

CHAPTER III

PROFILE OF THE STUDY AREA

3.1 Land characteristics and biophysical conditions

Magway division (Magway province) falls within the Dry Zone Area of Central Myanmar and agriculture is severely restricted to the existing climatic conditions. There are ample lands suitable for agriculture if irrigation water is available. For centuries, dry farming land (*Ya-land*) is the characteristics feature of the agricultural landscape of the region except a narrow strip along Man Stream (*Man Chaung*). Dry farming combined with animal grazing encourages rapid soil erosion both by rain and wind. Besides, very thin vegetative cover also accelerates the rate of erosion. This over time may lead the area to be affected by the process of desertification unless effective measures are taken (Kyaw Khaing Win, 1998).

3.1.1 Location of study area

Based on land classification by the amount of mean annual precipitation, the Myanmar Dry Zone covers 87,308 sq km (13% of the country's total land area) in 13 districts or 55 townships (sub-districts) of Magway, Mandalay and lower Sagaing Division. Magway Division (North Latitude 18° 55' and 22° 30', East Longitude 93° 55' and 95° 50'), occupying mostly in the western part of the Central Basin of Myanmar and lies on both side of the Ayeyarwaddy River. It is flanked on the north by Sagain Division, on the east by Mandalay Division, on the south by Bago Division

and on the west by Rakhine State and Chin State. It has an area of 44,820 sq km. The length of division from north to south is 434 km and its widest breadth is 161 km. As the length of division is nearly three times greater than its breath, it is less compact. This Division consists of five Districts; Gangaw, Magway, Minbu, Pakokku and Thayet which are made up of 25 townships (Figure 4).

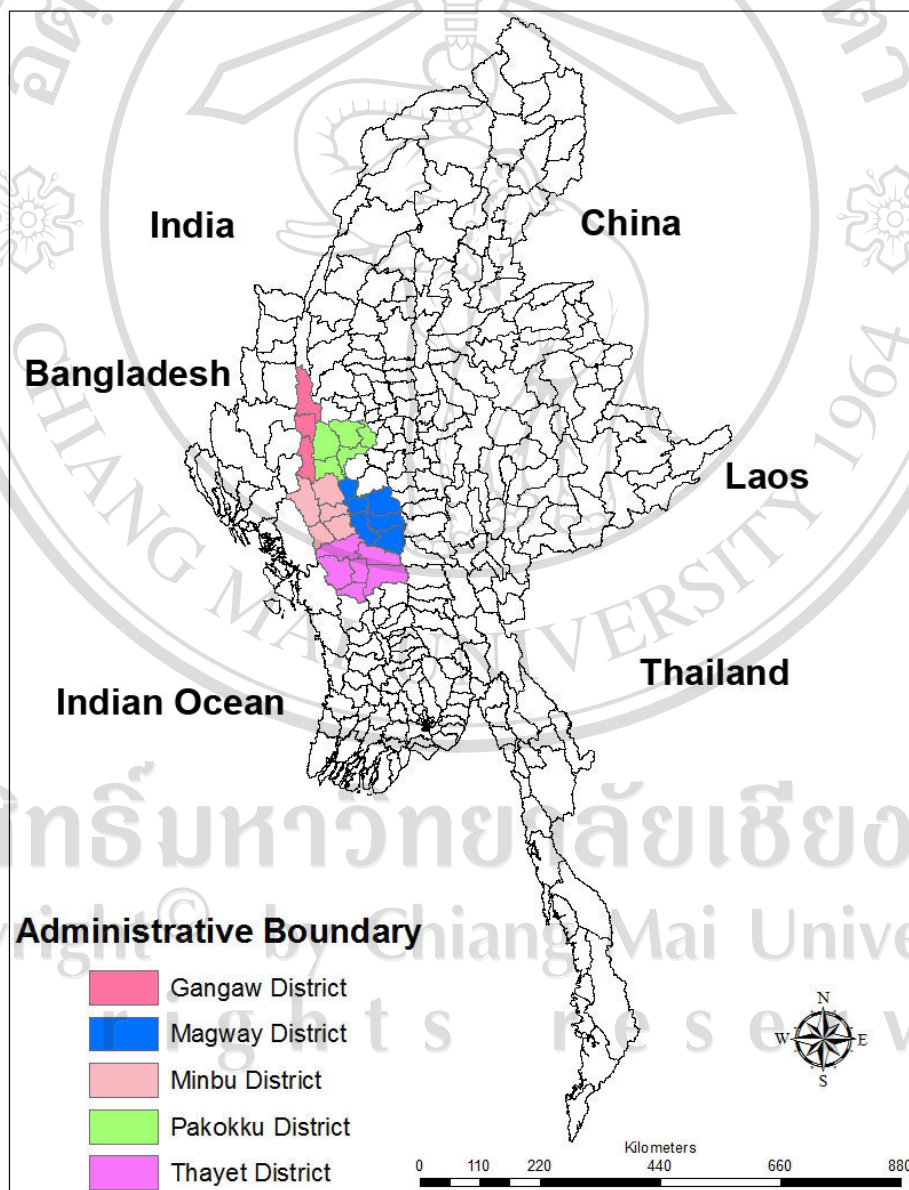


Figure 4. Administrative boundary map of Myanmar.

Magway district lies in the geographic heart of Myanmar and the whole portion is included in the Dry Zone. It has an area of 9,592 sq km and is located between 19° 36' N and 20° 55' N and between 94° 42' E and 95° 50' E with the average altitude is about 402 m above mean sea level.

It includes six townships (sub-districts) namely; Chauk, Magway, Myothit, Natmauk, Taungdwingyi and Yenanchaung (Figure 5). It is bordered on the east and north east by Mandalay division, on the south and south west by Thayet district and on the west by Minbu district.

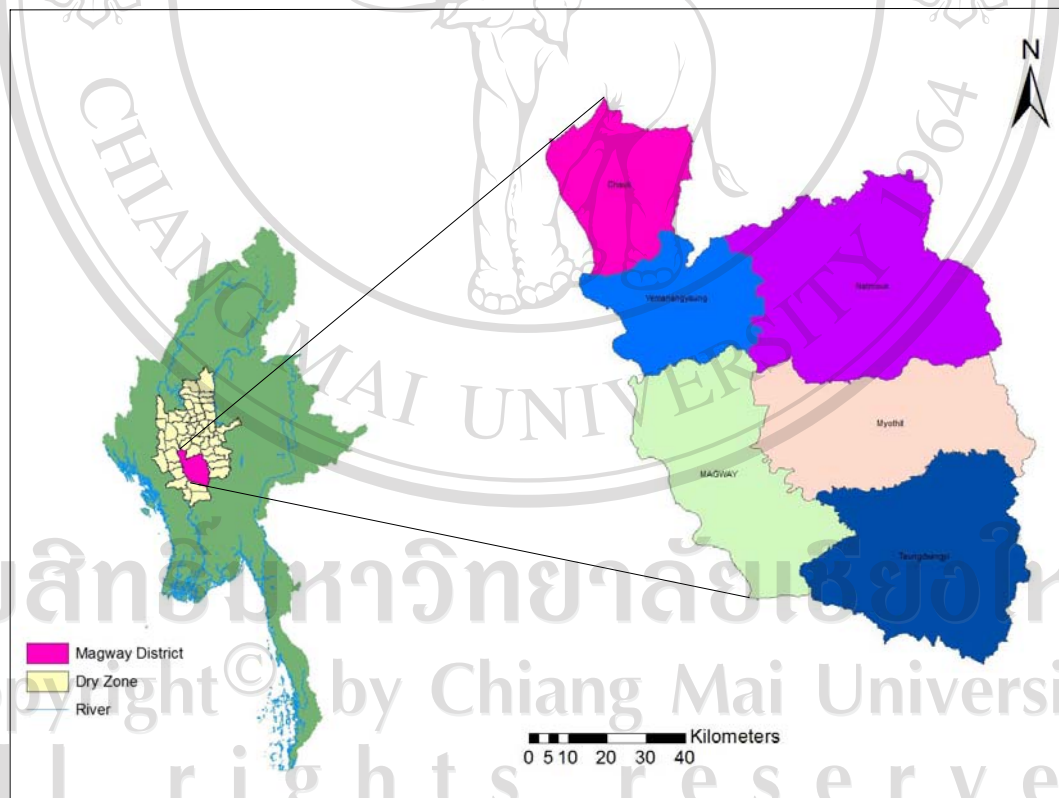


Figure 5. Location map of the study area.

3.1.2 Climate

Since the whole portion of Magway District falls in the dry zone area of central Myanmar, it is characterized by low rainfall, unreliable high rainfall with bimodal rainfall regime and greater annual range of temperature. However, such phenomena tend to decrease towards the east and west where rainfall is relatively high (Kyaw Khaing Win, 1998).

The livelihood of dry zone population is highly dependent on the south-west monsoon, which provides the region's annual share of rainfall and moisture. Precipitation is mostly confined to the period of mid May to mid October, a dry cool spell occurs from mid-October to mid-February, and the dry season runs from mid-February to mid-May (Table 2).

Annual precipitation in the dry zone is on average less than 30 inches (750 mm), with marked variation occurring between and within township. Over the last decade there has been an increasingly higher frequency of lower amounts of rainfall occurring annually. Records indicate that over the last decade only 2 to 3 years have been regarded attaining good levels of rainfall. The rainfall distribution over time and space is erratic with high rainfall intensities of up to 10 inches (250 mm) in a single day and with hourly intensities of over 4 inches (100 mm).

Apart from low rainfall, comparatively higher degree of unreliability of rainfall is the characteristic feature of the climate of Dry Zone. Thayet, lying in the southern part, receives about 41 inches of total rainfall, while Gangaw located in the north, and has 47 inches of total rainfall. The seasonal or monthly distribution of rainfall is also an important factor that greatly affects the success or failure of the

crops grown. According to the data shown in Table 2 and Figure 6 almost all the region have a bi-modal rainfall regime.

Although annual rainfall ranges between 20 inches (500 mm) and 40 inches (1000 mm), heavy individual storms and destructive showers occurring within a very short period causing flood and severe erosion (NCEA, 1997).

Temperature ranges from 12 °C to 42 °C over the hottest period of the year (March-April). Mean temperature of Magway is 21°C in January, about 32 °C is in April and 28 °C in July. The daily mean relative humidity is 55 % in January, 45 % in April, and 70-80 % in rainy season at Minbu. The area near Chindwinn River and Minbu Magway area have Tropical Steppe (BShw) climate. The rest of area receives Tropical Savannah (Aw) climate. The westernmost part has subtropical Monsoon (Cwa) type (Source: http://www.myanmardirectory.net/documentation/magway.php?c_id=8).

Table 2. Average monthly rainfalls in Magway district of Myanmar (1976-1995).

(Inches)

Sub-district Month	Chauk	Magway	Myothit	Natmauk	Taung- dwingyi	Yenan- chaung
Jan	0.00	0.02	0.01	0.02	0.02	0.02
Feb	0.09	0.15	0.05	0.08	0.11	0.07
Mar	0.02	0.11	0.18	0.10	0.11	0.09
Apr	0.68	0.79	0.75	0.70	0.80	0.59
May	2.14	4.71	4.19	4.45	5.29	3.61
Jun	3.56	5.14	5.92	5.96	6.55	4.20
Jul	2.52	4.00	4.61	4.27	6.17	2.82
Aug	4.75	4.49	6.06	5.03	7.38	3.23
Sep	4.80	5.41	6.51	5.64	7.70	4.24
Oct	4.14	4.21	3.62	4.54	4.82	4.27
Nov	1.90	1.87	1.89	2.27	1.33	1.86
Dec	0.09	0.32	1.25	0.36	0.33	0.36
Total	24.69	31.22	35.04	33.42	40.61	25.36

Source: Meteorology and Hydrology Department, Yangon

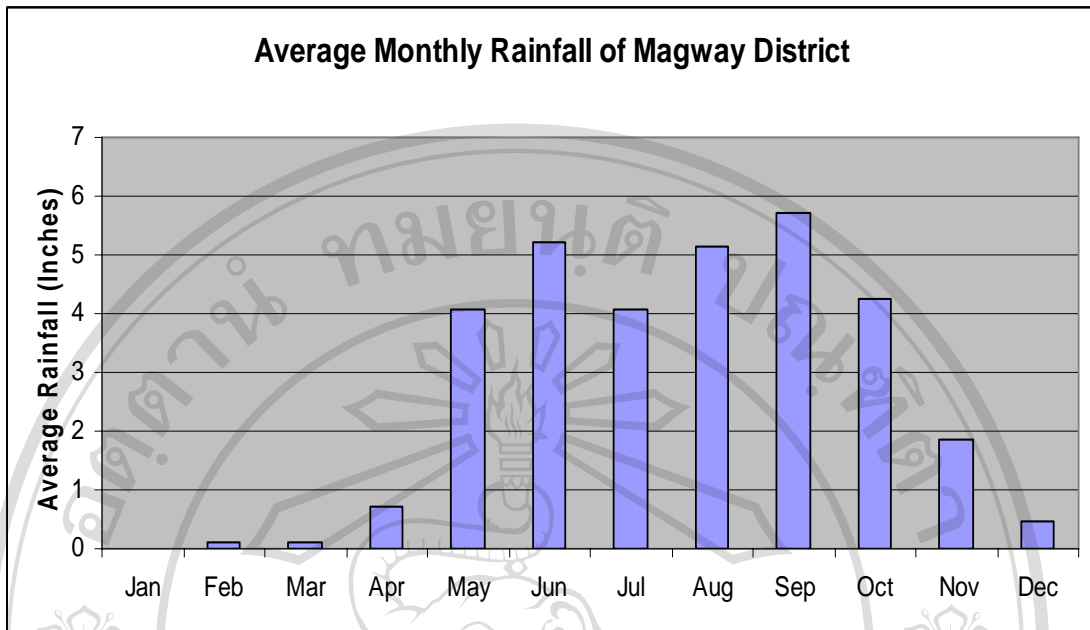


Figure 6. Rainfall distribution of Magway district, Myanmar.

3.1.3 Topography

Magway Division is flanked on the east by moderately high Bago Yoma and on the west by the Chin Hills and Rakhine Yoma of western Ranges. In between these ranges and spurs lie vast stretch of undulating land, flat plains formed by rivers and streams, and a series of young alluvial islands in the river. Some of the foothills of Bago Yoma spread out in the eastern part of this Division. In the northwestern part of Division, the Pondaung- Ponnya Range with an average elevation of 3,000 feet run from north to south, while Tankyi Taung and Nwama Taung run from Northwest to Southeast. Most of the local streams are dry for much of the year with water flow limited to rainy periods.

The topography is generally undulating. With the exception of Taungdwingyi Plain, rolling topography is the main feature in the rest of areas. Badland topography (the soil has been almost completely removed by water and wind erosion) is observed near Yenangyaung Township (Figure 7). Mud volcanoes are found near Yenangyaung, Minbu, Yebugwet and Pyalo.

The Ayeyarwaddy is the main river, which drains from northeast to southwest and then flows forwards the south. The tributaries flowing from west are Yaw, Salin, Mone, Mann, and Mindon and those from the east is Pin, Daungthay, Yin and Mindon streams. Most of the streams, having their sources in Bago Yoma, are intermittent streams.



Figure 7. Bad land topography in Yenanchaung township.

3.1.4 Soils

Land Use Division of Myanmar Agriculture Service under the Ministry of Agriculture and Irrigation is the sole agency responsible for soil survey and classification of soils in Myanmar.

According to the FAO's study, the Dry Zone townships are characterized by clay, sandy loam and sandy soils (including gravel). The soils clearly vary with topography. According to soil survey data, all soil series have low fertility and declining organic matter levels. Potassium levels are similarly low. Nitrogen is required for all non-legume crops on all soil types. This suggests the low organic matter level in the soil. Available soil moisture holding capacity of the soils of the Dry Zone is low and with the high level of evapo-transpiration, constitutes a major constraint to crop growth during periods of inadequate rainfall (June and July). Management practices that conserve soil moisture or increase the water holding capacity of the soils are being practiced to help take advantage of the full growing season. Hard pan formation is common to all upland areas.

Generally, the region is composed of sedimentary rocks of both Ayeyarwaddy and Bago Groups. Molasse-type units are also found in the western part. The predominant formation of plains, which are built up by streams, is alluvium. The predominant soil types on the east side of Ayeyarwaddy are Catena of Savannah soils on slopes (Luvisols), compact soils in depression (Vertisols), and primitive crushed stones (Lithosols). On the west side Cinnamon soils (Nitosols), Savannah soils (Luvisols), Compact soils (Vertisols), yellow brown forest soils (Ferrasols-xanthic), yellow brown dry forest and indaing soils (Cambisols) are found (Figure 8). Along the valleys meadow and alluvial soils are seen. Forests include dry forests and mixed

deciduous forests. Out of over 4,500 sq. miles of forests, nearly 4,000 sq. miles are reserved forests (Source: http://www.myanmarDirectory.net/documentation/magway.php?c_id=8).

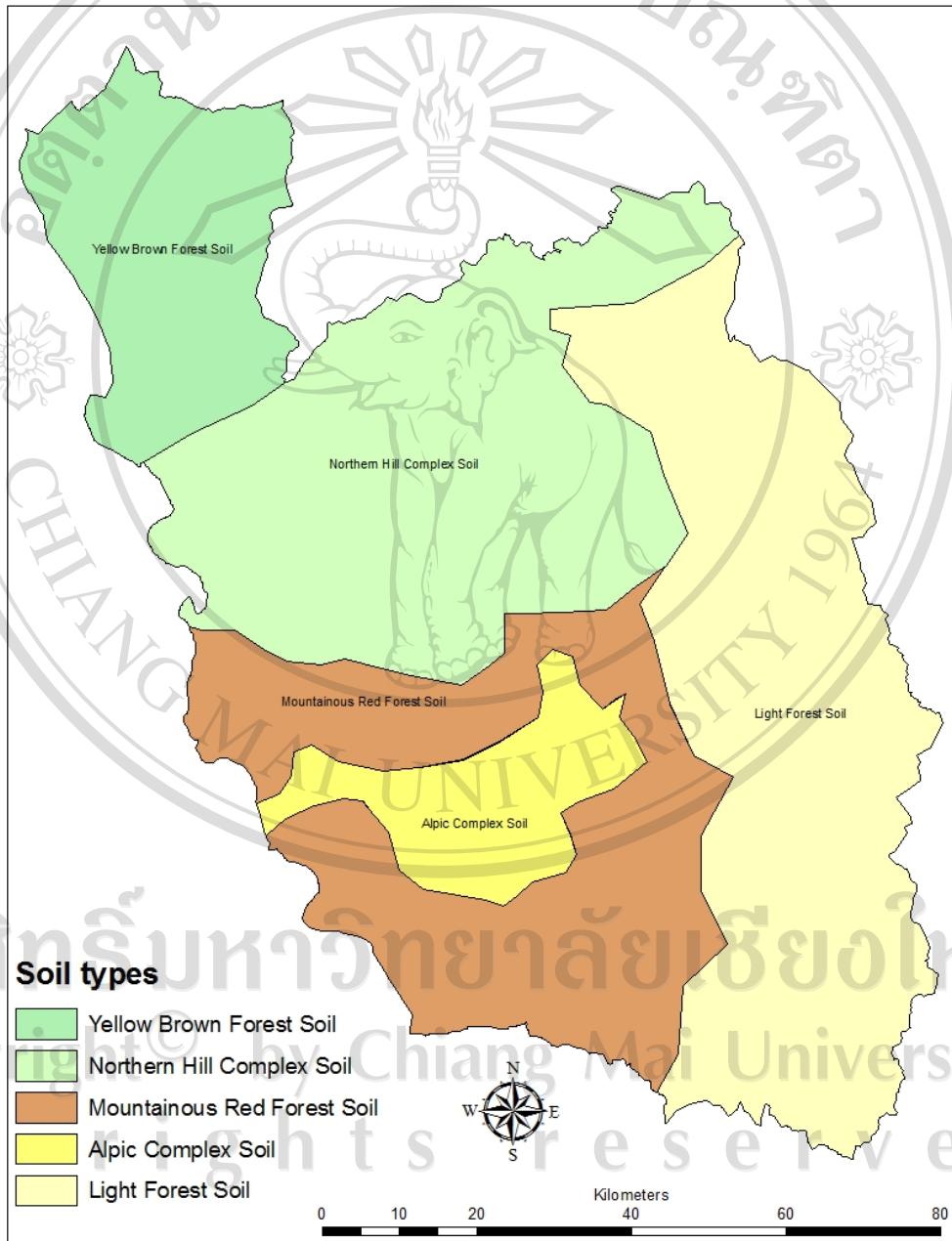


Figure 8. Soil map of Magway district.

3.1.5 Land cover and land use

When the Dry Zone Greening Department (DZGD) has been established, Remote Sensing and GIS Section of Forest Department under the Ministry of Forestry, it has performed land use mapping, erosion susceptibility mapping and regeneration plan mapping for the new department. For the land use mapping, six major classes are defined as follows;

- Good Forest (Closed Forest)

This includes Moist Forest (M), Semi-Indaing (Id), Dry Forest (DF), Hill Forest (H), High Indaing (In), Mixed Deciduous Forest (MDF), Moist Forest with Bamboo (M/B), Bamboo Breaks of Rakhine Yoma and Forest Plantations (Pt). Good means good vegetation cover for Dry Zone management. Some areas may not be good for Forest Management (timber production).

- Degraded Forest

This includes Scrub Forest (Sc), Scrub with Grassland (Sc/Gr), Scrub with Bamboo (Sc/B) and Grass land (Gr). Some area needs only natural regeneration methods.

- Shifting Cultivation

This includes Shifting Cultivation (Sh), Shifting cultivation with Bamboo (Sh/B), and Scrub land affected with Shifting Cultivation (Sc/Sh).

- Agriculture

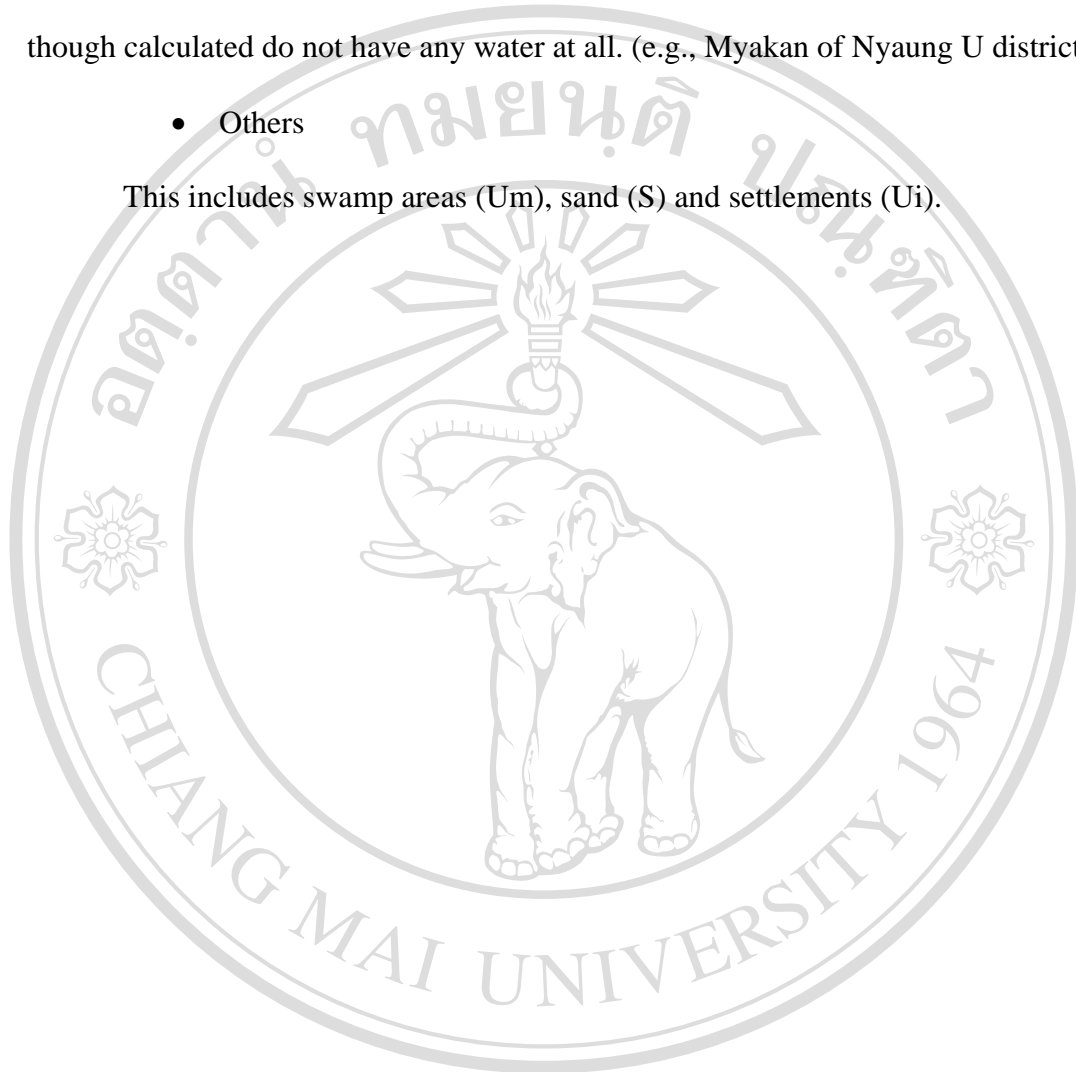
This includes Permanent Agriculture (Af), Agriculture with vegetative bunds (Af/B), Ya cultivation (Y), Alluvial Island Cultivation (Al) and Homestead Gardens (At).

- Water

This includes open water, lakes and major irrigation systems. Some dams though calculated do not have any water at all. (e.g., Myakan of Nyaung U district).

- Others

This includes swamp areas (Um), sand (S) and settlements (Ui).



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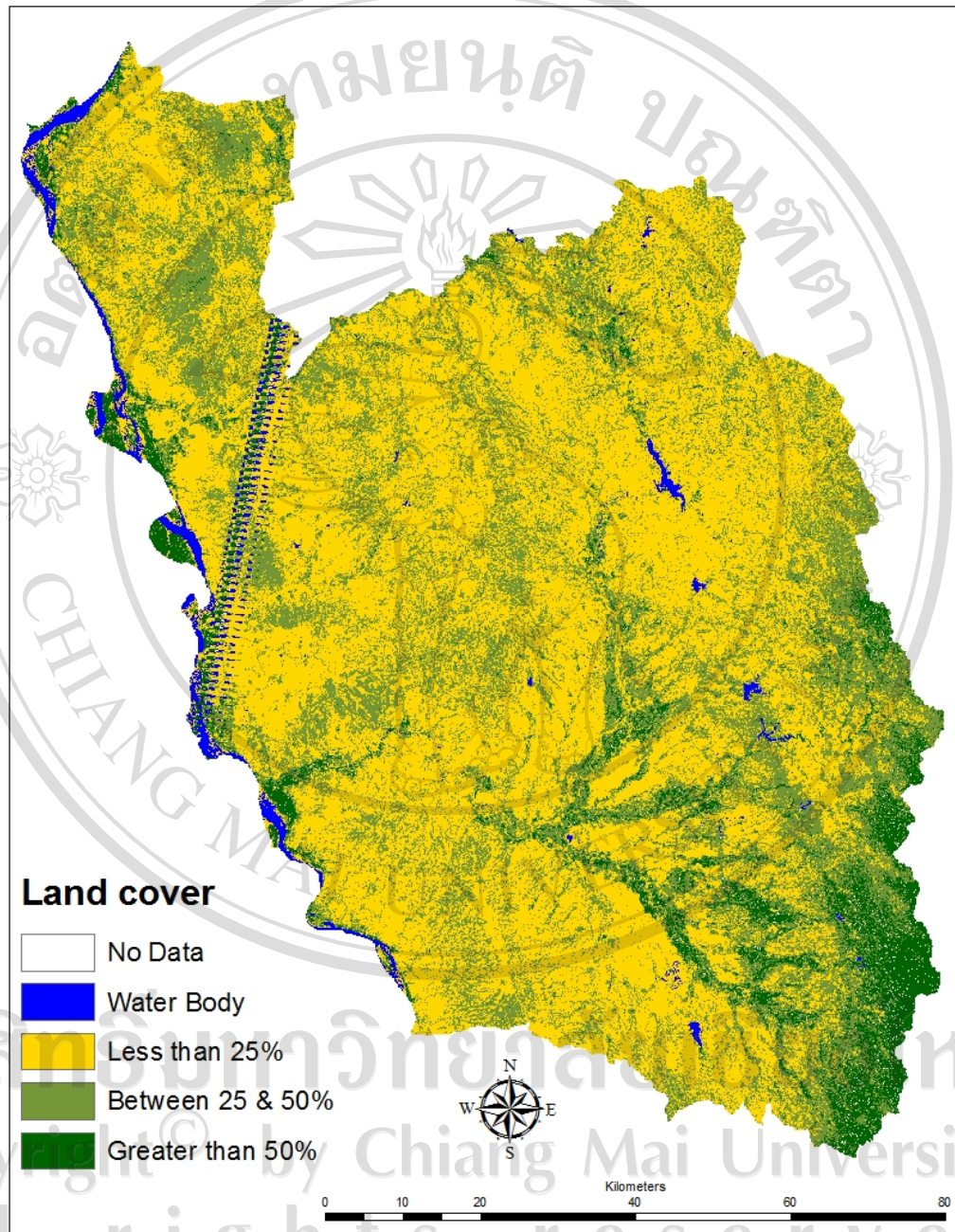


Figure 9. Land cover map of Magway district.

(Source: Landsat-5 TM image, 2007)

In this study, land use forms are broadly categorized into forest and scrub land, barren land and agricultural land. Figure 10 is showing Land use type of Magway district in 2007.

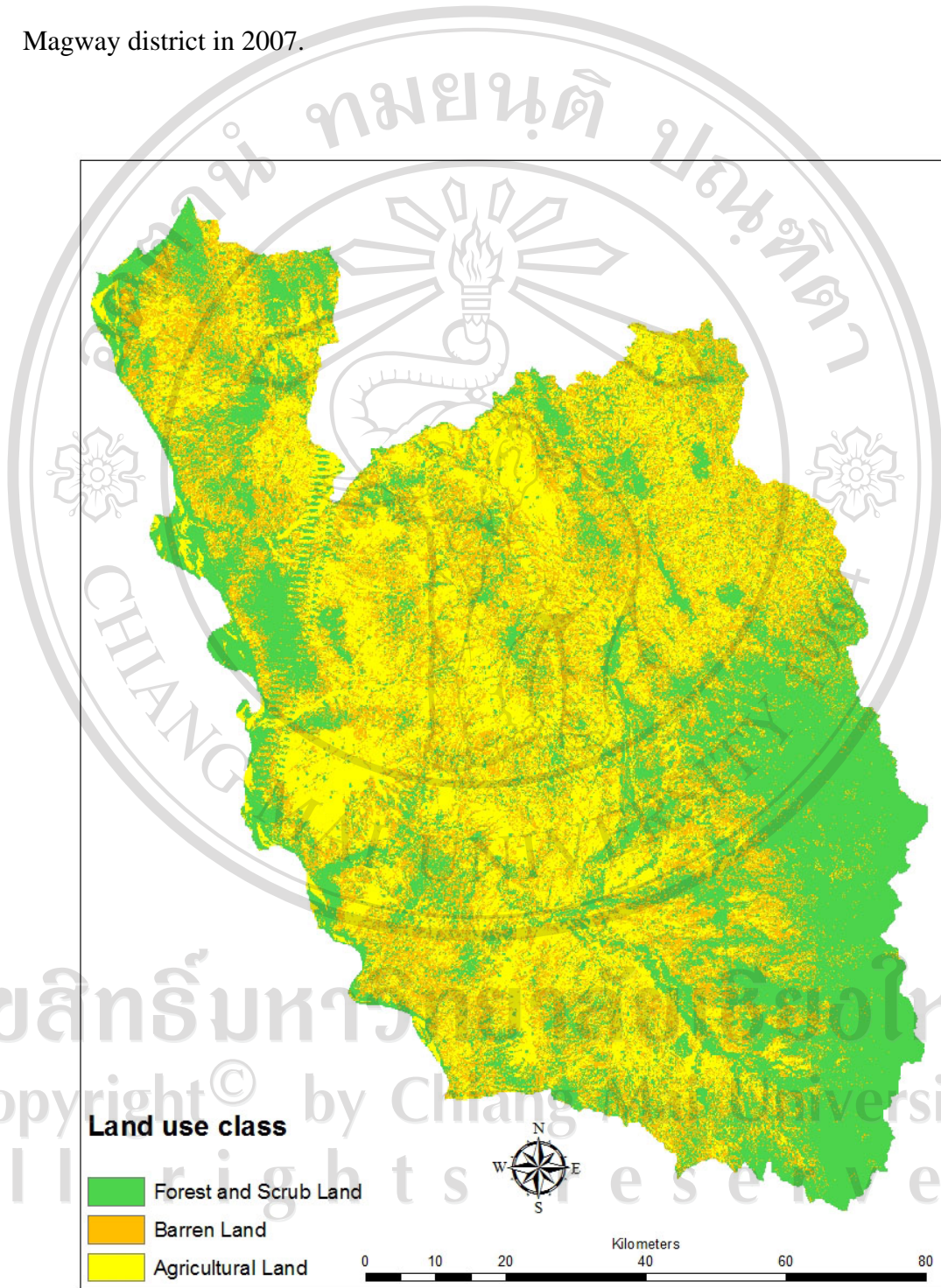


Figure 10. Land use map of the study area.

3.2 Socio-economic conditions

3.2.1 Demography

The human population of the Dry Zone is about 18 million constituting 34% of the country's total population of about 53 million in 2003 (Department of Population, 2003) with an annual growth rate of 2.02% at the national level. The average population density in the Dry Zone is 607 per sq km. It is the third most densely populated region in Myanmar.

The population of Magway Division was 2.63 million in 1973, and 3.24 million in 1983. The estimated population was 4.3 million in 1997 and 4.55 million in 2000. Female population is slightly higher than male population. Population density was 472 per sq km on average. The density was more than 1,295 per sq km in Yezagyo, Pakokku, and Chauk Townships, but lower in other areas, especially in the western part of the Division.

When the population is beyond the carrying capacity of a given area, the over population always makes certain impacts on the socio-economic and ecological conditions of the area. The natural resources particularly forest and land resources are always limited. The regeneration capacity of the forests is generally unable to meet increased demand for forest products under ever-growing population in many situations. As a result, the forests are degraded over time due to over cut and eventually denuded. Degradation of land becomes more apparent in the areas where the forests have been depleted. The effects of desertification will also become distinct when the land is no longer productive.

The accelerating population growth reduces the water and soil resources available for each individual land user and at the same time demand for food, timber, and fodder increases dramatically. In this circumstance, the farmers tend to shift towards an extensive use of natural resources, i.e. shorten or abandon the period of crop rotation, and increase exportation of biomass.

Figure 11 is showing the household size distribution in the sampled villages of the study area. Among 100 farm households, 69% is between 5 and 10 family members, 26% is less than 5 and only 5% is greater than 10 family members.

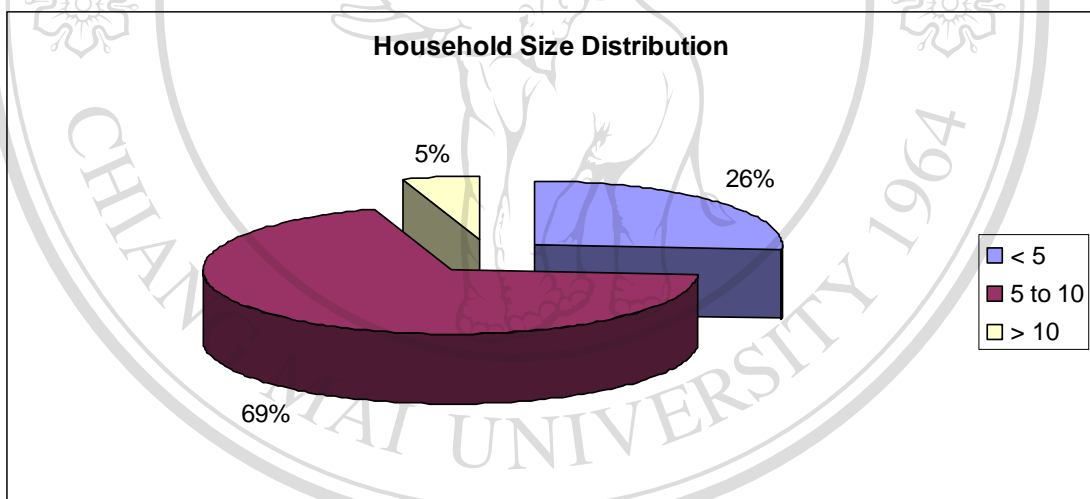


Figure 11. Distribution of household size in the study area.

(Source: Field survey, 2007)

3.2.2 Infrastructure

In addition of schools for Basic Education, there are one University of Arts and Science, one University of Medicine, one Technical College, one Computer College and one Educational Collage in Magway, one Collage and one Technical University in Yenangyaung, one University, one Technical University, one Computer College and one Educational College in Pakokku, one Technical University in Chauk, one State Agricultural Institute in Pwintbyu and some social welfare establishments in Magway and Pakokku.

Medical and health facilities (hospital, dispensaries and health centers) are provided in every Township. The general hospitals with specialist services are set up in Magway and Pakokku.

Ayeyarwaddy River and the southern section of Chindwin River are the effective channels of transportation. The Bago Yoma Circular railroad runs from Pyinmana (Mandalay Division) passing Taungdwingyi, Myothit and Natmauk (Magway Division) to Kyaukpadaung (Mandalay Division). Another railroad from Pyay (Bago Division), passing Aunglan, leads to Hsatthwa, near Taungdwingyi railroad was also built. From Kyaukpadaung a railroad continues to Kye-ni, near Chauk.

In the northern part, ChaungU-Pakokku-Myaing-Gangaw-Kalay railroad provides an important linkage between Magway and Sagaing Divisions. The length of railroad within this Division is 360.68 miles in 1998. The Yangon-Mandalay Highway passes through Aunglan, Taungdwingyi, Magway and Yenangyaung. Short roads from Sinbaungwe, from Natmauk and from Chauk join this highway, in the western part; the main roads are Pakokku-Yezagyo-Salingyi road, Pakokku-Myaing road, Pakokku-Gangaw-Kan road, Seikphu-Kampetlet (Chin State) road, Minbu-Ngape road and

Minbu-Ann (Rakhine State) road, Thayet-Minhla road and Thayet-Mindon road. Salin-Sinbyukun road continues northward to join Seikpyu-Saw road. The shorter roads are feeders linking the interior with the river ports. If the Pathein-Monywa road is completed, road transportation will contribute to the further development on the west bank. The Ayeyarwaddy Bridge (Anawrahta Bridge) near Chauk and Chindwin Bridge (Hsinbyushin Bridge) near Yazagyo will provide easy transportation and enhance trade opportunities. The length of arterial highways in this Division is 1,595 miles in 1996-97. The airports are at Magway, Pakokku, Lanywa, Pauk, Kyaukhtu, and Gangaw.

This Division has 138 postal services, (some with telegraph services) and 44 telephone exchanges with 7,471 telephone lines in September, 1995. Fax services are available at Magway and Pakokku.

Important minerals are oil and gas, which are extracted from Htaukshabin-Kanni and Petpei fields, Mann and Yenamma fields, Yenanchaung fields, Chauk-Lanywa-Ayadaw fields, Letpando and Kyaukkwet fields. Most of these fields are located on the west bank. Other minerals are limestone and gypsum from Thayet and Pakokku, chalk and clay from Minhla and Pakokku, and manganese from Minbu. Chromite deposits are found in northwest of Kadaing in Thayet District.

Industries comprise oil refineries at Chauk and Manthanpayakan at Minhla, fertilizer plant (using gas from oil and gas fields) at Kyunchaung, Sale and Kyawswa, Myanmar Heavy Industry (tractors, trailers etc.) at Malun, cement plant at Thayet, electric power plants (using gas) at Minbu and Kyuncahung, printing work at Wazi, cigarette factory at Pakokku, rice mills at Minbu, plain edible oil mills, cotton ginning mills and saw mills at some towns. Hydel electric power will be generated by Mone

Creek multipurpose Dam (Sedoktara Township). Cottage industries are cotton weaving, blacksmithing and cheroot-making at some towns and villages. The registered Private Industrial Enterprises are 2,202 employing 7,662 workers up to 1998.

This Division supplies mainly oil, fertilizer, cement, tractors and trailers, edible oil, forest products, pulses and oil seed, cigarettes etc. and imports textile, electrical goods, household goods, building machinery, machines and vehicles.

3.2.3 Cropping system

Rainfall is the most important climatic element that determines the crops and cropping systems in the agriculture of Myanmar Dry Zone. Small amount and unreliability of rainfall is connected with dry farming (*Ya*) and its associated multi-crop cultivation. Multiple cropping and double cropping are the typical cropping systems because single cropping is not safe for the farmers facing the meagre and unreliable rainfall. Multiple cropping is practiced at paddy land and farmland. Double cropping is practiced in the *Ya* lands as well as on the irrigated tract. The major rice fields are found in the irrigated alluvial plains.

Farmland occupies 1.0 million acres of about 1.1 million acres total arable land in the District. The major crops are sesame and groundnut. Other crops grown are rice, maize, common millet, sunflower, bean and pulses, Virginia tobacco, cotton, sugarcane, etc.

In the early part of 1990s, this Division had about 2.3 million acres of net sown area (inclusive of area other than demarcated agricultural land), over 0.52 million acres of fallow land and over 0.37 million acres of culturable waste land every

year. The area under mixed and multiple cropping was over 1.54 million acres. Magway Division has 0.6 million acres of paddy(*le*) land, 1.9 million acres of dry(*ya*) land, over 0.2 million acres of alluvial land, over 3,000 acres of garden land and about 56,000 acres of shifting cultivation (*taungya*) land in the occupied area.

In 1995-96, the acres under the main crops were 495,000 acres of paddy (439,000 acres of Monsoon paddy and 56,000 acres of Summer paddy), 52,000 acres of corn, about 200,000 acres of millet, about 1,400 acres of wheat, over 320,000 acres of groundnut, over one million acres of sesame, about 39,000 acres of sunflower, 939,000 acres of pulses and beans (mostly *pedisein*, *pesingon*, *penauk*, *pegyi*, *grams pelum* and *sadawpe*), about 300,000 acres of cotton, 10,000 acres of sugarcane, about 22,000 acres of toddy-palm, over 56,000 acres of fruit trees. Chilies, onions, and garlic occupied about 15,000 acres, over 15,000 acres, about 1,900 acres respectively. Area under tobacco (Myanmar) was 7,700 acres and that of Virginia 4,700 acres. Among the States and Divisions, Magway Division ranked first in groundnut and millet acreages, second in sesame, pulses and beans, and cotton acreages.

More prosperity can be obtained if the agricultural mineral and forest resources are better developed in this Division. Fallow land and culturable waste land can also be utilized for the prosperity of this Division.

3.2.4 Livestock production

Livestock are raised in sub-urban areas and villages. Periodic cattle markets were held at Tuangdwingyi and Aunlan. Population trend of grazing animals is increasing in the study area with lesser grazing land as shown in Figure 12.

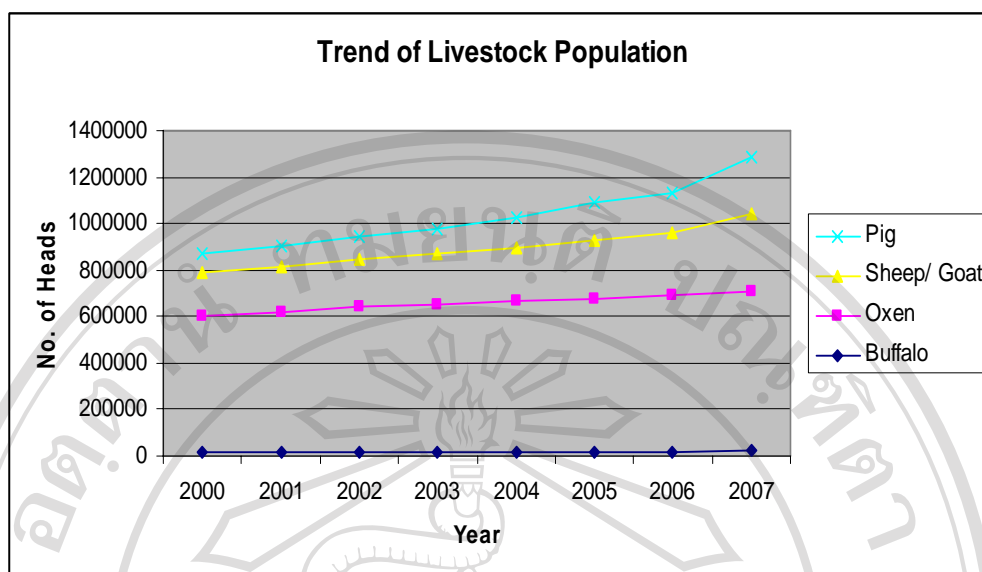


Figure 12. Trend of livestock population in Magway district.

(Source: Magway division Livestock Breeding and Veterinary Department, 2007)

3.2.5 Shifting cultivation and agriculture

As the main economy in the central Dry Zone of Myanmar is agriculture, it is the major land use type constituting about 55 percent of the total area of the region. The fertile alluvial plains provide natural good lands for cultivation. A large variety of agricultural crops with economic values such as onion, tobacco, potato, tomato and beans (pulses) etc. are grown.

Shifting cultivation in the central Dry Zone can be classified into two major types. The first type is shifting cultivation in the forested area, i.e. *Taung Ya* and the second type is agricultural shifting plain land where no forested area exists in and around the vicinity of *Ya*. The total forested area affected by shifting cultivation amounts to about 4,380 square miles in extent constituting 13 percent of the total are

of the Dry Zone. Due to demographic pressure, shifting cultivation that used to be sustainable has become no longer sustainable with shorter rotations (Than, 2001).

3.2.6 Environmental problems

In the Dry Zone of Myanmar, soils have been eroded to varying degrees. At some places the soil has been almost completely removed by water and wind erosion (badland topography). An ever increasing population in combination with unfriendly climatic conditions triggers the rapid misuse of land and over-exploitation of natural resources. As a consequence, soil erosion by water and wind and progressive removal of the vegetative cover are becoming common features observable in most parts of the Dry Zone. Such conditions, together with occasional outbreaks of wild fire also enhance the desertification process of the central dry zone and now becoming a state of seriousness (Carucci, 2001). Only about 5% of total area is covered by natural forest in Magway District in 2007. Figure 13 shows highly eroded bad lands, these areas can be identified from satellite images. No land use is possible except reforestation now. In this semi-arid monsoon climate, soil erosion is intensive and rapid as a result of heavy rain showers and because of the low degree of compaction of rocks. Removal of the natural savanna vegetation quickly leads to erosion, which is most intensive at the start of the monsoon rains on bare soils. In the Dry Zone, where rainfall is already low, reduced infiltration means a less effective utilization of precipitation. An increase of runoff also leads to an expansion of rill and gully erosion (Figure 14 and Figure 15).

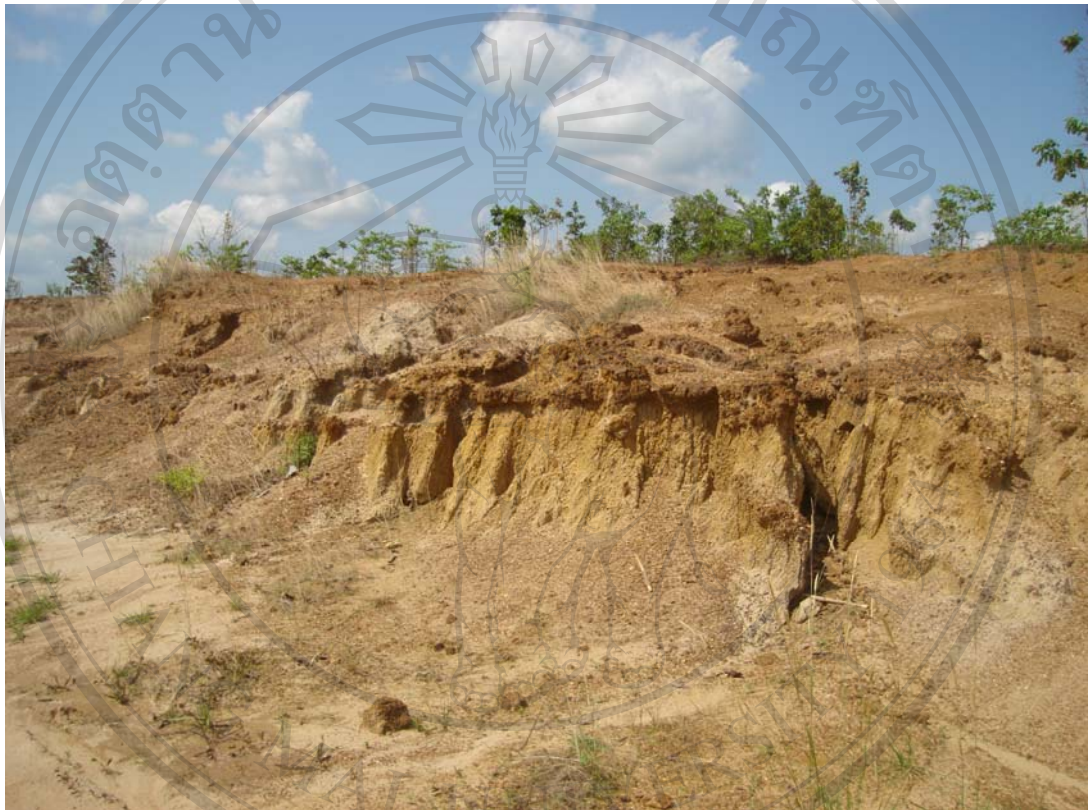


Figure 13. Highly eroded bad lands in Taungdwingyi township of the study area.

(Source: Field survey, 2007)

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Figure 14. Gully erosion in the study area.

(Source: Field survey, 2007)

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Figure 15. Gully erosion by runoff in the study area.

(Source: Field survey, 2007)

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