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A GEOGRAPHIC STUDY ON AGRICULTURAL LAND UTILIZATION IN MADAYA TOWNSHIP (2014-2015)

PRESENTED BY

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ABSTRACT

The economy of Myanmar is mainly based on agriculture. As the study area is well known by agriculture, the socio-economic conditions of Madaya Township may be affected by the development of agricultural land use. Although the irregular and scanty rainfall may affect on the primary sector of the region, the township is fortunately close to the source of water for irrigation (i.e, Sedawgyi Dam). In this study, the type of agricultural land use such as, *'Le'* land, *'Ya'* land, *'Kaing- Kyun'* land and '*Garden'* land were analyzed. In this research, the main aim is to observe the concentration of cultivated lands in the study area. Depending on the data availability, Dr. S. S. Bhatia's Index of Concentration Method was used for analysis on agricultural land use. The study of spatial differentiation in agricultural land use is immense value for planning the agricultural growth and regional development.

Keywords: land use, Dr.S.S.Bhatia's Index of Concentration Method

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INTRODUCTION

Land use is the surface utilization of all developed and vacant land on a specific point, at a given time and space. This "leads one back to the village farm and the farmer, to the fields, gardens, pastures, fallow land, forests and to the isolated farmstead" (Freeman, 1968) as geography deals with the spatial relationship between these aspects and planning.

Land utilization is the use made of the land by man, as surveyed and mapped in a series of recognized categories. The primary uses of land are for crops, forest, pasture, mining, transportation, gardening, residential, recreational, industrial, commercial, uncultivable waste and fallow land, etc.[1]

The Analysis of Concentration of Agricultural Land Utilization in Madaya Township is the main research methodology.

Among the types of land use, the important factor is the agriculture land use. In Madaya Township, the most important types of agriculture land are *"Le"* land, *"Ya"* land *"Kaing-kyun"* land and *"Garden"* land.

A comprehensive study was made in spatial analysis on agriculture land use in Madaya Township. According to their statistics, a study was explained about the spatial distribution by using research methodology from the geographical point of view.

Study Area

Madaya Township is located in the Dry Zone of Central Myanmar. In relief, there is a plain at the western part of the township and the eastern part is the western continuation of Shan plateau. It experienced the Tropical Steppe (BSh) types of climate, according to Köppen's climatic classification method. According to the history of the township, agriculture is famous in this region. Agriculture works effect the development of socio-economy in the township and also it is the main factor in development of socio-economic. Although this township falls in the dry zone, the physical features and social factors are supporting the development of agriculture.

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[1] MANDAL, R.B (1981) "Land Utilization Theory and practice" (first edition). Concept Publishing Company, New Delhi (India).pg 1.

Aim and Objectives

The main aim of this research is paper to study the concentration of agricultural land utilization in Madaya Township.

The objectives are as follow:

- To identify the basic needs for the agricultural land use and its effects on local people in the study area
- To analyze of the actual agricultural land utilization of the study area.
- To determine the agricultural land classes for the study area.

Data Collection and Methodology

The present study is based on primary and secondary sources of data. To analyze the crop concentration of the study area, official data, interviews, discussions, information, field data and questionnaires were used. In order to assess the regional differences in crop concentration indices its have been calculated in all the regional units with the help of Dr Bhatia's Index of Concentration Method.

$$\text{Index of Concentration of Crop} = \frac{\text{Area of Crop X in a Companent Areal Unit}}{\text{Area of all Crop in the Component Areal Unit}} \div \frac{\text{Area of Crop X in the Entire Region}}{\text{Area of all Crops in the Entire Region}}$$

In this present research, the method mentioned above is slightly modified as:

$$\text{Index of Concentration of Agricultural land} = \frac{\text{Area of Agricultural land X in a Component Areal Unit}}{\text{Area of all Agricultural land in the Component Areal Unit}} \div \frac{\text{Area of Agricultural land X in the Entire Region}}{\text{Area of all Agricultural land in the Entire Region}}$$

CHAPTER 1

PHYSICAL FACTORS

1.1 Location, Size, Shape and Boundary

Madaya Township is one of the (36) townships of Mandalay Regions. It is located between 20° 02' N and 20° 24'N latitudes and 96° 00'E and 96° 22'E longitudes. It covers an area of 454.97 square miles (291,187 acres). It consists of an urban centre with 5 wards and 83 village tracts.

The shape of the township is like a rectangle. The study area is bounded on the north by Singu Township, on the east by Pyin Oo Lwin Township, on the northeast by Naungcho Township, on the south by Patheingyi Township which serve as administrative land boundaries and on the west by Ayeyarwady River which serve as a natural water boundary between Mandalay and Sagaing Regions. The total length of land boundary is about 66 miles and water boundary is about 18 miles. (Map 1.1)

1.2 Topography

Generally, the study area is an alluvial plain which is deposited by Ayeyarwady River and Chaungmagyi Chaung. It may be divided into two which are as follows and shown in (Map 1.2)

1. The Western Plain and

2. The Eastern Highland.

(1) The Western Plain

It has an area of 365 square miles and occupies 80 percent of the total area of the township. This plain is sub-divided into three parts. They are: recent alluvial plain, old alluvial plain and foothill alluvial plain.

Recent alluvial plain is found in the western most part of the study area. It lies on the land of less than 200 feet above sea level and it is the lowest area. It occupies about one-fourth of the western plain area.

Old alluvial plain is situated on the east of recent alluvial plain which is the largest area of Madaya Township. It is the area between the contour lines of 200 feet and 250 feet above sea level. Chaungmagyi chaung, Shwelaung chaung and other streams flow on this plain.

Foothill alluvial plain lies between old alluvial plain and eastern highland. It occupies about a quarter of western plain area. It has an elevation of 250 to 300 feet above sea level. The northernmost part is the highest area. There is a hill, Bodaw Taung which is 1,487 feet high.

(2) The Eastern Highland

The Eastern Highland is the western continuation of Shan Plateau and it covers about 90 square miles. The Eastern Highland lies between the contour line of 500 feet and 2,000 feet. It rises gradually from west to east and composed of limestone. The Eastern Highland forms the watershed for Chaungmagyi and Shwelaung chaung.

1.3 Drainage

The main river is Ayeyarwady River and the famous streams are Chaungmagyi Chaung and Shwelaung Chaung. (Map 1.3)

1.4 Geology

Two groups of rock units are mapped in (Map 1.4), these are sedimentary rock units and metamorphic rock unit.

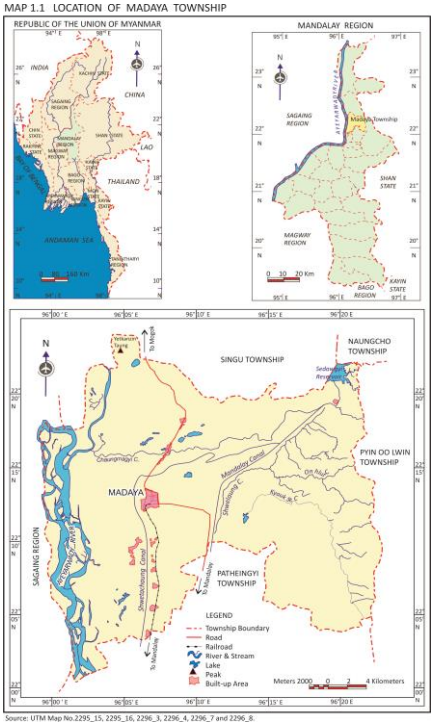
1.4.1 Sedimentary Rock Units

1. Ordovician Units
2. Plateau Limestone
3. Jurassic Units
4. Alluvium

1.4.2 Metamorphic Rock Units

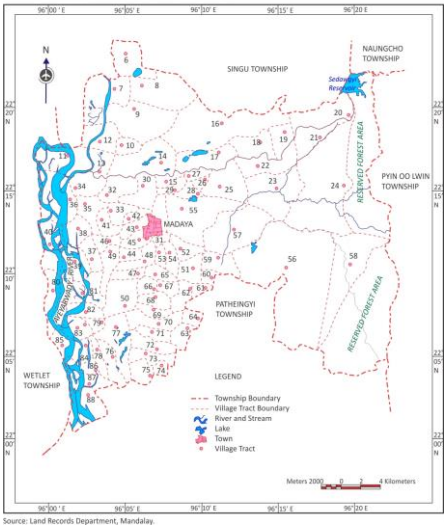
1. Sedawgyi Gneiss
2. Chaungmagyi Series

MAP 1.1 LOCATION OF MADAYA TOWNSHIP



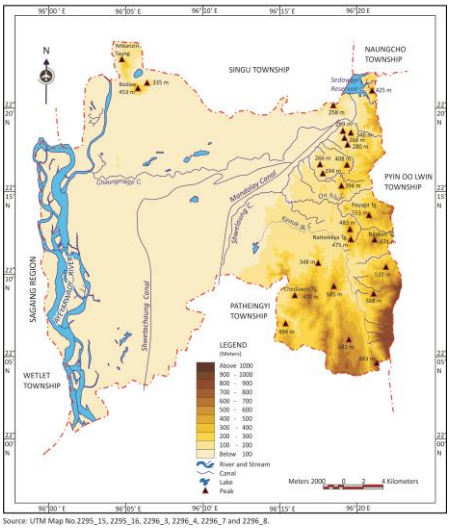
Source: UTM Map No.2295_15, 2295_16, 2296_3, 2296_4, 2296_7 and 2296_8.

MAP 1.2 VILLAGE TRACTS OF MADAYA TOWNSHIP



Source: Land Records Department, Mandalay.

MAP 1.3 TOPOGRAPHY AND DRAINAGE OF MADAYA TOWNSHIP



Source: UTM Map No.2295_15, 2295_16, 2296_3, 2296_4, 2296_7 and 2296_8.

1.5 Climate

Climate is the most important environmental factor that influences agriculture and also the dominant factor of determining agricultural land use.

According to the location of the township in the Dry Zone of Central Myanmar, Madaya Township receives a hot, dry climate. The temperature conditions of the township is high enough for crop cultivation. However, the rainfall cannot be expected with certainty.

1.5.1 Temperature Condition

During the period from 2000-2015, the mean annual temperature of Madaya township is about 82.23°F (27.91°C)with maximum mean temperature 93.06°F (33.92°C) and minimum mean temperature 71.39°F (21.88°C) respectively.

The hottest month is April with 88.86°F (31.59°C) and the coldest month is January with 71.49°F (21.94°C). Therefore the range of temperature is 17.37°F (-8.13°C).

1.5.2 Rainfall Condition

During the study period of (2000-2015), the average annual of rainfall in the township is about 37.75 inches (1.49 millimetres). During these periods the lowest recorded rainfall was received in 2005 with the total annual rainfall was 22.84 inches (0.89 millimetres).

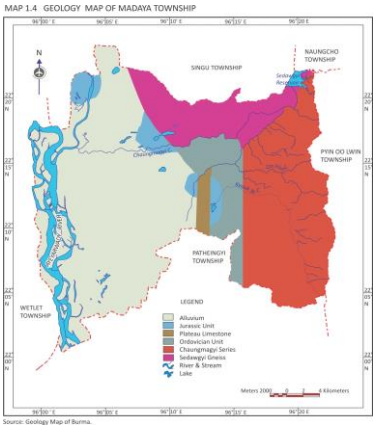
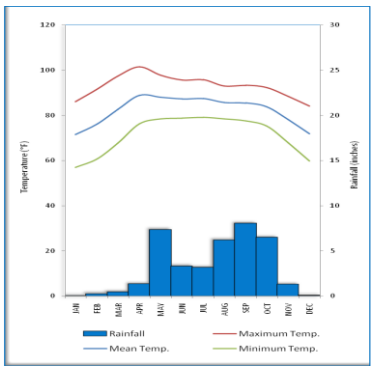


Figure 1.1 Climograph of Madaya (2000-2014)



Source: Based on Table (1.1)

Table (1.1)The Average Maximum, Minimum, Mean Temperature and Rainfall Condition of Madaya Township (2000-2014)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Avg/ Total
Maximum Temp.(°F)	86.08	91.52	97.47	101.46	97.71	95.68	95.76	92.99	93.28	92.28	88.37	84.13	93.06
Mean Temp.(°F)	71.49	76.08	82.63	88.86	88.07	87.24	87.43	85.72	85.45	83.77	78.06	71.94	82.23
Minimum Temp.(°F)	56.89	60.64	67.78	76.25	78.42	78.79	79.10	78.45	77.62	75.25	67.75	59.75	71.39
Rainfall (inches)	0.03	0.23	0.43	1.32	7.33	3.28	3.14	6.17	8.02	6.46	1.28	0.06	37.75

Source: Meteorology and Hydrology Department, Mandalay.

According to the Köppen's climatic classification, Madaya Township is recorded as having BSh (Tropical Steppe) climate with the average rainfall of 37.75 inches and mean temperature of 82.23°F. (Fig 1.1) and (Table 1.1).

1.6 Soils

Soil is the most important factor that governs for the successful agricultural activities of Madaya Township. The main soil types of Madaya Township can be grouped into the followings and are shown in (Map 1.5).

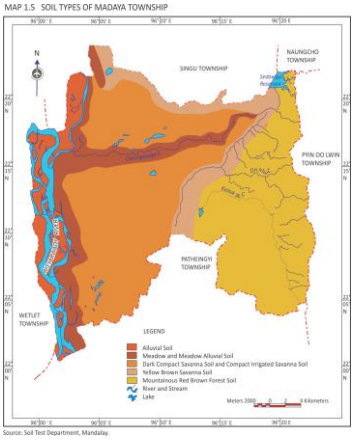
(1) Alluvial Soils

(2) Meadow and Meadow Alluvial Soils

(3) Dark Compact Savanna Soils and Dark Compact Irrigated Savanna Soils

(4) Yellow Brown Savanna Soils

(5) Mountainous Red Brown Forest Soils



1.6.1 Alluvial Soils

Alluvial Soils are found on the Ayeyarwady River flood plains. They are very fertile for the varieties of kaing-kyun crops. Alluvial Soils cover about 5 percent of the total township area.

1.6.2 Meadow and Meadow Alluvial Soils

Meadow and Meadow Alluvial Soils are mostly found on the both sides of Chanungmagyi Chaung and the eastern bank of Ayeyarwady River within the township. They occupy about 10 percent of the total area. These soils are suitable for cultivation of paddy, groundnut, sesamum, tobacco, maize and vegetables.

1.6.3 Dark Compact Savanna Soils and Dark Compact Irrigated Savanna Soils

Dark Compact Savanna Soils and Dark Compact Irrigated Savanna Soils covers mainly in the central part of the township. These soils occupy about 50 percent of total township area. Due to their high clay content, the dark compact savanna soils

have high plasticity and they are very sticky and heavy for cultivation whereas they are very hard when dry and are very difficult for cultivation. Therefore, dark compact savanna soils are the major soils for paddy, gram and various kinds of pulses, cotton, chilli and sesamum.

1.6.4 Yellow Brown Savanna Soils

Yellow Brown Savanna Soils occupy the eastern part of Mandalay Canal and the foothill areas of eastern highland area. They cover about 10 percent of the total area. These soils are loamy soils which are formed as a result of deposition of sediments of water erosion. They can be used as successful agricultural lands with the help of irrigation.

1.6.5 Mountainous Red Brown Forest Soils

Mountainous Red Brown Forest Soils are found under the forest areas in the north-eastern most part of the township. They occupy about (25) percent of the total area. They are suitable for "Ya" crops and "*Garden*" crops.

1.7 Natural Vegetation

Natural vegetation in an area depends on altitude, climate and soil. In Madaya Township, the forest area is (51,843) acres and it covers (17.80) percent of the township area. The reserved forest area is (38,806) acres and unclassified forest is (13,037) acres.

The dominant plant species is the lowland area are Cacti, Toddy Palm , Neem Tree, Rain Tree, Acacia, Plum, Tamarind, Than- dahat, Hsubok, Zaunggyan, Letpan, and short thorny plants.

In the eastern high land areas are found in Teak, Pyinkado, Thitya, Ingyin, In , Yamane, Htauk-kyant, Hnaw, Yinma, Mango, Padauk and Bamboo species such as Myinwa and Tinwa.

CHAPTER 2

SOCIAL FACTORS BASES FOR AGRICULTURE

2.1 Total Population and Population Growth

The population growth rates were calculated by the use of following formula described by J.I. Clarke and shown in (Table 2.1), (Fig 2.1)

$$R = \sqrt[t]{\frac{p_i}{p_o}} - 1 \times 100\%$$

R = Growth Rate

P_o = the population at the beginning of the period

p_i = the population at the end of the period

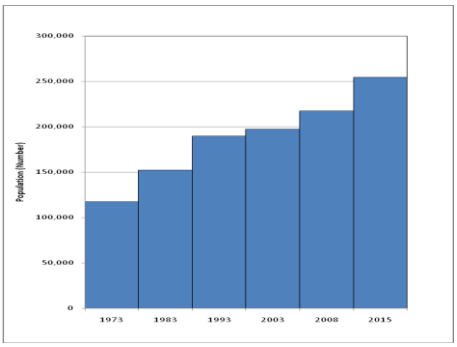
t = the number of year

Table (2.1) Total Population and Growth Rate of Madaya Township (1973-2015)

Year	Population			Increased Population	Growth Rate
	Male	Female	Total		
1973	57,747	59,850	117,597	-	-
1983	75,064	77,039	152,103	+34506	2.58%
1993	93,813	96,106	189,919	+37816	2.27%
2003	96,548	100,685	197,233	+7314	0.39%
2008	104,527	112,751	217,278	+20045	1.92%
2015	124,350	130,220	254,570	+37292	2.27%

Source: Immigration and National Registration Department, Madaya Township

Figure (2.1) Total Population Growth in Madaya Township (1973-2015)



Source: Based on Survey Data

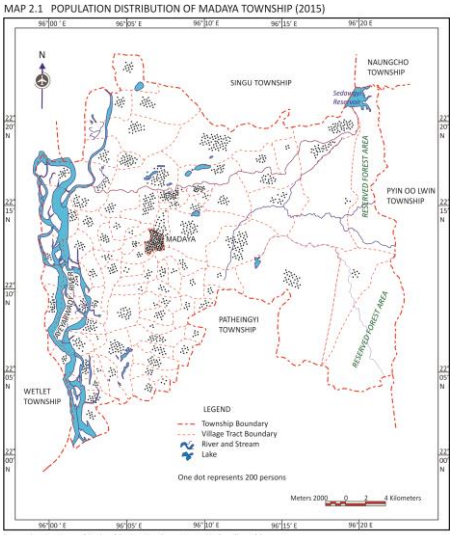
2.2 Population Distribution and Population Density

2.2.1 Population Distribution

The distribution of population of a region is related to topography, availability of water, communication and economic activities. The population of Madaya

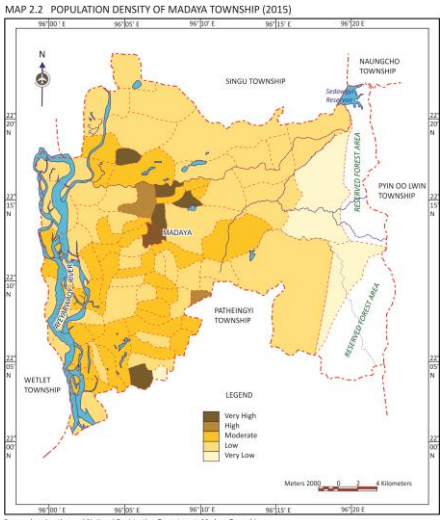
Township is not evenly distributed in Madaya Township. There are variations in the distribution of population in Madaya Township. The eastern hilly region of Madaya Township has a rugged terrain and the result is sparse population. In the central area, where the land is flat and where agriculture is more productive by irrigation, there is dense population. But, the western edge of the township is always flooded annually. Due to this effect, most of the people from that portion used to migrate seasonally. In the western lowland area, there is a moderately. (Map 2.1)

MAP 2.1 POPULATION DISTRIBUTION OF MADAYA TOWNSHIP (2015)



Source: Immigration and National Registration Department, Madaya Township.

MAP 2.2 POPULATION DENSITY OF MADAYA TOWNSHIP (2015)



Source: Immigration and National Registration Department, Madaya Township.

2.2.2 Population Density

The density of population in Madaya Township changes with time. According to 1973 Census, the density of population for the entire township was 259 persons per square mile. In 1983, it increased to 334 persons per square mile. In 1993, the density of population was 417 persons per square mile. In 2003 the density of population was 434 persons per square mile. In 2008, the density of population per square mile was 478 persons and in the year 2015 the density of population was 559 persons per square mile. (Map 2.2). Population density of Madaya Township can be divided into (5) groups. There are (1) very high population density (over 2,259), (2) high population density (between 1,522 and 2,259), (3) moderate population density (between 785 and 1,521), (4) low population density (between 48 and 784) and (5) very low population density (less than 48).

2.3 Urban- Rural Population

According to 1973 census, the composition of population in Madaya Township was urban and rural population with an amount of 8,419 persons and 109,178 persons, respectively. They were accounted for about 7.2 percent which was living in urban areas while 92.8 percent was living in rural areas.

In 1983, the urban population amounted to 13, 158 persons which were about 8.7 percent and the rural population of 138, 945 persons with 91.3 percent of the total population. During 1973 and 1983 period, a population of 4,739 persons was urban population and 29,767 persons of rural population were increased during a period of ten years.

In 1993, the urban population totaled about 16,111 persons or 9 percent and the rural population of about 173, 808 persons (or) 91 percent in Madaya Township. Thus, a population of 2,953 persons of urban and 34,863 persons of rural population was added during those ten year period.

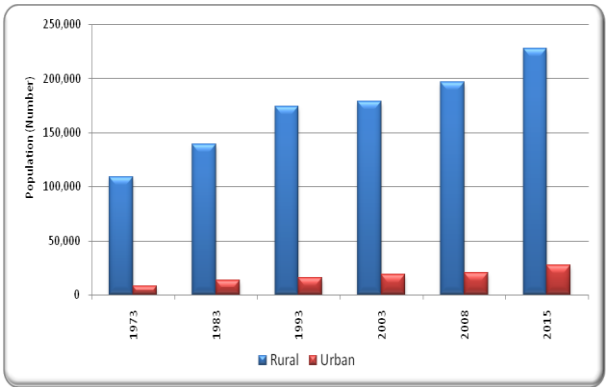
In 2003, the population of urban the rural were 18, 587 persons and 178,646 persons, respectively. They were shared by 9.42 percent and 90.58 percent of the township's total. There were 2,476 persons of urban and 4,838 persons of rural population which increased in a period of ten years during 1993 and 2003.

In 2008, the population of urban the rural were 20,425 persons and 196,853 persons, respectively. They were shared by 9.40 percent and 90.60 percent of the townships total. There were 1,838 persons of urban and 18,207 persons of rural population which increased in a period of five years during 2003 and 2008.

In 2015, the urban population of 27,247 persons and rural population of 227,323 persons are found with a shared of 10.70 percent and 89.30 percent of the total population of the township.

During 2008 and 2015 period, a population of 6,822 person of urban population and 30,470 persons of rural population are added in a period of seven years. According to (Fig 2.2), it can be observed that the urban population has been increased year by year so as of rural population.

Figure (2.2) Urban and Rural Population of Madaya Township (1973 – 2015)



Source: Based on Survey Data

2.4 Transportation and Communication

Movements of people, freight and information have continuously been fundamental components of human societies. The purpose of transportation is to overcome space which characterizes a variety of human and topography. Transport creates valuable links between regions and economic activities.

In Madaya Township, road and railway transportation systems serve the movement of the people and goods. Moreover, waterway transportation links short distances along Ayeyarwady River. There are 55 miles of metalled road, 24 miles of stone paved road and 15 miles of earthen road. The transportation route between villages is mainly used by cart tract. Metalled roads are connected to Mandalay, Singu, Mogok and to the village tracts of Panya, Taungpyone, Kabaing from Madaya Town.

Post, telegraph and telephone service or telecommunication service is one of the infrastructural agricultural comprises which indirectly support to raise up the socio- economic condition of rural people. Accessibility to the market or evaluating the crop price are needed by the farmers. Hence, telephone or telegraph or post facility can fill up this necessary action. Throughout the study area, there are one post office and one telegraph office in Madaya town and 987 telephone centre in urban area and in some large villages.

CHAPTER 3

THE ANALYSIS ON THE AGRICULTURAL LAND UTILIZATION IN MADAYA TOWNSHIP (2014-2015)

3.1 The Agriculture Land Use

In current occupied land, it includes net sown land and fallow land. The net sown land is the matured area out of sown area and the fallow land is the area which is left uncultivated area. In the year 2010- 2011, the agriculture land use is 136,800 acres and accounting for 46.98 percent of the total township area. In 2014- 2015, the agriculture land use is 136,824 acres and 46.99 percent of the total township area.

It was found that the agriculture lands are mostly located along the Ayeyarwady River, Chaungmagyi Chaung and Sedawgyi Canal. *"Le"* and *"Kaing-kyun"* are on the low land plain and island. *"Ya"* Land is found on the eastern of the township and the northern part of foothill regions and *"Garden"* land are found all over the township.

In 2010- 2011, the agriculture net sown land was 136,703 acres which were taken account into 46.95 percent of the township area. In 2014- 2015, the agriculture net sown land was 136,812 acres which was 46.98 percent of current occupied area.

In 2010- 2011, the fallow land was 97 acres which was 0.03 percent of the total township area.In 2014 - 2015, the fallow land was 12 acres which were taken into account 0.004 percent of the total area.

Table (3.1) Agricultural Land Use of Madaya Townships (2010-2011)-(2014-2015)

No	Year	Netsown	Agricultural Land Use (Percent)	Fallow	Agricultural Land Use (Percent)	Agricultural Land Use (Acres)	Agricultural Land Use (Percent)
1	2010-2011	136,703	46.95%	97	0.03%	136,800	46.98%
2	2014-2015	136,812	46.98%	12	0.004%	136,824	46.99%

Source: Land Records Department, Madaya

3.2 Agricultural Crops

According to the types of agricultural sources, variety of crops are growing in Madaya Township.

The variety of crops are grown by rainfall in addition irrigation water system are included. The main agriculture crops are cereal crops (paddy), edible crops (groundnut, sesamum, sunflower), pulses and beans, kitchen crops and vegetables. Paddy crop and other irrigated crops as well as monsoon paddy and summer paddy

are also grown. *"Ya"* crops are pulses, beans, cotton, sesamum, sugarcane, wheat, sunflower and peanut are grown as planning crop. *"Kaing-kyun"* crop are groundnut, maize, pulses and beans and vegetables. *"Garden"* crops are mango, coconut, jackfruit, betel vine, banana, papaya, plum, other vegetables and flowers.

Among them, most of the crop is paddy. It is 96,669 acres which were taken account into 70.65 percent of the total cultivable land of the township. Monsoon paddy is 53,167 acres and summer paddy is 43,502 acres. The second largest crop is pulses and beans with 80,861 acres which had taken account into 59. 09 percent of the total cultivable land. The third largest crop is edible oil crop with 29,680 acres which had taken account into 21.69 percent of the total cultivable land. Vegetable is 850 acres which had taken account into 0.62 percent of the total cultivable land. The least crop is kitchen crops crop 218 acres which had taken account into 0.15 percent of the total cultivable land.

3.3 The Analysis on The Types of Agriculture Land Use

Agricultural land use concentration of each village tract is calculated by Dr Bhatia's Method. In this concentration method, the variable used is cultivated acre of crop and this present research, instead of crop cultivated acre, types of agricultural lands is used to examine the concentration indices. In order to determine the regional concentration of land use, an index (the location quotient) is used. Agricultural land concentration is described by *"Le"* (paddy land), *"Ya"* (farm land), "*Kaing-kyun*" (riparian land) and "*Garden*" land (orchard land). The index of agricultural land use concentration is classified into three grades as high, medium and low**.**

$$\text{Index of Concentration of Agricultural land} = \frac{\text{Area of Agricultural land X in a Component Areal Unit}}{\text{Area of all Agricultural land in the Component Areal Unit}} \div \frac{\text{Area of Agricultural land X in the Entire Region}}{\text{Area of all Agricultural land in the Entire Region}}$$

3.3.1 *"Le"* Land

Madaya Township is situated in scanty rainfall area of Central Myanmar. Therefore, irrigation system is mainly practiced in this area. ***"Le"*** lands are found along Chaungmagyi and Sedawgyi Canals, flat area vicinity of Ayeyarwady and Myaung Rivers. In Madaya, *"Le"* land is a crucial for utilization of cultivable land. In 2014- 2015, the total area of *"Le"* land was 53,423 acres and accounting for 39. 05 percent of total cultivable land of Madaya Township.

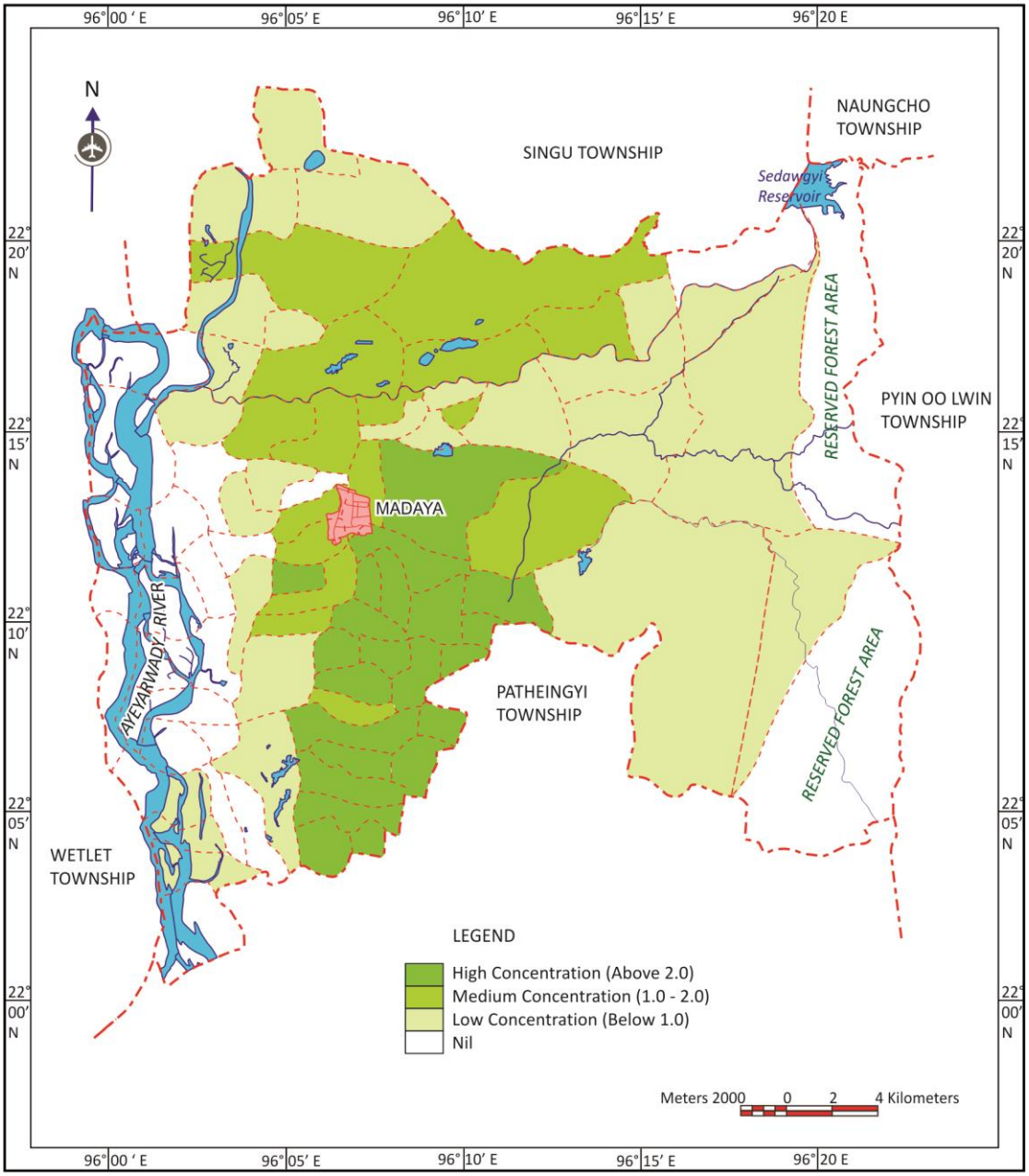
According to the data in 2014- 2015, *"Le"* land concentration of Madaya Township can be studied on (Map 3.1) and (Table 3.2) .Most of *"Le"* land are concentrated on the western parts of Mandalay Canal and along Shwetachaung Canal which area has irrigated water. In Madaya Township, high concentration of *"Le"* land are comprised of 23 village tracts. These are Tegon, Shantaw, Letkaunggyi, Wetke, Kantaphet, Taungpyone, Bayme, Winyindok, Wahthonedera, Kanbe, Yadanabonmi, Kyonewar, Thamintwin, Hteetawmoe, Linmyaychaung, Kyarwar, Htanpingone, Luntaung, Thalunphyu, Thayatkan (N), Thayatkan (S), Sitaikan and Kabaing Village Tracts.

The village tracts which have medium concentration of *"Le"* land are found in the northern parts of Chaungmagyi Chanung, near Shwelaung Chaung and along the Shwetachaung Canal. There are 16 village tracts in medium concentration of *"Le"* land. There are Kyauksayitgone(N), Kyauksayitgone (S), Myithar, Wunsu, Myitkauk, Madaya Town Proper, Mwayponkan, Thapyaythar, Kyaunggone, Yenathar, Lamaing, Thayattaw, Panya, Tetaw, Sathate and Theingone Village Tracts.

The village tracts which have low concentration of *"Le"* land are found in the eastern parts of the low lying area of Ayeyarwady River, near Myaung River in the eastern part of the foothill area of the township, 26 village tracts are included in low concentration of *"Le"* land. These village tracts are Thafanggaing, Yekyi, Nantawkyune, Nyaungoat, Kyarpin, Udein, Tawpu, Lower Taunggaing, Zephyugone, Mwayhintha, Sagabin, Hlaingkyune, Taungkan, Kaukyopon, Ywaysu, Thayezet, Thonesepay, Upper Taunggaing, Mwayshweke, Shwekyaung, Patleinn, Seikthar, Gwaypin, Sakyin, Kwetaw and Nyaunggone.

In Madaya Township, 19 village tracts have no *"Le"* land because these village tracts have *"Kaing-kyun"* land.

MAP 3.1 SPATIAL PATTERN OF "LE" LAND CONCENTRATION IN MADAYA TOWNSHIP



Source: Land Records Department, Madaya Township.

Table (3.2) *"Le"* Land Concentration Index in Madaya Township by Village Tracts (2014-2015)

Above 2.00 (High)	2.00-1.00 (Medium)	Below 1.00 (Low)	Nil
Tegone	Kyauksayitgone (N)	Thafanggaing	Myayzun
Shantaw	Kyauksayitgone (S)	Yekyi	Salay
Letkaunggyi	Myitkan	Nantawkyune	Powa
Wetke	Wunsu	Nyaungoat	Tekyune
Kantaphet	Myitkauk	Kyarpin	Hinthagone
Taungpyone	Madaya Town Proper	Udein	Shinhla
Bayme	Mwayponkan	Tawpu	Shwebogyi
Wayindok	Thapyaythar	Lower Taunggaing	Pyinkar
Wathonedera	Kyaunggone	Zephyugone	Halin
Kanbe	Yenathar	Mwayhintha	Waihigama
Yadanabonmi	Lamaing	Sagabin	Sukar
Kyoneywar	Thayattaw	Hlaingkyune	Chaungpauk
Thamintwin	Ponya	Taungkan	Kywechangone
Hteetawmoe	Tetaw	Kyaukyopon	Idai
Linmwaychaung	Sethtate	Ywaysu	Ngatoe
Kyarywar	Theingone	Thayezet	Shwebaung
Htanpingone		Thonesepay	Konetan
Luntaung		Upper Taunggaing	Sinkyune
Thalunphyu		Mwayshweke	Paukwe
Thayatkan (N)		Kwetaw	
Thayatkan (S)		Nyaunggone	
Sitaikan		Shwekyaung	
Kabaing		Patleinn	
		Seikthar	
		Gwaypin	
		Sakyin	
		Kwetaw	
		Nyaunggone	

Source : Land Records Departments, Madaya

3.3.2 *"Ya"* Land

Madaya Township is located in scanty rainfall of Central Myanmar, so *"Ya"* land is the third most important agricultural land. *"Ya"* land is undulating and rolling foothill and along the canal received irrigated water from Chaungmagyi and Sedawgyi.

"Ya" crops are a favored practice of cultivation in *"Ya"* land. The produce of the farm is more than sufficient for the inhabitants of the township and the surplus is exported to other places.

In Madaya Township, the total area of *"Ya"* land is 34,903 acres in 2014- 2015 and accounting for 25.51 percent of the total cultivable land.

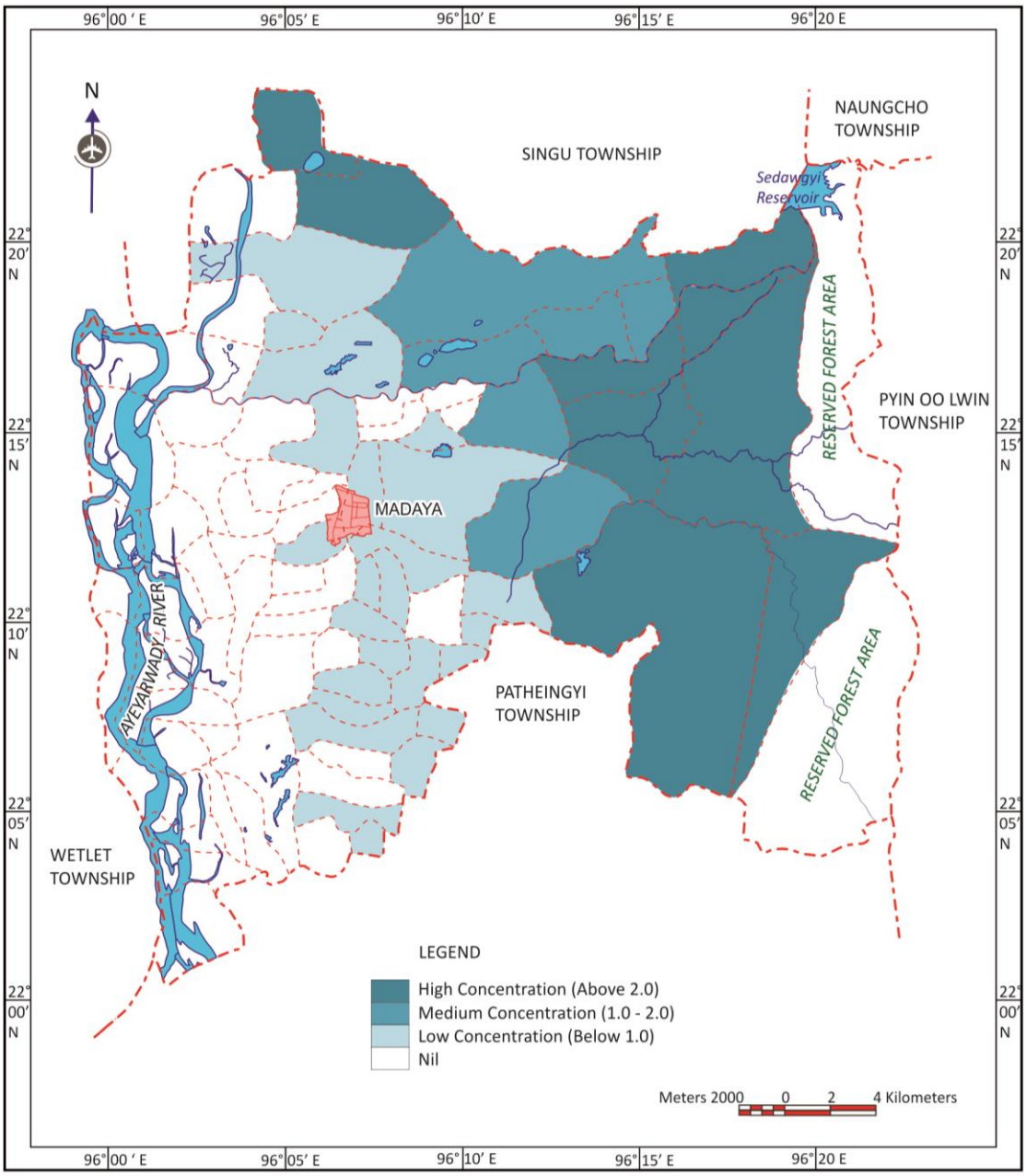
According to statistic in 2014 - 2015, *"Ya"* land concentration of Madaya Township can be shown on (Map 3.2) (Table 3.3). High concentration of *"Ya"* land are mainly found along the Mandalay Canal, eastern foothill and the northern hill areas. There are 9 village tracts in high concentration of *"Ya"* land. These are Upper Taunggaing, Sagabin, Patleinn, Taungkan, Nyaungoat, Salay, Thafangaing, Kyarpin and Yekyi Village Tracts.

The village tracts which have medium concentration of *"Ya"* land are found in the periphery area of northern part of Chaungmagyi Chaung and along the Mandalay Canal. In Madaya Township, medium concentration of *"Ya"* land are comprised of 6 village tracts. These are Thapyaythar, Seikthar, Yenathar, Lamaing, Myitkan and Gwaypin.

The village tracts which have low concentration of *"Ya"* land are found in the central part of the township along the Shwetachaung Canal near Chaungmagyi Chaung, 25 village tract are comprised in this group. These Madaya Town Proper, Htanpingone, Tetaw, Thamintwin, Wathonedera, Thayatkan (N), Thayatkan (S), Panya, Bayme, Kyarywar, Linmwaychaung, Luntaung, Wayindok, Yadanabonmi, Hteetawmoe, Kyoneywar, Theigone, Kanbe, Kantaphet, Wetke, Ywaysu, Sakyin, Letkaunggyi, Kyauksayitgone (N) and Mwayponkan Village Tracts.

In Madaya Township, there is no concentration of *"Ya"* land which has 44 village tracts. Because of these village tracts have *"Le"*, *"Kaing-kyun"* and *"Garden"* lands.

MAP 3.2 SPATIAL PATTERN OF "YA" LAND CONCENTRATION IN MADAYA TOWNSHIP



Source: Land Records Department, Madaya Township.

Table (3.3) *"Ya"* Land Concentration Index in Madaya Township by Village Tracts (2014-2015)

Above 2.00 (High)	1.00 - 2.00 (Medium)	Below- 1.00 (Low)	Nill	
Upper Taunggaing	Thapyaythar	Madaya Town Proper	Kaukyopon	Sitaikan
Sagabin	Seikthar	Htanpingone	Myayzun	Tegone
Patleinn	Yenathar	Tetaw	Mwayshweke	Thalunphyu
Taungkan	Lamaing	Thamintwin	Mwayhintha	Taungpyone
Nyaungoat	Myitkan	Wathonedera	Kyauksayitgone(S)	Kabaing
Salay	Gwaypin	Thayatkan (N)	Kyaunggone	Sukar
Thafangaing		Thayatkan (S)	Zephyugone	Nyaunggoe
Kyarpin		Panya	Ketaw	Chaungpauk
Yekyi		Bayme	Wunsu	Kywechangone
		Kyarywar	Thayezet	Idai
		Linmwaychaung	Udein	Ngayoe
		Luntaung	Powa	Shwebaung
		Wayindok	Tekyun	Konetan
		Yadanabonmi	Hinthagone	Thonesepay
		Hteetawmoe	Shinhla	Sinkyune
		Kyoneywar	Shwebogyi	Hlaingkyune
		Theigone	Pyinkar	Nantawkyune
		Kanbe	Tawpu	Paukwe
		Kantaphet	Halin	
		Wetke	Thayattaw	
		Ywaysu	Shantaw	
		Sakyin	Waihigama	
		Letkaunggyi	Myitkauk	
		Kyauksayitgone (N)	Saththate	
		Mwayponkan	Lower Taunggaing	
			Shwekyaung	

Source : Land Records Departments, Madaya

3.3.3 *"Kaing-kyun"* Land

In raining season *"Kaing-kyun"* land is inundated by rising of the river to water level. Alluvial soil is left on the inundated flat area when the water level is drop off. *"Kaing-kyun"* land is the second largest in Madaya Township. It can be seen along the Ayeyarwady, Myaung River, Chaungmagyi Chaung and along the Canal. In 2014-2015, the total area of *"Kaing-kyun"* land is 45,283 acres and accounting for 33.09 percent of the total cultivable land.

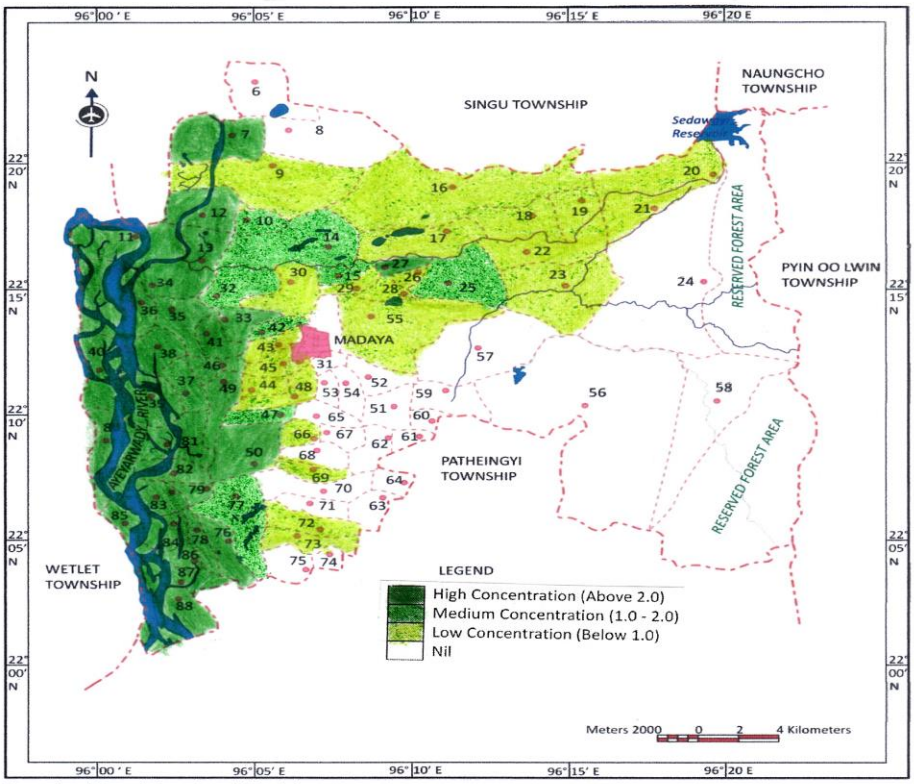
According to their sources in 2014- 2015, *"Kaing-kyun"* land concentration of Madaya Township can be studied on (Map 3.3) (Table 3.4). High concentration of *"Kaing-kyun"* lands are mainly found along the Ayeyarwady River. In Madaya Township, high concentration of *"Kaing-kyun"* land are comprised of 29 village tract. These are Myayzun, Powa, Tekyun, Hinthagone, Shinhla, Shwebogyi, Pyinkar, Waihigama, Sukar, Chaungpauk, Kywechangone, Idai, Ngatoe, Shwebaung, Konetan, Sinkyune ,Paukwe, Thayezet, Zephyugone, Mwayshweke, Shwekyaung, Thonesepay, Kaukyopon, Lower Taunnggaing, Tawpu, Udein, Hlaingkyune, Mwayhintha and Nantawkyune Village Tracts.

The village tracts which have medium concentration of *"Kaing-kyun"* land are obviously found near Myaung River and Chaungmagyi Chaung and the western part of Shwetachaung Canal. These 8 village tracts are Seikthar, Kyauksayitgone (N), Sakyin, Kyauksayitgone (S), Wunsu, Halin, Myitkauk and Nyaunggone Village Tracts.

The village tracts which have low concentration of *"Kaing-kyun"* land are found along the Shwetachaung Canal and Chaungmagyi Chaung, 22 village tracts are included in low concentration of *"Kaing-kyun"* land. These are Yenathar, Tetaw, Thayattaw, Letkaunggyi, Taungpyone, Shantaw, Thayatkan (N), Thafanggaing, Sagabin, Ywaysu, Thapyaythar, Myitkan, Panya, Sathtate, Gwaypin, Salay, Upper Taunggaing, Tegone, Mwayponkan, Theingone, Kyaunggone and Kwetaw Village Tracts.

In Madaya Township, there is no concentration of *"Kaing-kyun"* land which has 25 village tracts. Because of these village tracts have *"Le"* and *"Ya"* lands.

MAP 3.3 SPATIAL PATTERN OF "KAING-KYUN" LAND CONCENTRATION IN MADAYA TOWNSHIP BY VILLAGE TRACTS (2014-2015)



Source: Land Records Department, Mandalay.

Table (3.4) *"Kaing-Kyun"* Land Concentration Index in Madaya Township by Village Tracts (2014-2015)

Above 3.00 (High)	1.00-2.00 (Medium)	Below 1.00 (Low)	Nil
Myayzun	Seikthar	Yenathar	Madaya Town Proper
Powa	Kyauksayitgone (N)	Tetaw	Patleinn
Tekyun	Sakyin	Thayattaw	Nyaungoat
Hinthagone	Kyauksayitgone (S)	Letkaunggyi	Kyarpin
Shinhla	Wunsu	Taungpyone	Bayme
Shwebogyi	Halin	Shantaw	Sitaikan
Pyinkar	Myitkauk	Thayatkan (N)	Thamintwin
Waihigama	Nyaunggone	Thafanggaing	Wayindok
Sukar		Sagabin	Kantaphet
Chaungpauk		Ywaysu	Taungkan
Kywechangone		Thapyaythar	Lamaing
Idai		Myitkan	Yekyi
Ngatoe		Panya	Kyarywar
Shwebaung		Sathtate	Htanpingone
Konetan		Gwaypin	Wathonedera
Sinkyune		Salay	Hteetawmoe
Paukwe		Upper Taunggaing	Linmwaychaung
Thayezet		Tegone	Wetke
Zephyugone		Mwayponkan	Yadanabonmi
Mwayshweke		Theingone	Kanbe
Shwekyaung		Kyaunggone	Kyoneywar
Thonesepay		Kwetaw	Thalunphyu
Kaukyopon			Thayatkan (S)
Lower Taunnggaing			Kabaing
Tawpu			Luntaung
Udein			
Hlaingkyune			
Mwayhintha			
Nantawkyune			

Source : Land Records Departments, Madaya

3.3.4 *"Garden"* Land

"Garden" land is the least in Madaya Township. Formerly there were no separate lands to grow garden crops. People grew garden crops in their wide spacious house compounds. In 2014- 2015, the total area of *"Garden"* land is 3203 acres which taken into account 2.34 percent of the total cultivable land. Generally garden land is found both level land and the irrigation area.

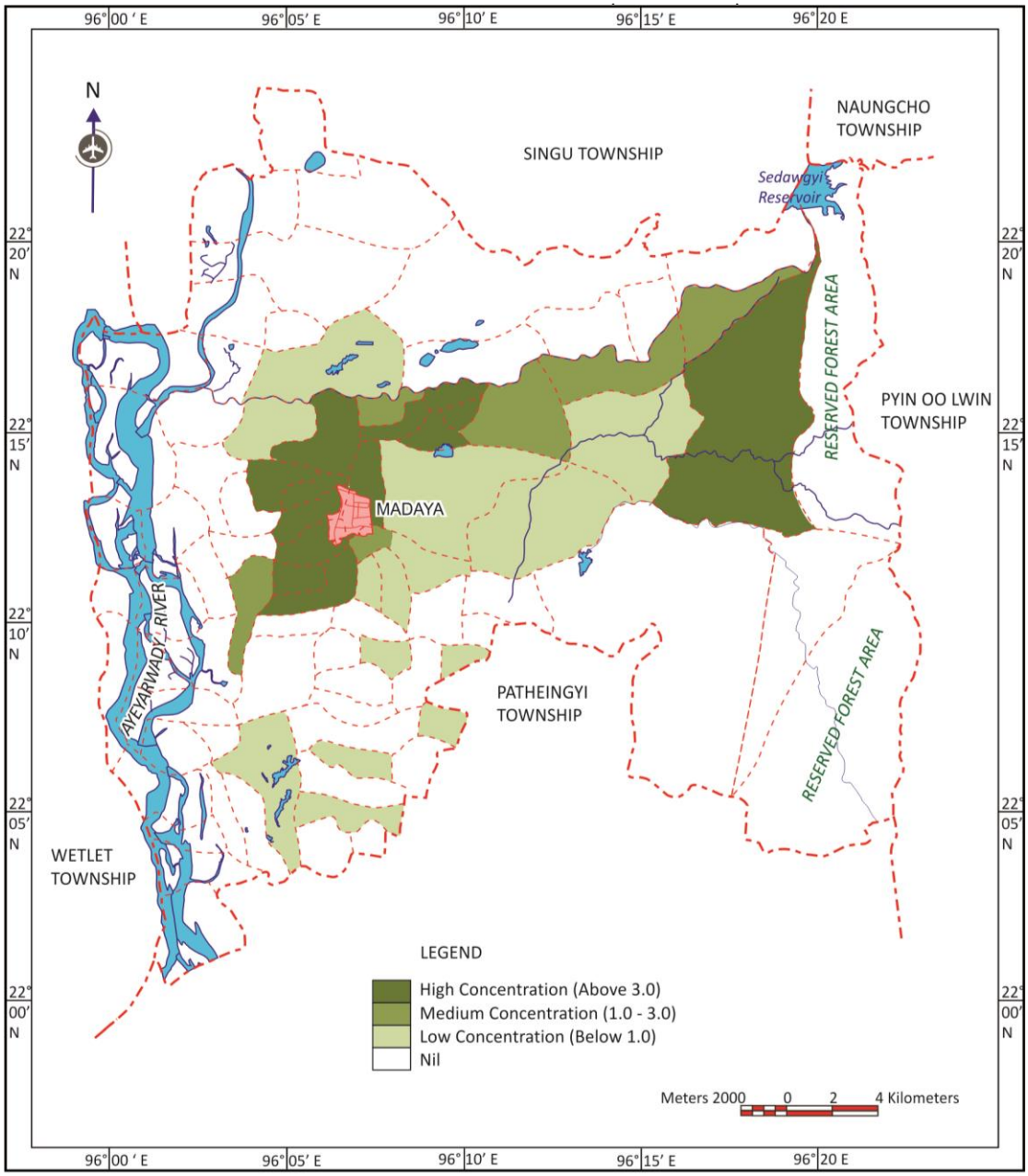
According to the data in 2014- 2015, *"Garden"* land concentration of Madaya Township can be shown on (Map 3.4) (Table 3.5). Most of the *"Garden"* Land is remarkably found along the Shwetachaung Canal and near Chaungmagyi Chanung. There are 14 village tract which have high concentration of *"Garden"* land. These are Ywaysu, Madaya Town Proper, Halin, Kwetaw, Thagattaw, Tetaw, Zephyugone, Panya, Shantaw, Kyaunggone, Thayezet, Saththate, Kyarpin and Upper Taunggaing Village Tracts.

The village tracts which have medium concentration of *"Garden"* land are mainly found along the Chaungmagyi Chaung and near Ayeyarwady River. There are 6 village tracts which have medium concentration of *"Garden"* land. These are Wathonedera, Kyauksayitagone (N), Sagabin, Seikthar, Bayme and Lower Taunggaing Village Tracts.

The village tract which have low concentration of *"Garden"* land are found around the town area. These are 13 village tract which have low concentration of *"Garden"* land. These are Kyauksayitgone (N), Thafangging, Wunsu, Thamintwin, Kantaphet, Wayindok, Letkaunggyi, Linmwaychaung, Thayatkan (N), Lamaing, Kanbe, Thalunphyu and Nyaunggone Village Tracts.

In Madaya Township, 51 village tracts have no *"Garden"* land because all agricultural lands in these village tracts are *"Le"*, *"Ya"* and *"Kaing kyun"* lands.

MAP 3.4 SPATIAL PATTERN OF "*GARDEN*" LAND CONCENTRATION IN MADAYA TOWNSHIP



Source: Land Records Department, Madaya Township.

Table (3.5) *"Garden"* Land Concentration Index in Madaya Township by Village Tracts (2014-2015)

Above 3 (High)	1.00-3.00 (Medium)	0.00-1.00 (Low)	Nil	
Madaya Town Proper	Wathonedera	Kyauksayigone(N)	Patleinn	Kyarywar
Ywaysu	Kyauksayitgone(S)	Thafangaing	Kaukyopon	Htanpingone
Halin	Sagabin	Wunsu	Nyaungoat	Hteetawmoe
Kwetaw	Seikthar	Thamintwin	Mwayponkan	Wetke
Thayattaw	Bayme	Kantaphet	Sakyin	Tegone
Tetaw	Lower Taunggaing	Wayindok	Myayzun	Yadanabonmi
Zephygone		Letkaunggyi	Mwayshweke	Kyoneywar
Panya		Linmwaychaung	Mwayhintha	Theingone
Shantaw		Thayatkan (N)	Yenathar	Taungpyone
Kyaunggone		Lamaing	Thapyaythar	Thayatkan(S)
Thayezet		Kanbe	Myitkan	Kabaing
Sathatate		Thalunphyu	Gwaypin	Sukar
Kyarpin		Nyaunggone	Salay	Chaungpauk
Upper Taunggaing			Udein	Kywechaungone
			Powa	Idai
			Tekyun	Ngatoe
			Hinthagone	Shwebaung
			Shinhla	Luntaung
			Shwebogyi	Konetan
			Pyinkar	Thonesepay
			Tawpu	Sinkyune
			Waihigama	Hlaingkyune
			Myitkauk	Nantawkyune
			Shwekyaung	Paukwe
			Sitaikan	Yekyi
			Taungkan	

Source : Land Records Departments, Madaya

CHAPTER 5

FINDINGS AND RESULTS

Madaya Township is located 21 miles far away from the north of Mandalay and its fall in Pyin Oo Lwin District. The eastern part is connected with Shan State. The cultivable land is found the western and central part of the township area. The alluvial plain is deposited by both side of Ayeyarwady River and Chaungmagyi Chaung.

This township falls in the Dry Zone of Central Myanmar and it, average rainfall is 37.75 inches (1.49 millimetres).

In Madaya Township, there are four types of agricultural land use; *"Le"* and, *"Ya"* land, *"Kaing-kyun"* land and *"Garden"* land. Among them, ***"Le"*** lands are found along Chaungmagyi and Sedawgyi Canals, flat area vicinity of Ayeyarwady and Myaung Rivers n. *"Le"* land has supporting the irrigated water.

In studying the land, the second most is *"Kaing-kyun"* land. It is found as island in the Ayeyarwady River during the winter period.

In studying the area, the third most is *"Ya"* land. It is found on the eastern of the township and the northern part of foothill regions. Its depend upon the physical factor such as relief features, climate and soil.

The *"Garden"* land is a few in Madaya Township. Because of the constraint of agricultural policy and small investment in agriculture.

In the study area, there is a good advantage in agricultural sector, i.e. the high percentage of agricultural land use and low percentage of fallow land. Because of the forest land are decreased and it can caused the loss of the biodiversity.

In Madaya Township most of the soils are dark compact savanna soil and dark compact irrigated savanna soil. Other soils are alluvial soil, meadow and meadow alluvial soil, yellow brown savanna soil and mountainous red brown forest soil.

In Madaya Township, most of the agriculture soil is dark compact savanna soil and dark compact irrigated savanna soil. The moderate *"Le"* land are found on meadow and meadow alluvial soil and dark compact savanna soil and and dark compact irrigated savanna soil near the Chaungmagyi Chaung. The least *"Le"* land are found on yellow brown savanna soil, meadow and meadow alluvial soil and mountainous red brown forest soil. *"Le"* crop and other irrigated crops as well as monsoon paddy and summer paddy are also grown.

In Madaya Township, the majority of *"Ya"* land are growing on the types of yellow brown savanna soil and mountain red brown forest savanna soil. The moderate *"Ya"* land are found on the types of dark compact savanna soil. The least *"Ya"* land

are found on meadow and meadow alluvial soil and dark compact savanna soil and and dark compact irrigated savanna soil. *"Ya"* crops are pulses, beans, cotton, sesamum, sugarcane, wheat, sunflower and peanut are grown as planning crop.

In Madaya Township, most of the *"Kaing-kyun"* land are found on alluvial soil and meadow and meadow alluvial soil. The moderate *"Kaing-kyun"* land are on the meadow and, meadow alluvial soil near the Chaungmagyi Chaung. The least *"Kaing-kyun"* land are on the dark compact savanna soil. *"Kaing-kyun"* crop are groundnut, maize, pulses and beans and vegetables.

In Madaya Township, most of the *"Garden"* land are found on dark compact savanna soil and dark compact irrigated soil and meadow and meadow alluvial soil. The moderate *"Garden"* land are on the meadow and meadow alluvial soil along the Chaungmagyi Chaung. The least garden land are near the available of water. *"Garden"* crops are mango, coconut, jackfruit, betel vine, banana, papaya, plum, other vegetables and flowers.

CONCLUSION

Summary

Madaya Township is located between 20° 02' N and 20° 24'N latitudes and 96° 00'E and 96° 22'E longitudes. It covers an area of 454.97 square miles (291187 acres). The shape of the township is like a rectangle. The total length of land boundary is about 66 miles and water boundary is about 18 miles. The study area is an alluvial plain which is deposited by Ayeyarwady River and Chaungmagyi Chaung. The main river is Ayeyarwady River and the famous chaungs are Chaungmagyi and Shwelaung. Two groups of rock units: these are sedimentary rock units and metamorphic rock unit. Climate is the most important environmental factor. According to the location of the township, Madaya Township receives Tropical Steppe (BSh) types of climate. During the period from 2000-2015, the mean annual temperature of Madaya township is about 82.23°F (27.91°C)with maximum mean temperature 93.06°F (33.92°C) and minimum mean temperature 71.39°F (21.88°C) respectively. The average annual total amount of rainfall in the township is about 37.75 inches (1.49 millimetres). The main soil types of Madaya Township can be divided into (5) grouped. There are (1) Alluvial Soils, (2) Meadow and Meadow Alluvial Soils, (3) Dark Compact S 29 a Soils and Dark Compact Irrigated Savanna Soils, (4) Yellow Brown Savanna Soils and (5) Mountainous Red Brown Forest Soils.

Natural vegetation in an area depends on altitude, climate and soil. In Madaya Township, the forest area is (51,843) acres and it covers (17.80) percent of the township area. The reserved area is (38,806) acres and unclassified forest is (13,037) acres. According to the data of 2015, the total population of the township had increase 254,570 persons. During the 7 year period from 2008 to 2015, there was an increase of 37,292 with the average growth rate of 2.27 percent per year.

In 2014- 2015, the agriculture net sown land was 136,812 acres which was 46.98 percent of current occupied area. The agricultures net sown land was a little variation. The fallow land was 12 acres which were taken into account 0.004 percent of the total area. The main agriculture crops are cereal crops (paddy), ediable crops (groundnut, sesamum, sunflower), pulses and beans, kitchen crops and vegetables.

In 2014- 2015, *"Le"* land concentration of Madaya Township can be studied. Most of *"Le"* land is concentrated on the western part of Mandalay Canal and along Shwetachaung Canal which area has irrigated water. In Madaya Township, high concentration of *"Le"* land are comprised of 23 village tracts. The village tracts which have medium concentration of *"Le"* land are found in the northern part of Chaungmagyi Chanung , near Shwelaung Chaung and along the Shwetachaung Canal. There are 16 village tracts in medium concentration of *"Le"* land. The village tracts which have low concentration of *"Le"* land are found in the eastern part of the low lying area of Ayeyarwady River, near Myaung River in the eastern part of the foothill

area of the township, 26 village tracts are included in low concentration of *"Le"* land. In Madaya Township, 19 village tracts have no *"Le"* land because these village tracts have *"Kaing-kyun"* land.

In Madaya Township, the total area of *"Ya"* land is 34,903 acres in 2014- 2015 and accounting for 25.51 percent of the total cultivable land. High concentration of *"Ya"* land are mainly found along the Mandalay Canal and eastern foothill and northern hill areas. There are 9 village tracts in high concentration of *"Ya"* land. The village tracts which have medium concentration of *"Ya"* land are found in the periphery area of northern part of Chaungmagyi Chaung and Mandalay Canal. There are 6 village tracts in medium concentration of *"Ya"* land. The village tracts which have low concentration of *"Ya"* land are found in the central part of the township along the Shwetachaung canal near Chaungmagyi Chaung, 25village tract are comprised in this group. In Madaya Township, there is no concentration of *"Ya"* land which has 44 village tracts. Because of these village tracts have *"Le"*, *"Kaing-kyun"* and *"Garden"* lands.

According to their sources in 2014- 2015, High concentration of *"Kaing-kyun"* lands are mainly found along the Ayeyarwady River. In Madaya Township, high concentration of *"Kaing-kyun"* land are comprised of 29 village tract. There are 8 village tracts in medium concentration of *"Kaing-kyun"* land. The village tracts which have low concentration of *"Kaing-kyun"* land are found along the Shwetachaung Canal and Chaungmagyi Chaung, 22-village tracts are included in low concentration of *"Kaing-kyun"* land. In Madaya Tov 30 , there is no concentration of *"Kaing-kyun"* land which has 25 village tracts. Because of these village tracts have *"Le"* and *"Ya"* lands.

Most of the *"Garden"* Land is remarkably found along the Shwetachaung Canal and near Chaungmagyi Chaung. There are 14 village tract which have high concentration of *"Garden"* land. The village tracts which have medium concentration of *"Garden"* land are mainly found along the Chaungmagyi Chaung and near Ayeyarwady River. There are 6 village tracts which have medium concentration of *"Garden"* land. These are 13 village tract which have low concentration of *"Garden"* land. In Madaya Township, there is no concentration of *"Garden"* land which has 51 village tract. Because of these village tracts have *"Le", "Ya"* and *"Kaing- kyun"* lands.

Suggestion

Agriculture is the main function in Madaya Township. In studying the agricultural land use, the government's agriculture policy is the most important. According to the physical factors this township has huge flat plain, well drainage system and sufficient amount of rainfall with 37.75 inches and a good agriculture soil. So, the agriculture function was successful in the study area. Now, the agriculture area is slightly decreased in number due to the growth of population. And the agricultural works are done by intensive agriculture method. To improve the agriculture sector,

the traditional methods should be changed into the modernized farming method, machinary, technique and using organic fertilizer. Moreover, mixed crop farming and double crop farming should be pratised in the study area and to gain the quality products. And also the educative talks about fertilizer contribute to farmers in village tracts wise. According to the government's policy, its support to uplift the agriculture works and rural village level will be developed. To promote the socio-economic standard level of Madaya Township, the agriculture crops are extended to grow in the study area. By doing so, the socio economy of this township will be prosperous in near future.

Future Prospects

In analyzing agricultural land use in Madaya Township, the agricultural land use is 46.98 percent of the total township land area. Most of the land use is *"Le"* land in Madaya Township. There are fertile soils and also adequate water for cultivated crops in the study area. Based on these facts, systematic utilization of land is essential in the study area. Moreover, by conducting the reclamation of fallow land and cultivable waste land are utilizing the mechanized farming. According to agriculture statistics, the study area is more developed in agricultural activities. By utilization land resource systematically, the sustainable development of Madaya Township will become a better condition and more successfully in future.

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