

A Geographical Study on Land Cover Changes in Surrounding Area of Taungthaman Lake in Amarapura Township, Mandalay Region

Htay Htay Mon*, Aung Myint, Phyu Sin Ei***, Mar Mar Htwe******

Abstract

This paper focuses on the USGS images data analysis especially for the land cover changes during 1988 to 2021 period from the geographical point of view. Amarapura Township is located in Mandalay Region. Land cover changes in Surrounding Area of Taungthaman Lake in Amarapura Township were analyzed by using 1995 and 2021 Landsat 8 Images and Classification in Esri. In inquiring land cover conversion, it is found that the area converted from agricultural land to non-agricultural land was the largest during 35-year period from 1988 to 2021. However, the area converted from orchard land to water body area was the smallest during the 35-year period from 1988 to 2021. The main causes of changes were due to the natural and social factors. This affected on a variety of environmental, ecological, economical and social conditions and processes. Therefore, annual decreasing rate of orchard area in Amarapura Township should be controlled by the systematic ways.

Keywords: USGS, land cover, changes, Landsat 8, Esri

Introduction

Land cover change is defined as the loss of natural areas, particularly loss of forest to urban or exurban development, the loss of agricultural areas to urban or exurban development. Most Land cover changes are now derived from dwelling use and land use practices have major direct effects on environmental processes and systems. This research attempts to assess the land use and land cover conversion in Amarapura township by studying from the geographical point of view.

Aim and Objectives

The aim of this research is to study land cover changes in the surrounding area of Taungthaman Lake in Amarapura Township. This research has been carried out with the following objectives;

- To examine land cover in the study area.
- To evaluate the area converted from land cover to another type land cover.
- To analyse the factors responsible for this change.

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Data and Method

At first basic map of Amarapura Township is conducted by using MIMU and UTM maps. Data on areas of village tracts are collected from the Township General Administrative Office, village tract-wise population from the Township Immigration and Population Department, temperature and rainfall data from the Meteorology and Hydrology Department, Mandalay. Then on the Google Earth Engine, land use and land cover changes are examined. The collected data are processed and transformed into necessary and useful data by using GIS method and computer. Then by using the processed data, spatial distribution of settlements are analyzed by means of graphical methods, nearest neighbour analysis and field observation.

USGS, Earth Explorer Landsat 8 (path 133, row 045) was used in this study. The Landsat TM+ image (01 January 2001) and (6 February 2022) were downloaded from Google Earth Image. Image Classification was carried out of nine reflective bands of Landsat images. Remote sensing image processing was performed by using Arc GIS 10.4.1. Pixel dimensions of this Slope Map are in 30 x 30 m. The maps served as inputs to GIS.

Study Area

Taungtheman lake is situated in Amarapura Township, Mandalay Region in the Dry Zone of Central Myanmar. It is located between north latitudes 21° 52' 16" and 21° 54' 35" and between east longitudes 95° 03' 06" and 96° 04' 27".

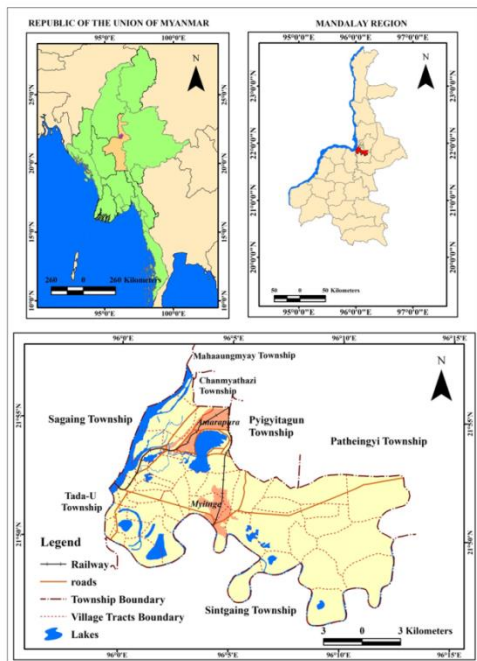


Figure (1) Location of Amarapura Township

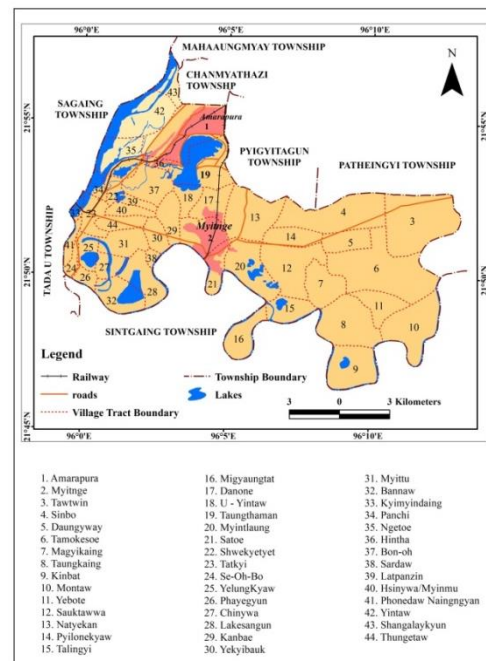


Figure (2) Distribution of Village Tracts in Amarapura Township

Source: UTM Maps No.2195-13, 2196-01, 2296 -04 Source : UTM Maps No.2195-13, 2196-01, 2296 -

Amarapura Township is about 15 miles long from east to west and about 5.71 miles wide from north to south. The township has an area of 80.15square miles (or) 207.59 sq-km (or) 51296 acres. Amarapura Town is composed of 8 wards. It is composed of Two Town Proper (Amarapura and Myitnge), 41 Village Tracts and 171 Villages. The pattern of land cover conversion in Amarapura Township is relatively complex, being derived from the spatial divergences in the physical-socio-economic variants. As Amarapura Township is located on the Mandalay-Kyaukse plain, it is mostly flat plains. The topographic feature of the Amarapura Township is a level plain which is situated at the junction of the Ayeyarwady River and the Myitnge River. It is a flat plain with a height that about 192 feet above sea level in the west and 250 feet above sea level in the east. The topographic surface is slightly higher in the eastern part and the land gradually slopes towards the Ayeyarwady River in the west. Taungthaman Inn (Lake) is the largest, about 1.1mile in width and 2.26 miles in length. This lake plays an important role in the socio-economic factors for local people.

During the period of 35 years from 1987 to 2020, the average maximum temperature of (92.4°F), average mean temperature of (82.19°F) and average minimum temperature of (71.89°F) are respectively. The range of temperature is 19°F. The total annual rainfall receives is 36.35". According to Koppen's Climatic Classification, Amarapura township has Tropical Savanna Type of Climate (Aw). During the 35 year period 1987-2021 the highest total rainfall is 61.9" (2016). Four main types of soil such as Meadow Alluvial Soil, Meadow Soil, Red Brown Savanna Soil, and Dark compact Savanna Soil are found. The natural vegetation is found in the Than-dahat Forest and Thorn Forest of Amarapura Township. (Figure-3)

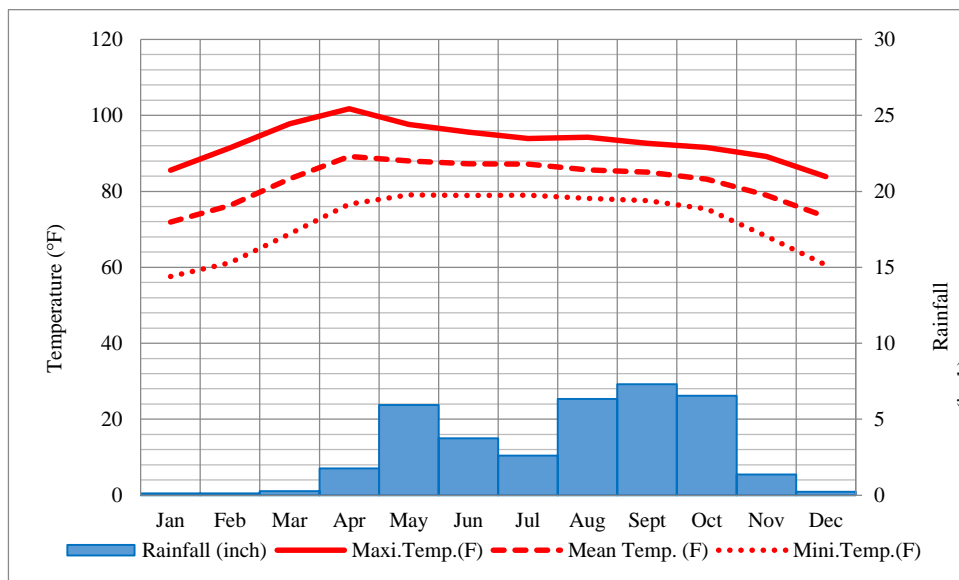


Figure (3) Temperature and Rainfall of Mandalay (for Amarapura) in 1987-2021

Source : Meteorology and Hydrology Department, Mandala

Accordingly to the increase of population in Mandalay City, the population of Amarapura which is the nearest township of Mandalay has also increased. The growth of the population in the study area depends on the natural increase and net migration. The population data of Amarapura

Township was 106,197 persons in 1973 and 125,830 persons in 1983. Thus during 10 years period from 1973 to 1983 population of the township had increased by 19,633 persons with an annual growth rate of 1.71 per cent. During the 10-year period of 1983 to 1993, the population has increased by 13,633 persons with the annual population growth of 1.03 per cent. In 2003, the total population of the study area had increased to 166,854 persons and thus during the 10-year period of 1993 to 2003 the population had increased by 27,391 persons with the growth rate of 1.81 per cent (Table 1). According to the 2014 census data, the population had increased to 194,394 persons.

According to the population data of Amarapura Township in 2016, the total population of the Amarapura Township had 191,181 persons. The decrease appears to be due to out-migrants where better incomes are obtained. This growth within these years appeared to be due to opening of Yadanabon University and settling of more people in the township. In 2018 the township's population had increased to 206,328 persons. In 2019 and 2020 year the total population has increased by 200,765 persons and 203,359 persons.

Table (1) Total Population and Growth Rate of Amarapura Township

No	Year	Total Population	Increased/ Decreased Population	Growth Rate
1	1973*	106,197	-	-
2	1983	125,830	19,633	1.71%
3	1993	139,463	13,633	1.03%
4	2003	166,854	27,391	1.81%
5	2014*	194,349	27,495	1.40%
7	2016	191,181	-3,168	1.01%
8	2018	206,328	151,47	3.94%
9	2019	200,765	-55,63	-.3.00%
10	2020	203,359	2594	1.00%

Source: Township Department of Immigration and Population, Amarapura

* Census Year

Result and Discussion

The study areas of land cover group within Amarapura Township are agricultural land, fallow land, non-agricultural land and Cultivated waste land. Land use and Land cover categories of Amarapura Township, in the year 2020 are shown in table 2.

Table 2 Land Use and Land Cover Categories In Amarapura Township (2020)

No	Type	Type	Area (Acre)	Percentage %
1	Agricultural Land Use	"Le" Land	16151	31.77
2		"Ya" Land	3667	7.21
3		"Kaing-Kyun" Land	6810	13.4
4		"Garden" Land	3163	6.22
5	Fallow Land	"Le" Land	1576	3.1
6		"Ya" Land	132	0.26
7		"Kaing-Kyun" Land	1148	25.96
8		"Garden" Land	41	0.08
9	Non-Agricultural Land Use	Industrial Land	416	0.82
10		Urban Land	1950	3.84
11		Rural Land	2292	4.51
12		Other Lands	286	0.56
Cultivated Waste Land			13198	25.96
Total			50830	100

Source: Department of Agricultural Land Management and Statistics, Amarapura

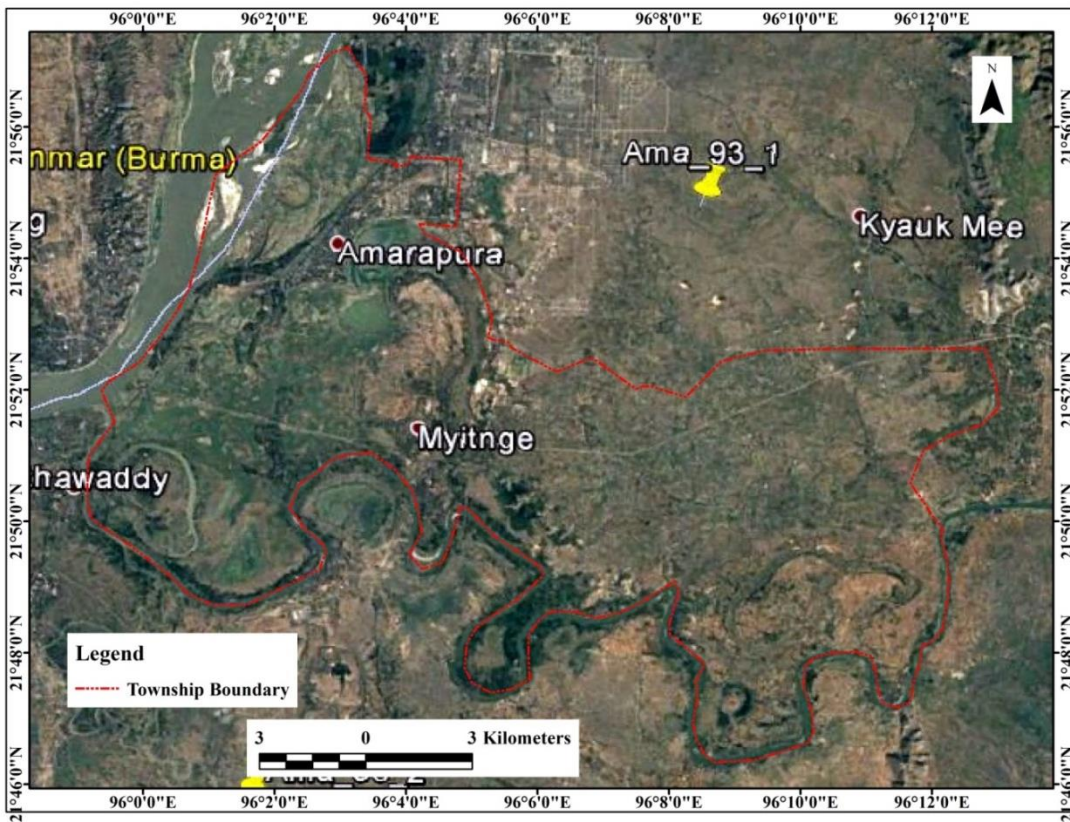


Figure (4) Distribution of Settlements in Amarapura Township (12, 1990)

Source : Google earth image

As agriculture is the main economic activity in Amarapura Township, the agricultural land is the dominant type of land use and land cover category in the study area. In 2020, the agricultural land and fallow land were 29,791 acres (58.08 percent) and 2897 acres 5.65 percent which of the total land area of Amarapura Township.

In Amarapura Township, agricultural land are 'Le'land (paddy land), 'Ya'land (dry farming land), 'Kaing-Kyun'land and 'Garden' land. 'Le'land occupied the largest acreage with 16,151 acres amounted to 54.21 percent of the total agricultural land. Average annual rainfall of Amarapura Township is low. Four main types of soil such as Meadow Alluvial Soil, Meadow Soil, Red Brown Savanna Soil and Dark Compact Savanna Soil are suitable for the cultivation of this area.

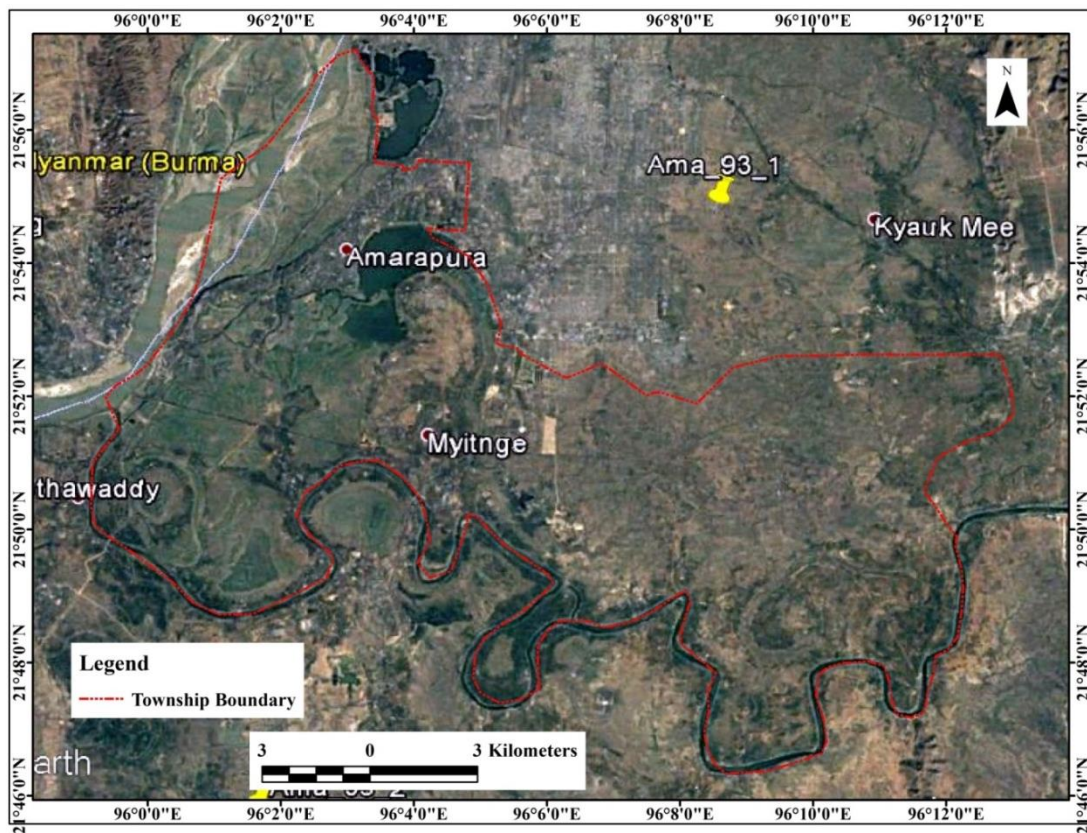


Figure (5) Distribution of Settlements in Amarapura Township (12, 2010)

Source: Google earth image

In 2020 *Kaing-kyun* land area of Amarapura Township was 6,810 acres which amounted to 13.40 percent of the total agricultural land. The third largest area of *Ya* agricultural land was 3,667 acres (7.21 percent) of the total agricultural land. In this year, Garden Land was 3,163 acres (6.22 percent) in Amarapura Township.

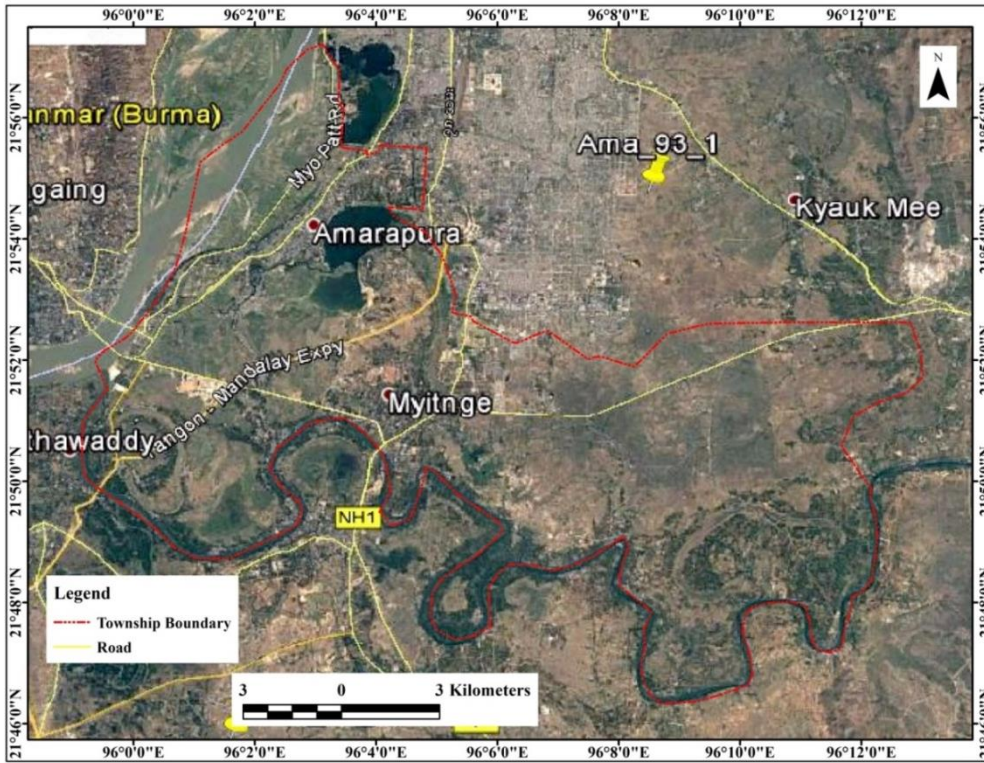


Figure (6) Distribution of Settlements in Amarapura Township (8, 2020)

Source: Google earth image

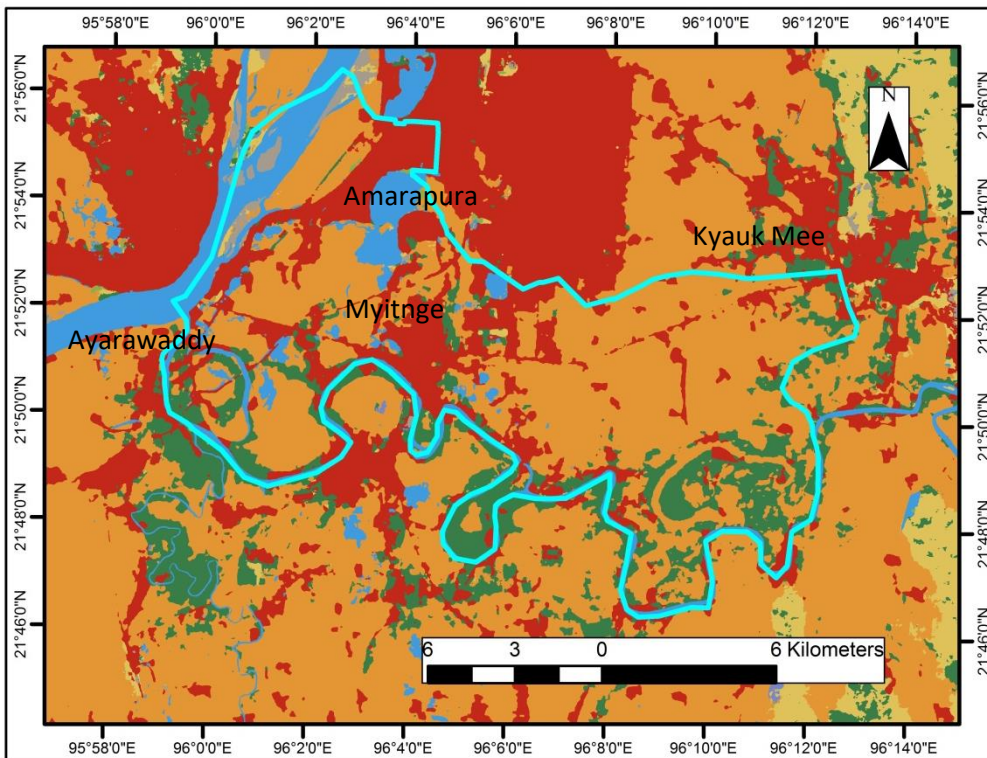


Figure (7) Changes of Land Use/ Land Cover of Amarapura Township (2022)

Source: Digital Elevation Model (DEM), Landset-8

Table 3 Changes of Land Use/ Land Cover of Amarapura Township

No	Type of Land	1989-1990		1999-2000		2009-2010		2019-2020		Change	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
1	Net Sown Acres	40203	78.42	40414	78.83	34970	68.21	29791	58.61	-10623	-20.22
2	Fallow Land	954	1.86	590	1.15	219	0.43	2897	5.69	-2678	-5.26
3	Non Agricultural Land	9653	18.82	9864	29.24	15785	30.79	2944	9.73	-10841	-21.06
4	Cultivated waste Land	458	0.89	400	0.78	294	0.58	13198	25.96	-12904	-25.38
	Total	51268		51268		51268		50830			

Source: Land Records Department, Amarapura Township

The Land use and Land cover of the Amarapura Township were analyzed under types of categories.

In 1989-1990, the total area of agricultural land of human activities in Amarapura township is 40,203 Acres, which accounts for about 78.42 percent of the total area of Amarapura township. There are 954 acres 1.86 percent of fallow land, 9,653 acres (18.82 percent) of Non-agricultural land and 458 acres (0.89 percent) cultivated waste land, respectively. (Table 3)

In 1999-2020, Land use/ land cover condition is changed agricultural land and Non-Agricultural land are slightly increased them 1989-1990 fallow land and cultivated waste Land are decreased 590 acres (1.15 percent) and 400 acres (0.78 percent).

In 2009-2010, Although non-agricultural land is increased net sown acres 34970 acres (68.21 percent), fallow land 219 acres (0.43 percent) and cultivated waste land are declined.

In 2019-2020, net sown Acre 29,791 acres (58.61 percent) and non-agricultural land 4,944 acres (9.73 percent) are decreased fallow land 2,897 acres (5.69 percent) and cultivated waste land 13,198 acres 25.96 percent are increased.

Conclusion

Climate and Economic conditions cause land cover changes. Most of land cover changes effects on environmental processes and system. Therefore, it is found that the more the land use, the less the land cover.

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