Spatio- Temporal Change Analysis of Agricultural Land, Water Bodies and Bare Land at Bogura, Bangladesh Using Landsat Images

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Abstract

Bogura the gateway of North Bengal is situated at 24º 32′to 25º 07′ north latitudes and 88º 58′ to 89º 45′ east longitudes. Bogura is bound by Chalan beel on the south, Joypurhat and Gaibandha on the north, Jamuna river on the east, and Chalan beel and Natore district on the west. This research is investigated, the tendency of land cover changes in bogura by the geographic information system (GIS) and remote sensing (RS) within 1990 to 2020 into four different time intervals. Landsat images are used as spatiotemporal data and the study area shapefile are created by ArcGIS from GCS- WGS-1984 to WGS- 1984- UTM- Zone 46 N. Water index (NDWI), agricultural land use index (NDVI) are also studied whereas image layer staking, mosaicking, and radiometric correction are carried on using ERDAS. Agricultural land, water bodies, and bare land are studied within 10 years intervals. From 1990 to 2000 the agricultural land in this area increases 20.4% whereas at next period it turns into the previous area which is to regain in 2020 as 234817 hectares. Although the area of water bodies remains constant from 2000 to 2010 which is decreases from 113780 hectares to 48817.1 hectares during the last 30 years which trend is similar in the case of bare land. A remarkable change occurred from 2010 to 2020 and 65.07 % of bare land decreases due to the bloom of agricultural technology. The possessions, cultivation of bare land are turned into vegetation which is shown in Landsat- 08 images.

Keywords: *NDWI; NDVI; agricultural land; water bodies; Landsat- 08 images.*

1. Introduction

Degrade of biodiversity and change of land pattern can be observed by land cover changes. Soil, water, and air are the main component of the environment and the change of water bodies and soil are related to each other. Today which is a water body turns into bare land tomorrow and this is a continuous process over time. Land pattern is changing due to natural and anthropogenic activities (Meyer et al., 1994) such as: over vegetation and cultivation into grasslands (Conant et al., 2001), cut of trees for pasture (Lepers et al., 2005; Neil and Davidson, 2000), cultivation (Davidson and Ackerman, 1993), Deforestation and tropical forest clearing (Allen, 1985; Detwiler, 1986), and the recovery and disturbance of land use (Schlesinger 1986). Land modification is known as land cover change which responsible for some changes related to management and intensity (Verburg et al., 2000). Bogura is one of the economically important districts and it plays an important role in the supply of agro products all over Bangladesh. GIS and RS are widely used to identify land cover changes for any specific region (Petit et al., 2001, Hathout, 2002, Pereira et al., 2002, Wu et al., 2006, Porter-Bolland et al., 2007; Bin et al., 2007). Remote sensed (RS) image shows the geospatial images of land pattern changes by different color bands and by using RS, and images are collected concerning time. Modis images are used for the analysis of land cover changes of haor areas of Bangladesh (Salauddin and Saiful, 2011)
Therefore Bogura is important its agricultural activities, the myriad number of youth are engaged themselves in modern farming, and because of modern technology, the harvest increases in a binary fusion way. Geographically bare land and water bodies are changed continuously by Jamuna river. Moreover, Bogura situated at the bank of Karatoya river thus results in fertile land which implies good vegetation conditions among Bogura. River erosion causes the formation of bare land and during the rainy season, it occurs frequently around the jamuna river and Karatoya river. As well as water body is another parameter that changed with time.
This study is conducted to observe the actual condition of land pattern changes: agricultural land, bare land, and water bodies for the period of the last 30 years. Total time is segmented as four different time intervals numbered 1990, 2000, 2010, and 2020 at the 10 years differences.

2. Materials and Method

2.1 Area of Interest

Figure 1 illustrates the area of interest for this study. Bogura is off of the northern district of Bangladesh and the area of this district is 2898.25 sq. km, situated between 24°32' and 25°07' north latitudes and 88°58' and 89°45' east longitudes. The geological location of Bogura is Joypurhat and Gaibandha on the north, Jamuna river on the east, and other sides are covered by Chalan Beel, Naigaon, and Natore district. Karatoya River passed over this district.

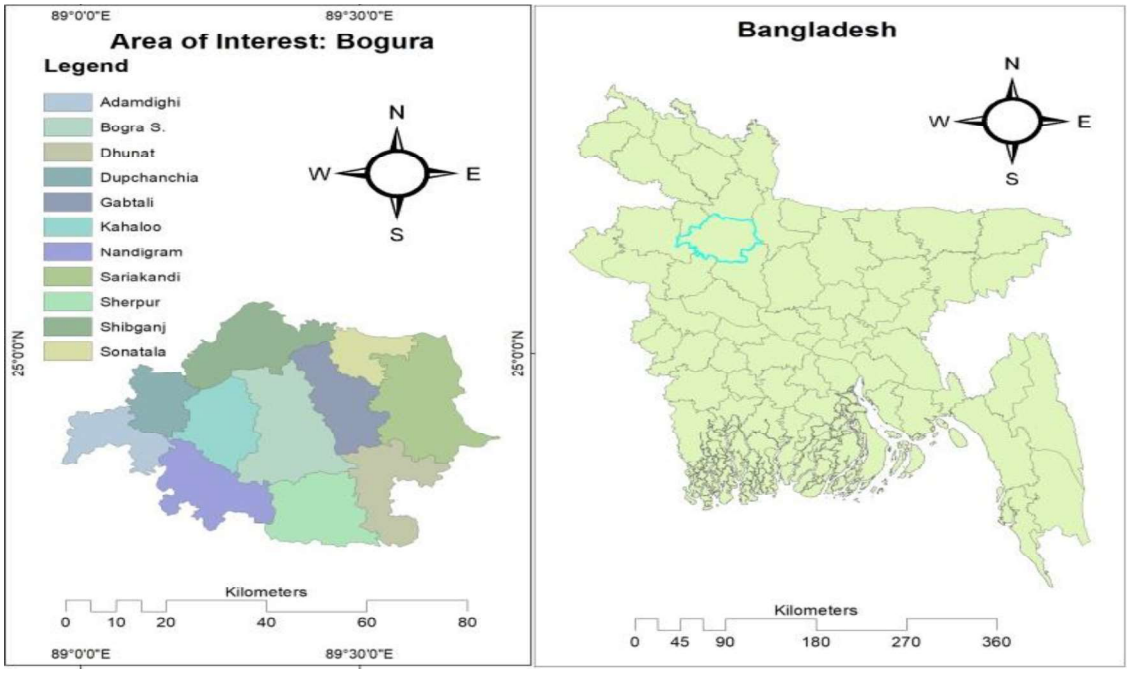

Figure 1. GIS-based graphical representation of Study area

2.2 Satellite Imagery

Remotely sensed images Landsat LT 04, 05, and Landsat LC 08 are taken as secondary data. These images are collected from United States Geological Survey (USGS) with the different aforementioned periods of 1990, 2000, 2010, and 2020 which is illustrated in table 1.

Table 1: specification of Landsat dataset

Satellite	Sensor	Path/Row	Resolution
Landsat 04- 05 Landsat 08	LT- TM LC	WRS 138/043	30 m

2.3 Image Processing

Took the image from Earth Explorer- United States Geological Survey (USGS) which are staking by ERDAS (Earth Resources Data Analysis System) IMAGING- 2014 software and haze, noise are removed as well as histogram equalization and radiometric correction is done after layer stacking of the images. Using ArcGIS Area of Interest are selected which are overlaid upon the preprocessed image. Finally, subset and supervised classification of the required images are operated for further investigation.

2.4 Identify Water Body, Bare Land, and Agricultural Land Change

Landsat image gives the total area of agricultural land, bare land, and water body of Bogura area during 1990, 2000, 2010, and 2020 time period. Using remote sensing we can calculate the total area of land use by agriculture, water body, and bare land.

2.5 Schematic Diagram of Methodology

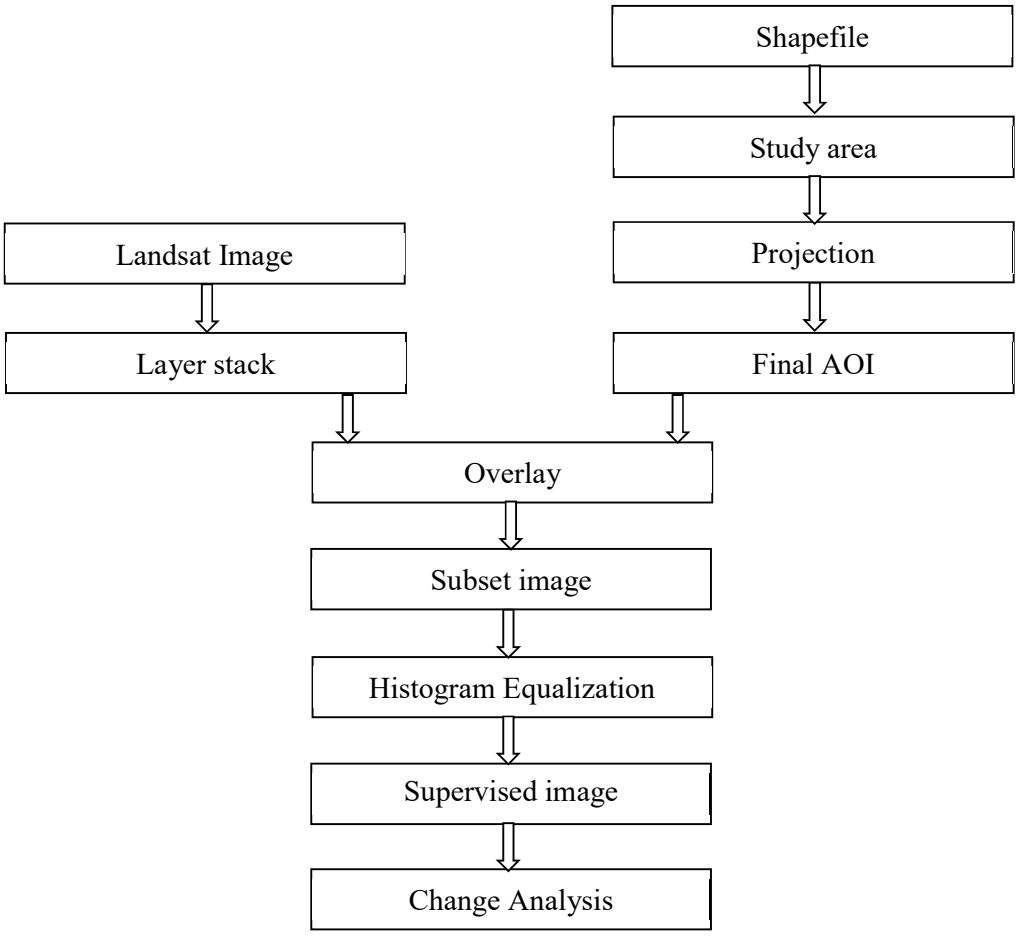

Figure 2. The schematic diagram for change analysis of agricultural land, bare land, and water body in Bogura

3. Results and Discussion

3.1 *Agricultural Land, Water Body, and Bare land Changes*

Figure 3 depicts the changes of land use patterns named water bodies, bare land, and agricultural land are displayed for the time period of 1990, 2000, 2010, and 2020. From 1990 to 2000 the agricultural increase remarkably numbered 183023 hectors which are decreased again and finally turned into 234817 hectors. On the contrary bare land, change myriad hectors from 62167.8 to 8074.62 whereas water body remains unchanged from 2000 to 2010 which is decreased in 2020.

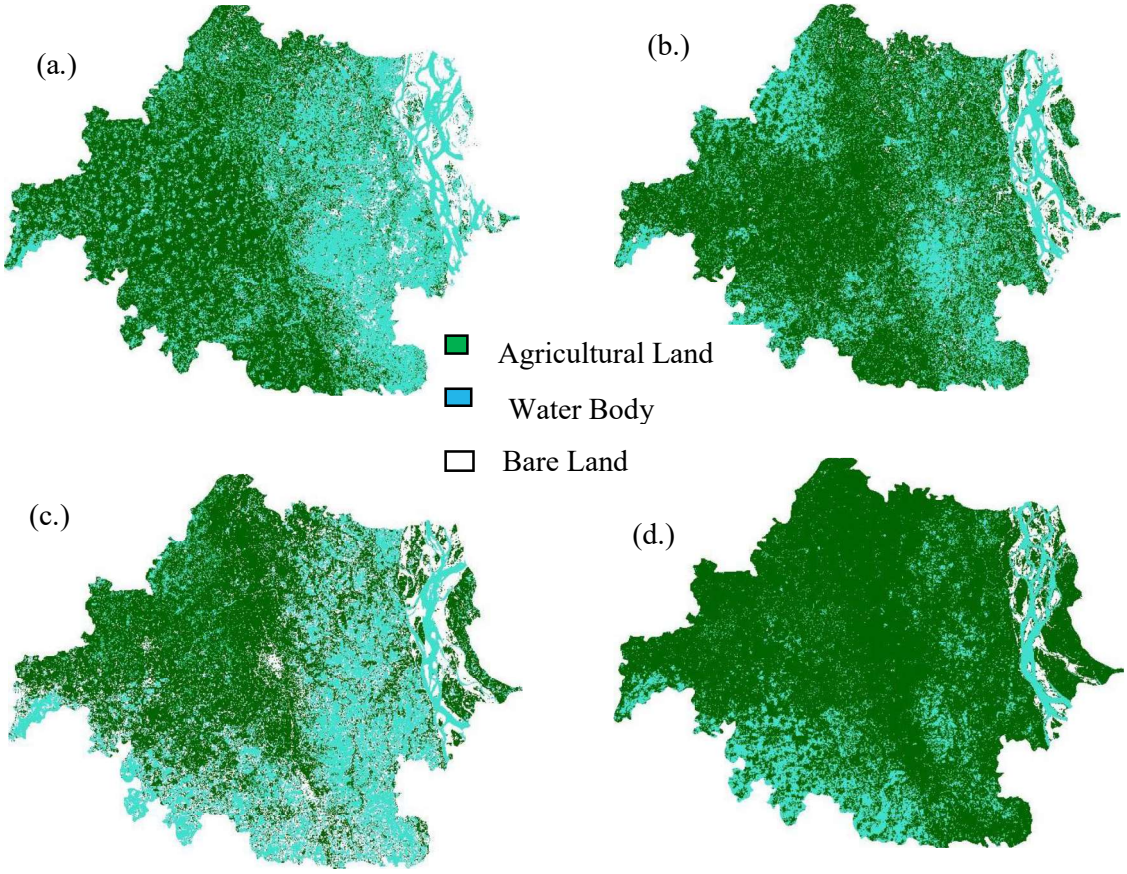

Figure 3. Change of land use categories water body and agricultural land during (a) 1990, (b) 2000, (c) 2010, and (d) 2020

3.2 *Comparison studies*

Agricultural land increases than other different two parameters in the modern era whereas bare land reached the lowest area in 2020. In the case of water bodies, it was similar before 2020 and presently decreases drastically.

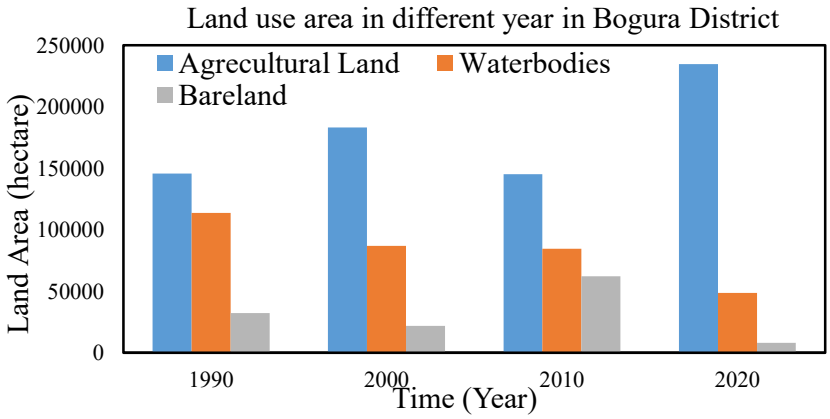

Figure 4. Relative changes of water bodies, bare land, and agricultural land in Bogura for the time of 1990, 2000, 2010 and 2020

4. Conclusion

A sharp trend is found in agricultural land use whereas water bodies decline relatively by the consecutive time. Though bare land forming is decreased day by day, it was alarming since 2010.

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