ANALYSIS OF NATURAL ENVIRONMENTAL CHANGES USING REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM (GIS): CASE AREA OF MOEYUNGYI WETLAND WILDLIFE SANCTUARY AND ITS ENVIRONMENT, BAGO REGION IN MYANMAR

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Abstract

Moeyungyi Wetland Wildlife Sanctuary is located about 6 furlong away from the Yangon-Mandalay old high way, near Pyinpongyi village, Bago and Waw Township, Bago Region. Moeyungyi Wetland WS is a man-made wetland. It was constructed in 1904 and it provides water flow into Bago-Sittaung canal. Many years later, the reservoir changed naturally into wetland, notified as a wildlife Sanctuary in1988. The maps of the classification of the land use in wetland area are important for natural resource management. The changes of the land use in the natural wetland area have been tested by the accuracy of remote sensing and GIS techniques based on UTM map and Landsat TM satellite data (2006-2019). The maximum likelihood supervised classification technique was applied for land cover classification such as land areas including paddy field and swamp areas, water body area, natural vegetation area consist of shrubby grass. There are many environmental changes year by year. The main water body areas gradually declined during 2006-2015 but water body area sharply enlarged in 2019. Natural Vegetation gradually reduced and shrubby grass areas mainly in wetland decreased during 2006 and 2019 due to deforestation and land use changes which paddy field areas gradually increased duration of 18 years. Over all, not only the original wet land area, but also the whole surrounding area had been transformed into land area by 2019 image analysis. Therefore, the natural ecosystem of wetland can change in the future. If the ecosystem of wetland will be changed, the biodiversity of birds and other species will decrease because the ecosystem of wetland area is not suitable for their habitat.

Keyword: Natural Environmental Changes, Wetland

Introduction

Moeyungyi Wetland Wildlife Sanctuary is one of the 19 wetlands sites in Myanmar (2004, Ministry of Environment, Japan). They designated as a Wildlife Sanctuary with the objective of protecting the seasonal migratory birds and resident birds as well as for conserving the ecosystem of the wetland habitat. People have settled around the wetland as villages in many years ago. There are diverse terrestrial and aquatic animals, birds, insects and natural vegetation in and around the Moeyungyi Wetland Wildlife Sanctuary. The warm wetland habitat attracts various kinds of birds, including the migratory birds from the Arctic Region for wintering, which provides a good indicator of site significance. Moeyingyi Wetland Wildlife Sanctuary is under those flyways and it becomes a crucial sanctuary for both migratory and resident water birds.

Moeyungyi Wetland Wildlife Sanctuary comprises a floodplain and storage reservoir that is important for flood control. Originally, it was constructed in 1904 in the form of a rectangular man-made water storage reservoir by bonding, to provide water to the Bago-Sittaung canal (linking the Bago and Sittaung rivers) for transport of timber by boat. The site now functions as a source of fresh water for downstream areas where rice cultivation takes place. It floods in the

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wet season from May to October and from October to March it hosts over 20,000 migratory waterbirds. The local communities use the site for fishing, grazing, duck-rearing and some paddy-growing and there is a small tourist facility to accommodate birdwatchers. Moeyungyi Ramsar site No. is 1431 (Ministry Of Environment Japan, 2004).

Location and Size

The study area including Moeyungyi Wetland WS is located in the southern part of Bago Region, the western and southwestern parts belong to Bago Township and the southern and eastern parts located in Waw Township. It lies between north latitudes 17° 26' and 17° 40' and between east longitudes 96° 30' and 96° 44'. The northern boundary demarcates between the wetland and Daik-Oo Township. It lies immediately the east of Yangon-Mandalay Highway between mile-post 63 and 70. Although the wetland was 16.7 feet deep when the water level rises to the brim, it is 7 feet deep at the time of 2019, February. The frame or the width of the embankment is 8 feet. The wetland covers an area of 40 square miles or 256,000 acres see figure 1.

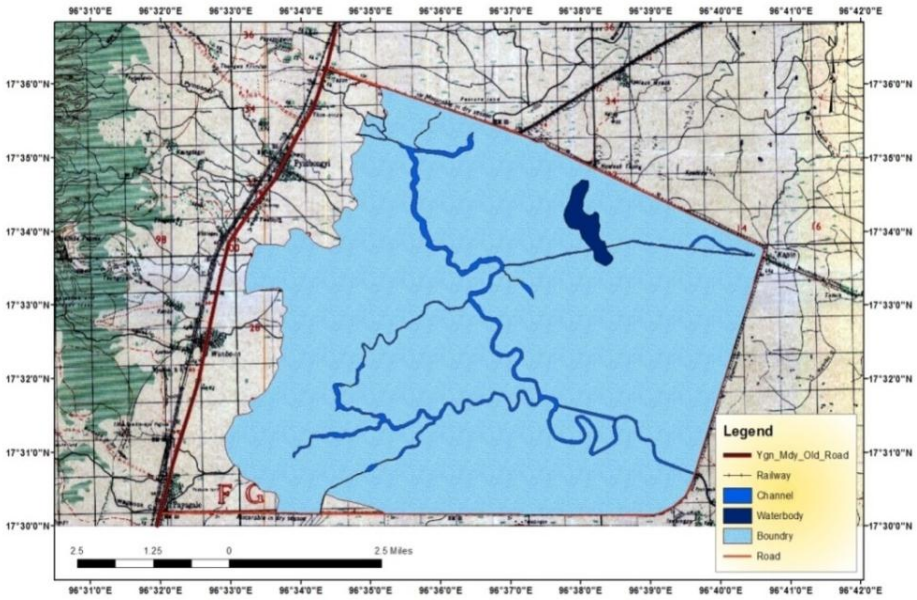


Figure 1 Location Map of Bago Region and Moeyungyi Wetland Wildlife Sanctuary

Aim and Objective

- To study and classify the natural environmental changes especially land use and land cover changes of Moeyungyi Wetland Wildlife Sanctuary and its environment by using remote sensing and GIS approach.
- To investigate and manage the land use planned for natural environment of the Natural Wildlife and its environment.

Material and Methods

Satellite Image Data

The four years of Landsat TM/ETM satellite images which were produced from U.S.Geological survey's (USGS) Earth Explorer website (www.usgs.glovis.gov) in Geo tiff file are collected. Four cloud-free Landsat ETM+ and TM data especially 2006, 2011, 2015 and 2019

are collected from USGS and the study area Moeyungyi Wetland Wildlife Sanctuary and its environment is retrieved to analyze land cover and land use changes. These satellite images consist of seven bands for landsat7 and eleven bands for landsat8. And then Universal Transverse Mercator map projection (UTM, Zone 47N) and WGS 84 datum are projected. The details of the collected Landsat satellite images are as shown in Table 1.

Table 1 Characteristics of the Lands at datasets used in the study

Acquisition Date	Sensor	Path/Row	Spatial Resolution of Reflective Bands	Number of Bands	Format
17 February 2006	Landsat 5 TM	132/48	30	7	Geo TIFF
15 February 2011	Landsat 5 TM	132/48	30	7	Geo TIFF
26 February 2015	Landsat 8 OLI	132/48	30	11	Geo TIFF
21 February 2019	Landsat 8 OLI	132/48	30	11	Geo TIFF

Methodology

The study area was studied based on satellite images during 2006 to 2019 by using remote sensing application of unsupervised classification. After that, the field survey was conducted around natural wetland area to confirm the land use and land cover, collected the field data such as the water depth in natural wetland and secondary data of migrated bird and environmental conservation condition. The prime step of this methodology was land use and land cover (LULC) characterization which was done using ENVI 5.1 and ArcGIS 10.1. Land cover maps are classified with five classes; land area including paddy field, water body area, swamp area, plant cultivation area and shrubby grass area by using supervised classification. The depth of wetland basin is measured based on two data sources, the first one is Google Earth Map 2015 and the another one is measured by using Global Positioning System (GPS) and depth sounder which is surveyed during 2019 February.

Previous Works

In 2001, a wetland survey was organized by Ministry of Environment (Japan) for studying the biodiversity and their wetland environments.

In 2012, Dr Win Swe studied geology and economic mineral of Myanmar. He also gathered and combined the valuable geological data of many geologists. And then he published as a journal of the Myanmar Geosciences Society.

In 2014, Biodiversity and Nature Conservation Association (BNCA) and Bago University carried out the biodiversity and socio-economic survey of Moeyungyi Wetland Wildlife Sanctuary.

Topographic Feature and Relief

Generally Moeyungyi Wetland Wildlife Sanctuary lies in a low, flat plain, being part of lower Sittaung valley. However, the land slopes slightly towards the west of study area to the foothill of the Bago Yoma. It is the southern continuation of Daik-U_Pyuntansar plain

characterized by deep water fields. The creeks which drain into the wetland are Sinsu-Phayarlay, U Kaung wathit, Wunbae wetland, Yetarshay and Pyinbongyi which take their sources over the mountain spurs of Bago Yoma See figures 2 and 3.

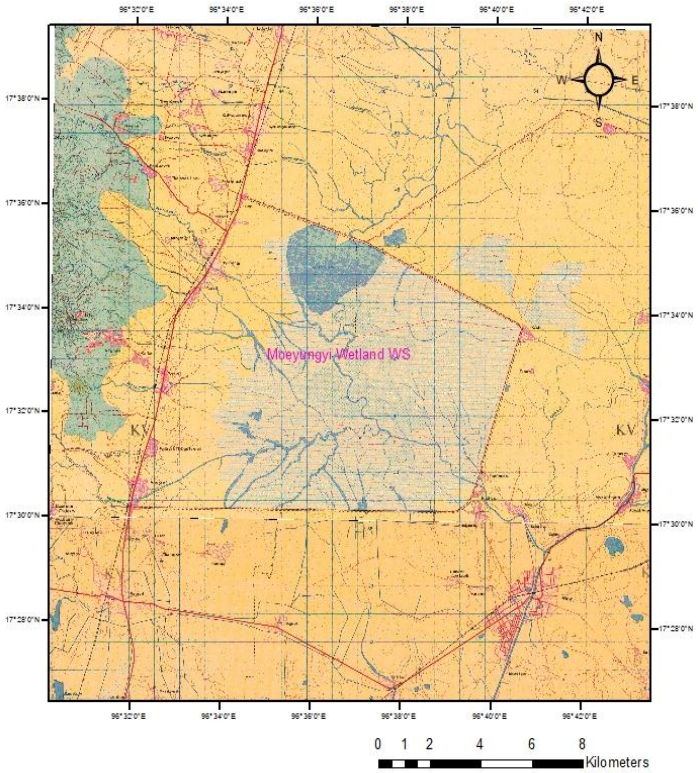


Figure 2 To pography a round Moeyungyi Wetland Wildlife Sanctuary

Climate

Moeyungyi Wetland Wildlife Sanctuary falls within the tropics and temperatures fairly high throughout the years with a mean annual temperature of 26.95°C. The mean monthly temperature is highest in April with 30.5°C and lowest in January with 23.72°C. The mean monthly maximum temperature is highest in April with 38°C and the mean monthly minimum temperature is lowest in August with 29.4°C. With an annual rainfall of 3543.05 mm, the study area experiences the Tropical Monsoon climate, characterized by alternate wet and dry season. Moeyungyi Wetland Wildlife Sanctuary serves as a significant link in flying network route of Asian Winter Migratory Birds during the period from December to February. When the water level of the wetland recedes in the dry season, the local inhabitants depend more on catching fish from the wetland.

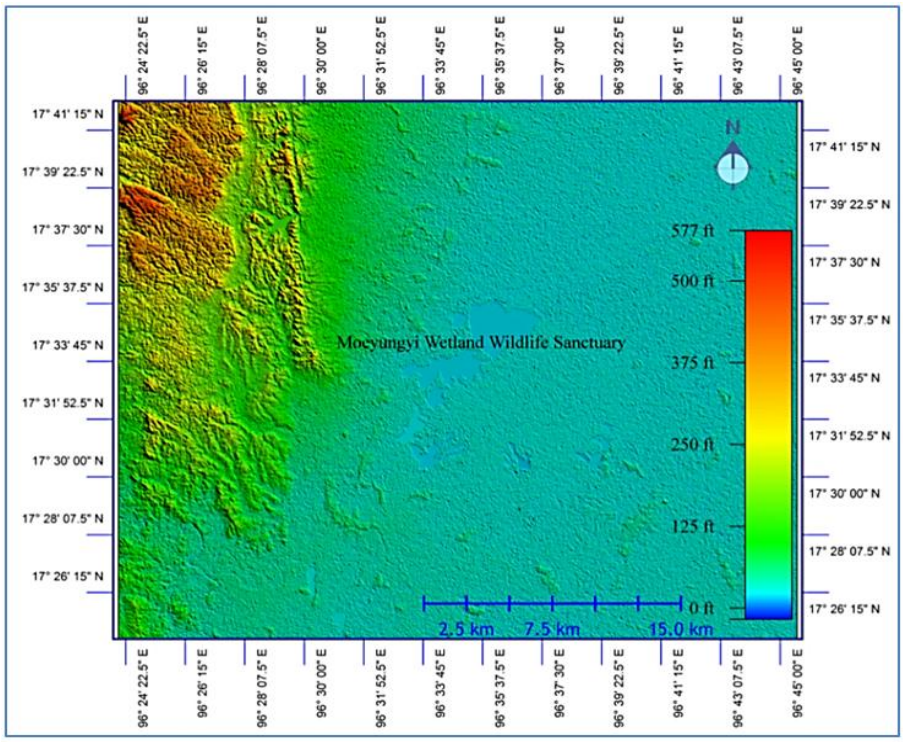


Figure 3 Differential Elevation Map of Moeyungyi Wetland Wildlife Sanctuary

Natural vegetation

The natural vegetation of the study area is more associated with the water body of the wetland, in addition to its low relief and periodical changing of monsoon climate. Therefore, in and near the wetland essentially includes hydrophytes of different species namely reeds, water-hyacinth, water-lily and raw grasses. A certain kind of grasses bear fruits richly in the winter and this is one of the reasons that the wetland can attract more birds in winter. The sacred lotus plants grow in thick groups. Reeds and other hydrophytes serve as favorable habitat for the reproduction processes of the aquatic animals. The natural vegetation of the wetland, to some extent, supports the livelihood of some local inhabitants.

Soils

The dominant soils are original that derived from alluvium and thus meadow grey soils and meadow alluvial soils cover the floor of wetland upon which a substantial amount of sediments is deposited by mountain torrents, causing serious silting. This leads to lowering the depth of the wetland, though it enriches the soil fertility.

General Geology

Bago (Pegu) Region occupies the southernmost on land segment of Central Myanmar Belt. It is bordered on the north by Magway and Mandalay Regions, on the east by Kayin and Mon States, on the south by Yangon and Ayeyarwady Regions, and on the west by Rakhine State. The geology of Bago Region is in fact interesting and is unique because the region embraces the southern segment of Western Ranges (WR), southern segment of Central Myanmar Belt (CMB) and a narrow western part of Eastern Highlands Province (EHP). Geological succession of Bago Region is composed of a mixture of some rock unit of the Western Ranges, the CMB and a few of the EHP. The study area, Moeyungyi Wetland Wildlife Sanctuary is composed mostly of flat alluvial plains.

Geospatial Analysis

In this research, the projected coordinate system is WGS_1984_UTM_Zone_47N. The satellite images were classified for natural environmental changes by using the geospatial analysis of RS and GIS. The land cover changes were studied between the years of 2006 and 2019 images see figures 4-7. The drainage basin of Moeyungyi Wetland Wildlife Sanctuary was analyzed based on differential elevation map. There are four sub-basins. The Moeyungyi Wetland Wildlife Sanctuary is situated at largest sub-basin (1). Most of the first order streams flow into the wetland and then it flows out to the Sittaung River see figure 8. The changes of basin elevation was classified by using the geospatial analysis of two data sources, the Google Earth Map 2015 and field data 2019 see figure 9 and 10. In 2019, the depth of wetland basin is shallower than 2015 because the land use and land cover is more rapid changed during four years.

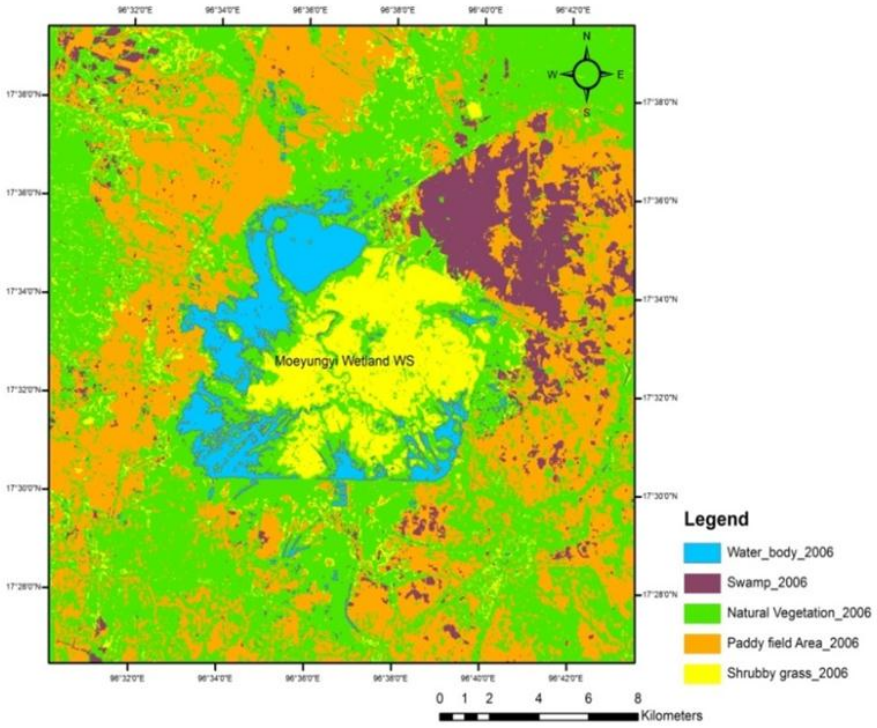


Figure 4 Land Use and Land Cover Classification Map of Moeyungyi Wetland Wildlife Sanctuary of Bago Region in Myanmar: Landsat TM Satellite Data 2006 (132_48N)

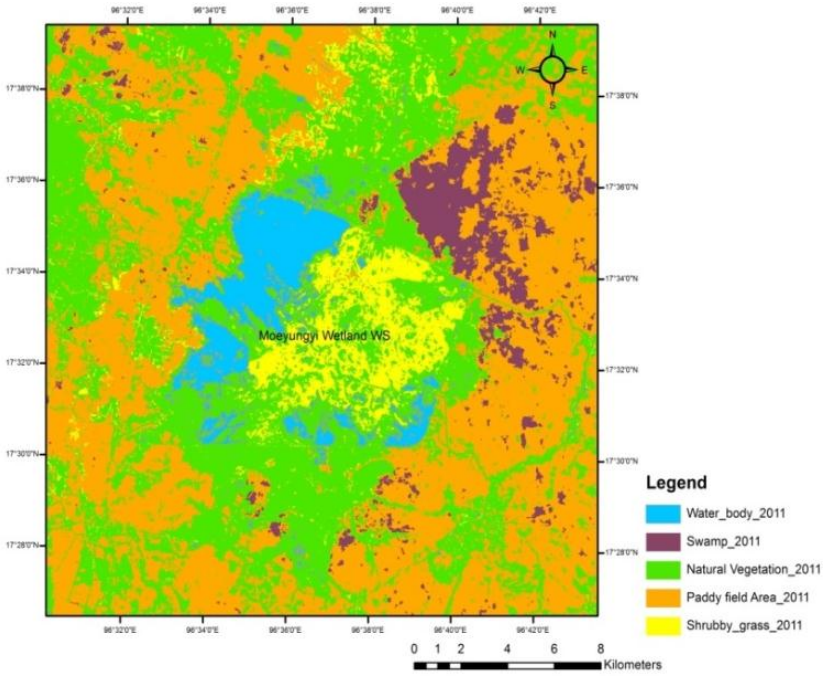


Figure 5 Land Use and Land Cover Classification Map of Moeyungyi Wetland Wildlife Sanctuary of Bago Region in Myanmar: Landsat TM Satellite Data 2011 (132_48N)

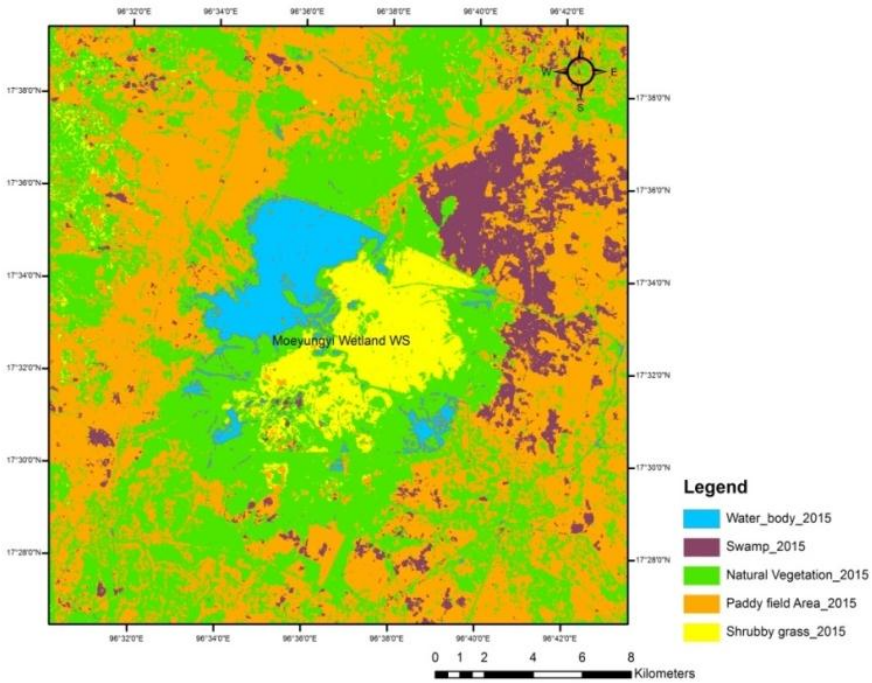


Figure 6 Land Use and Land Cover Classification Map of Moeyungyi Wetland Wildlife Sanctuary of Bago Region in Myanmar: Landsat TM Satellite Data 2015 (132_48N)

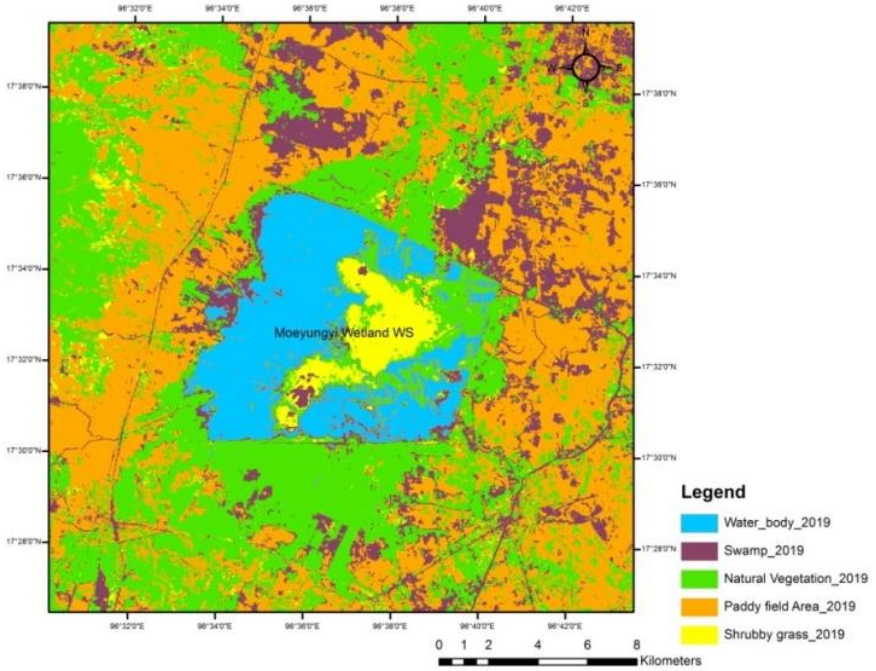


Figure 7 Land Use and Land Cover Classification Map of Moeyungyi Wetland Wildlife Sanctuary of Bago Region in Myanmar: Landsat TM Satellite Data 2019 (132_48N)

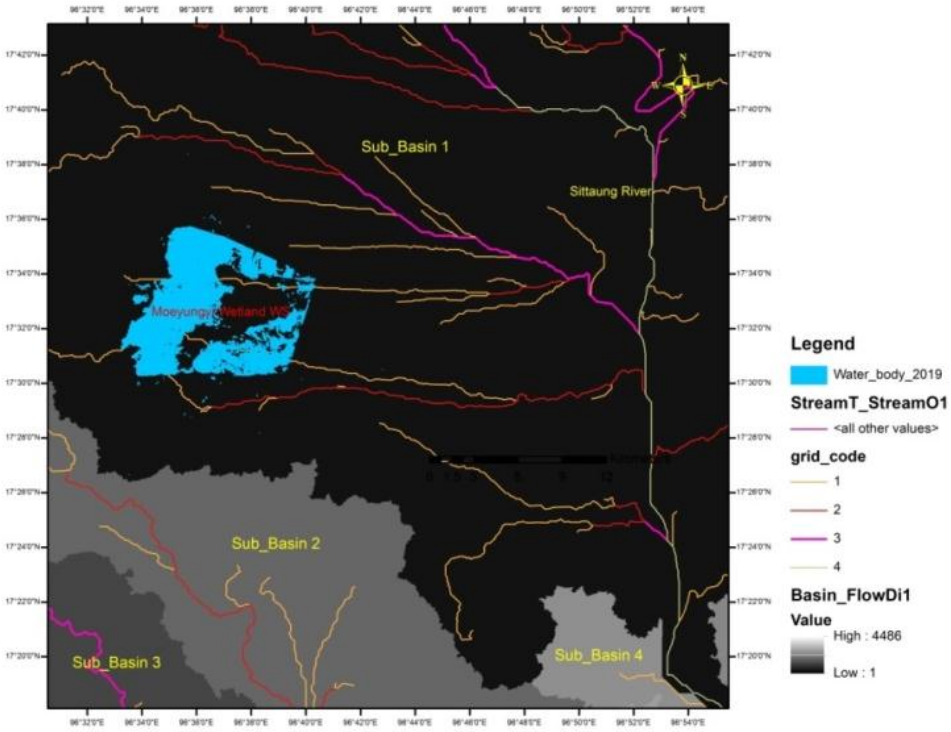


Figure 8 Drainage Basin Analysis Map of Moeyungyi Wetland Wildlife Sanctuary: Data Source from Differential Elevation Model

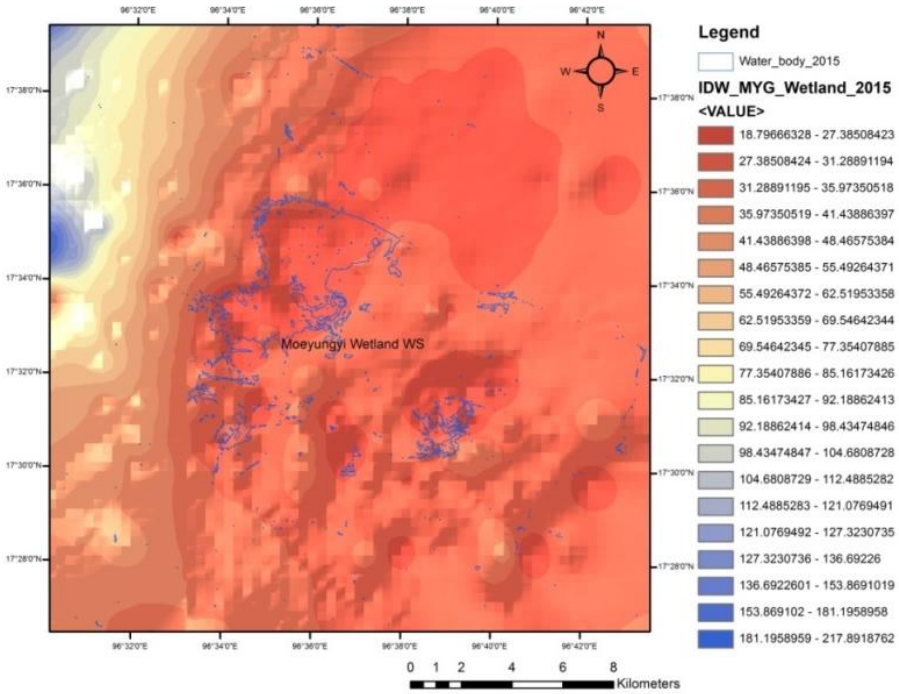


Figure 9 Drainage Basin Analysis Maps of Moeyungyi Wetland Wildlife Sanctuary: Data Source from Google Earth Map 2015

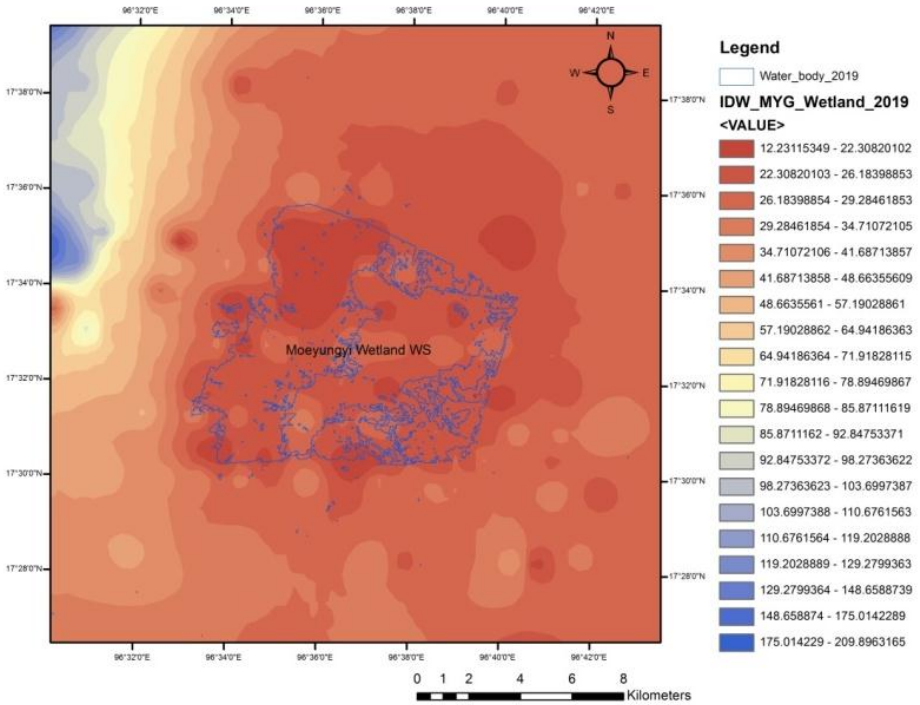


Figure 10 Drainage Basin Analysis Maps of Moeyungyi Wetland Wildlife Sanctuary: Data Source from field data 2019

Results and Discussion

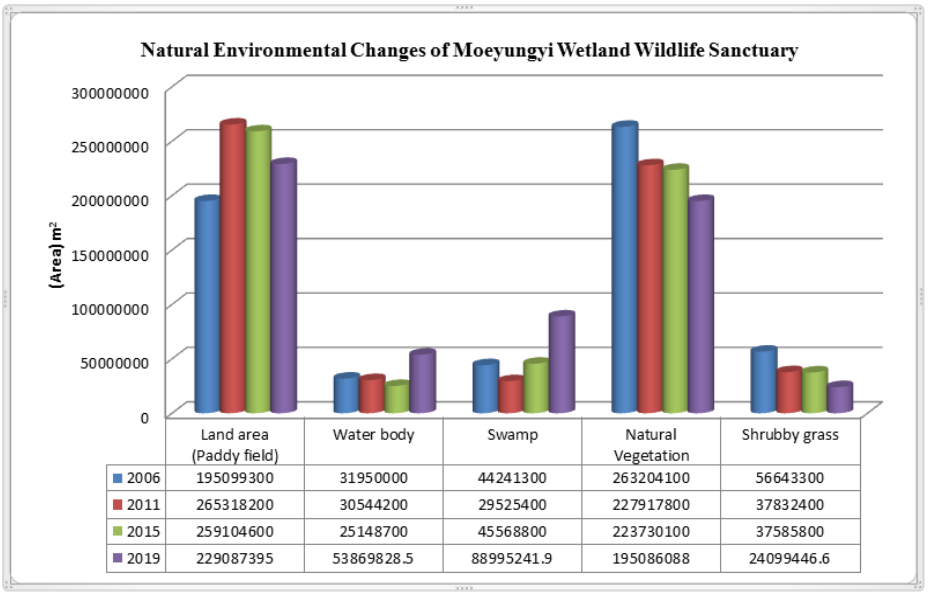
The maps of the classification of the land use in wetland area are important for natural resource management. The changes of the land use in the natural wetland area have been tested by the accuracy of remote sensing and GIS techniques based on UTM map and Landsat TM satellite data (2006-2019). The maximum likelihood supervised classification technique was applied for land cover classification such as land areas including paddy field and swamp areas, water body area, natural vegetation area and shrubby grass.

There are many environmental changes year by year. The main water body areas gradually declined from 31950000m^2 to 25148700 during 2006-2015 but water body area sharply enlarged to 53869828.5 m^2 in 2019. Natural cultivation areas gradually reduced from 263204100m^2 to 195086088 m^2 and shrubby grass areas mainly in wetland decreased 56643300 m^2 to 24099446.6m^2 during 2006 and 2019 due to deforestation and land use changes which paddy field areas gradually increased from 195099300 m^2 to 229087395 m^2 duration of 18 years see figure (11).

There are four sub-basins in study area. The Moeyungyi Wetland Wildlife Sanctuary is situated at largest sub-basin (1). Most of the first order streams flow into the wetland and then it flows out to the Sittaung River.

The drainage basin of Moeyungyi Wetland Wildlife Sanctuary is gradually shallower due to the siltation during four years from 2015 to 2019. When the unconsolidated soil from the over cultivated paddy field was much deposited in the wetland, the depth of wetland basin is much shallower. Consequently, the depth of wetland basin declines, the water level gradually rises and it over flows in the wetland area.

Over all, not only the original wet land area, but also the whole surrounding area had been gradually transformed from natural vegetation area to land area by 2019 image analysis. Therefore, the natural ecosystem of wetland can change in the future. If the ecosystem of wetland will be changed, the biodiversity of birds and other species will decrease because the ecosystem of wetland area is not suitable for their habitat.



	Land area (Paddy field)	Water body	Swamp	Natural Vegetation	Shrubby grass
2006	195099300	31950000	44241300	263204100	56643300
2011	265318200	30544200	29525400	227917800	37832400
2015	259104600	25148700	45568800	223730100	37585800
2019	229087395	53869828.5	88995241.9	195086088	24099446.6

Figure 11 Geospatial analysis of natural environmental changes around the Moeyungyi Wetland Wildlife Sanctuary based on satellite image 132_48N (2006_20111_ 2015_2019) :land area including paddy field, water body area, swamp area, plant cultivation area and shrubby grass area

Conclusion

This assignment identified that land area including paddy field, water body area, swamp area, natural vegetation area and shrubby grass area were changing year by year with the aid of geospatial analysis. The natural environmental changes maps of Moeyungyi Wetland Wildlife Sanctuary that show the changes of land area including paddy field, water body area, swamp area, natural vegetation area and shrubby grass area are important for the natural resource management. The Remote Sensing and Geographical Informational System technologies can contribute to the land use planning and administration or resources management.

Suggestion

The land use planning is an essential tool for pollution, prevention and controlling of the natural wetland. The changes of the land use refer to the different socioeconomic activities occurring in a particular area and the behavior of the natives has the effect on the environment. The Ministry of Agriculture, Livestock and Irrigation and Ministry of Natural Resources and Environmental Conservation should manage or control the sustainable development and the management of land use in a natural wetland area and protect the water channel to support the agriculture, fishery product, ground water, weather condition, biodiversity system and operational navigable channel of the surrounding regions effectively.

Acknowledgements

I am deeply grateful to Dr Kyi Kyi Maw, Head of Geology Department, Dagon University for permission to carry out the present research paper. I am special thankful to Dr Aye Aye Aung, Professor of Geology Department, Dagon University for her advice and comment on the study work. My special thanks go to Professor Dr Lai Lai Wai, English Department of Dagon University for reading the manuscript. Finally, I wish to thank the Department of Higher Education for financial support.

References

Win Swe, (2012), Outline Geology and Economic Mineral Occurrences of the Union of Myanmar: journal of Myanmar Geosciences Society, no.1, 97-101

Biodiversity and Nature Conservation Association (BNCA) and Bago University, (2014), Biodiversity and socio-economic survey of Moeyungyi wetland Wildlife Sanctuary.