ ကျေးဇူးငဲ့လည်း
မယားမဲ့သူ မဟုတ်ပါတဲ့
ဟုလည်းကောင်း
သားတော်ရင်နှစ်၊ သားရင်းစစ်သို့
ထီးလှစ်မင်းမူ၊ ငါ၏တူဟု
နိုင်သူမင်းက ဖိတ်ခေါ်သည်
ဘကြီးတော်ရဲ့၊ ကျေးဇူးငဲ့လည်း
ဖခင်မဲ့သူ မဟုတ်ပါတဲ့
ဟုလည်းကောင်း
ငါ၏ထံမှောက်၊ ဆေးဝါးသောက်၍
ထမြောက်ခါမူ၊ ပြန်လေတူဟု
နိုင်သူမင်းက ဖိတ်ခေါ်သည်
ဘကြီးတော်ရဲ့၊ ကျေးဇူးငဲ့လည်း
သေခြင်းမဲ့သူ မဟုတ်ပါတဲ့

ဟုလည်းကောင်း အပြန်အလှန်ပြောစကားတို့ဖြင့် ကဗျာဇာတ်လမ်းကိုဖော်ဆောင်ပါသည်။ ဇာတ်ဆောင် ပြောစကားတို့ဖြင့် မင်းရဲကျော်စွာ၏ပြတ်သားသော စိတ်ဓာတ်၊ သေရမည့်အချိန်အထိ အပြောင်းအလဲ မရှိသော တည်ကြည်သည့် စိတ်ဓာတ်တို့သည် ဝိုင်ပုံပေါ်လာသည်။ မြန်မာ့သမိုင်းတွင် လူငယ်သူရဲကောင်းအဖြစ်ထင်ရှားခဲ့သော အင်းဝဘုရင်မင်းခေါင်၏ သားတော် မင်းရဲကျော်စွာ၏ ရဲစွမ်းသတ္တိကို အပြန်အလှန်ပြောစကားဖြင့် ဇာတ်လမ်းအသွင်ပုံဖော်ခဲ့ပါသည်။

မင်းသုဝဏ်၏ဇာတ်လမ်းကဗျာ(၃)ပုဒ်လုံးတွင် ဇာတ်ဆောင်တို့ အချင်းချင်းပြောစကားတို့ဖြင့် ဇာတ်ကွက်ထင်ရှားအောင်၊ ဇာတ်ဆောင်၏အမူအရာထင်ရှားအောင်၊ကဗျာဦးတည်ချက်သို့ရောက်ရှိအောင် ရေးဖွဲ့ထားပါသည်။

၃၊ ၁၊ ၃။ လွမ်းဆွေးဖွယ်ဇာတ်ကွက်ဖြင့်ဖန်တီးပုံ

ဇာတ်လမ်းကဗျာများသည် အကြောင်းအရာမျိုးစုံကိုအခြေခံရေးဖွဲ့သော်လည်း များသောအားဖြင့် အလွမ်းအဆွေးသဘော၊ ကြေကွဲဖွယ်သဘောတို့ဖြင့် စိတ်လှုပ်ရှားခံစားဖွယ်ဖြစ်အောင် ရေးဖွဲ့လေ့ရှိသည်။ မင်းသုဝဏ်၏ ဇာတ်လမ်းကဗျာသုံးပုဒ်လုံးတွင် လွမ်းဆွေးဖွယ်ဇာတ်လမ်းဖြစ်ရပ်တို့ကိုအခြေခံ၍ ရေးဖွဲ့ထားပါသည်။

'ဖိုးမောင်လာပြီ'ကဗျာတွင် ငါးရှာပြန်လာစဉ် ဓားပြများလက်ချက်ဖြင့် ဖိုးမောင်သေဆုံးသွားသည်မှာ စိတ်လှုပ်ရှားဖွယ်ကောင်းသည်။ မိမိအသက်ကိုစွန့်၍ ရွာကိုကယ်တင်လိုက်သောဖိုးမောင်ကို ရွာသူရွာသားများ အောက်မေ့သတိရဖြစ်နေကြသည်မှာ ရင်နှင့်ဖွယ်၊ လွမ်းဆွေးဖွယ်ဖြစ်သည်။ ခွေးဟောင်သံကြားတိုင်း 'ဖိုးမောင်လာပြီ'ဟု ဆိုစမှတ်ပြုတတ်ကြပုံဖြင့် အဆုံးသတ် ဖွဲ့ဆိုထားသည်။ လွမ်းဆွေးဖွယ် အခြေအနေဖြင့် ကဗျာဖတ်သူရင်တွင်းစွဲငြိအောင် ဇာတ်လမ်းဆင် ဖန်တီးနိုင်သည်။

'သူမှာတမ်း'ကဗျာတွင် ရွာသူရွာသားများက ပြောက်ကျားတပ်သားလေးအား မေးမြန်းနေကြစဉ် ပြောက်ကျား သားလေး အသက်ထွက်သွားပုံကို 'မေးမြူကြတုန်း၊ အနောက်ကုန်းတွင်၊ နေလုံးကွယ်လေပြီတကား' ဟုကဗျာကို သုံးသပ်ကာ နေလုံးကြီးကွယ်သွားပုံဖြင့်သင်္ကေတပြု၍ ဇာတ်သိမ်းထားပုံမှာ ရင်နင့်ဖွယ်ဖြစ်သည်။ မျိုးချစ်ပြောက်ကျား သားလေး၏ဘဝနိဂုံးကို လွမ်းဆွေးဖွယ်ဖြစ်အောင် ဖွဲ့ဆိုထားသည်။

'မင်းရဲကျော်စွာ' ကဗျာတွင် မင်းရဲကျော်စွာကို ရာဇာဓိရာဇ်က စည်းစိမ်အမျိုးမျိုးဖြင့် ဖိတ်ခေါ်ပါသော်လည်း ငြင်းပယ်ခဲ့သည်။ ထို့ကြောင့် 'လှံဓားကိုလဲ၊ စစ်မြေထဲ၌၊ မင်းရဲကျော်စွာ၊ စေတီသာကို၊ ရာဇာဓိရာဇ၊ ရေစက်ချလျှက်၊ အမျှ သုံးကြိမ်ဝေသည်၊ မြို့ငြခြေဒလ တောကြီးတန်း' ဟူ၍ မင်းရဲကျော်စွာ၏ အရိုးအိုးစေတီတွင် ရာဇာဓိရာဇ် ရေစက် ချ၍အမျှဝေနေပုံဖွဲ့ဆိုပါသည်။ မင်းရဲကျော်စွာ၏ကြေကွဲဖွယ်ဘဝနိဂုံးကိုသင်္ကေတပြုလိုက်ခြင်းဖြစ်သည်။ သူရဲကောင်း နှိုးဆုံးရသည့်ဖြစ်ရပ်ဖြင့် လွမ်းဆွေးဖွယ်ဇာတ်လမ်းဆင်ဖွဲ့ဆိုထားသည်။ မင်းသုဝဏ်သည် လွမ်းဆွေးဖွယ် ဇာတ်ကွက် ဇာတ်လမ်းကို စွဲငြိအောင်ဖွဲ့သည်။ ကဗျာဦးတည်ချက်ကိုလည်း ပေါ်လွင်စေပါသည်။

၂.၂ အရေးအဖွဲ့ပိုင်းဖန်တီးပုံ

မင်းသုဝဏ်သည် ဇာတ်လမ်းကဗျာများကိုဖန်တီးရာတွင် ခံစားမှုနှင့်ရိုးရှင်းပြီးထက်မြက်သော စကားလုံးတို့ ဖြင့်ဖန်တီးထားသဖြင့် စွဲငြိဖွယ်ဖြစ်အောင် ရေးဖွဲ့ပါသည်။ မင်းသုဝဏ်၏ အဖွဲ့အနွဲ့စွမ်းရည်ကြောင့် ဇာတ်လမ်းကဗျာများသည် ကဗျာဆန်ဆန်ပြင်ကာ လွမ်းမောဖွယ်ကဗျာများအဖြစ် ထင်ရှားခဲ့ပါသည်။

၂.၃ စကားအသုံးအနှုန်းဖန်တီးပုံ

ဇာတ်လမ်းကဗျာများ၏ထူခြောမှုမှာ ရိုးရှင်းသောစကားအသုံးအနှုန်းတို့ဖြင့် ရေးဖွဲ့လေ့ရှိခြင်းဖြစ်သည်။ မင်းသုဝဏ် သည်လည်း ဇာတ်လမ်းကဗျာများတွင် ရိုးရှင်းလွယ်ကူသော စကားအသုံးအနှုန်းများကို အများဆုံး အသုံးပြုရေးဖွဲ့ပါသည်။

'ဖိုးမောင်လာပြီ'ကဗျာတွင် ညအမှောင်ထုအောက် ငါးရှာဖွေသည့်အလုပ်ကို လုပ်ကိုင်သူ ဇာတ်ဆောင်ဖိုးမောင်ကို ကျေးဇူးထောင် မောင်ဖိုးမောင်'ဟုလည်းကောင်း၊ ဖိုးမောင်၏ ဝမ်းစာရှာဖွေသွားချိန်ကို 'ညခါ' ဟုလည်းကောင်း၊ ဖိုးမောင်၏ လုပ်အကိုင်ကို 'ငါးထောင်'ဟုလည်းကောင်း၊ ဇာတ်ဆောင်ဖိုးမောင်ကို 'မောင်ဖိုးမောင်' ဟုလည်းကောင်း၊ ဖိုးမောင်ငါးရှာ ပြန်လာချိန်ကို 'လူခြေတိတ်၍' ဟုလည်းကောင်း၊ ဖိုးမောင်ပြန်လာလျှင် ကင်းသမားဖွင့်ပေးသည့် တစ်ယောက်ဝင်ရုံသာ ရှိသည့်တက္ကဖွင့်နိုင်ပိတ်နိုင်သောတံခါးကို 'မလွယ်ပေါက်' ဟုလည်းကောင်း၊ ဖိုးမောင်ငါးရှာသွားရာ အသုံးပြုသောပစ္စည်း များကို 'အုပ်ဆောင်း၊ တက်ချောင်း၊ ငါးပလိုင်း' ဟုလည်းကောင်း၊ ဇာတ်ဆောင် ဖိုးမောင်၏အခြေအနေ နှင့်လိုက်ဖက်သည့် ရွာသားသောစကားလုံးရိုးရိုးများကိုသာ အသုံးပြုထားပါသည်။

ရွာအနီးသို့ဓားပြများရောက်ရှိလာကြောင်း ရွာသားများကိုအော်ဟစ်အသိပေးလိုက်သော ဖိုးမောင်အား 'ဓားပြများ ရောက်တတ်သံကို- 'ဒိုင်း ဒုန်း ဒိန်း သံ' ဟု မြည်သံစွဲ စကားလုံးများကိုဆင့်ကာဆင့်ကာ အသုံးပြုထားသည်။ မရှုမလှခံရမည့် ဖိုးမောင်၏အခြေအနေ မြင်သာစေသည်။ ဖိုးမောင်အတွက် စိတ်ထိခိုက် လှုပ်ရှားစေသည့် အသံစကားလုံးများ ဖြစ်ပါသည်။

'သူမှာတမ်း' ကဗျာတွင် ပြောက်ကျားတပ်သားလေး၏အမှာစကားများ၌ ပထမအမှာစကားသည် ချစ်သူအတွက် မြို့ပြီး မိမိမရှိသည့်နောက် ချစ်ရေးချစ်ရာအားလုံးချစ်သူမည်သို့ ဆောင်ရွက်သည်ဖြစ်စေ နားလည်ခွင့်လွှတ်ပုံကို 'ခွင့်လွှတ်' သောစကားသုံး၊ ဒုတိယအမှာစကားသည် မိဘအတွက်ဖြစ်ပြီး မိဘတို့ကို ရှိခိုးကန်တော့ခဲ့ကြောင်းကို 'ဦးတင်' ဟူသော စကားသုံး၊ တတိယအမှာစကားသည် တိုင်းပြည်အတွက်ဖြစ်ပြီး မိမိတိုင်းပြည်ကိုလွတ်လပ်ရေးရသည်အထိ တိုက်ပွဲမဝင်နိုင် ကြရှာသော်အားနာလှကြောင်းကို'အားနာ'ဟူသောစကားသုံးတို့ဖြင့် ရေးဖွဲ့ထားသည်။ စကားလုံးရိုးရိုးလေးများဖြင့် ပြောက်ကျား တပ်သားလေး၏ သိမ်မွေ့မှု၊ ယဉ်ကျေးမှု၊ မြန်မာ့ဓလေ့မြန်မာ့အမူအရာများ ထင်ရှားစေသည်။ တိုင်းပြည်အတွက် အသက် စွန့်လိုက်ဖြစ်သော်လည်း လွတ်လပ်ရေးမရမီလမ်းခုလတ်တွင်ခွဲခွာရခြင်းကြောင့် မိမိကိုယ်ကိုတာဝန်မကျေသေးဟု ယူဆနေ သော ပြောက်ကျားတပ်သားလေး၏မျိုးချစ်စိတ်ကို 'အားနာ' ဟူသောရိုးရှင်းပြီး မြန်မာဆန်လှသည့် စကားလုံးလေးဖြင့် ဖော်ကြွေးခဲ့သည်။

ပြောက်ကျားတပ်သားလေး ကွယ်လွန်သွားပုံကို နေမင်းကြီးဝင်ရောက်ကွယ်ပျောက်သွားပုံဖြင့် သင်္ကေတပြုကာ 'နေလုံးကွယ်' ဟုသုံးထားသည်။ ပြောက်ကျားတပ်သားလေးကို လောကလူသားတို့ တန်ဖိုးထားသော နေမင်းလမင်းနှင့် တင်စားကာ သုံးနှုန်းရေးဖွဲ့ထားသည်။ ပြောက်ကျားတပ်သားလေး၏တိုင်းပြည်ချစ်စိတ်ရှိခြင်း၏တန်ဖိုးကြီးမားမှုကို ပေါ်လွင်စေသည်။

'မင်းရဲကျော်စွာ' ကဗျာတွင် မင်းရဲကျော်စွာ ဒဏ်ရာပြင်းထန်စွာရနေသည့်အခြေအနေကို 'အနာသည်းလည်း'၊ ရရှိသောဒဏ်ရာများကို ကြိတ်မှိတ်သည်းခံပြီးအားတင်းနေရသည့် ရုပ်အမူအရာကို 'ခံသည်းညည်း'၊ 'မညည်းမညူ' ဟူသော ရိုးရှင်းသည့်နေ့စဉ်သုံး စကားသုံးများဖြင့် ရေးဖွဲ့ထားသည်။ အသုံးပြုသည့်စကားသုံးများသည်ရိုးရှင်းသော်လည်း အဓိပ္ပာယ်လေးနက်ထင်ရှားသည်။မင်းရဲကျော်စွာ၏ သူရဲကောင်းတစ်ဦးသတ္တိကို မြင်သာစေပါသည်။

ရာဇဝိရာဇ်က မင်းရဲကျော်စွာအား တိုင်းပြည်တစ်ဝက်ပေးမည်ကို 'ပြည်ကိုဝက်'၊ ရာဇာဓိရာဇ်ကို 'နိုင်သူမင်း'၊ ဘကြီးတော်ရာဇာဓိရာဇ်က မင်းရဲကျော်စွာအပေါ် အခွင့်အရေးပေးမှုများကို 'ကျေးဇူး'၊ ရာဇာဓိရာဇ်၏ကမ်းလှမ်းချက်များကို 'ဖိတ်ခေါ်'၊ မင်းရဲကျော်စွာကို 'တူတော်' ဟူသော ရိုးရှင်းသည့် စကားသုံးများဖြင့် ဇာတ်လမ်းအဖြစ်အပျက်ထင်ရှားအောင်၊ ဇာတ်ဆောင်တို့အမူအရာပေါ်လွင်အောင် အသုံးပြုထားသည်။

ရာဇာဓိရာဇ်က အခွင့်အရေးပေးပါသော်လည်း မင်းရဲကျော်စွာ၏ငြင်းပယ်မှုများကို 'တိုင်းပြည်မဲ့သူ၊ မယားမဲ့သူ၊ ဖခင်မဲ့သူ၊ သေခြင်းမဲ့သူ' ဟူသော ရှင်းလင်းပြီး အနက်အဓိပ္ပာယ်ပေါ်လွင်သော စကားသုံးများဖြင့်သာ ရေးဖွဲ့ထားသည်။ အရိုးရှင်းဆုံးစကားသုံးများဖြင့် မင်းရဲကျော်စွာ၏သူရဲကောင်း ပီသသောဂုဏ်ရည်ကိုပေါ်လွင်အောင် ဖွဲ့ဆိုထားသည်။ သို့ဖြစ်၍ မင်းသုဝဏ်၏ဇာတ်လမ်းကဗျာများ တွင် ရိုးရိုးရှင်းရှင်းစကားသုံးများဖြင့်သာ ဖန်တီးရေးဖွဲ့ကြောင်းတွေ့ရပါသည်။

၃၊ ၂၊ ၂။ ဝါကျဖန်တီးပုံ

ဇာတ်လမ်းကဗျာတွင် ဦးတည်ချက်ပေါ်လွင်စေရန် ဇာတ်ဆောင်တို့၏ အပြုအမူထင်ရှားလာစေရန် ဇာတ်လမ်းဆင်တင်ပြရာ၌ ဇာတ်ဆောင်တို့၏ပြောစကားများဖြင့် ဖန်တီးရပါသည်။ ဇာတ်ဆောင်တို့၏ ပြောစကားများကို ကဗျာဆရာသည် ကဗျာဝါကျများဖြင့်ပုံဖော်ရပါသည်။

'ဖိုးမောင်လာပြီ' ကဗျာသည် မိမိရပ်ရွာကို အသက်စွန့်ကာကွယ်သွားသော ဖိုးမောင်၏ဂုဏ်ရည်ကို လွမ်းဆွေးဖွယ်ကောင်းအောင်ပုံဖော်ထားသော ကဗျာဖြစ်သည်။ ချောမွေ့ပြေပြစ်သည့် ဝါကျများကို အများဆုံး တွေ့ရသည်။

ဖိုးမောင်ငါးရှာပြီး ညအခါမှပြန်လာလေ့ရှိပုံကို-

ဂုတ်ကျား ကျယ်လောင်၊ ဆီးကြိုဟောင်သော်၊

ဖိုးမောင်လာပြီဆိုကြသည်

ညခါ ငါးထောင်၊ မောင်ဖိုးမောင်သည်၊

ရွာတောင်ချောင်းက ပြန်ခဲ့ပြီ

ဟူသော ချောမွေ့ပြေပြစ်သည့် ဝါကျများဖြင့် ရေးဖွဲ့ထားသည်။ ဖိုးမောင်နေ့စဉ်လုပ်ဆောင်ရသော ဘဝအခြေအနေထင်ရှားစေပါသည်။

ငါးထောင်ပြီးပြန်လာသောဖိုးမောင်၏ရုပ်သွင်သည် ညအမှောင်ထုအတွင်း၌ မပီဝိုးဝါးဖြစ်ရပုံကို-

လူပင်လေလား တစ္ဆေလား

ဟူသော အမေးဝါကျအဖွဲ့မျိုးဖြင့် မကြောက်မရွံ့ခက်ခဲပင်ပန်းစွာ ဘဝဝမ်းကျောင်းရသူအဖြစ် သိမြင်စေသည်။

ဓားပြများရွာအနီးရောက်ရှိလာသောကြောင့် ဖိုးမောင်က ရွာသားများအား အော်ဟစ်အသိပေးရာတွင်-

မောင်းကိုထုပါ၊ လူစုပါဟော့

...သော စေခိုင်းဝါကျများ၊

...သေးမှ ကာကွယ်ကြလော့

...သော တိုက်တွန်းဝါကျဖြင့် ရေးဖွဲ့ထားသည်။ ဇာတ်ဆောင်ဖိုးမောင်၏အသံများ ကြားယောင်လာ စေသည်။ စာပြများ၏ ...ယ်ကိုမင့်ဘဲ မိမိရွာကိုကယ်တင်လိုသော ဖိုးမောင်၏စေတနာ၊အနစ်နာများ ထင်ရှားလာစေသည်။ ပညာမဲ့ဆင်းရဲသား ...သည်တစ်ဦးဖြစ်သော်လည်း မိမိအသက်ကိုအလေးမမူဘဲ ရပ်ရွာအကျိုးကို ရှေ့တန်းတင်လိုသော ဖိုးမောင်၏ဂုဏ် ...ွင်စေပါသည်။

'သူမှာတမ်း' ကဗျာတွင် ရှင်းလင်းပြေပြစ်သည့်ဝါကျများ၊ ဇာတ်ဆောင်အချင်းချင်း အပြန်အလှန် အမေးအဖြေ ...ဖြင့် မြန်မာပြောက်ကျားတပ်သားလေး၏ တိုင်းပြည်ချစ်စိတ်ကို ပုံဖော်ထားသည်။ ရွာသားများကမေးသော အမေး ...ခွန်းများ ပြောက်ကျားတပ်သားလေးက ပြန်လည်ဖြေကြားသော အဖြေဝါကျအဖွဲ့များဖြင့် ဇာတ်ကွက်ကို ဖော်ဆောင် ...သည်။ သာဓကအားဖြင့်-

...ောင်ပြောက်ကျား၊ ချစ်သူအားကို

...မျှော်မှာခဲ့လိုသနည်း

...ကြင်မြတ်၊ မိသက်မှတ်ကို

...လွှတ်ခဲ့ကြောင်း၊ ပြောပါလေ

ရှင်းလင်းပြေပြစ်သောဝါကျများဖြင့် ရွာသားများ၏မေးသံ၊ ပြောက်ကျားတပ်သားလေး၏ဖြေသံများ ကြားယောင်စေပါ ...သည်။ ဇာတ်ဆောင်များကိုလည်း မြင်ယောင်စေပါသည်။ အထူးသဖြင့် ပြောက်ကျား တပ်သားလေး၏ အမှာစကားများတွင်-

...လွှတ်ခဲ့ကြောင်း ပြောပါလေ

...ကြင်ခဲ့ကြောင်း ပြောပါလေ

...နာခဲ့ကြောင်း ပြောပါလေ

ရှင်းလင်းသော ဝါကျဖွဲ့ဟန်များကြောင့် ပြောက်ကျားတပ်သားလေး၏ ချစ်သူကိုနားလည်ခွင့်လွှတ် တတ်သော၊ မိဘကို ...မေလေးစားသော၊ တိုင်းပြည်ကိုချစ်မြတ်နိုးသော မြန်မာမျိုးချစ်လူငယ်တစ်ဦး၏ စိတ်ထားပေါ်လွင်စေပါသည်။

'မင်းရဲကျော်စွာ' ကဗျာတွင် ရာဇာဓိရာဇဇ်က မင်းရဲကျော်စွာအား အခွင့်အရေးပေးကမ်းလှမ်းမှုများကို-

...ိုပေလျက်၊ ပြည်ကိုဝက်၍

...းဆက်မင်းမူ၊ ငါ၏တူဟု

...မီးတော်နှင့်၊ ဥကင်ဖွင့်၍

...ဆင့်မင်းမူ၊ ငါ၏တူဟု

...ဆိုမှောက်၊ ဆေးဝါးသောက်၍

...မြောက်ခါမူ၊ ပြန်လေတူဟု

...ကျတိုင်းတွင် '၍' သမ္မန္ဓကိုသုံးကာ ပုံစံတူဝါကျဖြင့်ဖွဲ့ထားသည်။ ပုံစံတူဝါကျဖွဲ့ဟန်များကြောင့် အခွင့်အရေးပေး စည်းရုံး ...သည့် ရာဇာဓိရာဇဇ်၏သဘောထားများ ရှင်းရှင်းလင်းလင်းမြင်လာပါသည်။

ဤသို့ ရှင်းလင်းပြေပြစ်သောဝါကျများဖြင့် မင်းရဲကျော်စွာကို ရာဇာဓိရာဇဇ်က ကမ်းလှမ်း ဖိတ်ခေါ်မှုများ၊ အညှဉ်မခံ ...ိုက်ဖြင့် ငြင်းပယ်ခဲ့သော မင်းရဲကျော်စွာ၏ သူရဲကောင်းဝိသမ္မများပေါ်လွင် စေပါသည်။ မင်းသုဝဏ်သည် ဇာတ်လမ်း

ဇာတ်ကွက်ထင်ရှားစေသည့် ဇာတ်ဆောင်တို့၏ရုပ်၊ အသံတို့ကို မြင်ယောင်ကြားယောင်စေသည့် ရှင်းလင်းပြေပြစ်သော ဝါကျဖွဲ့ဟန်များဖြင့် ဇာတ်လမ်းကဗျာများကို ဖန်တီးရေးဖွဲ့ပါသည်။

၃၊ ၂၊ ၃။ ထပ်ကျော့ရေးဖွဲ့ဖန်တီးပုံ

ဇာတ်လမ်းကဗျာတွင် ထပ်ကျော့ဖွဲ့ဆိုမှုများဖြင့်ဇာတ်ကွက်ကို ထင်ရှားစေသည်။ ဇာတ်လမ်းဦးတည်ချက် ပေါ်လွင်စေသည်။ မင်းသုဝဏ်၏ ဖိုးမောင်လာပြီကဗျာတွင် ရွာကလေးကို ငါးရှာကျွေးနေသောဖိုးမောင်ပြန်လာချိန်ကို ကဗျာအစတွင်-

ဂုတ်ကျား ကျယ်လောင်၊ ဆီးကြိုဟောင်သော်၊

ဖိုးမောင်လာပြီဆိုကြသည်

ဟူ၍ ဂုတ်ကျားဟောင်သံကြားရပါက ဖိုးမောင်လာပြီဟုသိကြပုံဖြင့် ဦးစွာဇာတ်ကွက်စခဲ့ပါသည်။ ကဗျာ၏အဆုံးတွင် ဖိုးမောင်ကွယ်လွန်ခဲ့ပြီးဖြစ်သော်လည်း ရွာသားများ၏စိတ်တွင် ဖိုးမောင်အပေါ် သတိရနေကြပုံကို-

ဂုတ်ကျားကျယ်လောင်၊ ရမ်းရော်ဟောင်သော်

ဖိုးမောင်လာပြီဆိုမြဲပင်

ဟုထပ်ကျော့ကာဖွဲ့ဆိုထားပါသည်။ 'ဖိုးမောင်လာပြီဆိုကြသည်' ဟုလည်းကောင်း၊ 'ဖိုးမောင်လာပြီဆိုမြဲပင်' ဟုလည်းကောင်း ထပ်ကျော့ဖွဲ့ဆို၍ ဇာတ်ဆောင်ဖိုးမောင်သည် ရွာ၏အကျိုးသယ်ပိုးခဲ့သောကြောင့် ရွာသူရွာသားတို့ သတိတရရဖြစ်နေကြပုံ ကို ပေါ်လွင်စေပါသည်။

'သူမှာတမ်း'ကဗျာတွင် ဗုံးထိမှန်၍သေလုနီးနီးဝေဒနာခံစားနေသော မြန်မာပြောက်ကျားတပ်သားလေးကို ရွာသားရွာသူတို့မေးမြန်းကြပုံ၊ မေးမြန်းနေသောအချိန်သည် ယမ်းငွေ့တို့တအူအူထွက်ပေါ်နေသော အချိန်ဖြစ်ပုံကို ကဗျာ၏အစတွင်-

ရွာသားရွာသူ၊ မေးကြမြူသည်

အူအူယမ်းငွေ့ ထတုန်းတည်း

ဟုဖွဲ့ဆိုပါသည်။ ယင်းသဘောအခြေအနေမျိုး ကဗျာအဆုံးမှာလည်း-

ယမ်းငွေ့အူအူ၊ တလူလူနှင့်

မေးမြူကြတုန်း

ဟု ထပ်ကျော့ဖွဲ့ဆိုပါသည်။

ဗုံးပေါက်ကွဲပြီးခါစအခြေအနေ စစ်၏အနိဋ္ဌာရုံကို ထင်ရှားစေသည်။ ပြောက်ကျားတပ်သားလေး၏ ဘဝနိဂုံးကို လွမ်းမောဖွယ် ဖြစ်စေသည်။

'မင်းရဲကျော်စွာ' ကဗျာတွင် ရာဇာဓိရာဇဓံက မင်းရဲကျော်စွာကိုမသတ်လိုဘဲ မက်မောဖွယ်ရာ စည်းစိမ်များဖြင့် စည်းရုံးခြင်းကို 'နိုင်သူမင်းက ဖိတ်ခေါ်သည်' ဟူသောစကားဖြင့် အပိုဒ်တိုင်းမှာ ထပ်ကျော့ကာဖွဲ့ဆိုပါသည်။

မင်းရဲကျော်စွာကလည်း ရာဇာဓိရာဇဓံ၏ချီးမြှင့်စည်းရုံးမှုများကို လက်မခံဘဲ ငြင်းပယ်ပုံကို 'ဘကြီးတော်ရဲ့၊ ကျေးဇူးငဲ့လည်း' ဟူသောစကားဖြင့် အပိုဒ်တိုင်းမှာထပ်ကျော့ဖွဲ့ဆိုပါသည်။ ဤသို့ဖွဲ့ဆိုမှုဖြင့် စစ်နိုင်သူရာဇာဓိရာဇဓံက အကြိမ်ကြိမ် စည်းရုံးမှုများကို ရှုံးနိမ့်သူ မင်းရဲကျော်စွာကလည်း အကြိမ်ကြိမ်ငြင်းပယ်ကြောင်း ကဗျာဇာတ်ကွက်တွင် ထင်ရှားလာသည်။ ထို့ပြင် စစ်ရှုံးသော်လည်း ရန်သူ့ထံမှာအညံ့မခံ၊ သေရမည်ကိုမကြောက်သော သူရဲကောင်းတစ်ဦး၏ ရဲစွမ်းသတ္တိပြည့်ဝပုံကို ပေါ်လွင်စေသည်။ မင်းသုဝဏ်သည် ဇာတ်လမ်းကဗျာသုံးပုဒ်လုံးတွင် ဇာတ်ကွက်အတွင်း ထပ်ကျော့ကာဆိုသည့် စကားတို့ဖြင့် ဇာတ်လမ်းအဖြစ်အပျက် ဇာတ်ဆောင်တို့၏ အမူအရာကို ပေါ်လွင်စေသည်။

နိဂုံးသင်္ချိုက်

ခေတ်စမ်းစာဆို မင်းသုဝဏ်သည် ဥရောပဘဲလက်ကဗျာတို့ကို မြန်မာဘာသာပြန်ဆိုကာ စတင်ရေးဖွဲ့ စမ်းသပ်ခဲ့သည်။ ထို့နောက် 'ဖိုးမောင်လာပြီကဗျာ'၊ 'သူမှာတမ်း' ကဗျာ၊ 'မင်းရဲကျော်စွာ' ကဗျာတို့ကို ရေးဖွဲ့ခဲ့သည်။ အနောက်တိုင်းသင်္ချိုက်ကဗျာသဘောကိုအခြေခံကာ မိမိ၏စိတ်ကူးသစ် အတွေးသစ် တို့ဖြင့် ပုံဖော်ခဲ့ခြင်းဖြစ်သည်။

မင်းသုဝဏ်၏ ဧာတ်လမ်းကဗျာသုံးပုဒ်လုံးသည် အဖြစ်အပျက်တစ်ခုဧာတ်ကွက်တစ်ကွက်ကို ဧာတ်လမ်းဆင်ကာ ရေးခဲ့သည်။ 'ဖိုးမောင်လာပြီ' နှင့် 'သူမှာတမ်း' ကဗျာတို့သည် မင်းသုဝဏ်၏ကိုယ်ပိုင် စိတ်ကူးသစ် အတွေးသစ်တို့ဖြင့် ဧာတ်လမ်းပွဲခြင်းဖြစ်သည်။ ဖိုးမောင်၏ဂုဏ်ရည်ကိုဖော်ကြူးသည့် ဧာတ်လမ်းတွင် ဖိုးမောင်အပေါ် စာနာသနားဖွယ်ရာ၊ နှာခေါင်းရွံ့ဖွယ်ရာ၊ လွမ်းမောဖွယ်ရာဖြစ်အောင် ဧာတ်လမ်းဆင်ဖန်တီးနိုင်သည်။ 'သူမှာတမ်း' ကဗျာတွင် ရွာသူရွာသားများက ဖြတ်ကျားတပ်သား လေးကို မေးမြန်းနေသော စကားသံများ။ ပြောက်ကျားတပ်သားလေးက ပြန်လည်အမှာစကားပြောသံများဖြင့် ဧာတ်လမ်းဆင်ရေးဖွဲ့ပါသည်။ ဧာတ်ဆောင်များ၏အပြန်အလှန်ပြောစကားများဖြင့် ပြောက်ကျားတပ်သားလေး၏ တိုင်းပြည်ချစ်စိတ်၊ ယဉ်ကျေးလိမ္မာသည့် သားကောင်းတစ်ဦး၏ အမူအရာများကို ဖော်ကြူးထားသည်။ ပြောက်ကျားတပ်သားလူငယ်တစ်ဦး၏ မျိုးချစ်စိတ်၊ နိုင်ငံချစ်စိတ်ကို လွမ်းဆွေးဖွယ်ဧာတ်ကွက်ဖြင့် ဖန်တီးကာ ဖွဲ့ဆိုထားသည်။ 'မင်းရဲကျော်စွာ' ကဗျာသည် ရာဇာဓိရာဇဓံအရေးတော်ပုံကျမ်းမှ မင်းရဲကျော်စွာနှင့် ရာဇာဓိရာဇဓံတို့ အပြန်အလှန် တွေ့ဆုံသွားသည့် အခန်းကို စိတ်ကူးဖြင့်ဧာတ်လမ်းဆင် ပုံဖော်ခြင်း ဖြစ်သည်။ 'မင်းရဲကျော်စွာ' ကဗျာတွင် ရာဇာဓိရာဇဓံနှင့် မင်းရဲကျော်စွာတို့ အပြန်အလှန်ပြောကြားသည့် စကားတို့ဖြင့်တစ်ဆင့်ပြီးဆစ်ဆင့် ဖွဲ့ပြသည်။ ရာဇာဓိရာဇဓံက စည်းစိမ်အမျိုးမျိုးဖြင့် ဖိတ်ခေါ်စည်းရုံးသော်လည်း မင်းရဲကျော်စွာက ပြတ်သားစွာ ငြင်းပယ်သည့် ဧာတ်လမ်းကိုရိုးရှင်းစွာဖွဲ့ပြသည်။ ရှုံးနိမ့်သော်လည်း ဒူးမထောက်လက်မခြောက် အညှဉ့်မခံဘဲရဲရင့်ပြတ်သားသော စိတ်ဓာတ်နှင့်သူရဲကောင်းတို့၏ ရဲစွမ်းသတ္တိများ ဆောင်လွှင်အောင် ဧာတ်ဆောင် မင်းရဲကျော်စွာ၏ပြောစကားတို့ဖြင့် ဖော်ကြူးခဲ့သည်။

ကဗျာသုံးပုဒ်လုံးတွင် ဧာတ်ဆောင်ပြောစကားများ။ ဧာတ်ဆောင်အချင်းချင်း အပြန်အလှန် ပြောစကားများဖြင့် စွဲငြိုက်ဖြစ်အောင် ဧာတ်လမ်းဆင်ဖွဲ့ဆိုပါသည်။ ကဗျာများတွင် ဧာတ်ဆောင်၏ ဂုဏ်ရည်ကို ဧာတ်ဆောင်တို့၏ ပြောစကားများဖြင့် ပေါ်လွင်စေပါသည်။ ကဗျာကိုအဆုံးသတ်ရာတွင် ဧာတ်ဆောင်အကြောင်း ဝမ်းနည်းဖွယ် လွမ်းဆွေးဖွယ်ရာ အခြေအနေဖြင့် အလွမ်းအဆွေးသဘော သက်ဝင်အောင် ဖွဲ့ဆိုသည်။ ယင်းသည် ဧာတ်လမ်းကဗျာတို့၏ သဘောလက္ခဏာ ဖြစ်သည်။ မင်းသုဝဏ်သည် ဧာတ်လမ်းကဗျာသုံးပုဒ်လုံးကို ရိုးရှင်းသောစကားသုံးများ မြန်မာဆန်သော စကားသုံးများဖြင့် ဖွဲ့ဆိုခဲ့သည်။ ထို့ကြောင့် ဤကဗျာသုံးပုဒ်သည် မြန်မာကဗျာလောကတွင် ထင်ရှားသော ဧာတ်လမ်းကဗျာများအဖြစ် ကောက်ကိုင်စိုက်ထူနိုင်ခဲ့ပါသည်။

နိဂုံး

ဤစာတမ်းသည် မင်းသုဝဏ်၏စာပေလက်ရာများမှဧာတ်လမ်းကဗျာဖန်တီးပုံကို လေ့လာထားပါသည်။ မင်းသုဝဏ်၏အထင်ရှားဆုံးဧာတ်လမ်းကဗျာ(၃)ပုဒ်ဖြစ်သည့် "ဖိုးမောင်လာပြီ၊သူမှာတမ်း၊မင်းရဲကျော်စွာ" ကဗျာတို့ကို အလေ့လာအဖြစ်သတ်မှတ်တင်ပြပါသည်။ မင်းသုဝဏ်သည် အနောက်တိုင်းဘဲလက် ကဗျာပုံစံကိုယူ၍ မြန်မာလူနေမှုဘဝ ပတ်ဝန်းကျင်နှင့်အံဝင်မည့်ဧာတ်ကွက်ဧာတ်လမ်းတို့ကို စိတ်ကူးဖြင့်ပုံဖော်ကာ ဧာတ်လမ်းကဗျာများကို ဖန်တီးနိုင်ခဲ့သည်။ မင်းသုဝဏ်၏ဧာတ်လမ်းကဗျာများသည် ထူးခြားခြင်း၊ ထက်မြက်ခြင်း၊ ရသမြောက်ခြင်းဂုဏ်ရည်တို့ဖြင့် ပြည့်ဝလှသည်။ မင်းသုဝဏ်၏ ဧာတ်လမ်းကဗျာများကို ဥရောပဘဲလက်ကဗျာတို့နှင့် နှိုင်းယှဉ်လေ့လာသည့် သုတေသနလုပ်ငန်းများ ဆက်လက်ဆောင်ရွက်နိုင်ပါသည်။

GIS-based on Landslide Susceptibility Map of Singu Area, Pyin-Oo-Lwin District, Mandalay Region

Chit San Aung[1]

Abstract

Susceptibility mapping is one of the most fundamental components of hazard management and an important basis for the provision of measures aimed at decreasing the risk of living with landslides. There are many methods that are available in literature for preparation of landslide susceptibility maps. In the study area, weighted overlay method is used to get the final map. Landslides are governed by several factors; however, it is not always possible to obtain all the data. In Singu area six factors were considered for landslide susceptibility mapping. They are DEM elevation, rainfall, earthquakes, drainage, slope and slope aspect. Though road cutting and earthquakes are the two important triggering factors for landslides, these are also considered in this study due to get landslide susceptibility map The purpose of the study is to develop a methodology for evaluating landslide prone areas and produce a landslide susceptibility map for Singu area (1) the preparation of a landslide inventory of the study area based on field studies and data from previous works; (2) the determination of controlling parameters (3) the use of geographical information systems; and (4) the control of the reliability of the susceptibility map produced.

Keywords: Susceptibility, Landslide, Slope, Slope Aspect, GIS

Introduction

Location, Size and Accessibility of the Study Area

The study area, Singu, is a township of Pyin-Oo-Lwin District, Mandalay Division, Myanmar. Singu including Kandaung area is bounded by vertical grids 730 to 860 and horizontal grids 110 to 330 within one inch to one-mile scale topographic maps 93 B/1 and 93B/ 2. It is situated on the east bank of the Ayeyarwady River, centering Singu which is 56 miles by road and 48 miles by waterways north of Mandalay. Singu Township is bounded by Thabeikkyin Township on the north, Nyaungcho Township on the east, Madaya Township on the south, and Khin U, Wetlet and Shwebo Townships separated by the Ayeyarwady on the west. It is accessible by car throughout the year Fig (1).

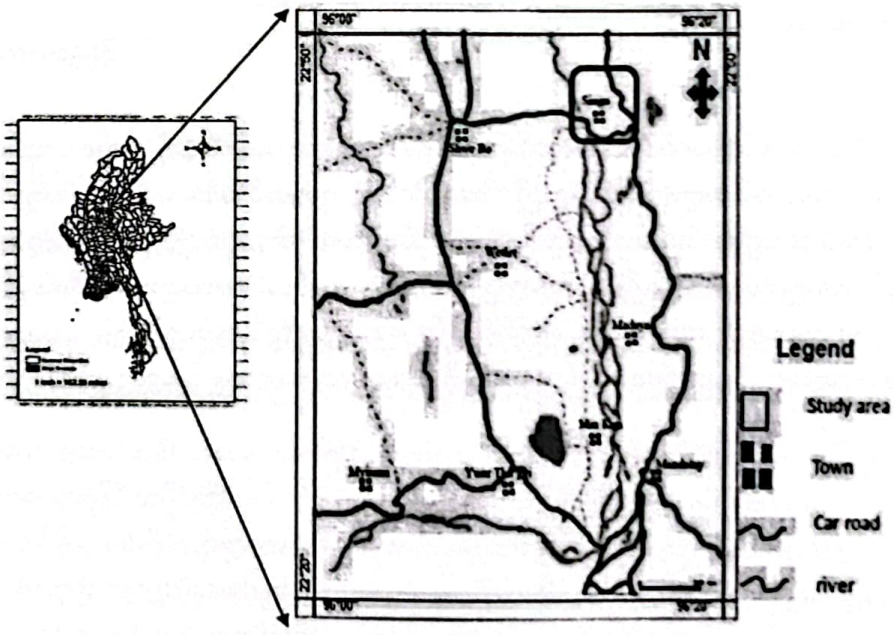

Fig (1) Location Map of the study area

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Present investigation is locally known for its gold mineralization. Primary gold, electrum, copper, lead- zinc, pyrite, chalcopyrite, arsenopyrite and graphite widely occur in marbles and gneisses of the area. So, the vegetation cover is rather sparse in some parts of the area. Mining operations that use blasting techniques often causes the risk of sliding to slide due to vibrations under the soil. Landslides cause dramatic effects on human lives and economy worldwide. The evaluation of landslide susceptibility is perceived as the initial stage for mitigating landslide hazards. There is a growing interest worldwide in developing robust methods for landslide susceptibility and risk mapping, and hence provide planners with tools for selecting suitable areas for development scheme implementation.

The methodology has been developed using data from shallow landslides of the mountainous part of project area. In the area, igneous and metamorphic units are exposed with differing areal coverage. Metamorphic rocks are gneisses and marbles. Most of the landslides develop in the biotite graniterocks that exposed in eastern part of the area. The topographical elevation values vary between 30 and 2600 m and the dominant drainage pattern is dendritic. From a climatic point of view this part of the area receives a mean annual rainfall of about 1100mm Fig (3 and 4). The annual rainfall in Singu is a little more than normal. The general physiographic trend is N-S and dipping E and SE following the main drainage system. The study area, being a structurally complex terrain, is prone to slope instability due to its lithological and structural characteristics.

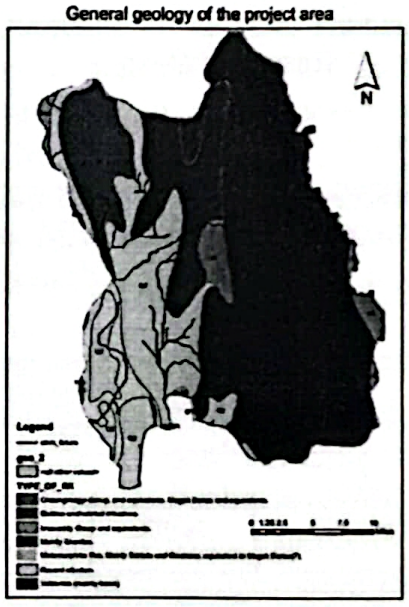


Fig (2) General geology map of Singu area.

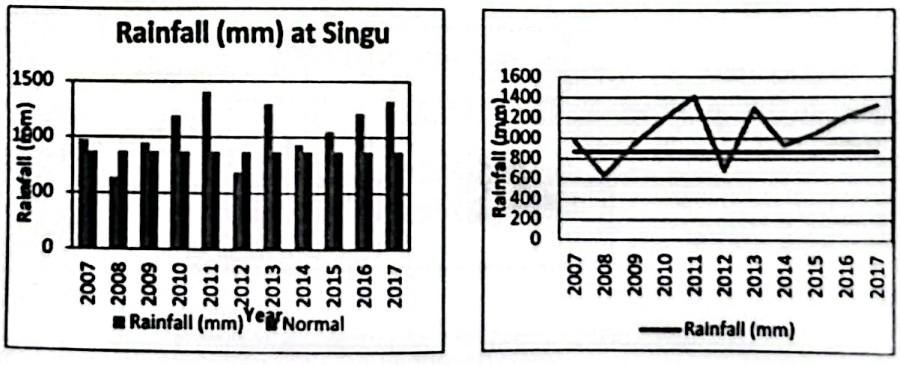


Fig 3.a).Histogram for Annual rainfall data in Singu area b).Line chart for annual rainfall for Singu area

Aim and Objectives

The purpose of the study is to develop a methodology for evaluating landslide prone areas and produce a landslide susceptibility map for Singu area (1) the preparation of a landslide inventory of the study area based on field studies and data from previous works; (2) the determination of controlling parameters (3) the use of geographical information systems; and (4) the control of the reliability of the susceptibility map produced.

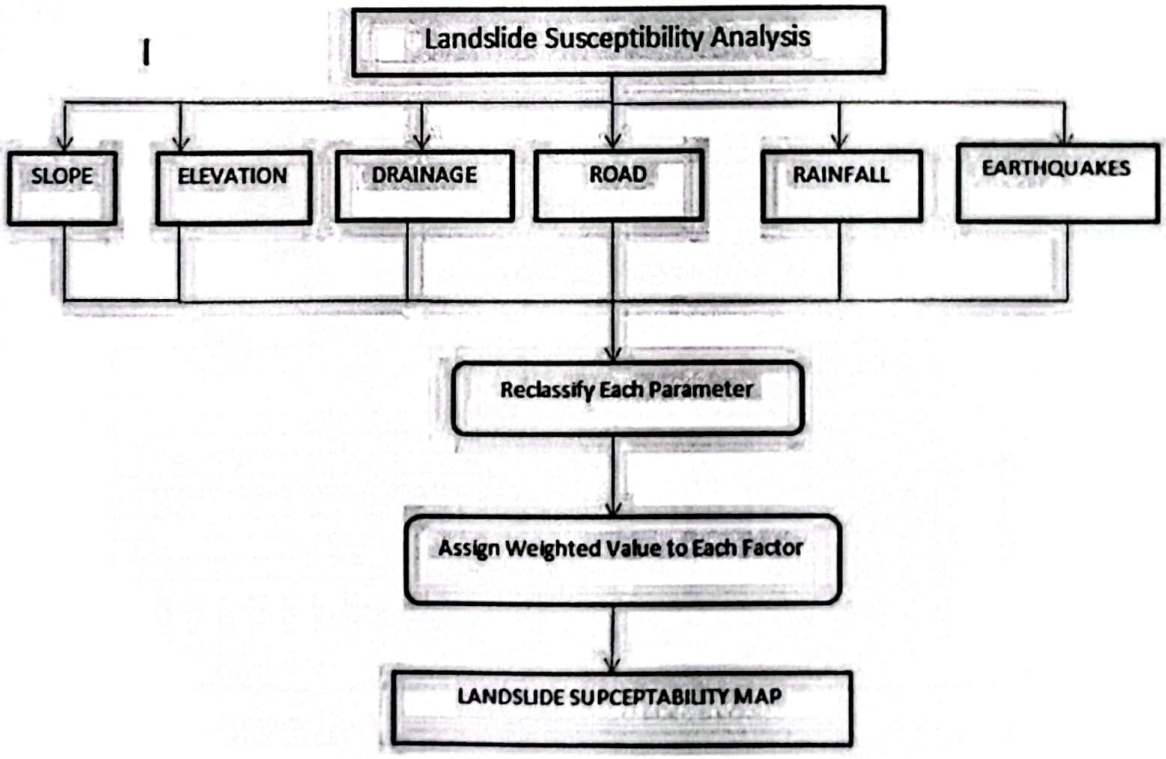
Methodology

Landslides are governed by several factors; however it is not always possible to obtain all the data. In the present study six factors were considered for landslide susceptibility mapping. They are DEM elevation, rainfall, earthquakes, drainage, slope and slope aspect. Though rainfall and earthquakes are thetwo important triggering factors for landslides, these are also considered in this study due to get landslide susceptibility map. The factors considered here are essentially the preparatory factors, which can be collected easily from the field and available information. The thematic data layers for each of the factors were prepared in GIS based on topographic, remote sensing and field data. There are basically two ways to determine the weights. The landslide susceptibility map was finally prepared by integrating the data in GIS and classifying the integrated values into different classes of landslide susceptibility (Gupta & Joshi, 1990).

Research Design

Controlling Parameters

The data layers corresponding to the six factors were prepared in GIS. The data used to prepare these maps were collected from DEM images, published literatures and field investigation (Wang, et al., 2015). A brief description of these layers is given below.



DEM and its derivatives: DEM (digital elevation model) is digital representation of a topographic surface with the elevation above a geodetic datum. The DEM of the study area was prepared from the contours.DEM showing the elevation classes information given in the topographic maps using TIN module of Arc View 3D Analyst in Fig (5.a).

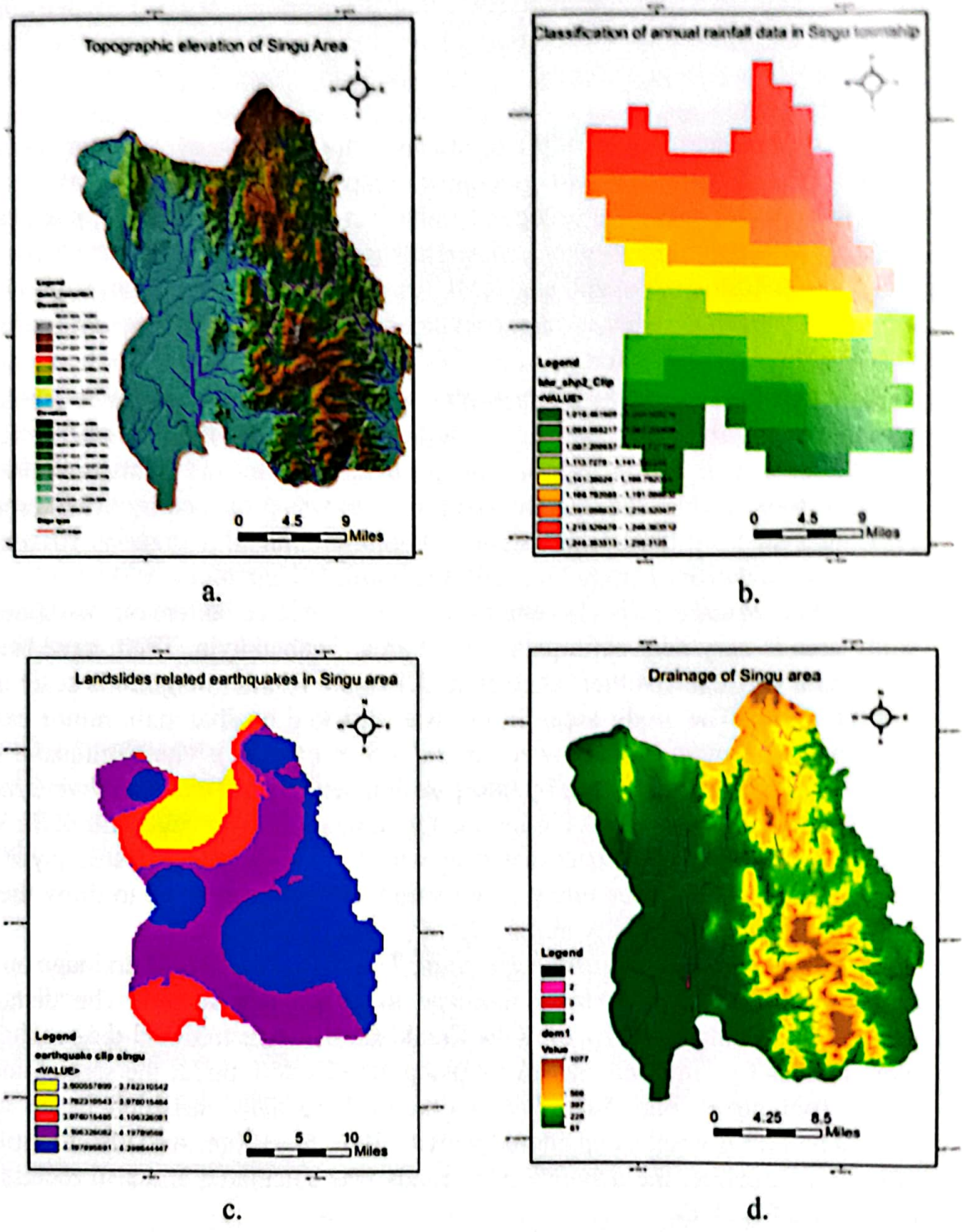
Lithology: It is one of the prime and important causative factors causing slope instability. The geology and geological map of the study area has already been described above. Seven lithological units were identified and mapped, i.e. marble, basic igneous rocks, gabbro and related intrusive, granites, metamorphic rocks such as mainly schist and gneiss, and also CMG containing recent alluvium(Fig 2A). From the final result, biotite granite is the most landslide prone area because of its exposed slope and its lithologic characters.

Rainfall:The assessment results were mapped for different rainfall events within the GIS, we choose a typical value for each rainfall type, and the calculations. This classification was conducted by means of natural break points method from rainfall station. The rainfall layer was produced by the interpolation of rain fall data from the rainfall station. Minimum annual average is 1016 mm in the south and the north of study area and maximum is 1298 mm.

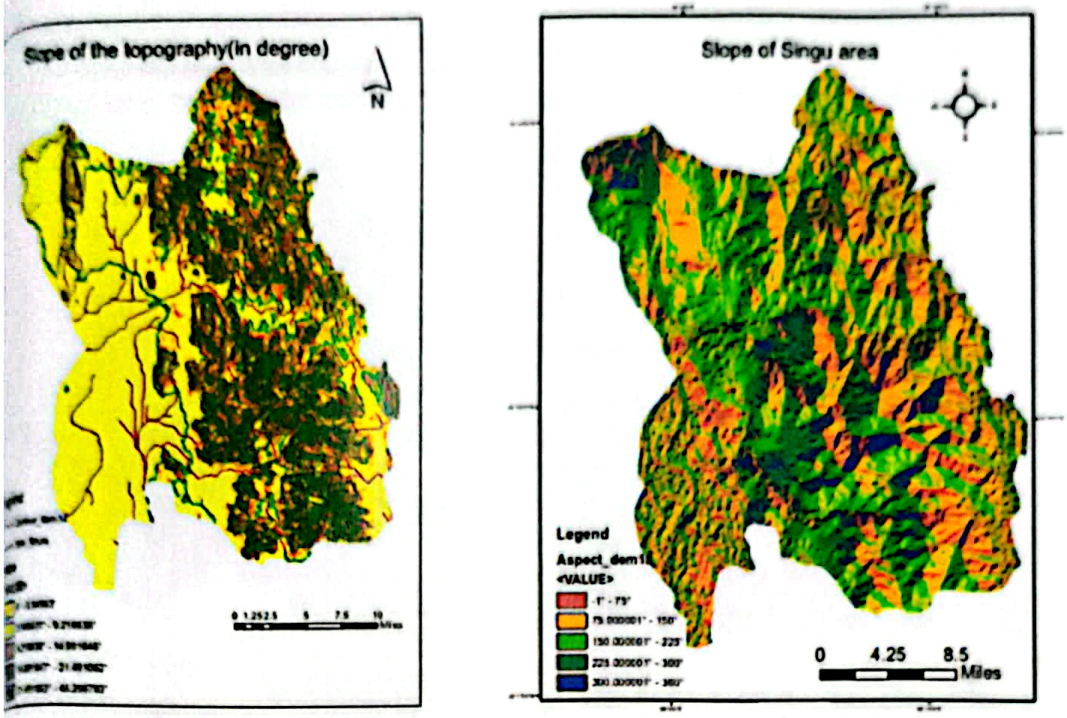
Earthquakes:it is also one of the most causative factors on landslides, and the study area is very near earthquake prone area, Thabeikkyin. There have been shaken by several earthquakes that range from 3.1 to 6.8 Richter magnitude scale during the last ten years. The study area, Singu, was strucked by five main minor earthquakes that ranges on magnitude between 3 and 4.5 in Fig (5.c). The earthquake layer was also created for ten years data by interpolation method and the results were reclassified into five classes such as 1 for low, 2 for moderate, 3 for high and 4 for very high landslide susceptibility areas that deal with the earthquakes. In this layer building, Thabeikkyin earthquakes interpolated values effects were used to draw the decision for landslides susceptibility map.

Distance from drainage and road: To assess the effect of drainage on landslide occurrence, the distance from drainage axes was considered. The distance from drainage was calculated by the GIS Euclidean distance tool and the resultant values were reclassified into ten classes by using classify tool under the spatial analyst tool in arc tool boxes Fig (5.d). The drainages were then classified based on stream order.The buffer widths considered were 0–50m, 50–100m. And also to introduce the effect on landslide, the distance from roads was calculated and also reclassified into ten classes Fig (8.c).

Slope and slope aspect :Surface topography is the origin of the mass movements and it guides their direction, thus controlling the density and extent of landslides (Chauhan *et al.*, 2010; Arnous, 2011; Avtar et al., 2011).

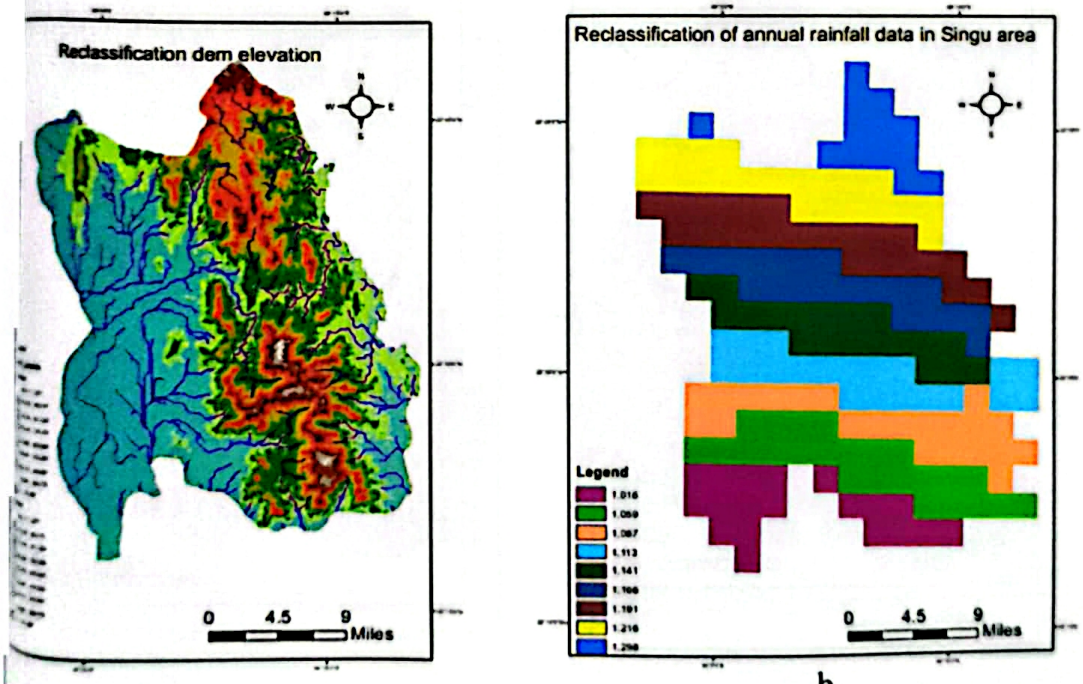


Fig(5) a. Topographic elevation map b. annual rainfall map c.landsli related earthquakes map d. Drainage map of Singu area



a. b.

Slope of the topography in degree b. Slope aspect of Singu area



a. b.

Reclassification of DEM and b. Annual rainfall in Singu area

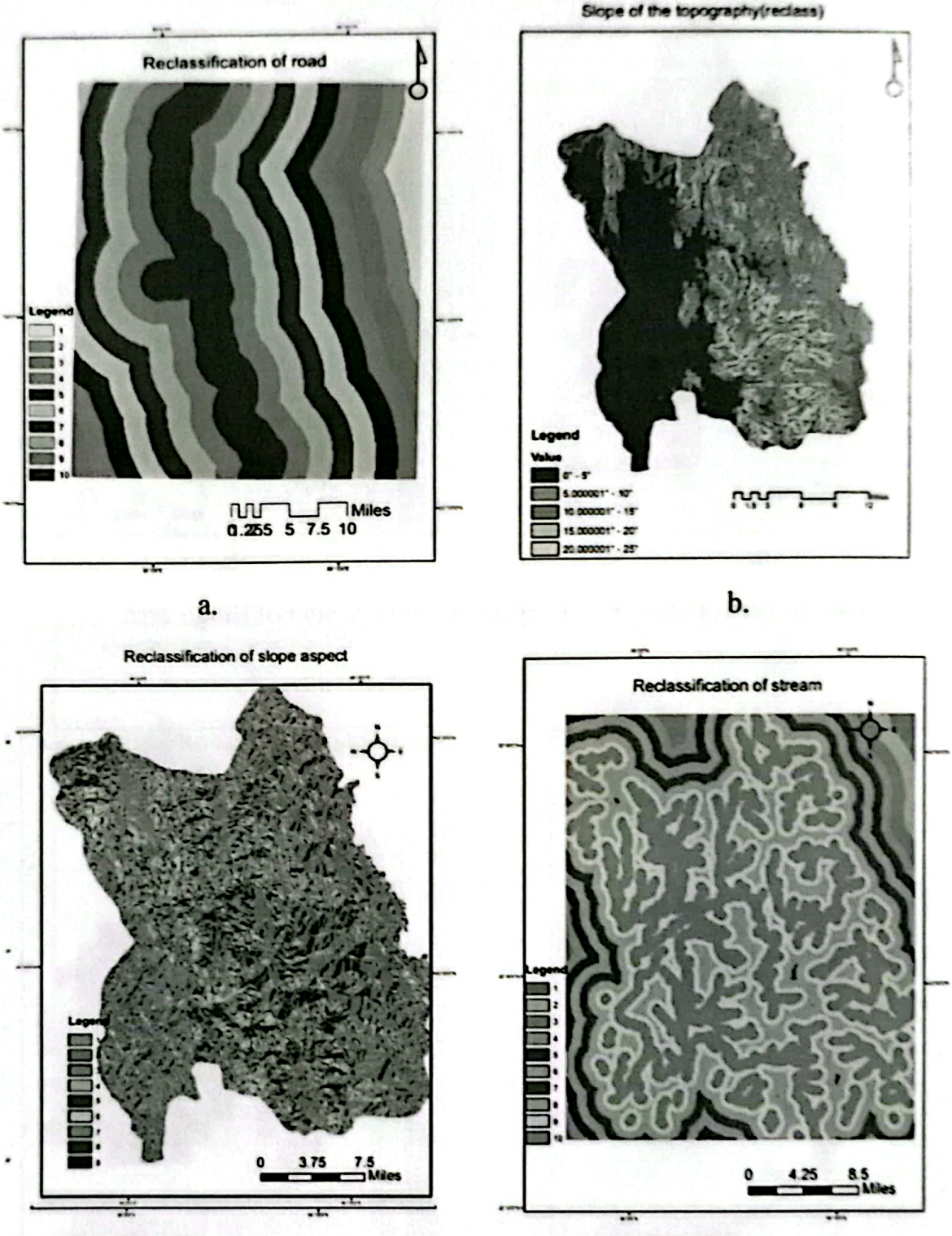
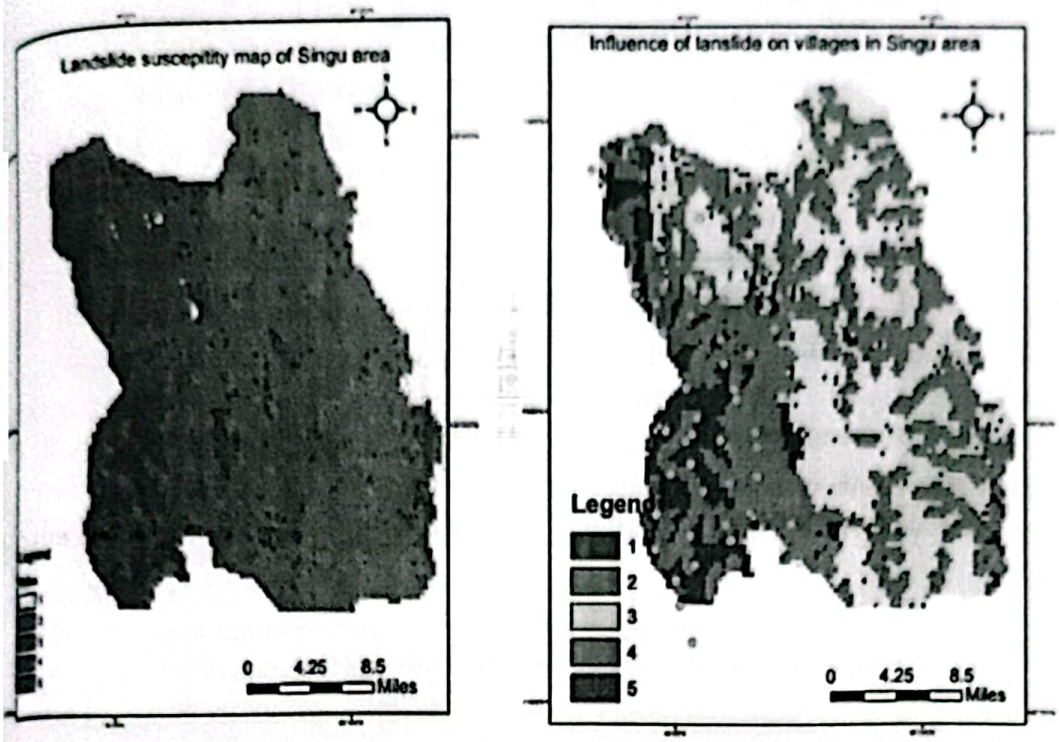
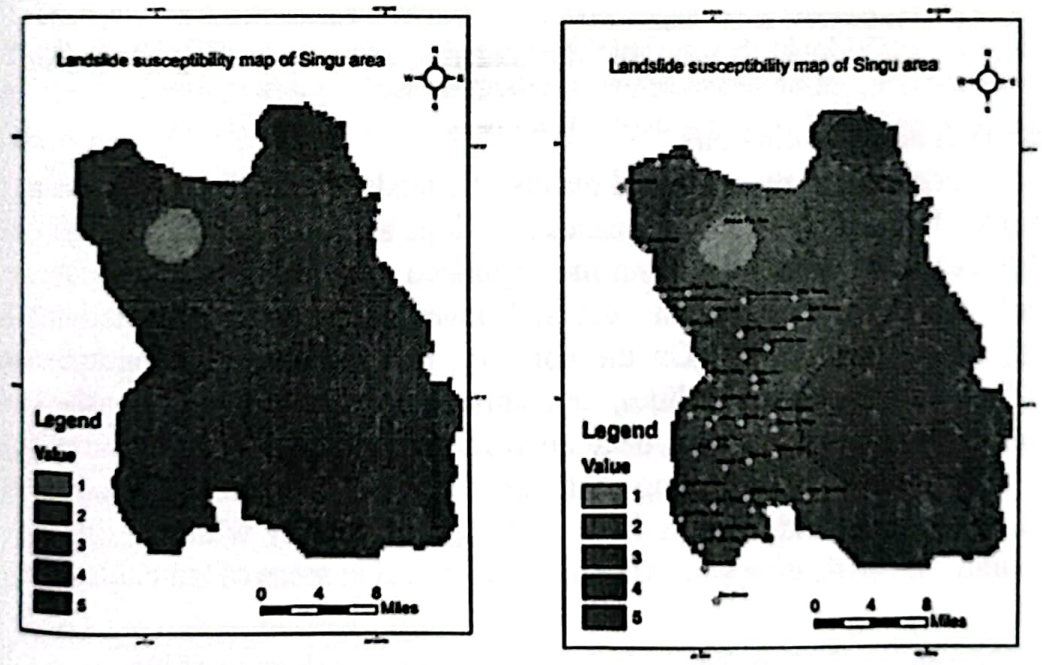


Fig (8)a. Reclassification of landslides related earthquake b.stream, c.road and d. slope



(10) a.Final landslide susceptibility map b. Influence of landslide on villages in Singu area loaded with weighted overlay on classification values



(11) a. Landslide susceptibility map b. Influence of landslide on villages in Singu area loaded without classification values

Therefore, a range of features including slope and slope aspect maps were obtained from DEM. Slope is considered to be the most important cause of the occurrence of mass movements in an area. Based on the obtained information from the DEM map, the spatial distribution of train influence of landslide on villages in Singu area loaded without classification values slopes of the region was divided into five categories: (a) 00 to 5° (very low)°, (b) 5° to 10°-low, (c) 10° to 20°- medium, (d) 20° to 25°- high Fig(8.d.). Slope aspect in the region has a significant role in the development of mass movement and the slope aspect's thematic layer was generated by the DEM. The slope aspects of the area were divided into 5 categories of: a) -1°-75°, b) 75°-150°c) 150°-225° d) 225°-300°, e) 300°-360°, which can be seen in Figure (9).Both slope and slope aspect were also reclassified to proceed landslide susceptibilityon spatial analysis tool in Fig (6.f and g).Based on the determined importance weights the final landslide susceptibility map for the study area was created (Fig 10.a and b), with index values ranging from 1 (high susceptible areas) to 5(very low susceptibility to landsliding). The results are shown in tabular form in Table1

PARAMETERS	*OBJECTED*	*RECLASSIFICATION VALUES*	*COUNTS*	*%BY AREA*
RAINFALL	1	15	14	0.14
EARTHQUAKE	2	20	1900	19
SLOPE ASPECT	3	20	3317	33
SLOPE	4	15	949	9.49
STREAM DISTANCE	5	15	231	16.37
ROAD DISTANCE	6	15	542	22

Table(1) Result table for landslide analysis in Singu area

Discussion and Conclusions

According to the produced results, the landslides in the study area are mainly controlled by road cutting, earthquakes and slope aspect. Most of the highly damaged landslides can be seen away from the populated area Fig (7.b). Therefore, landslide hazards can't affect on human lives and poverties except human activities in gold mining (Anabalagan, 1992). On the contrary, no dominant physiographic direction was found to favour landslides, in contrast to what was previously mentioned by other researchers. In fact, data analysis determined an importance weight of 25% for earthquakes, indicating that this parameter contribute as secondly factor to the occurrence of landslides in the area. Weighted overlay with classification values and without classification values are nearly identical in areas of landslide susceptibility map.

Moreover, the present work demonstrated the influence of human activities in the landslide occurrence. Some of landslides in the study area occurred on road sides or in residential areas, indicating thus that they might have been prevented if proper design and construction methods were employed.

As a concluding remark, it should be stated that the presented dology seems to be a reliable approach for landslide susceptibility mapping, ding a mathematical basis for expressing each controlling parameter, and ining numerical and categorical data in the computational procedure. From the resulted map, Shauk Pin Yoe, War YarKone, Lat Pan Hla and surrounding small es such as KyaungSek, ShweHtay and KokeKo may be damaged by landslide s caused by earthquakes and slope stability on road. Second most dangerous lides related by slopes can be seen on the eastern part of Singu area and they are way from populated areas.

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