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LANDUSE/LANDCOVER CHANGES IN PHYU TOWNSHIP

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Abstract

This paper aims to landuse/landcover changes in Phyu Township using Remote Sensing (RS) & Geographical Information System (GIS). In this paper, Phyu Township is located in the eastern part of Bago Region. There are two major modes of transport in the study area. One follows the railway line passing through nearly 30.57 kilometers (19 miles) within the study area. There are two roads; one is Yangon Mandalay Highway and the next route is Yangon Mandalay Expressway selected to find out the relationship between landuse/ landcover changes. The analysis of the present study was only from 2000 and 2018 data. Landuse and landcover maps were prepared using Landsat-7 Nov (2000) and Landsat-8 Nov (2018) and ground checked during the field survey. The main aim of this research work is to identify the spatially changes of landuse/ landcover in Phyu Township and its surroundings using Remote Sensing data. During 2000-2018, it was observed that the majority of the changes occurred from dense vegetation to sparse vegetation, built-up land, vacant land and water area. Transport is one of the important factors influencing the arrangement of spatial relations and creating spatial interactions in society. Access to facilities, services and socio-economic opportunities plays a critical role in the growth and decline of cities and human settlement. The different measures are tested based on their capacity to explain the spatial pattern of different landuse/landcover types.

Keywords: *GIS; RS; landuse/ landcover change*

Introduction

The study area, Phyu Township is located between Bago Yoma and the Sittaung River in the Taungoo District, Bago Region (East). Accessibility is of the most important factors of land-use and land-cover changes from a geographic standpoint. The accessibility is a construction of three components, transportation, activities and individual (Niedzielski and Eric Boschmann 2014), defined as the interaction between transport and land use.

The population distribution and population density is uneven because these are influenced by topography, accessibility, etc. The distribution of the population differs from place to place depending on transport facilities and configuration of the land. There are two major modes of transportation in Phyu Township. They are railways and roads with their respective advantages. The Yangon-Mandalay Railway line passes through nearly 30.57 kilometers (19 miles) within Phyu Township. There are two main motor roads: one follows the Yangon-Mandalay highway, the segment passing through the Phyu Township and the next one is Yangon- Mandalay Expressway. Now, many people use Yangon-Mandalay Expressway for trade and commerce, social, and government affairs. The general landuse/ landcover change of Phyu Township is influenced by physical, social and economic factors. These factors had caused the migration of population from rural to urban areas. The landuse/ landcover change of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. During the two periods, 2000 and 2018 were analyzed in the study area. To find landuse/ landcover changes for

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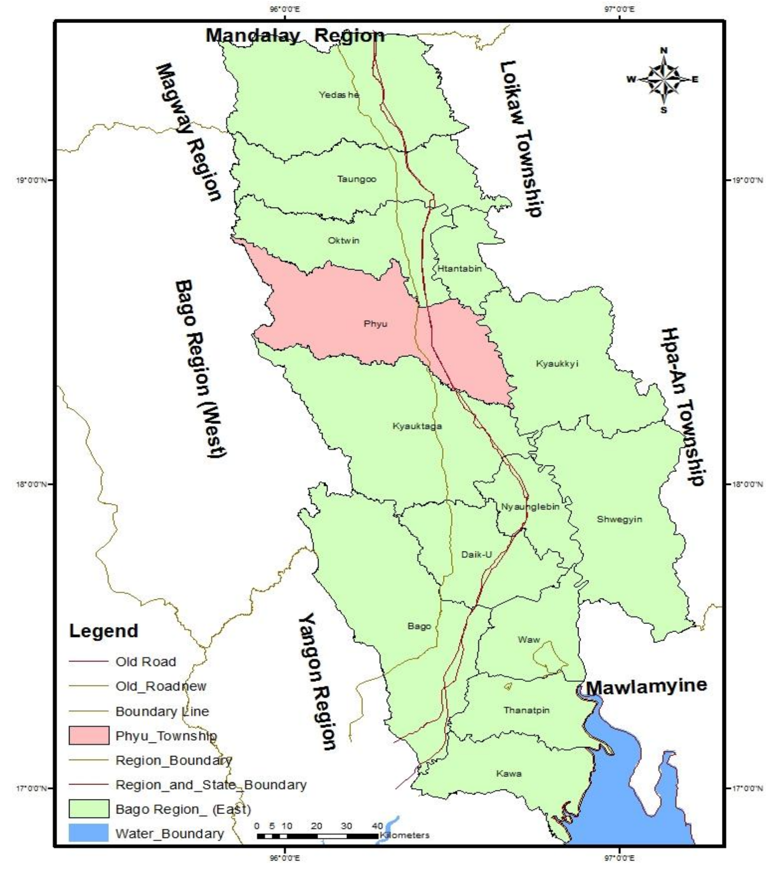
the year 2000-2018, the amount of landuse/ landcover changes from dense vegetation, sparse vegetation, built up, water area and vacant land were found.

Study Area

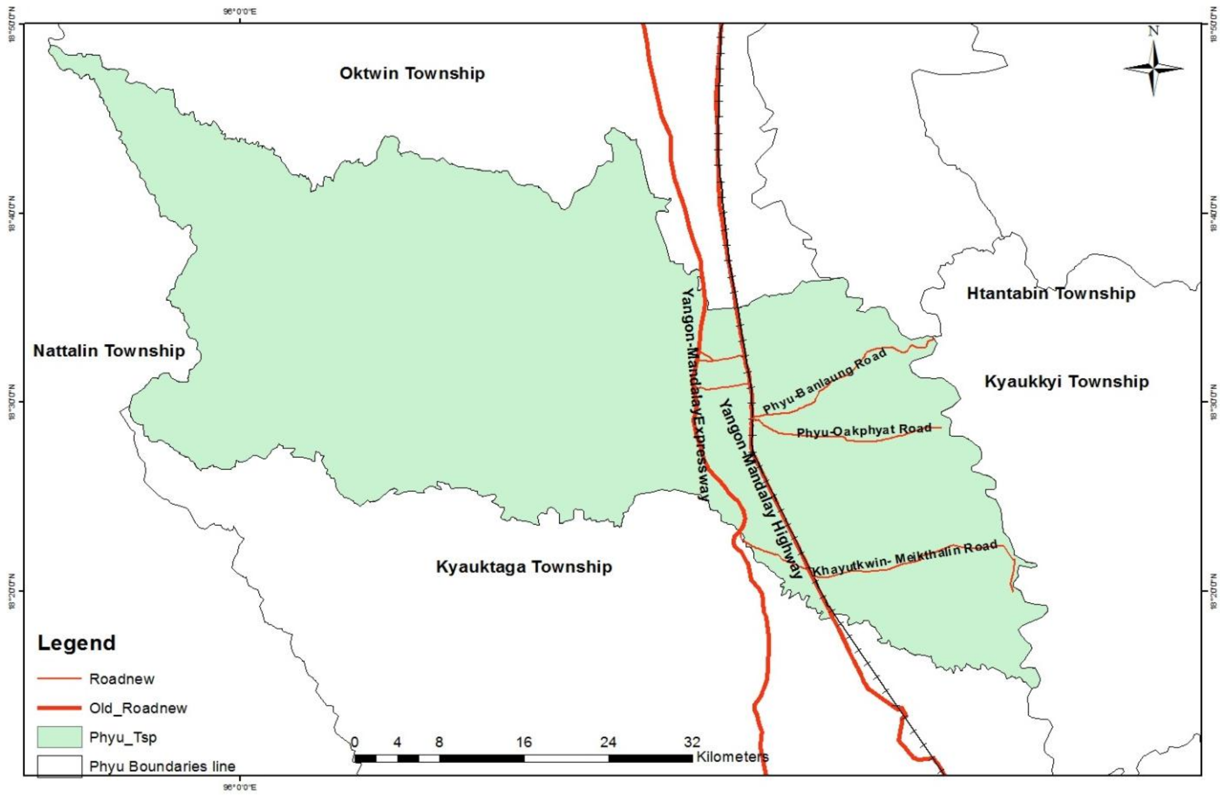
The study area is Phyu Township in the eastern Bago Region, located on the western bank of the Sittaung River, between 18˚15" N and 18˚50" N and longitudes 95˚50" E and 96˚40" E with the area of coverage 72322.4 Square Kilometer (896.7 Square miles). The study area comprises of 62 village tracts in which 313 villages. It is bounded by Oktwin Township on the north, Htantabin and Kyaukkyi Townships serves as a demarcating boundary in the east, it is demarcated by Nattalin Township in the east and Kyauktaga Township serves as the southern limit. The topography of Phyu Township is higher in the western part and lower in the eastern part. It is a flat plain and 24 Kilometers (15 miles) wide from Sittaung River to eastern edge of Bago Yoma. The western part of Phyu Township is the highland region which is about 76.2 meters (250 feet) to 457.2 meters (1500 feet) above sea level. This highland region in the eastern part of Bago Yoma covers three-fifths of total township area.

The prominent drainage system is the Sittaung River. The main tributaries are Phyu Chaung and Kun Chaung which flow into Sittaung River from the western part. Mean daily maximum and minimum temperatures of the study area range from the 32.5°C to 21°C. The average annual rainfall of Phyu Township is 2652 mm (104.4 inches). The total population was 256435 people in which the urban population was 63251 persons and rural population 196683 persons in 2014. (Population Census 2014).



Source: Myanmar Survey Department, Yangon

Figure 1 Location of Phyu Township in Bago Region (East)



Source: Myanmar Survey Department, Yangon

Figure 2 Location of Phyu Township

Aim and Objectives

Aim

The main aim of this research work is to identify the spatial changes of LU/LC in Phyu Township and its surroundings using multidate Remote Sensing data.

Objectives

The major objectives are to prepare landuse/ landcover maps of Phyu Township from Remote Sensing data, to examine the major changes in landuse/ landcover distribution during 2000-2018.

Methodology

The landuse/ landcover changes data were extracted by Landsat 7 and 8 (2000 and 2018). Landsat 7 and 8 image from November 2000 and 2018 on path 132 and row 47 and path 133 and row 47 are used. The data were provided as level L1T data captured under clear atmospheric conditions (cloud coverage = 0.01%). The image is in UTM projection (zone 47 N) and was retrieved from the United States Geological Survey (USGS), Earth Explorer website.

In general, all the five types in the study area are dense vegetation and sparse vegetation, built-up land, vacant land and water area are their highest digital number (DN) in band 10; vacant land as the first and built-up is the second highest DN in this band. In most bands, The DN of vacant land is higher than that of built-up areas, only in bands 1 and 2 is the spectral signature of the built-up higher than that of vacant land. The DN value of water is lower than the DN of all other classes across all bands. Spectral disparity of built-up and vacant land is low in the Blue band, however, it is large in the TIR1. The urban areas had higher blue reflectance than vacant land soil as a result of the type of building materials, mainly concrete, used for roof surfaces and walls. After testing Landsat 8 bands, these classes can be distinguished in Blue and TIR1 in the study area.

$$\mathrm{DBI} = \frac{p\mathrm{Blue} - p\mathrm{TIR1}}{p\mathrm{Blue} + p\mathrm{TIR1}} - \mathrm{NDVI}$$

Where $p\mathrm{Blue}$ =band 2, $p\mathrm{TIR1} = \mathrm{band}\ 10$

A mask was applied to water surface pixels using water index NDWI

$$\mathrm{NDWI} = \frac{p\mathrm{Green} - p\mathrm{NIR}}{p\mathrm{NIR} + p\mathrm{NIR}}$$

$$\mathrm{NDVI} = \frac{p\mathrm{NIR} - p\mathrm{RED}}{p\mathrm{NIR} + p\mathrm{RED}}$$

Where NDVI is normalized difference vegetation index, pNIR is the surface reflectance of band 5 and pRED is the surface reflectance of band 4 in Landsat 8. The reason for subtracting the DBI layer from the NDVI values is that built-up areas can be identified better. Dry built-up index (DBI) values of green vegetation will decrease and the features with higher DBI values but lower NDVI values will be enhanced. The DBI values can be between -2 to +2 and the higher numbers represent more built-up areas. The built-up from the output of the equation can be used for mapping built-up and non-built-up areas. DBI and dry bare-soil index (DBSI) to extract built-up and vacant land soil may vary based on the study area. Landsat 8 bands suggested that differentiation of these types could be done based on spectral values in the SWIR1 and Green bands.

$$\mathrm{DBSI} = \frac{p\mathrm{SWIR1} - p\mathrm{Green}}{p\mathrm{SWIR1} + p\mathrm{Green}} - \mathrm{NDVI}$$

where pSWIR1 = the surface reflectance of band 6, pGreen = the surface reflectance of band 3 in Landsat 8. The DBSI values can be between -2 to +2, and higher numbers represent more vacant land soil (Deng, C.; Wu, C. BCI: 2012).

Landuse and Landcover Analysis

Table 1 and figure 4 and 6 shows the landuse/ landcover classification for the year of 2000 and 2018 of the study area. Based on the satellite images, dense vegetation, sparse vegetation, water area, built- up area and vacant land are mainly classified into five types.

In 2000**,** the total area is 232243.97 (ha) of the study area. Dense vegetation and sparse vegetation area occupy 156471.56 ha and 47010.47 ha. The dense vegetation is the largest landuse/ landcover type of the study area. Dense vegetation is also more than one-third of the sparse vegetation land. The built-up land is 20597.37 ha and the vacant land is 20597.37ha. The water area is 506.50 ha.

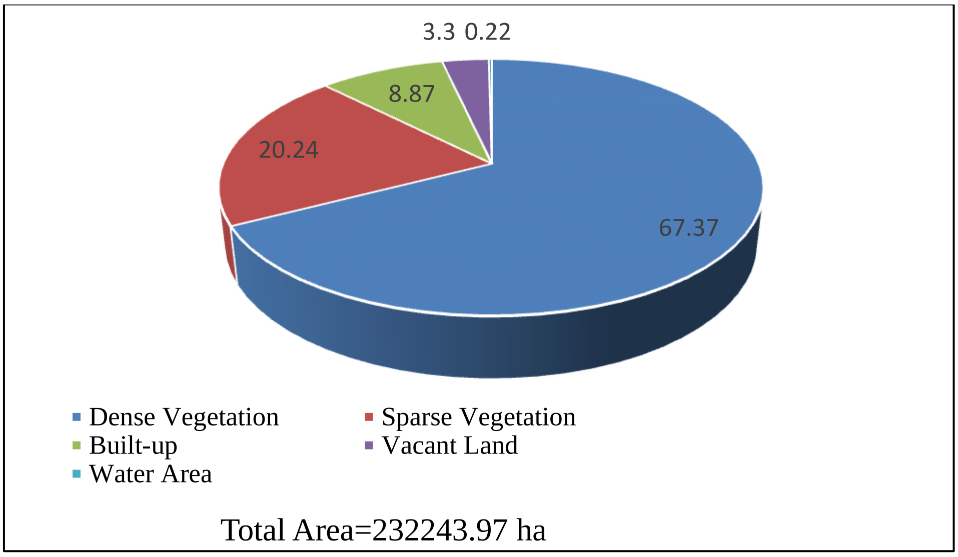
In 2018, the total area is 232243.97 (ha) of the study area. Dense vegetation and sparse vegetation land occupy 74147.41 ha and 70037.48 ha. The built-up land is 67469.78 ha and the total vacant land is 9849.24 ha. The water area is 10740.06 ha.

According to the Table 1, the dense vegetation areas are changed from 67.37% in 2000 to 31.93 % in 2018. The total dense vegetation areas are decreased to 35.44 % during 2000-2018. Therefore, the most changes area is the dense vegetation area that is converted to sparse vegetation, built-up land, vacant land and water area. Most of the sparse vegetation, built-up land, vacant land and water area increased during 2000-2018. The change from dense vegetation areas to other categories with the high rate was during 2000-2018 due to the increasing population and built-up land expansion occurring on the dense forest area. The sparse vegetation area increased from 20.24 % to 30.16 % during 2000-2018. Most of the dense vegetation is converted to built-up land (8.87% in 2000 to 29.05 % in 2018), Water area (0.22% in 2000 to 4.62 % in 2018) and vacant land (3.30 % in 2000 to 4.24 % respectively in 2018).

Table 1 LULC changes in Phyu Township (2000-2018)

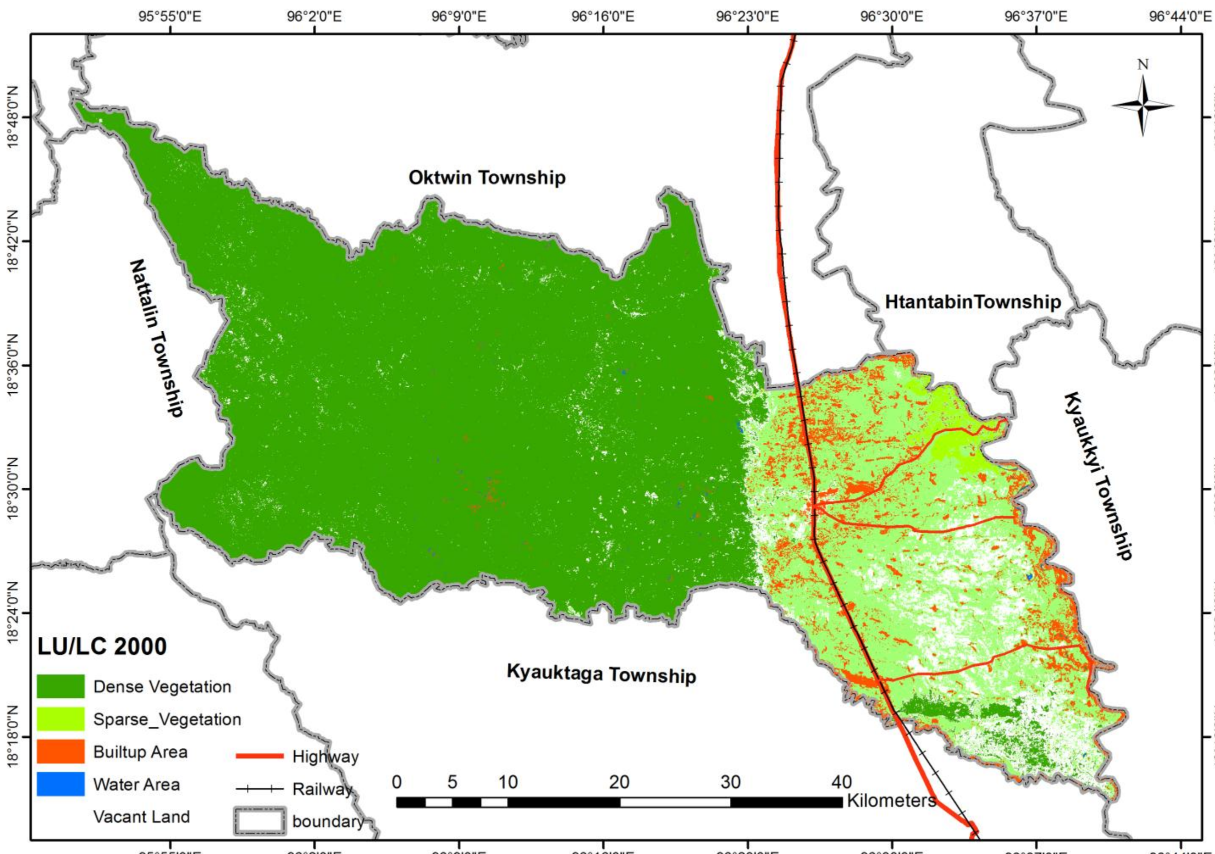
Sr.No	LU/LC Types	2000 (ha)	Percent	2018 (ha)	Percent
1	Water Area	506.5	0.22	10740.06	4.62
2	Dense Vegetation	156471.56	67.37	74147.41	31.93
3	Sparse Vegetation	47010.47	20.24	70037.48	30.16
4	Vacant Land	7658.08	3.3	9849.24	4.24
5	Built-up	20597.37	8.87	67469.78	29.05
	Total	**232243.97**	100	**232244**	100

Source: Landsat 7 and 8 (2000-2018)



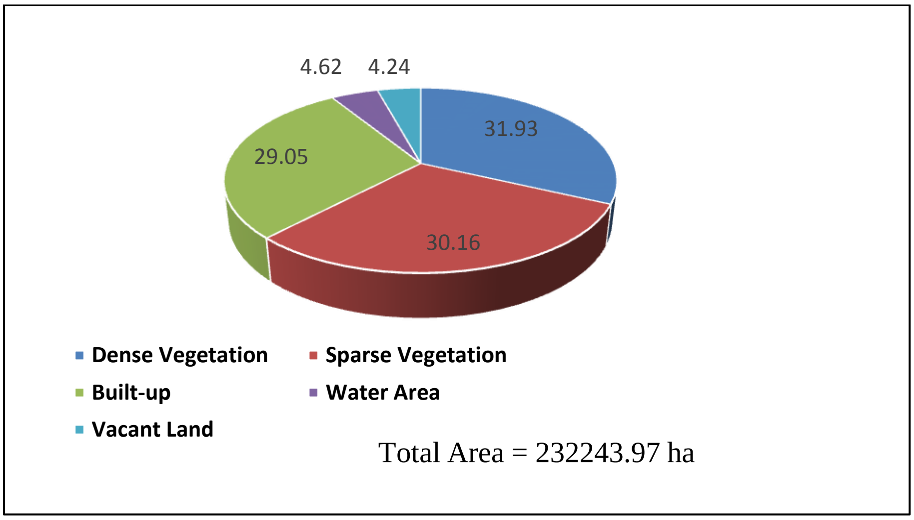
Source: Based on Table 1

Figure 3 Landuse/ Landcover Changes in Phyu Township (2000)



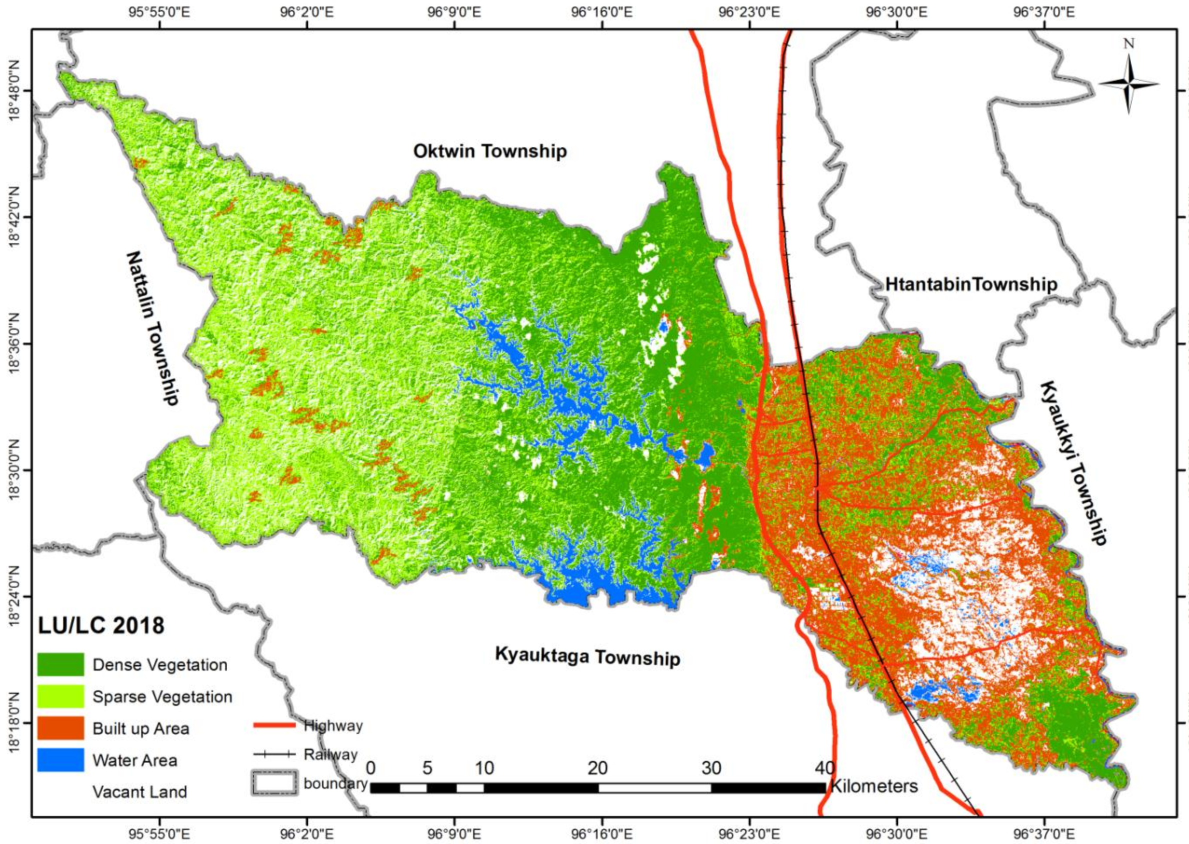
Source: Landsat 7

Figure 4 Landuse/ landcover map in Phyu Township (2000)



Source: Based on Table 1

Figure 5 Landuse/ landcover changes in Phyu Township (2018)



Source: Landsat 8

Figure 6 Landuse/ landcover changes in Phyu Township (2018)

Initially, accessibility was not conceived in space and concept. It was merely a two-component concept within the dimension (Hanson, 1959), defined as the interaction between transport and landuse. The accessibility and communication of the rural area play a vital role in the social and economic development of local people in Phyu Township. Before 2000, road transportation is mainly connected with town and villages in the central lowland of the study area. But the quality of the roads is poor condition. During 2005-2009, not only the construction of new Yangon-Mandalay Expressway (Yangon- Naypyidaw section) but also upgrading in the road conditions lead to the socio-economic development of the study area. Moreover, the road extended to the eastern part of the study area makes the development of some towns and villages. The Yangon- Mandalay Expressway (New Road) is connected to the Yangon–Mandalay Highway (Old Road) with two branches: Phyu-Banlaung road and Kanyutkwin- Meikthalin road within the study area. Only Phyu-Oakhpyat-Mone road is connected to Yangon-Mandalay highway (Old Road). Due to the good accessibility, becomes densely populated this area along the Yangon-Mandalay highway but Phyu-Okehpyat Road and area along the Sittaung River is still sparsely populated. After 2000, the commodity easily flows from Phyu to Yeni, Taungoo, Zeyarwady, Nyaungpinthar and Kanyutkwin Townships Due to the construction of New Yangon-Mandalay Expressway, the largest number of people shifted from Yangon-Mandalay highway to this new Expressway in 2010.

Figure (4) and (6) show the changes from dense vegetation areas to sparse vegetation and built-up area with the high rate of changes between the highway road and Expressway during

2000-2018. The significant conversion from dense vegetation to water area is found in the planned area of Phyu Dam which is an irrigation channel in Phyu Township Feb 17, 2013 (Htoo Aung/ The Myanmar Times). The Kun Chaung dam was constructed in 2013. Moreover, the Phyu Chaung Bridge and Kun Chaung Bridge link to other towns that support easy flow of commodity and people. The dense vegetation is mostly converted to built-up land (8.87% in 2000 to 29.05 % in 2018) a planned area that has been started Yangon-Mandalay Expressway since 2010. The towns along Yangon-Mandalay Railway Line and Highway road are also developed. The developments of transport facilities within Phyu Township during 2000-2018 are privately owned transport services which were improving year by year. Some farmers buy agricultural machine directly from Yangon. As the main economy of the rural area is mainly based on agriculture, the agricultural products of Phyu Township are carried to the other area through the roads and railway line. Therefore, better transportation is a basic necessity to carry farm implements and agricultural products. Many inter-village access roads have been constructed after 1988 and hence heightened the transportation and communication within the rural and urban areas of the township.

Conclusion

Phyu Township is located between Oktwin Township in the north and Kyauktaga Township in the south. Yangon-Mandalay old road and railway pass through alluvium plain. Yangon-Mandalay expressway has been used after 2000 year which passes through Phyu Township along foothill of Bago Yoma. The roads in the study area serve as the connection between Upper Myanmar and Lower Myanmar.

Landsat 7 ETM and Landsat 8 OLI satellite images of 2000 and 2018 were used for the GIS and RS image analysis. During 2000-2018, the majority of the changes occurred from dense vegetation to sparse vegetation, built-up land, vacant land and water area. The study reveals that the landuse and landcover pattern and its spatial distribution are the major rudiments for the foundation of a successful land-use strategy that is required for the appropriate development of any area. The DBI and DBSI were applied in mapping urban areas and bare land in the study area. The suggested DBI index can separate only general built-up areas; it cannot separate finer urban cover types such as commercial and residential areas in detail. In this paper, the indices have demonstrated a potential for using Landsat 8 images to delineate between built-up areas and vacant land within the study area. According to the 2000-2018 landuse/ landcover data, the development of the socio-economic condition in Phyu Township is mainly depended on the accessibility of this area.

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