

A Geographical Analysis of Major Crops Concentration in Ayadaw Township Moe Thu Khaing¹

Abstract

The study area, Ayadaw Township is located on the western bank of Mu River and in the central dry zone of Myanmar. Crop concentration means that the ratio subregion for area and the whole region for any crop in the given time. The main aim of this paper is to analyse the major crop concentration of the study area. This analysis is based on sown acreage of major crops and total sown acreage within the village tract of the study area in the year of (2018-2019). The role of major crops is investigated by crop concentration with the help of Dr. S.S. Bhatia's method. The government had laid down the plan for major crops to develop economy and the associated plan to grow crops. These major crops are paddy, sesame, groundnut, sunflower, pigeon pea, green gram, black gram, cotton, and sugarcane. Sesame is the most cultivated crop in the study area. Sugarcane is the least cultivated crop in the study area. The villages where are the highest concentration of major crops are Naungchaytauk, Kaingywa, Leinhla, Oakshingyi, Minywa, Neyagin, Kyundaw, Khintha, Sintale, Ngwedwin, Myaynet, Thaleba and Kantha. The villages where are the lowest concentration of major crops are Ayadaw-3, Yegyin, Wayaung, Wadawma and Hmawdaw. The major crops concentration of the study area is found to be the result of the varies with natural factors and social factors. The five major crops are analysed for the period from (2009-2010 to 2018-2019). The temporal changes of five major crops cultivation in the study area are analysed for the period from (2009-2010 to 2018-2019). In the year (2012-2013) there were the most variable year for the temporal changes of five major crops cultivation during the 10 years (2009-2010 to 2018-2019). The acreage of paddy, sesame and green gram decreased significantly in (2012-2013) due to the climatic condition, farmers' choices and crop prices. Groundnut acreage increased significantly in (2012-2013).

Keywords: Major Crop Concentration, Paddy, Sesame, Groundnut, Sunflower, Pigeon Pea, Green Gram, Black gram, Cotton, and Sugarcane, Ayadaw Township, Temporal Changes of Five Major Crop

1. Introduction

Crop concentration means that the ratio subregion for area and the whole region for any crop in the given time. The concentration of a crop in an area largely depends on its terrain, climate, soil conditions and soil factors.

Ayadaw Township is located in the central dry zone of Myanmar. The type of agricultural land and growing crops vary from place to place, in the Township. Besides, the irrigation works play an important role for the production of crops in the study area.

1.1 Study Area

Ayadaw Township is located in the southern part of Sagaing Region. It lies between latitudes 22°00'N and 22°30'N and longitudes 95°15'E and 95°40'E. In general, the study area can be divided into two parts: the western hilly area and the eastern plain. Mu River flows as the east boundary. It comprises of 3 wards of Ayadaw Town and 38 village tracts.

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1.2 Aim and Objectives

The main aim of this research is to analyse the major crops concentration of Ayadaw Township. The objectives of the study are;

1. to study about the major crops of Ayadaw Township.
2. to analyse the major crops concentration by village tracts in Ayadaw Township.
3. to analyse temporal changes of five major crops cultivation for 10-years period from (2009-2010 to 2018 -2019) in Ayadaw Township.

1.3 Scope and Methods of Study

Secondary data on this research were obtained from the various township office such as the Department of Meteorology and Hydrology, Agricultural Land Management and Statistics, Department Ayadaw and Monywa Township.

To find the major crops in Ayadaw Township, graphical methods are applied and then the spatial distribution maps of “Ya” land and “Le” land are drawn. Based on processes information, graphs and maps, the analysis was made geographically.

The local differences of major crops concentration indices have been calculated in all the village tracts with the help of Dr. S.S. Bhatia's (1965) Location Quotient Method. The method is as follows:

$$\text{Index for determining concentration of crop} = \frac{\text{area of crop "a" in the component areal unit}}{\text{area of all crop in the component areal unit}} \div \frac{\text{area of crop "a" in the entire region}}{\text{area of all crop in the component areal unit}}$$

2. Physical Bases of Ayadaw Township

2.1 Location, Size, Shape and Boundary

Ayadaw Township is situated in Monywa District, Sagaing Region. It is located in the central dry zone of Myanmar. It lies between latitudes 22°00'N and 22°30'N and longitudes 95°15'E and 95°40'E. Map (2.1)

The township has an area of (302,400) acres or (472.5) square miles which account for (35.22) percent of the total area of Monywa District. The township extends from north to south for about 24 miles and from east to west for about 20 miles. The shape of the township is an irregular trapezium. The township is constituted with 3 wards of Ayadaw Town and 38 village tracts composed of 155 villages. Table (2.1) and Map (2.2).

Ayadaw is bounded by Depeyin on the north, by Wetlet Township divided by the Mu River on the east, by Myinmu Township on the South and by Monywa and Budalin Township on the west.

2.2 Topography

The major crops concentration is dependent mainly on the condition of terrain, topography and altitude. The “Le” cultivation (or) paddy cultivation requires level fields and “Ya” cultivation (or) pigeon pea cultivation requires the undulating or well-drained topography. The

amount of rainfall received in a region directly and indirectly affects the agriculture. Apart from altitude, terrain, aspect of slope and the nature of surface also affect agricultural activities.

In general, topographic features in the Ayadaw Township are low hills and the undulating terrain in some village tracts. The hills gradually decline towards the Mu River to the east. The eastern part of the township is level plain. The topography of Ayadaw Township can be divided into two parts based on the 500 feet contour. These two parts are (1) the western hilly region and (2) the eastern plain.

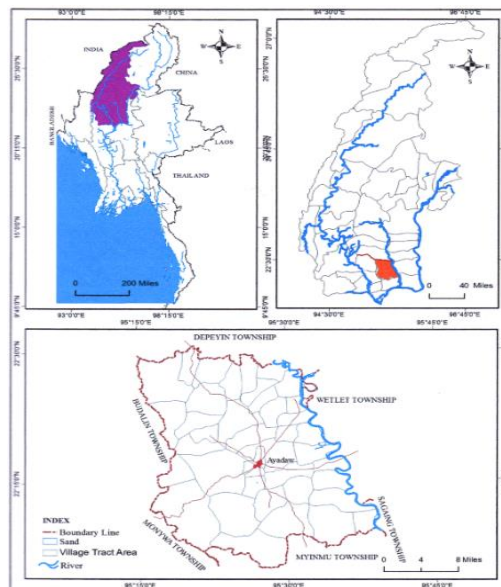
The western hilly regions are covered on the eastern flank of the Kyaukka range. The hills are the continuation of Kyaukka Range which is about 900 feet (274.32 m) above sea level. The hilly portion gradually slopes down towards the east and becomes narrow towards the north. In this portion occupy “Ya” land.

The eastern plain is the portion east of Ayadaw Town. It is relatively wide in the northern part and it declines slightly to the Mu River. The plain is formed of very fertile alluvium deposited by annual floods and is used as cultivated fields, irrigated by Karbo Dam. Most of the cultivable lands and most of the irrigation works of Ayadaw Township are found in this plain. Map (2.3).

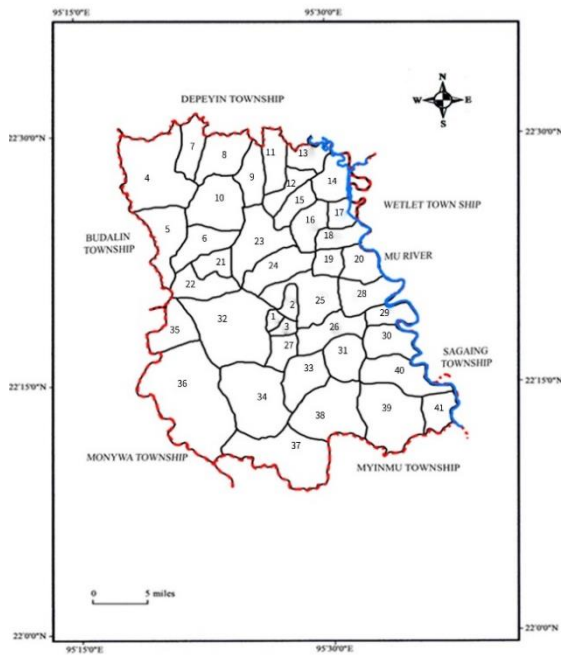
2.3 Drainage

The main drainage in Ayadaw Township is Mu River and its tributaries. Mu River running in the east of the Township flows from north to south. In Ayadaw Township most of the streams take their sources in Kyaukka range and flow toward the east as the intermittent streams into the Mu River.

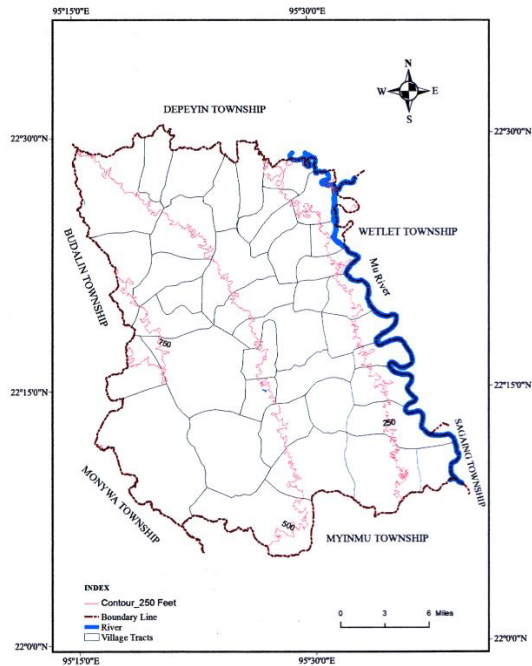
The Kyaukka range exists as a watershed between the Chindwin River on the west and the Mu River on the east. Many streams entering the Mu River from the west are Baungkya *Chaung*, Wetkhae *Chaung*, Mahura *Chaung*, Kanponi *Chaung*, Minngame *Chaung*, Bayanbaga *Chaung*, Guebingwa *Chaung* and Thazi *Chaung*. There is also man-made drainage as canals of dam and river water pumping sites.



Map (2.1) Location Map of Ayadaw Township
Source: UTM Map No. 2285_06, 07, 08, 11 and 12



Map (2.2) Wards and Village Tracts Map of Ayadaw Township
Source: Department of Agricultural Land Management and Statistic, Ayadaw Township



Map (2.3) Topography and Drainage of Ayadaw Township
Source: UTM Map No. 2285_06, 07, 08, 11 and 12

Table (2.1) Wards and Village Tracts of Ayadaw Township (2018-2019)

Code Numbers	Ward / Village Tract	Area	
		Acres	Square Miles
1	Ayadaw-1	1440	2
2	Ayadaw-2	1320	2
3	Ayadaw-3	2057	3
4	Yathit	17938	28
5	Chinbin	12283	19
6	Yeyo	6171	10
7	Ngapyawgyan	4031	6
8	Oakshitgyi	5419	8
9	Leinhla	5741	9
10	Naunggyiaing	10215	16
11	Neyagin	4013	6
12	Kaingywa	3645	6
13	Oakshingyi	3789	6
14	Khintha	5339	8
15	Kyundaw	3735	6
16	Shagone	5090	8
17	Baungkya	1982	3
18	Aungtha	3733	6
19	Taungmwa	3722	6
20	Wetkhae	3986	6
21	Wadawma	3756	6
22	Hmawdaw	7162	11
23	Magyigan	10942	17
24	Yegyin	8775	14
25	Kantha	6755	11
26	Myaynet	8408	13
27	Kyaukpyauk	5432	8

28	Dondit	4798	8
29	Zayit	3460	5
30	Magyisauk	4426	7
31	Ngwedwin	6333	10
32	Kanbyu	19854	31
33	Thaukhutpinle	6149	10
34	Wayaug	15576	24
35	Thitkyingyi	8828	14
36	Wadan	25759	40
37	Maletha	15219	24
38	Minywa	13139	21
39	Naungchaytauk	11803	18
40	Thaleba	6809	11
41	Sintale	3368	5
Total		302,400	472.5

Sources: Department of Agricultural Land Management and Statistic, Ayadaw Township

2.4 Climate

Ayadaw Township is situated in the central dry zone of Myanmar. The township is hot throughout the year and receives a small amount of annual rainfall. As there is no Department of Meteorology and Hydrology in Ayadaw, temperature and rainfall of Monywa are used for this township because it is 23 miles far from Monywa. According to Köppens Classification, it experiences a Tropical Steppe (BSh) climate. During 35 years period from (1984 to 2019) data, the annual average mean temperature is 81.92°F with the average maximum temperature is 94.57°F and the average minimum temperature is 69.26°F. During this period, the average annual rainfall is about 28.62 inches. According to the average monthly temperature, the hottest month is May with mean temperature of 89.15°F. The coldest month was January with mean temperature 70.47°F. The range of temperature is 18.68°F. See table (2.2) and figure (2.1).

Table (2.2) Temperature and Rainfall Conditions of Ayadaw Township (1984-2019)

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave / Total
Max Temp°F	85.43	90.87	99.5	103.74	102.28	99.2	97.74	95.88	94.84	91.72	88.76	84.87	94.57
Mean Temp°F	70.47	74.3	82.42	87.6	89.15	88.32	87.77	86.42	85.26	82.36	77.4	71.54	81.92
Min Temp°F	55.5	57.72	65.34	71.45	76.02	77.43	77.8	76.96	75.68	73	66.03	58.21	69.26
Rainfall (inches)	0.07	0.09	0.24	1.24	3.25	3.41	2.54	4.96	6.68	5.01	1.01	0.12	28.62

Source: Department of Meteorology and Hydrology, Monywa

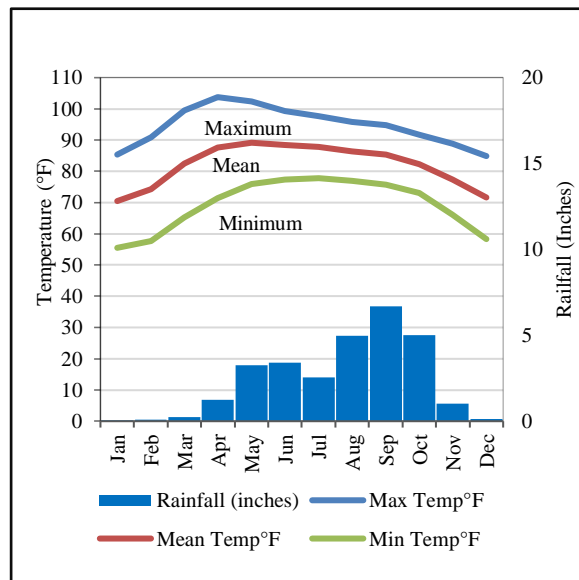


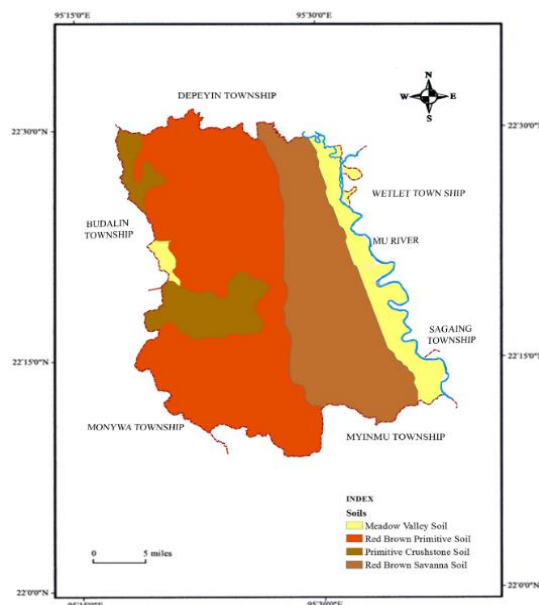
Figure (2.1) The Climograph of Ayadaw Township from(1984 to 2019)
 Source: Department of Meteorology and Hydrology, Monywa

2.5 Soils

Soils presented in the study area are varied in accordance with topography, rock type and natural vegetation. The soil types found in the township are meadow valley soils, primitive crushed stone soils, red brown primitive soils and red brown savanna soils.

Meadow valley soils are found in the eastern most part along Mu River. Therefore, they are the most fertile and rich in soil moisture. Primitive crushed stone soils are found in the western most part where the highest land area of the township. These soils experience the high erosion and composed of crushed stones.

Red brown primitive soils are found as the largest area in the western part of the township. If the irrigation works engage, the cultivation of various crops will be successful. Red brown savanna soils are found in the eastern part of the township. Map (2.4)



Map (2.4) Soils Map of Ayadaw Township
 Source: UTM Map No. 2285_06, 07, 08, 11 and 12

3. Land Use Pattern in Ayadaw Township

3.1 General Land Use Pattern of Ayadaw Township

Land is the basic resource of human society. The primary use of land is found crops, forest, pasture, mining, transportation, gardening, residential, commercial and virgin land etc.

The general land use of Ayadaw Township in (2018-2019) is mentioned in Table (3.1). According to the table, out of the total area (302,400) acres, current cultivated land occupies about (258,876) acres or (85.61) percent of the township's total. Areas under uncultivated land occupy about (38,827) acres or (12.84) percent of the township's total. Cultivable waste land area amounts to (2,735) acres or (0.90) percent of the total area. There are (1,962) acres of forest land which represents about (0.65) percent of the township's area Figure (3.1).

In general land use of the township can be divided into four:

- (1) Cultivated Land,
- (2) Uncultivated Land,
- (3) Cultivable Waste Land and
- (4) Forest Land

The land use of Ayadaw Township is mostly dependent on the conditions of terrain, topography and altitude. In the western part of the township, as it is a hilly area, cultivation cannot be made because of steep slopes. Cultivation is possible only in the narrow valleys of the streams such as Baungkya *Chaung*, Wetkhae *Chaung*, Matura *Chaung* and etc. In the western part of the township is suitable for cultivation of “*Ya*” crops such as sesame, pigeon pea, pulses and other heat-resistant crops, which can grow under the dry climate. Along the western bank of the Mu River the terrain is flat and is covered with alluvial soil. Thus, it is possible to cultivate paddy by irrigation. In addition, dry crops can also be cultivated.

Table (3.1) General Land Use in Ayadaw Township (2018-2019)

No	Types of Land Use	(2018-2019)Acres	% of Total	
1	Cultivated land	<i>Le</i> land	30,607	10.12%
		<i>Ya</i> land	224806	74.34%
		<i>Kaing-Kyun</i> land	3,432	1.14%
		Garden land	31	0.01%
		Total	258,876	85.61%
2	Uncultivated land	38,827	12.84%	
3	Cultivable Waste land	2,735	0.90%	
4	Forest land	1,962	0.65%	
Total		302,400	100.00%	

Sources: Department of Agricultural Land Management and Statistic, Ayadaw Township

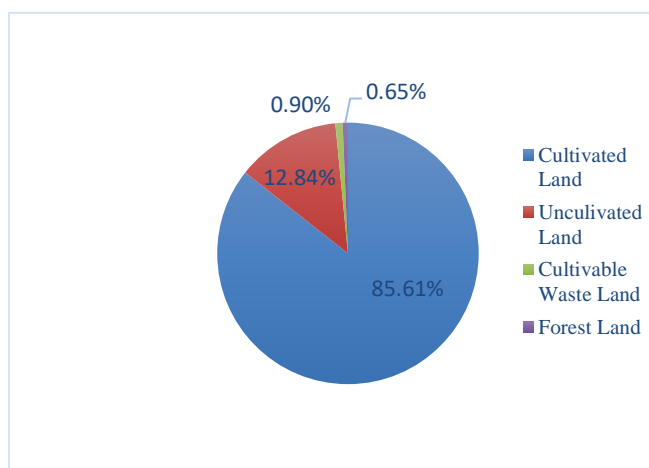


Figure (3.1) General Land Use in Ayadaw Township (2018-2019)

Source: Department of Agricultural Land Management and Statistic, Ayadaw Township

3.2 Agricultural Land Use Pattern of Ayadaw Township

According to the data shown in Table (3.1) in (2018-2019), the agricultural land forms (85.61) percent of total land area and consists of “*Ya*” land, “*Le*” land, “*Kaing-Kyun*” land and “*Garden*” land which total about (25,8876) acres.

Among the four types of agricultural land, “*Ya*” land acreage of (224,806) acres, “*Le*” land acreage of (30,607) acres, “*Kaing-Kyun*” land (3,432) acres and “*Garden*” land acreage of (31) acres are included. So, it can be seen that “*Ya*” land (86.84) percent of the total agricultural land are the most in acreage. It is wider area than the total of the reaming types. “*Le*” land (11.82) percent of the total agricultural land acreage are the second most. “*Kaing – Kyun*” land (1.33) percent and “*Garden*” land (0.01) percent are included. The major agricultural land is “*Ya*” land.

4. Analysis of Major Crops Concentration in Ayadaw Township

4.1 Major Crops

The crops cultivated in Ayadaw Township are “*Le*”, “*Ya*”, “*Kaing-Kyun*” and “*Garden*” crops. Among these crops, “*Ya*” crop are diverse and the sown acreage are large. The “*Le*” and “*Kaing-Kyun*” crops from the second and the third most cultivated crops respectively. The acreage of garden cultivation is found to be very small. So that the crop cultivation is limited to “*Le*” cultivation.

The sown acreages of crops fluctuated depending on the climate, soil conditions, the government project crops, the prices of crops and need of local people. There are ten crops by government- designated in Ayadaw Township. They are paddy, sesame, groundnut, sunflower, pigeon pea, green gram, black gram, cotton, sugarcane and sorghum. However, nine crops are grown expect for sorghum in Ayadaw Township. The government had laid down the plan for major crops to develop economy and the associated plan to grow crops. Paddy is a cereal crop. Sesame is the dominant oil seed crop. Groundnut and sunflower are minor oil seed crops in the study area. Pulses are assumed as commercial crops.

The sown acreage of pulses such as pigeon pea, green gram and black gram are dominated in the study area. Cotton is grown as industrial crops, but its sown acreage was very few because of the high price of pesticides and market price of cotton and so on.

According to (2018-2019) data, there are nine major crops in Ayadaw Township. These major crops are (27,011) acres or (5.98) percent, sesame (91,456) acres or (20.26) percent, groundnut for (29,493) acres or (6.54) percent, sunflower (5,671) acres or (1.26) percent, pigeon pea (40,097) acres or (8.88) percent, green gram (17,200) acres or (3.81) percent, black gram (5168) acres or (1.15) percent, cotton (8,055) acres or (1.79) percent and sugarcane (9) acres or (0.0) percent of the total sown acres.

4.1.1 Paddy

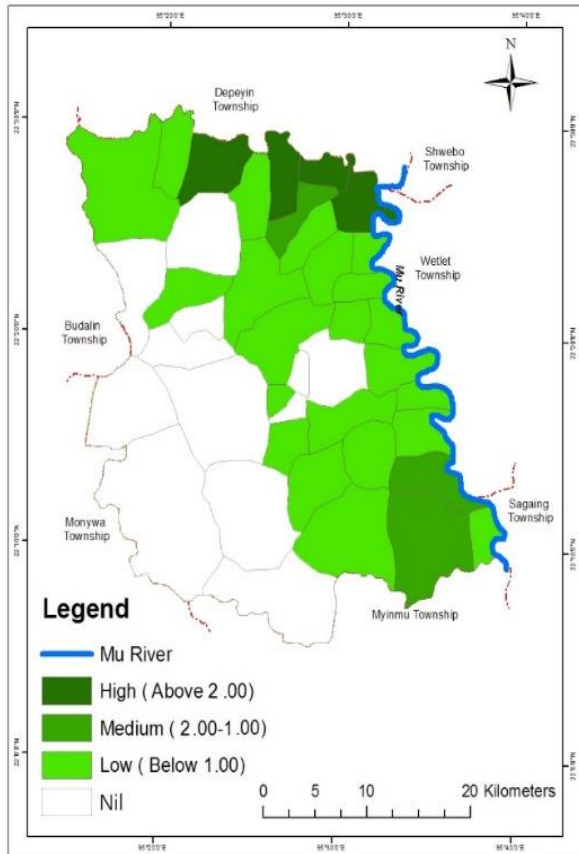
Paddy is a cereal crop and most important crop in Ayadaw township. Paddy accounts for (27,011) acres or (5.98) percent of the total sown acreage of Ayadaw Township. Summer paddy is grown in April and harvested in July. Monsoon paddy is grown in July and harvested in November. Paddy is cultivated in irrigated “Le” land areas, inundated “Kaing-Kyun” land areas and some “Ya” land areas are irrigated by water supply.

Paddy is largely cultivated in “Le” land and alluvial land. Oakshingyi has the largest sown acreage of paddy with (3,890) acres. Paddy concentration can be observed high concentration (above 2.00) was found 11 village tracts. Where the area can be supplied by the irrigation and along the western bank of Mu River. Medium concentration (between 2.0-1.00) was found 6 village tracts. There have 1 ward and 10 village tracts in low concentration (below 1.00) categories. Ayadaw-1, and Ayadaw-3 wards and Chinbin, Yeyo, Naunggyiaing, Wadawma, Hmawdaw, Kantha, Kanbyu, Wayaung, Thitkyingyi, Wadan and Maletha village tracts do not have a concentration in the township. Map (4.1).

4.1.2 Sesame

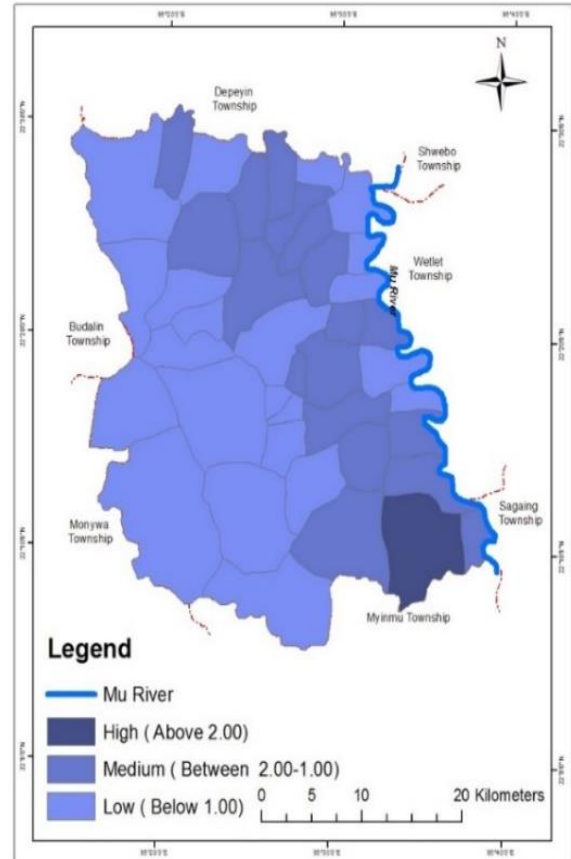
Sesame is the dominant oil seed crop. Sesame is the most cultivated crop in Ayadaw Township. Sesame cultivation accounts for (91,456) acres or (20.26) percent of the total sown acreage in Ayadaw Township. Sesame is cultivated in late monsoon and pre-monsoon seasons. Sesame is grown separately or with pulses. Monsoon sesame is grown after the first rains in May. Winter sesame is grown at the end of September and pre-irrigated sesame is planted at the of March. The soil is well drained and fertile and the type of soil that can retain moisture and is not flooded. It can be grown indifferent types of soil. It is usually cultivated on “Ya” land with loam, sandy loam and red brown savanna soils.

Sesame concentration can be observed that high concentration (above 2.00) was found in only Naungchaytauk village tract. Sesame high concentration can be observed in the south east portion of the study area. The village tract of soil is suitable for sesame cultivation. Medium concentration (between 2.00- 1.00) was found 1 ward and 17 village tracts. Low concentration (below 1.00) 2 ward and 20 village tracts the regional pattern of sesame concentration is separated by area of low concentration in the study area. Map (4.2)



Map (4.1) Spatial Pattern of Paddy Concentration in Ayadaw Township (2018-2019)

Source: Department of Agricultural Land Management and Statistics, Ayadaw Township



Map (4.2) Spatial Pattern of Sesame Concentration in Ayadaw Township (2018-2019)

Source: Department of Agricultural Land Management and Statistics, Ayadaw Township

4.1.3 Groundnut

Groundnut is a definite marketable crop. Groundnut is also account for (29,493) acres or (6.54) percent of the total sown acreage of Ayadaw Township. Groundnut is grown beginning of the rainy season in May. Winter groundnut is grown from October to November and it harvested January to February. The main moisture is important and can be irrigated. It is grown in alluvial soil, and sandy soil.

Regarding the concentration of groundnut area, the high concentration (above 2.00) was found 2 wards and 2 village tracts. They are, Ayadaw-1, Ayadaw-2, Kantha and Myaynet village tracts were found in the central portion and in the southeast of the Ayadaw Township. These village tracts of soils are suitable for groundnut cultivation.

Medium concentration (between 2.00 - 1.00) consists of 1 ward and 20 village tracts. Medium concentration occurs on the north and on the west band of the Mu River and in the central part and in the south east of the study area were found in the central portion and in the southeast of the Ayadaw Township.

Low concentration (below 1.00) consists of 14 village tracts occur in the western and northern part of the township and on the west band of the Mu River and in the central part and in the south east of the study area. Chinbin and Hmawdaw village tracts do not have a concentration in the township. Map (4.3).

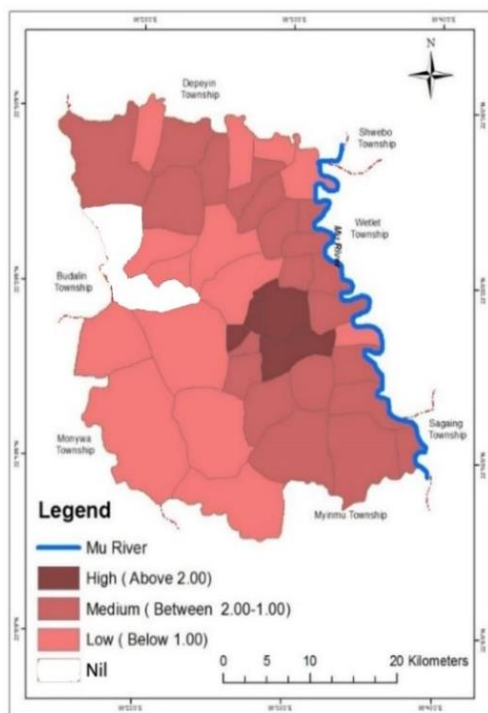
4.1.4 Sunflower

Sunflower is a crop that can contribute to the domestic consumption of oil due to its low planting cost, low damage. Sunflower is good oil yield. Sunflower is also cultivated in Ayadaw Township accounting for (5,671) acres (1.26) percent of total sown acreage. Sunflower is grown in June and July and it is harvested in September and October.

During the late period sunflower is grown during the period from October to November and is harvested during the period from January and March. Sunflower is largely cultivated in the village tracts in the plain areas with loamy soil and loamy meadow soil. Sunflower grows well in the rainy season and summer.

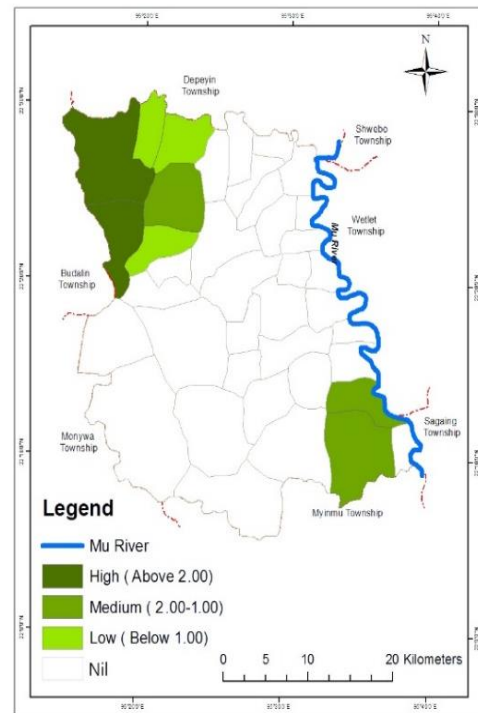
Yathit village tract has the largest sown acreage with (4,073) acres. Oakshitgyi village tract has the least sown acreage with 28 acres. Sunflower concentration can be observed that high concentration (above 2.00) was found 3 village tracts. They are Yathit, Thaleba and Chinbin village tracts. Sunflower concentration high can be observed in the northwest and in the southeast portion of the study area.

Medium concentration (between 2.00- 1.00) was found 3 village tracts. They are Naunggyiaing, Naungchaytauk and Ngapyawgyan village tracts. Low concentration (below 1.00) was found 2 village tracts. They are Yeyo and Oakshingyi village tracts. 3 wards and 30 village tracts do not have a concentration in the township. Map (4.4).



Map (4.3) Spatial Pattern of Groundnut Concentration in Ayadaw Township (2018-2019)

Source: Department of Agricultural Land Management and Statistics, Ayadaw Township



Map (4.4) Spatial Pattern of Sunflower Concentration in Ayadaw Township (2018-2019)

Source: Department of Agricultural Land Management and Statistics, Ayadaw Township

4.1.5 Pigeon pea

Pigeon pea is a cash crop. Pigeon pea cultivation accounts for (40,097) acres or (8.88) percent of total sown acreage in Ayadaw Township. Pigeon pea can be cultivated in different kinds of soil. Pigeon pea is grown separately or mix crop. It is usually cultivated on “Ya” land as it is cultivated on the early and middle of the rainy season.

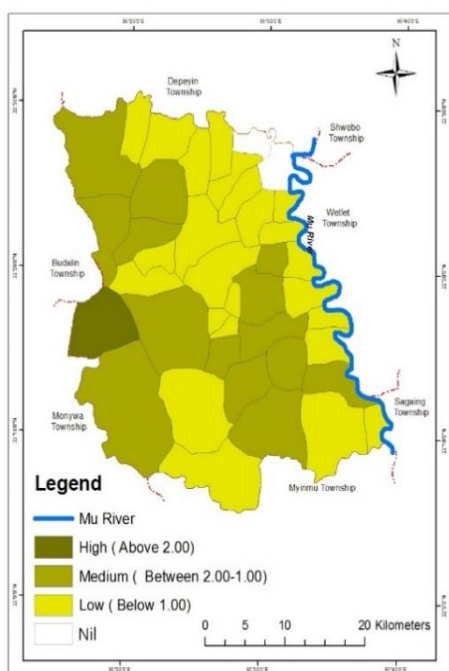
High concentration (above 2.00) of pigeon pea area occurs Thitkyingyi village tract in the northwestern of the Ayadaw Township. Medium concentration (between 2.00- 1.00) was found 14 village tracts. Low concentration (below 1.00) was found 3 wards and 21 village tracts. Oakshingyi and Khintha village tracts do not have a concentration in the township. Map (4.5).

4.1.6 Green gram

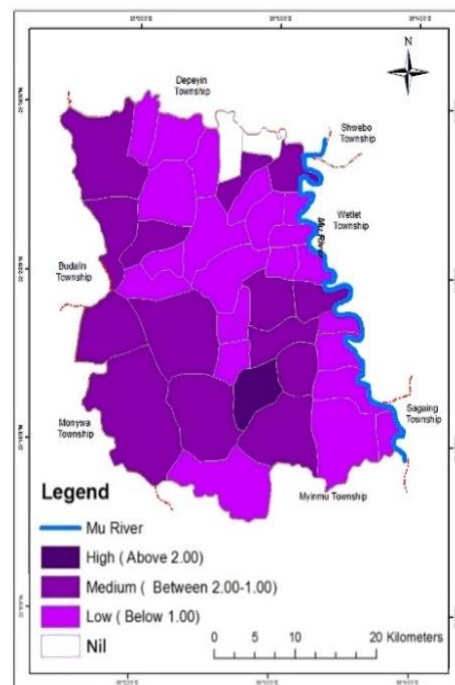
Green gram is the most widely grown crop as a mix crop in Ayadaw Township. Green gram is cultivated with account for (17,200) acres or (3.81) percent of total sown acreage of Ayadaw Township. Green gram is grown on Ya and during the early and mind rain period.

They are grown on loamy sand soils and loamy soils or alluvial soils. They are grown from the middle of January to the middle of April.

High concentration (above 2.00) is found in Thaukhutpinle village tract. This village tract situated in the south portion of the study area. Under medium concentration (between 2.00- 1.00) was found 14 village tracts and 3 wards and 21 village tracts were found low concentration (below 1.00). Neyagin and Oakshingyi village tracts do not have a concentration in the township. Map (4.6).



Map (4.5) Spatial Pattern of Pigeon pea Concentration in Ayadaw Township (2018-2019)



Map (4.6) Spatial Pattern of Green gram Concentration in Ayadaw Township (2018-2019)

Source: Department of Agricultural Land Management and Statistics, Ayadaw Township

4.1.7 Black gram

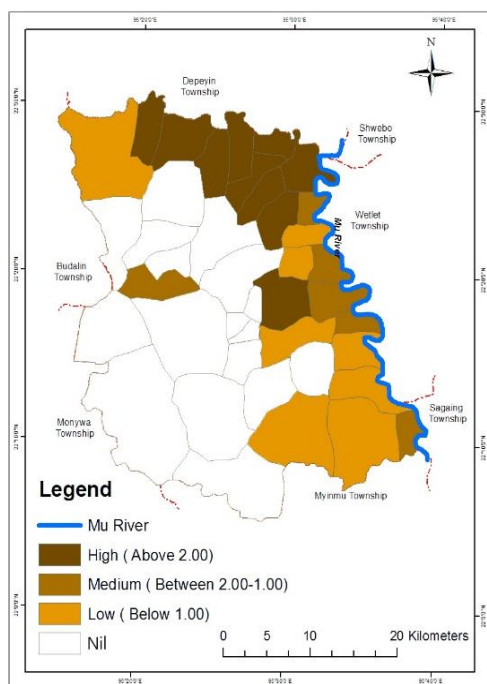
Black gram is an important pulses crop. Black gram is usually grown in winter season. Black gram is also cultivated in Ayadaw township with accounts for (5,168) acres or (1.15) percent of total sown acreage. Black gram is grown from the middle of September to December and are harvested from the middle of January to April.

Leinbla village tract has the largest sown acreage of with (9,24) acres. High concentration (above 2.00) occurs 11 village tracts. Medium concentration (between 2.00-1.00) was found 6 village tracts. Low concentration (below 1.00) occurs 7 village tracts. 3 wards and 14 village tracts do not have a concentration in the township. Map (4.7)

4.1.8 Cotton

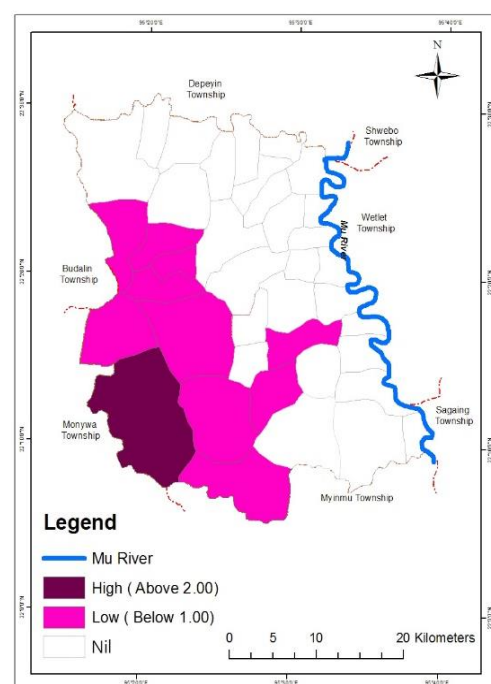
Cotton is grown as industrial crops. Cotton is cultivated in Ayadaw township accounting for (8,055) acres or (1.79) percent of total sown acreage. During the flowering period dry conditions are beneficial to prevent excess vegetative growth. Abundance of hot days with much sunshine is required. A balanced supply of nutrients is important.

Wadan village tract has the largest sown acreage of cotton with (6,820) acres. Myaynet village tract has the least sown acreage of cotton with 3 acreage. High concentration (above 2.00) was found Wadan village tract. Medium concentration (between 2.00-1.00) was found Thitkyingyi village tract. Low concentration (below 1.00) was found 10 village tracts. 3 wards and 27 village tracts do not have a concentration in the township. Map (4.8).



Map (4.7) Spatial Pattern of Black gram Concentration in Ayadaw Township (2018-2019)

Source: Department of Agricultural Land Management and Statistics, Ayadaw Township

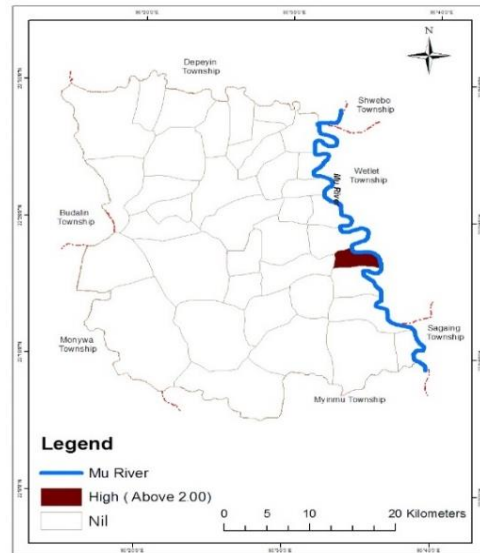


Map (4.8) Spatial Pattern of Cotton Concentration in Ayadaw Township (2018-2019)

Source: Department of Agricultural Land Management and Statistics, Ayadaw Township

4.1.9 Sugarcane

Sugarcane is usually grown in the tropics and subtropics. Sugarcane is cultivated on loam land. Sugarcane is also cultivated in Ayadaw township accounting for (9) acres or (0.0) percent of total sown acreage. High concentration (above 2.00) was found Zayit village tract.3 wards and 37 village tracts do not have a concentration in the township. Map (4.9).



Map (4.9) Spatial Pattern of Sugarcane Concentration in Ayadaw Township(2018-2019)
Source: Department of Agricultural Land Management and Statistics, Ayadaw Town

4.2 Temporal Changes of Five Major Crops Cultivation

Temporal analysis on five major crops cultivation in Ayadaw Township is made based on the available secondary data from Department of Agricultural Land Management and Statistics. Temporal changes of five major crops cultivation will be analysed for 10-years period from (2009-2010 to 2018-2019) in the study area. Table (4.1) and Figure (4.1)

Figure (4.1) shows the yearly cultivation of paddy in Ayadaw Township. It is observed that the paddy cultivation was the highest acreage in (2010-2011). It may be due to the sufficient rainfall or water supply. In (2012-2013), the paddy cultivation was the lowest acreage. It may be due to unfavorable of climate.

According to Figure (4.1) the fluctuation trend of sesame cultivation can be found. In (2015-2016) the sesame cultivation was the highest acreage. It may be due to the sufficient rainfall. In (2012-2013) the sesame cultivation was the lowest acreage. It may be due to unfavorable climatic condition.

Figure (4.1) indicates the fluctuation trend of groundnut cultivation can be found. In (2012-2013) the groundnut cultivation was the highest acreage. It may be due to the sufficient rainfall. In (2009-2010) the groundnut cultivation was the lowest acreage. It may be due to the unfavorable climatic, farmer's choice, pesticides, fertilizers, and capital needed to grow groundnut.

Figure (4.1) shows the yearly pigeon pea cultivation in Ayadaw Township. It is observed in (2016-2017) the pigeon pea cultivation was the highest acreage. In (2018-2019)

the pigeon pea cultivation was the lowest acreage. This is because are grown depending on the market price.

Figure (4.1) shows the yearly cultivation of green gram in Ayadaw Township. It is observed in (2011-2012) the green gram cultivation was the highest acreage. It may be due to the sufficient rainfall. It may be due to unfavorable climatic condition. In (2012-2013), the green gram cultivation was the lowest acreage.

Table (4.1) Five Major Crops Cultivated Area in Ayadaw Township (2009-2010 to 2018-2019)

No	Year	Paddy(Acre)	Sesame(Acre)	Groundnut(Acre)	Pigeonpea (Acre)	Green gram(Acre)
1	2009-2010	34362	90801	20104	41676	40548
2	2010-2011	35050	91547	20110	42583	41414
3	2011-2012	27032	94063	20442	42584	42113
4	2012-2013	22068	80909	30306	42658	11523
5	2013-2014	24514	103740	20842	42988	11892
6	2014-2015	23658	101822	21429	43152	13634
7	2015-2016	25471	110853	21652	43367	14158
8	2016-2017	26324	103053	24205	45266	21614
9	2017-2018	27436	91745	27863	41898	17015
10	2018-2019	27011	91456	29493	40097	17200
Total		272926	959989	236446	426269	231111

Source: Department of Agricultural Management and Statistic, Ayadaw Township

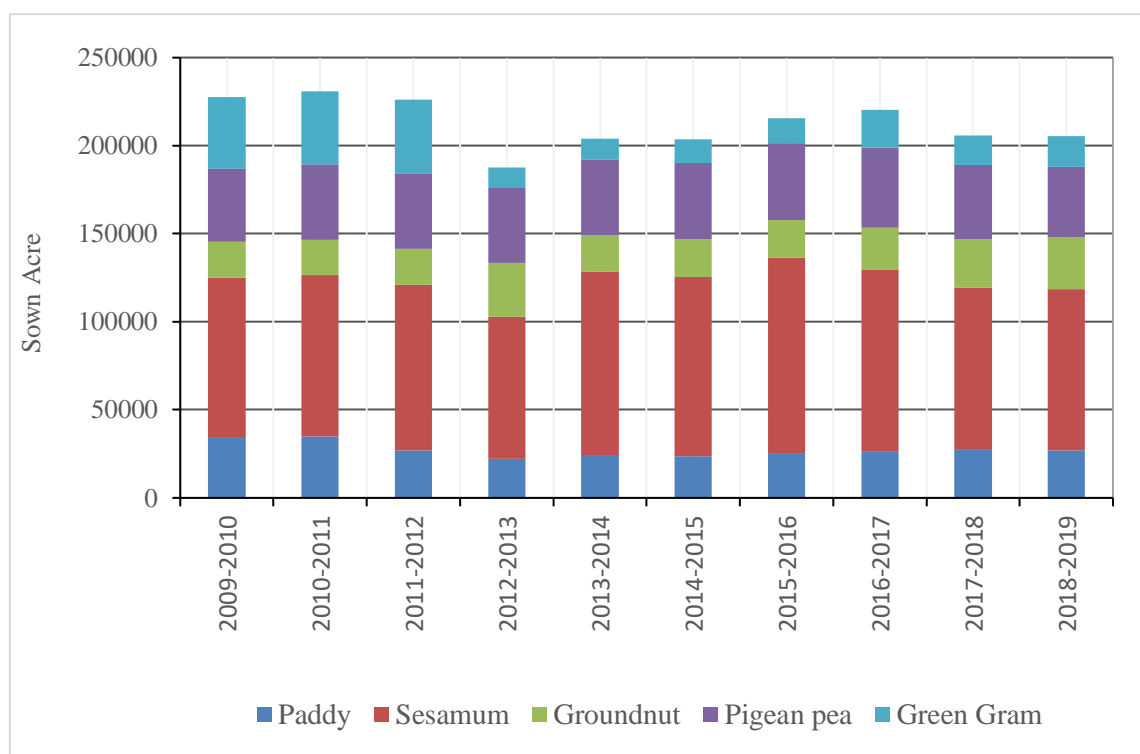


Figure (4.1) Temporal Changes of Five Major Crops Cultivation in Ayadaw Township (2009-2010 to 2018-2019)

Source: Base on Table 4.1

5. Findings and Results

The total area of Ayadaw Township was (302,400) acres. Current cultivated land occupies the most land which account for about (258,876) acres or (85.61) percent. The proportion of “Le” land (30,607) acres or (11.82) percent, “Ya” land includes (224,806) acres or (86.84) percent, “Kaing-Kyun” land (3,432) acres or (1.33) percent and “Garden” land (31) acres or (0.01) percent. On these lands 29 crops are grown widespread. It can be found that the development of Ayadaw Township by study major crop concentration from the geographical point of view.

The majority of “Ya” lands are the places without irrigated lands and the large acreage of “Le” land are found within the irrigated area and along the Mu River. “Kaing-Kyun” land lies in the flood area of the river. Major crops mean that government had laid down for the agricultural planning in this area. These major crops are paddy (27,011) acres or (5.98) percent, sesame (91,456) acres or (20.26) percent, groundnut (29,493) acres or (6.54) percent, sunflower (5,671) acres or (1.26) percent, pigeon pea (40,097) acres or (8.88) percent, green gram (17,200) acres or (3.81) percent, black gram (5,168) acres or (1.15) percent, cotton (8,055) acres or (1.79) percent and sugarcane (9) acres (0.00) percent. Sesame is the most cultivated crop. Pigeon pea is a cash crop.

Paddy is high concentration and it was found 11 village tracts where the area can be supplied by the irrigation and along the western bank of Mu River. Paddy is low concentration and it was found 1 ward and 11 village tracts where this is due to the insufficient water supply.

Sesame concentration can be observed that high concentration was found Naungchaytauk village tract in the south east portion of the study area. The village tract of soil is suitable for sesame cultivation. Sesame is low concentration and it was found 2 wards and 20 village tracts where in addition to sesame, other crops are also grown.

Groundnut concentration can be observed that high concentration was found 2 wards and 2 village tracts. These village tracts were found in the central portion and in the southeast of the Ayadaw Township. These village tracts of soils are suitable for groundnut cultivation. Groundnut is low concentration and it was found in 14 village tracts where inadequate use of pesticides and fertilizers, and lack of capital to grow groundnut.

Sunflower concentration can be observed that high concentration 3 village tracts. These village tracts of soil are suitable for sunflower cultivation. Sunflower concentration high can be observed in the northwest and in the southeast portion of the study area. Sunflower is low concentration and it was found 2 village tracts where this is due to mix cropping and incorrect rainfall during the growing season.

High concentration of pigeon pea area occurs Thitkyingyi village tract in the northwest of the Ayadaw Township. The village tract of soil is suitable for pigeon pea cultivation. Pigeon pea is low concentration and it was found 3 wards and 21 village tracts where this is due to the abundance of le land and kaing-kyun land and the cultivation of horticultural crops.

High concentration of green gram occurs Thaukhutpinle village tract. These village tract is found in the south portion of the study area. The village tract of soil is suitable for green gram cultivation. Green gram is low concentration and it was found 3 wards and 21 village tracts were due to pesticides, fertilizers, and mix cropping.

High concentration of black gram occurs 11 village tracts. High concentration of cotton was found Wadan village tract in the western portion of the study area. The village tract of soil is suitable for black gram cultivation. Black gram is low concentration and it was found in 7 village tracts where because of the topography and soil conditions, growing other cash crops is more than a growing black gram.

High concentration of sugarcane was found Zayit village tract in the eastern portion of the study area and 3 wards and 38 village tracts do not have sugarcane concentration in the township.

Temporal changes of five major crops cultivation will be analysed for 10-years period from (2009-2010 to 2018-2019) in the study area. The paddy cultivation was the highest acreage in (2010-2011). It may be due to the sufficient rainfall or water supply. In (2012-2013) the paddy cultivation was the lowest acreage. It may be due to the unfavorable climatic condition.

The fluctuation trend of sesame cultivation can be found as well. In (2015-2016) the sesame cultivation was the highest acreage. It may be due to the sufficient rainfall. In (2012-2013) the sesame cultivation was the lowest acreage. It may be due to unfavorable climatic condition.

The fluctuation trend of groundnut cultivation can be found. The groundnut cultivation was the highest acreage in (2012-2013). It may be due to the sufficient rainfall. Although the groundnut cultivation was the lowest acreage in (2009-2010). It may be due to the unfavorable climatic, farmer's choice, pesticides, fertilizers, and capital needed to grow groundnut.

The yearly pigeon pea cultivation in Ayadaw Township. It is observed in (2016-2017) the pigeon pea cultivation was the highest acreage. In (2018-2019) the pigeon pea cultivation was the lowest acreage. This is because are grown depending on the market price.

The yearly cultivation of green gram in Ayadaw Township. It is observed in (2011-2013) the green gram cultivation was the highest acreage. It may be due to the sufficient rainfall. It may be due to unfavorable climatic condition. In (2012-2013) the green gram cultivation was the lowest acreage.

Thus, it can be assumed that the major crops concentration has depended on physical factors and human factors. If the transportation facilities are more convenience, then the present, major crops concentration can be changed in Ayadaw Township. If the under-ground water is available within none irrigated area; major crops concentration area will be increase in Ayadaw Township.

6. Conclusion

Ayadaw Township is situated on the western bank of the Mu River in Monywa District, in the Sagaing Region. It is situated between latitudes of 22°00' N and 22°30' N and between longitudes of 95°15' E and 95°45' E. Like other township within Sagaing Division, economy of Ayadaw Township is based on Agriculture. The agricultural sector is controlled by physical and social factors.

Ayadaw Township is located in the suitable condition for agriculture. That mean it is situated on the west bank of Mu River, it receives renew land along the river and the lowest capacity in soil erosion and the highest capacity of soil moisture maintenance. In the western

area, there are hills and then hilly part gradually slope towards the east. These areas are high rate of soil erosion depleting the rich mass of the soil. The physical character of Ayadaw Township except less rainfall encourage to create the intensive agriculture for some village tracts within irrigated area. In contrast, social feature except irrigation facilities have not supported effectively to crops develop.

When the crop pattern of the Ayadaw Township is examined, the sesame, groundnut and pigeon pea crop are concentrated as the cluster pattern and green gram as the scatter pattern. These patterns can be changed through price of crop, development in transportation system and improvement in technology of agriculture.

The study area, Ayadaw Township is situated in the central dry zone of Myanmar, temperature condition and soil types are permitting to the whole year crops cultivation. Now Ayadaw Township grows various types of crops. At the present time, the population pressure on agriculture as gradually increasing in Ayadaw Township. Along, with the increasing in population, it is needed to change the farming system.

6.1 Suggestions

The Development of Ayadaw Township also depends on the major crop concentration. Ayadaw Township to development is dependent on major crops concentration. Ayadaw Township of major crops concentration relationship between physical factors and economic factors. In order to develop Ayadaw Township, it is necessary to find ways to irrigation cultivate manpower, machinery, and input.

If irrigated agriculture is to be successfully implemented from the Mu River Project. About half of the agricultural land will be irrigated and in addition, village tracts along the Mu River Basin should rely on water from Mu River to grow major irrigated crops.

So, the exploration of new irrigation method, and mechanized farming system are become for major crops concentration in Ayadaw Township. By performing the above-mentioned activities, Ayadaw Township will be a developed Township in Sagaing Division.

Acknowledgements

Firstly, I would like to express my deepest gratitude to Dr. Moe Moe Yee, Rector, University of Co-operative and Management, Sagaing for her valuable suggestion, guidance and encouragement to accomplish this research. I would like to acknowledge U Win Naing Tun, Pro-Rector (Admin), University of Co-operative and Management, Sagaing. I wish to express my gratitude to Dr. Thein Tun, Rector (Retired), Co-operative University, Thanlyin, for his reading, giving the constructive criticisms and valuable advices. I would like to express my special thanks to my supervisor Daw Ohnmar Pa Pa, Associate Professor and Head, Department of Economic Geography, University of Co-operative and Management, Sagaing for her constructive comment and valuable advice to my research paper. Finally, I would like to thank all my colleagues at the Department of Economic Geography for their kind cooperation.

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ကျမ်းကိုးစာရင်း

ဝင်းအောင်မောင်။ (၁၉၉၂-၉၃) ။အရာတော်မြို့နယ်၏ဒေသန္တရပထဝီဝင်။

အရာတော်မြို့နယ်။ (၂၀၁၉) ။အရာတော်မြို့နယ်၏အထွေထွေအုပ်ချုပ်ရေးဦးစီးဌာန၊စက်တင်ဘာလ၊

အရာတော်မြို့နယ်၏မှတ်တမ်း။

အရာတော်မြို့နယ်။ (၂၀၁၉) ။အရာတော်မြို့နယ်လယ်ယာမြေစီမံခန့်ခွဲမှုနှင့်မြေစာရင်းဦးစီးဌာန၊

အရာတော်မြို့မြန်မာနိုင်ငံ၏လယ်ယာမြေကောက်ယူမှုမှတ်တမ်း။