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Analysis on the Relationship Between Slope Classes and Cropping Pattern in Ayadaw Township

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Abstract

The study area, Ayadaw Township is located in Sagaing Region, dry zone of central Myanmar. The aim of this paper is to find out the influence of slope condition upon the cropping pattern. Slope conditions may affect directly or indirectly on the crop cultivation in the study area. Overlay analysis was used to find out the relationship between slope classes and cropping intensity using GIS. In the case of slope classification, slope conditions were identified into five classes by A. Young (1975). Most of the cultivated land was found under the slope of under 0°-2° and 2°-5°. Moreover, for the study of relationship between slope classes and cropping pattern, cropping intensity index was used. The lower the slope classes, the higher the cropping intensity was. Because of the high concentration of ground water is found in the area where the slope value is low. It is noted that physical environment especially slope based on the elevation influences upon the cropping pattern and sustainable agriculture. Agricultural efficiency is not absolutely related to the slope classes.

Key words: slope classes, cropping pattern, cropping intensity, overlay analysis, agricultural efficiency.

Introduction

This research paper intends to analyze the influence of slope upon the cropping pattern in Ayadaw. In order to determine the slope classification, slope classes were identified by Athony Yong's method (1975). Slope of land is also one of the important physiographic aspects influencing the agricultural land-use of an area. The effects of slope on agriculture may be both direct and indirect. The most obvious effect of influence of slope is in the form of restrict on cultivation and accessibility. The indirect effect of slope manifests itself in pedological and climatic modifications. Based on the physical and technical influences, agriculture should be managed and promoted effectively in all cultivated areas of the whole country.

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The study area, Ayadaw Township is located in Sagaing Region, dry zone of central Myanmar. As the relief of the western portion of township is a rugged terrain with abrupt steep slope, almost all the streams have a large volume of water and high velocity. Therefore, slope is the most vital element for the crop cultivation in the study area. It experiences scarcity of rainfall as well as dense population who depends mainly on irrigation for agriculture. Irrigation is the artificial distribution and application of water to arable land to initiate and maintain plant growth. It is précised to supply water to crops whenever it requires. It is necessary in the area with annual rainfall between 12 inches (30cm) and 20 inches (50cm).

Land efficiency is defined as the extent to which, the net sown area is re-sown. The total cropped area (gross cropped area) as a percentage to the net sown area gives a measure of lard use efficiency, which really means the intensity of cropping. The intensity of cropping refers to the number of crops raised on a field during one agricultural year.

According to the data of 2012-2013, the size of land ownership was about 1.71 acres of per person. But in 2003-2004, the size of land ownership was 1.1 acres per person. Agricultural land use in Ayadaw Township was 261,768 areas or 86.57 percent of the total area of study area in 2012-2013. Types of Agricultural land in Ayadaw Township can be classified into 'Le' land 'or' Paddy land, 'Ya' land or dry farming land, 'Kaing-Kyun' land and Garden Land. The majority of the cultivated land in Ayadaw Township is "Ya" land. The second least agricultural land is 'Kaing-Kyun' land and the least is Garden land.

Aim and Objectives

The aim of this paper is to find out the influence of slope upon the cropping pattern in Ayadaw Township. As the supportive elements for the main mentioned above, the objectives are:

- To analyse the slope class which may influence directly or indirectly upon the crop cultivation?
- To examine the physical environment which determines upon the cropping intensity?
- To study agricultural efficiency whether it is related to the slope classes or not

Data and method

This study is based on the analysis of primary data collect from field observation, interviews and informal talks. Secondary data is collected from General Administration and Land Records Department and Agriculture and Irrigation Department. The data bases are processed and assessed by quantitative method as well as statistical method. For slope classification GIS technique is applied, especially for mapping based on the slope degrees with the help of Young's method. To compute the cropping intensity, the following formula is used:

$$IC = \frac{\text{Grossed Cropped Area}}{\text{Net Sown Area}} \times 100$$

IC = Intensity of cropping

Grossed cropped Area = Net-area sown plus area sown than once in a year.

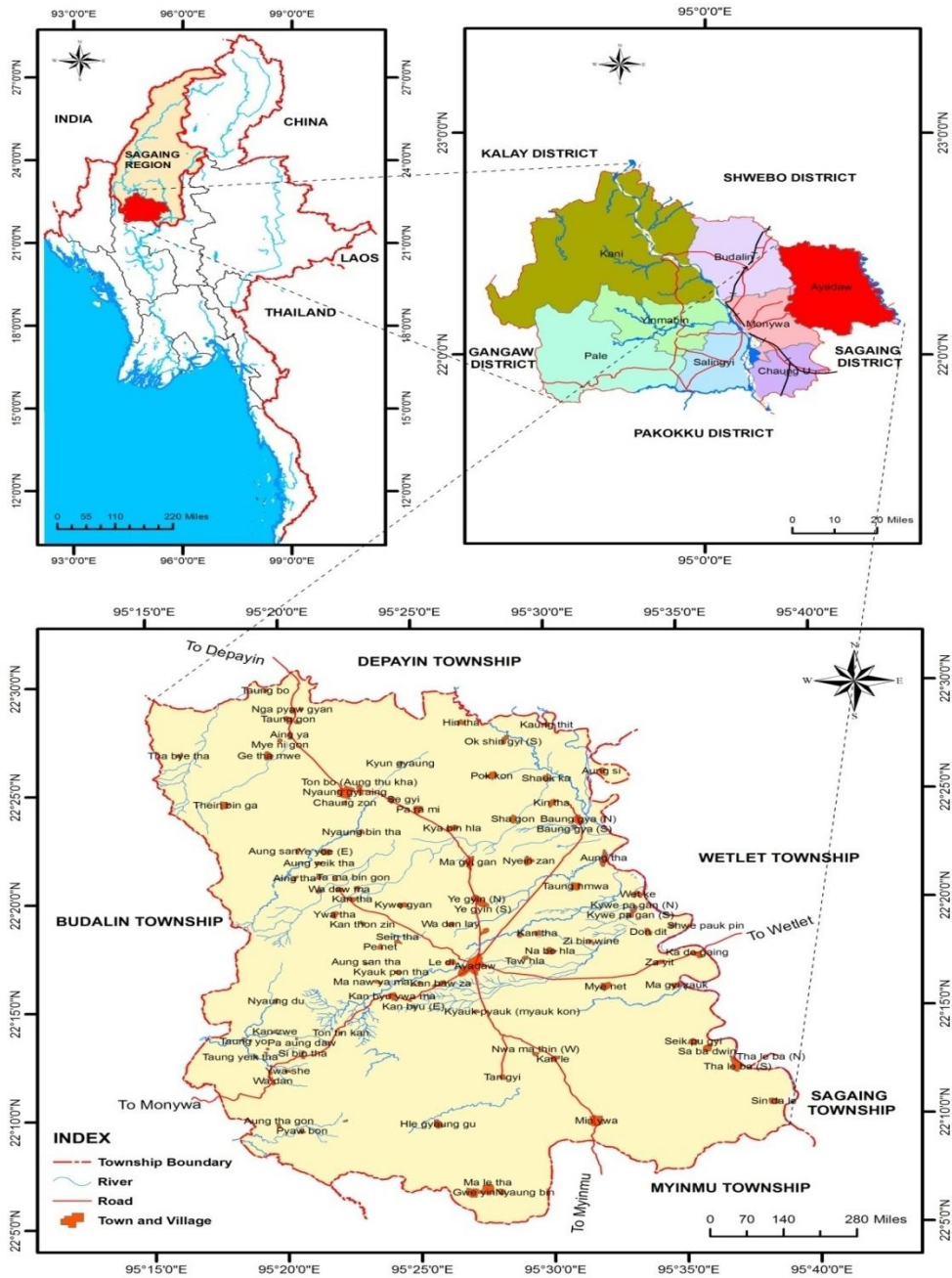
Net sown Area = Area sown only once in a year.

To find out the relationship between slope classes and cropping intensity, overlay method was used.

The Study Area

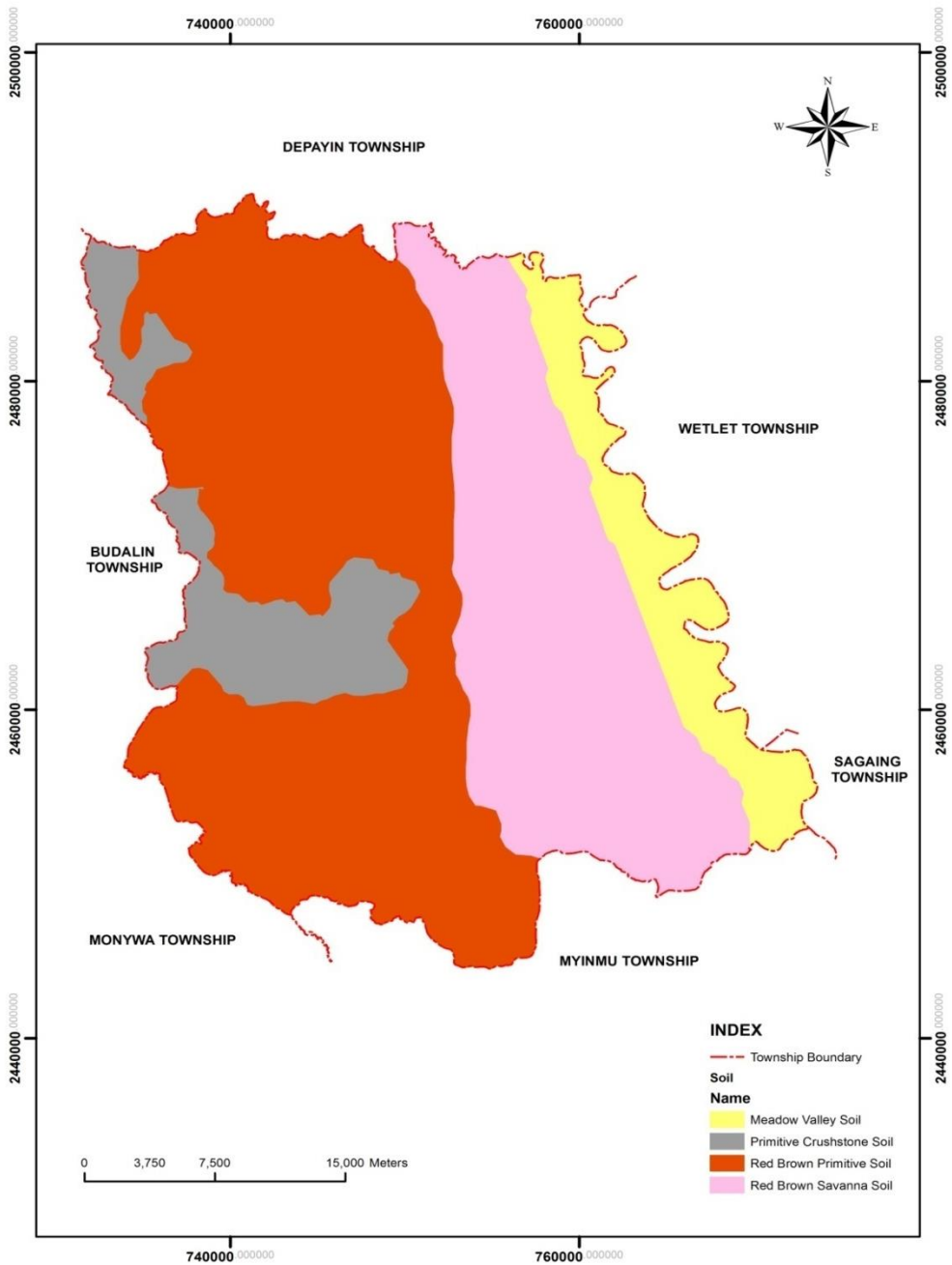
The study area, Ayadaw Township is located in Sagaing Region, dry zone of central Myanmar. In general, the western part of the township has low hills and small valleys rise to undulating terrain. The eastern part of the township is relatively level plain. This plain area of the township is relatively level. This plain is built up of sediments deposited by the streams draining in the western area. This part of the township provides main land for cultivation. The eastern part of the plain is about 500' feet (152.9m) high near Ayadaw Town and it slopes imperceptibly to Mu River. Most of the soil type of Ayadaw Township is Red Brown Primitive Soils. On this soil, various crops can be grown with the help of water supply (Map 1 and 2).

MAP (1) LOCATION MAP OF AYADAW TOWNSHIP



Source : UTM Map No. 2295_06, 07, 08, 11 and 12.

MAP (2) SOIL MAP OF AYADAW TOWNSHIP



Source : Department of Soil, Yangon.

Discussion and Conclusion

Relationship between Slope Classes and Cropping Pattern

Slope of land is also one of the important physiographic aspects influences the agricultural land use of an area. The effect of slope on agriculture may be both direct and indirect. Slope and cultivation is a universal fact that with increase in steepness of slope, the use of even very simple farm machinery becomes difficult. Moreover, there is hardly any information available about how cultivation cost varies with steepness. Five distinct classes of shape condition are found in the study area. These slope classes are 0° , 0° - 2° , 2° - 5° , 5° - 10° and 10° - 18° . The slope value (less than 2°) is almost flat and is imperceptibly sloping thus ensuring an adequate drainage. It provides ideal conditions for any type of farming. The value of slope of (2° - 5°) is gentle type of sloping terrain which presents no serious problem to cultivation. Since the slope with (5° - 10°) is moderately sloping, the problem of drainage does not rise. Slope (10° - 18°) is moderately steep sloping. In such moderately steep sloping areas; the cultivated area rapidly decreases because of obstruction to ploughing. In general, most of the slope was found under 0° - 2° and 2° - 5° in the whole township. The least of the slope condition was found less than 10° - 18° . (Map 3)

Along the Mu River of the eastern most in the township, the slope condition is comparatively high, i-e 10° to 18° . But the slope condition is observed in the form of patches. Therefore, it can be assessed that the land figure favours crop cultivation successfully. Whereas, the area with the slope values of less than 2° is not unique one because such area could be flooded whenever there was heavy and torrential and prolonged rain or high water level of nearby river of stream. Fortunately, the eastern bank of Mu River is rather steep so that the water from Mu River could not overflow in the study area even during rainy season. In the southern part the slope conditions of Maletha, Minywa, Thakhutpinle and Thaleba Village tracts, flooding were mostly occurred under less than 2° . Intensity of cropping, extent of maturity and increasing the yield from the existing cultivated areas are problems of the importance in the agricultural economy of a region.

During 2012-2013, the average total sown acreage of Ayadaw Township is 10,893.56 acres and the average net sown acreage is 6,361.83 acres, respectively. Thaleba village tract is the highest index of intensity of cropping with 265.96% and the lowest index of cropping intensity is Nyaungchaytauk village tract with 127.42%. To analyses the intensity of cropping in Ayadaw Township, the three groups of extra crop cultivability

are divided as follow; under 160.32%, between 160.32-190.88% and over 190.88%. Twelve village tracts were found fewer than 160.32% intensity of cropping in Ayadaw Township. These village tracts were Oakshitgyi, Leinhla, Neyagin, Kaingywa, Shagone, Baungkya, Kanbyu, Taungmwa, Kyaukpyauk, Ngwedwin, Nyaungchaytauk and Minywa.

In this group, although Oakshitgyi, Leinhla, Neyagin, Kaingywa, Shagone, Baungkya were irrigated areas, they have lessen the cultivated areas and mainly cultivated only one crop such as paddy. Besides, Taungmwa, Kyaukpyauk, Kanbyu, Ngwedwin, Nyaungchaytauk and Minywa village tracts have not been supplied enough water and were dependent on the climatic conditions, especially rainfall, irrigation facilities and fertility. Therefore, these village tracts were the low areas of cropping intensity. Baungkya (131.43%) and Nyaungchaytauk (127.42%) village tracts are the lowest areas of cropping intensity. The areas of moderate cropping intensity are Oakshitgyi (140.74%), Shagone (145.46%), Kanbyu (144.51%) and Minywa (142.06%) village tracts.

In the second group of 160.32% to 190.88% intensity of cropping, eighteen village tracts and two wards are included. These village tracts are Ngapyawgyan, Oakshingyi, Khintha, Kyundaw, Chinbin, Yeyo, Aungtha, Yegyin, Wadawma, Kantha, Wetkhae, Myaynet, Wadan, Wayaung, Thakhutpinle, Magyigan, Magyisauk, Maletha and Ayadaw-1 and Ayadaw-3. Except the non-irrigated area, Chinbin, Wadawma, Wadan, Wayaung, the reaming village tracts are located at the main irrigated area, along the Mu River and flatted areas. Therefore, these village tracts are the net sown cultivated areas that are mostly grown. In this group, Ngapyawgyan, Oakshingyi, Chinbin, Wadawma, Wetkhae, Myaynet, Wadan, Wayaung are the areas under moderate intensity of cropping as a result of the uneven flat areas and less cultivated land areas. Khintha, Kyundaw, Yeyo, Magyigan, Aungtha, Yegyin, Kantha, Thakhutpinle, Magyisauk, Maletha village tracts are the high intensity of cropping areas because of the abundance of "Ya" lands where the irrigation work can be practised.

In the high group of over 190.88% intensity of cropping, nine village tracts are Yathit, Naunggyiaing, Hmawdaw, Thitkyingyi, Dondit, Zayit, Thaleba, Sintale and Ayadaw-2. Except Naunggyiaing, Hmawdaw and Thitkyingyi, the remaining village tracts are irrigated areas. Yathit village tracts (199.49%) have enough water-supply from the dam site and soil moisture, so it has become the cropping area with the high intensity. Dondit, Zayit, Thaleba and Sintale are the irrigated areas from Mu River by private pumping system. Thus, these village tracts have become the high intensity of cropping areas within the township. Although Naunggyiaing, Hmawdaw and Thitkyingyi are

non-irrigated areas, the index of cropping intensity is high. For this reason, these village tracts mainly cultivated multi-crops of 'Ya'. Besides, it is found that Naunggyiaing village tract cultivated lesser acreages of 'Le' land.

The cropping intensity of Ayadaw Township is dependent on the interrelationship between the physical factors and economic factors. The total sown acres are more than the net sown acres that can be found within the township. For the reason, most of village tracts can be cultivated once in pre monsoon and irrigated in post monsoon period.

During the study period, it is observed that the lowest the degree of shape, the highest the cropping intensity was to map (4) it is clearly seen that the minimum values of cropping intensity could be in the northeastern part and the southern part of the township, while the medium and the highest intensity values occupied in the middle, the western and the eastern parts of the study area. Generally, the medium and the highest intensity were occupied about two-third of the township's area. (Map 4)

In the high intensity of cropping, the slope conditions of Yathit and Naunggyi-aing village tracts are mostly found under the slope degree of 0° to 2° . It is almost flat and is imperceptibly sloping. It provides ideal conditions for any type of farming. Moreover, these two village tracts are also irrigated areas. Village tracts of Thitkyingyi and Hmawdaw are located at foothill slope of Kyaukka range. Although the slope values (5° - 10°) in these village tracts there are mostly found the problem of drainage does not rise. Ward of Ayadaw-2 is occupied under condition of slope (0° - 2°). This area is supplied water from tube wells and Ayadaw-2-Magyisauk water pumping project. Zayit, Dondit, Thaleba and Sintale village tracts are located at the bank of Mu River. Slope conditions of these village tracts are mostly found between 2° to 5° . These village tracts are the irrigated areas from Mu River by private pumping system. Therefore, it is found that these village tracts have become the high intensity of cropping areas within the township because of the high concentration of ground water as well as the value of slope is low.

In the medium group of cropping intensity, there are eighteen village tracts and two wards are included. Ngapyawgyan, Oakshingyi, Khintha and Kyundaw village tracts are occurred under slope condition of 0° to 2° . The crop cultivation of these village tracts are irrigated by canals from Kabo Dam and Kindat Dam. The middle portion of township's area is located that Chinbin, Yeyo, Wadawma, Magyigan, Yegyin, Kantha village tracts the Ayadaw-1 and Ayadaw-3 wards are presented under 5° - 10° of slope value. In the same way, Wadam, Wayaung, Maletha and Thakhutpinle village

tracts are also found less than 5° - 10° of slope value. Aungtha, Wetkhae and Magyisauk village tracts are occupied under slope condition of 2° - 5° . Thus, these village tracts are the areas under moderate intensity of cropping as a result of the uneven flat areas and of a little steep of slope degree.

In the low intensity of cropping, Oakshingyi, Leinhla, Neyagin, Kaingywa, Shagone, Baungkya and Taungmwa are the village tracts which have under slope conditions 2° to 5° . These village tracts were irrigated areas where they have less cultivated areas and mainly cultivated only one crop such as paddy. The slope of Kanbyu, Kyaukpyauk, and Myaynet and Ngwedwin village tracts is found under moderately slopping (5° - 10°). Besides, these village tracts have not been supplied enough water conditions. Therefore, these village tracts were the low areas of cropping intensity (Table 1).

Table (1) Cropping Intensity by Village Tracts in Ayadaw Township (2012-2013)

Sr No.	Village Tract	Gross Cropped Area	Net Sown Area	Cropping Intensity (%)
1	Yathit	29,800	14,938	199.49
2	Ngapyawgyan	5,132	3,051	168.21
3	Oakshityi	7,352	5,222	140.79
4	Leinhla	9,585	6,016	159.33
5	Neyagin	5,544	3,491	158.81
6	Oakshingyi	5,534	3,404	162.57
7	Khintha	8,995	5,023	179.08
8	Kyundaw	5,456	3,184	171.36
9	Kaingywa	6,041	4,009	150.69
10	Naunggyiaing	18,404	8,194	224.60
11	Chinbin	17,101	10,106	169.22
12	Yeyo	9,629	5,411	177.95
13	Magyigan	19,515	10,247	190.45
14	Shagone	7,747	5,326	145.46
15	Baungkya	1,426	1,085	131.43
16	Aungtha	4,376	2,497	175.25
17	Yeyin	14,395	7,893	182.38
18	Wadawma	5,346	3,273	163.34
19	Hmawdaw	9,684	4,652	208.17
20	Thitkyingyi	11,570	5,012	230.85
21	Kanbyu	28,743	19,890	144.51
22	Kantha	12,884	7,280	176.98
23	Taungmwa	5,397	3,517	153.45
24	Wetkhae	4,754	2,938	161.81
25	Dondit	7,242	3,259	222.22
26	Zayit	3,973	1,992	199.45
27	Myaynet	14,148	8,825	160.32
28	Kyaukpyauk	7,447	4,867	153.01
29	Wadan	34,508	21,016	164.20
30	Wayaug	25,156	15,403	163.32
31	Thakhutpinle	9,402	5,078	185.15
32	Ngwedwin	10,413	6,856	151.88
33	Magyisauk	7,338	3,894	188.44
34	Thaleba	10,258	3,857	265.96
35	Sintale	4,674	2,267	206.18
36	Nyaungchaytauk	13,438	10,546	127.42
37	Minywa	15,158	10,670	142.06
38	Maletha	23,770	13,901	170.99
39	Ayadaw-1	1,758	921	190.88
40	Ayadaw-2	1,219	539	226.16
41	Ayadaw-3	2,324	1,285	180.86
	Total	446,636	260,835	

Source: Land Records and Survey Department, Ayadaw Township.

Result and Findings

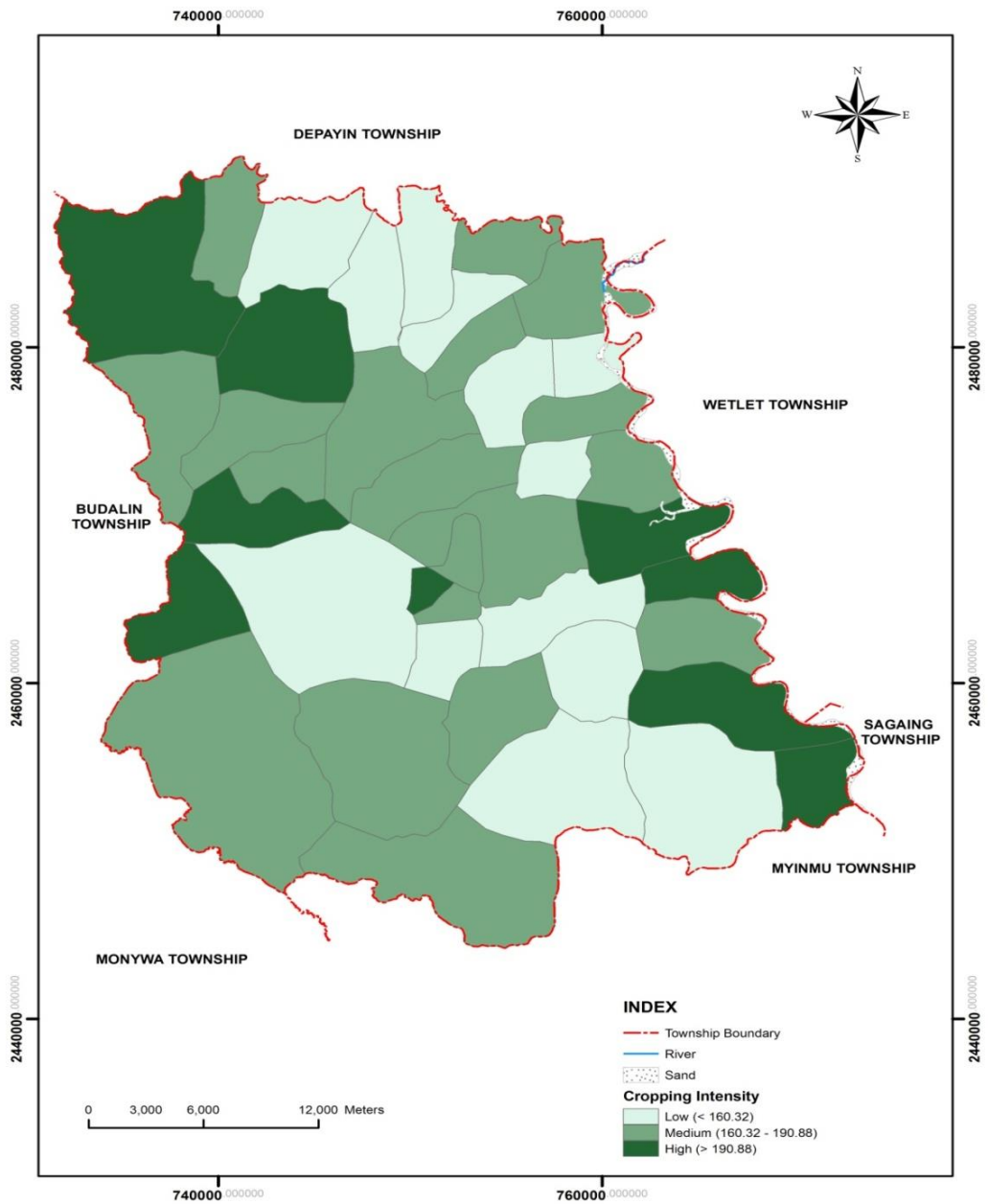
According to the slope classification with Athony Young (1975), most of the slope can be found under 0° - 2° and 2° - 5° in the study area. The least of the township can be found under the slope degrees of 10° - 18° . The slope value between 2° - 5° is spreading throughout the township. Along the Mu River of the easternmost in the township, the slope condition is comparatively high i.e 10° - 18° . Therefore, it can be assumed that, about 90 % of the total area is with the slope degree of less than 5° . As a result, the land figure favours crop cultivation successfully. During the study period, it is observed that the lowest the degree of slope, the highest the cropping intensity was. The high concentration of ground water is found in the area where the slope value is low. It is noted that the physical environment especially slope based on the elevation influence upon the cropping pattern and sustainable agriculture.

MAP (3) OVERLYING SLOPE CLASSES - CROPPING INTENSITY BY VILLAGE TRACTS IN AYADAW TOWNSHIP



Source : Calculated by Researcher
 Note : H = High, M = Medium, L = Low

MAP (4) CROPPING INTENSITY BY VILLAGE TRACTS IN AYADAW TOWNSHIP



Source : Calculated by Researcher Based on Table (3.4).

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