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Detection of Land Use Land Cover Changes Using Remote Sensing and GIS Techniques in a Secondary City in Bangladesh

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Abstract

This study aims at classifying land use land cover (LULC) patterns and detect changes in a 'secondary city' (Savar Upazila) in Bangladesh for 30 years i.e., from 1990 to 2020. Two distinct sets of Landsat satellite imagery, such as Landsat Thematic Mapper (TM) 1990 and Landsat 7 ETM+ 2020, were collected from the United States Geological Survey (USGS) website. Using ArcMap 10.3, the maximum likelihood algorithm was used to perform a supervised classification methodology. The error matrix and Kappa Kat were done to measure the mapping accuracy. Both images were classified into six separate classes: Cropland, Barren land, Built-up area, Vegetation, Waterbody, and Wetlands. From 1990 to 2020, Cropland, Barren land, Waterbody, and Wetlands have been decreased by 30.63%, 11.26%, 23.54%, and 21.89%, respectively. At the same time, the Built-up area and Vegetation have been increased by 161.16% and 5.77%, respectively. The research revealed that unplanned urbanization had been practiced in the secondary city indicated by the decreases in Cropland, Barren land, Wetland, and Waterbody, which also showed direct threats to food security and freshwater scarcity. An increase in Vegetation (mostly homestead vegetation) indicates some environment awareness programs that encourage people to maintain homestead and artificial gardens. The study argues for the sustainable planning of a secondary city for a developing country's future development.

Keywords

LULC; Savar City; Urbanization; Spatial changes; ArcGIS

Introduction

Land use land cover (LULC) is a distinct concept, but often, it is used interchangeably (Dimyati *et al.*, 1996; Fonji and Taff, 2014; Rawat and Kumar, 2015; Hu *et al.*, 2019; Spruce *et al.*, 2020). Land use is described what people do with the landscape environment for economic activities such as agriculture, commerce, settlement, and recreation; the land cover represents the physical landscapes of the ground surface, including crops, buildings, soil, water, grassland, and forest (Anderson *et al.*, 1976; Pilon, Howarth and Bullock., 1988; Rawat and Kumar, 2015; Rai *et al.*, 2017).

A secondary city in developing countries is an urban area where the population ranges from 100,000 to less than 750,000 (Davis, 1955; Rondinelli, 1983; Goodall, 1987; UN-HABITAT, 2008; World Bank, 2008). As reported by the World Bank, about 40% of the world's population resides in secondary cities. Secondary cities form a vital part of a growing global system that substantially impacts countries' economic development in the future (World Bank, 2009; Roberts and Hohmann, 2015). The secondary cities represent diverse population dynamics, infrastructure growth, and financial activities and struggle to manage urban development and environmental issues (Roberts and Hohmann, 2015; McEvoy *et al.*, 2014; Roberts, 2014; Marais, Nel and Donaldson, 2016). However, each county’s city system has taken a significant role in neighboring cities of a primary city or metropolitan area (World Bank, 2008).

The land use pattern represents the socio-economic condition of a country. Two factors directly or indirectly affect the land use land cover (LULC) change: anthropogenic and natural activities. The anthropogenic activities, such as population growth, urbanization, economic, technologies, culture, and religion (Lambin *et al.*, 2001; Coppin *et al.*, 2004; Wang, Wu and Yang, 2014; Yesmin *et al.*, 2014), are the factors that alter the land use land cover (LULC). The knowledge of land use land cover (LULC) change is a new concern for making the best selection, planning, restoration, and maintenance of natural resources (Homer *et al.*, 2007; Ahmed and Ahmed, 2012; Jensen, 2014). So, the land use/cover change assessment is essential for environmental management to understand the landscape dynamics over time better.

Satellite results are now suited and helpful for land use land cover (LULC) transition assessment studies. Integrating the two technologies, i.e., remote sensing and GIS, help understand the environmental process and analyze a considerable extent of spatial data (Milla, Lorenzo, and Brown, 2005). This data has an unprecedented advantage over the ground survey method of remote sensing due to its wide-area coverage and effectiveness in map isolated or data-poor areas (Baban, 1999). Remote Sensing (RS) and Geographical Information System (GIS) techniques are more effective than conventional approaches because they offer high resolution, informative, precise, and up-to-date information to investigate landform shift in less time at a reduced cost and with greater precision (Jensen, 1983; Kachhwala, 1985; Jenson and Cowen, 1999; Belal and Moghanm, 2011).

In the context of Bangladesh, a large body of literature is available on land use land cover (LULC) changes, using RS and GIS techniques at national, regional, and local levels (Dewan, Yamaguchi and Rahman, 2012; Al Mamun, 2013; Islam *et al.*, 2014; Haque and Basak, 2017; Parvin *et al.*, 2017; Rai *et al.*, 2017; Bhuiyan *et al.*, 2019; Xu *et al.*, 2020). Several studies are found on land use land cover (LULC) change by using satellite images on Savar Upazila in the local context. These studies included the impact of ribbon development on land use along the Dhaka-Aricha highway in the context of the dynamics of the land price, land use transformation, and assessment of land-use change (Chowdhaury, 1990; Rashid, 2003; Sharif and Esa, 2013; Hasan, Hossain and Ahmad, 2017; Rahman, Rashid and Iqbal, 2021). Savar was a river-bound rural area in 1951, but it transformed into a modern road networked city by 2001 and has been rapidly growing as a secondary city in Bangladesh since 1949 (Rashid, 2003). Savar Upazila is the neighboring city of the northwest of the capital Dhaka city at about 24 kilometers. Besides the tannery and readymade garment industries, the country's Export Processing Zone (EPZ) exists here. The transformation of Savar Upazila from rural to suburban and urban was also revealed by the study on land use change and land value in the Savar municipality (Chowdhaury, 1990; Masud, 2008; Amin, 2009). Savar municipality has significant changes in the settlements that affect rural-urban migration and land price value (Rashid, 2003; Sharif and Esa, 2013; Rahman, Rashid and Iqbal, 2021). One of the recent studies was conducted by using CORONA 1953, SRDI Map 1992, and Landsat 8-OLI 2016 images and categorized the pictures into four classes, such as agricultural lands, homestead vegetation, settlement, and water bodies, where the increase of territory and homestead vegetation, and reduction of farmlands and water bodies were observed (Rahman, Rashid and Iqbal, 2021).

This study is different from the previous research conducted in this area between 1953 and 2015, classifying images only into four environmental elements. There is no assessment of the conversion matrix. This study's main objective is to derive land use land cover (LULC) changes category wise and to detect the conversion matrix taking the place of a secondary city (Savar Upazila) by using remote sensing and GIS techniques (with data representing for 30 years period, i.e., 1990 to 2020).

The following critical questions regarding land use land cover (LULC) change in Savar Upazila were addressed: (1) what are the major categories and status of land use land cover (LULC); (2) what are the net gains and losses; (3) what are the primary land use land cover (LULC) conversions from 1990 to 2020? To address these questions, the primary land use/cover categories were classified, and land use land cover (LULC) was quantified at the local scale using analysis of 30 m resolution Landsat imageries representing 30 years interval (1990–2020). Post-Classification Comparison (PCC) method was used to detect the land use land cover (LULC) conversion matrix. The findings accruing from data analysis of land use land cover (LULC) changes in Savar Upazila, Dhaka, Bangladesh, were evaluated.

Study Area

The secondary city, Savar, is an Upazila of Dhaka district, Bangladesh, located at 23.8583° N latitude and 90.2667° E longitude (Figure 1). According to the Bangladesh census, it had a population of 1,387,426 (BBS, 2014) in 2011. The study area is 28,593 hectares (ha) or about 285 square kilometers. Savar Upazila consists of 12 unions and one municipality. The elevation of the land increases from the east to the west. Different rivers surround this area.

The Dhalashwari River has a significant influence on the study area for agriculture and other socio-economic activities. The region has a subtropical monsoon climate. The mean annual precipitation is high, about 2,882 mm, mainly from June to September (Choudhury, 1999). The physiographic units are the terraces in the east and flood plains in the west. So, the river deposits of the flood plain soil are common in this area.

Material and Methods

Data acquisition and land use land cover (LULC) classification

The 30 m resolution Thematic Mapper (TM) 1990 and Enhanced Thematic Mapper Plus (ETM+) 2020 Landsat images were used in the research. They were gathered from the USGS Earth Explorer website (www.earthexplorer.usgs.gov). The photos were taken in February since it used to be the dry season when the sky was clear, and the images are selected based on the absence of cloud cover. The temporal shifts in water bodies are minimal during this period. Multiple atmospheric and topographical conditions may create data variances when multi-date imagery from various sources is used (Mondal *et al*., 2015). As a result, radiometric adjustments were used in this work, besides an atmospheric correction. Ground control points were obtained to rectify the 2020 image during fieldwork conducted in February 2021. Ten ground control points, mostly major road junctions, were created using Google Earth images from 2021 to improve georeferenced accuracy. In ArcMap 10.3, the 1990 image was co-registered with the 2020 image. Both images were projected using a 30 m resolution with a UTM coordinate system (UTM-WGS 1984 Zone 46).

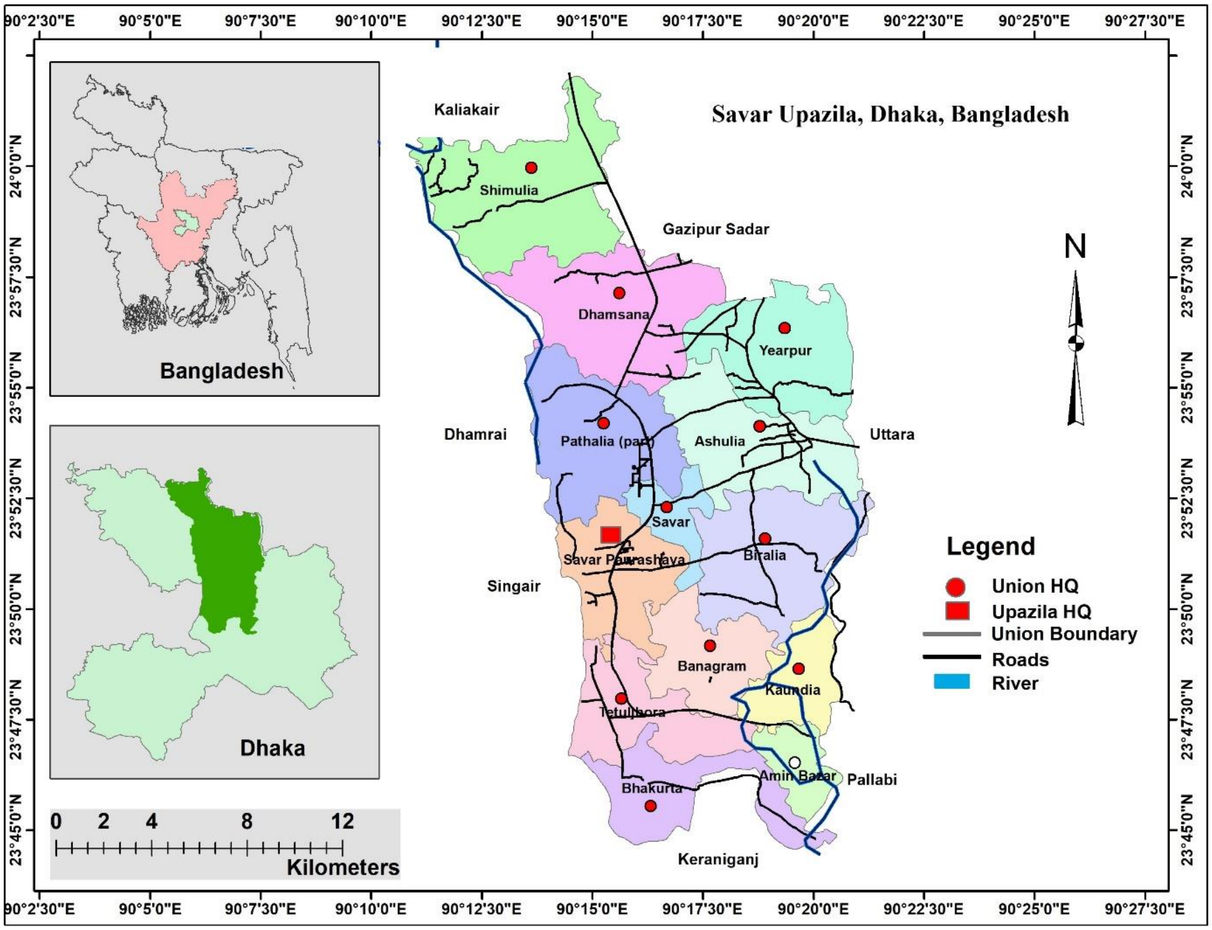

Figure 1: Location of the study area map of Savar Upazila, Dhaka, Bangladesh.

Table 1: Characteristics of Landsat satellite images data used for the study

Satellite name	*Sensor id*	*Row/ Path*	*Data acquisition date*	*Resolution*	*Source*
Landsat 5	TM	137, 44	24/02/1990	30 m	USGS
Landsat 7	ETM+	137, 44	28/02/2020	30 m	USGS

First and foremost, an appropriate categorization method for the study area is required to categorize satellite images. As a result, various types of LULC classes were identified using a modified classification method (FAO, 2011). The per-pixel supervised classifications were used, which categorize satellite imagery pixels with the same or comparable spectral reflectance characteristics. In the ArcMap version 10.3, the supervised classification method was used the maximum likelihood algorithm to determine the land use land cover (LULC) for the 1990 and 2020 Landsat imagery. The raster layer was added, then composited all bands and produced a False Color Composite (FCC). Some indices such as Normalized Difference Built-up Index (NDBI), Normalized Difference Vegetation Index (NDVI), and Normalized Difference Water Index (NDWI) have been created for better classification of the images. Based on field observations, Google Maps and the different combinations of band images help distinguish the other land use land cover (LULC) in the pictures. Fifty pixels were captured for each training site and produced a signature file for each land use land cover (LULC). Then the image classification was carried out by applying the maximum likelihood classifier tool for each satellite image. The following steps were included in the approach to create LULC maps from satellite images in this study: data acquisition, classification scheme, classification of the satellite image, classified image, final LULC maps and accuracy assessment (Figure 2). In the study area, the following six land use land cover (LULC) classifications were identified: Cropland, Barren land, Built-up area, Vegetation, Waterbody, and Wetlands (See Table 2).

Table 2: Specific definitions of land use land cover (LULC) categories (FAO, 2011)

Land use/cover categories	*Definitions*
Cropland	Crops, paddy fields, and other vegetables.
Barren land	Unused agricultural land, loose and shifting sand, bare soil, and agriculturally unsuitable areas.
Built-up area	It includes a commercial, residential area, transportation, industrial infrastructures, and brickfields.
Vegetation	Sparsely vegetated areas with (2-10) % canopy cover, rural homestead, and rural vegetation.
Waterbody	Rivers, ponds, lakes, reservoirs, and other areas with flowing water (water persistence of 12 months/year).
Wetlands	Swamps, permanent and seasonally inundated areas (Water persistence > 4 months), and riverine areas.

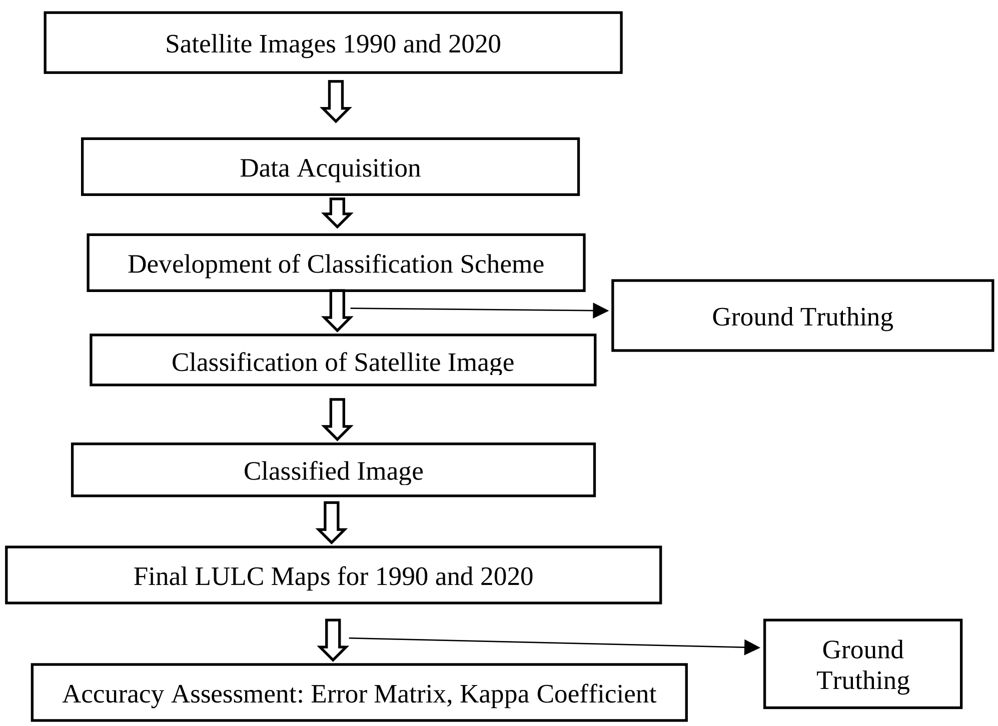

Figure 2: Flowchart of the land use land cover (LULC) mapping process.

Relative Changes of LULC (1990-2020)

The relative changes (LULC areas of 1990 — LULC areas of 2020) result from differing land use land cover (LULC) development patterns. Both periods had the same land use land cover categories.

Detection of the conversion matrix

The land use land cover (LULC) conversion matrix was obtained by the Post-Classification Comparison (PCC) change detection method (Pontius, Shusas and McEachern, 2004; Dewan and Yamaguchi, 2009; Mondal *et al*., 2015). It is the most prevalent technique used to correlate maps of different roots despite some limitations. The method provides comprehensive and complete "from-to" land use land cover (LULC) change information (Coppin *et al.*, 2004; Teferi *et al.*, 2013; Rawat and Kumar, 2015; Hassan *et al.*, 2016; Chowdhury, Hasan and Abdullah-Al-Mamun, 2020). Two classified Landsat satellite image maps from three different decade data matched using cross-tabulation matrix and overlay functions in ArcGIS to assess quantitative views of the changes from 1990 to 2020. Excel has been used in change matrix data analysis and calculating gross gains and losses for 1990-2020.

Accuracy assessment

For defining the confusion areas, ground verification was done. The accuracy assessment was driven by creating an error matrix and calculating overall accuracy, producer's accuracy, user's accuracy, and the Kappa statistic (Congalton, 1991). An overall accuracy of 83.3% for 1990 and 86.0% for 2020, on average around 85% (Table 3 & 4), were found. The Kappa Kat Co-efficient for 1990 and 2020 maps were 0.78 and 0.82, on average 0.8 (Table 3 & 4).

Table 3: Land use land cover (LULC) change map assessment accuracy in the year 1990.

Land cover categories	*Cropland*	*Barren land*	*Built-up area*	*Vegetation*	*Waterbody*	*Wetlands*	*Classification overall*	*User's accuracy*	*Overall accuracy*
Cropland	18	0	0	2	1	2	23	78.3%	83.2%
Barren land	1	18	2	0	0	1	22	81.8%	
Built-up area	2	5	85	2	3	4	101	84.2%	
Vegetation	1	0	1	22	2	2	28	78.6%	
Waterbody	1	1	0	2	39	2	45	86.7%	
Wetlands	2	0	2	2	3	26	31	83.9%	
Truth overall	25	24	90	30	48	37	250		
Producer's accuracy	72.0%	75.0%	94.4%	73.3%	81.3%	70.3%			

Table 4: Land use land cover (LULC) change map assessment accuracy in the year 2020.

Land cover categories	*Cropland*	*Barren land*	*Built-up area*	*Vegetation*	*Waterbody*	*Wetlands*	*Classification overall*	*User's accuracy*	*Overall accuracy*
Cropland	48	1	1	2	0	3	55	87.3%	86.0%
Barren land	1	26	2	0	0	1	31	83.9%	
Built-up area	0	3	70	0	0	2	75	93.3%	
Vegetation	1	0	0	19	0	0	20	95.0%	
Waterbody	2	1	0	0	17	4	24	70.8%	
Wetlands	5	1	2	0	2	35	45	77.8%	
Truth overall	57	32	75	21	19	45	250		
Producer's accuracy	84.2%	81.3%	93.3%	90.5%	89.5%	77.8%			

Results and Discussion

Three land-use maps of 1990 and 2020 were brought from analyzing the Landsat images (Figure 3). These maps displayed land use land cover (LULC) classes and the changing land use pattern during 1990 and 2020 over 30 years. They also helped visualize the land use land cover (LULC) change perfectly. Every map is classified into six classes (i.e., Cropland, Barren land, Built-up area, Vegetation, Waterbody, and Wetlands).

Land use land cover (LULC) condition

Figure 3(a) represents land use land cover (LULC) patterns of the Savar Upazila for the year 1990, while figure 3(b) represents for the year 2020. These data show that in 1990, about 35.5% (10,105.6 ha) area was under Cropland, 8.4% (2,403.4 ha) under Barren land, 11.7% (3,337.7 ha) as Built-up area, 10.1% (2,900.8 ha) under Vegetation, 5.2% (1,499.1 ha) under Waterbodies, and 29.2% (8346.2 ha) under Wetlands. Figure 3(b) in 2020, 24.5% (7,009.9 ha) area was under Cropland, 7.5% (2,132.8 ha) under Barren land, 30.5% (8,716.6 ha) Built-up area, 10.7% (3068.3 ha) under Vegetation, 4.0% (1146.3 ha) under Waterbody, and 22.8% (6519.5 ha) under Wetlands (Figure 4 and Table 5).

Relative Changes of LULC (1990-2020)

Table 5 and Figure 6 show that the land use land cover (LULC) trend in the Savar Upazila has changed positively and negatively. Cropland area has declined from 1990 to 2020, accounting for approximately 10.8% of the estimated study area. The extent of Barren land has reduced by 0.9 % from 1990 to 2020. The Built-up area has risen by about 18.8%. Vegetation has grown from 1990 to 2020 and growth accounts for 0.6 %. The research area's Waterbody has decreased from 1990 to 2020, accounting for 1.2 %. The Wetlands field has narrowed from 8346.2 ha in 1990 to 6519.5 ha in 2020, a 6.4 % reduction.

Land use land cover (LULC) change assessment

The vital drivers for the land use land cover (LULC) changes consist of rapid settlement, industrialization, population growth, rural-to-urban migration. Savar Upazila is a fast-developing secondary-level city since 1949 (Rashid, 2003). The population density of the Upazila is the highest amount of any other Upazila in Bangladesh, about 4,951 per km^2 (Rahman, Rashid and Iqbal, 2021).

The study has estimated a total of 28,593 hectares of LULC changes from 1990 to 2020. Table 5 concluded that the dominant class of LULC changes were Cropland, Wetlands, Built-up area, Vegetation, Barren land, and Waterbody. The Cropland used for crops, paddy fields, and other vegetables vastly decreased from 10,105.6 ha (1990) to 7,009.9 ha (2020). A large amount of Cropland converted into the Built-up area, Vegetation and other activities. The agricultural land was 12471.6 ha (1953), 19000 ha (1992), and 7233.4 ha (2015) (Rahman, Rashid and Iqbal, 2021). Wetlands were the second dominant class and it included swamps, permanent and seasonally inundated areas (Water persistence > 4 months), and riverine areas. This LULC class also converted into mostly Cropland and Built-up area, others Vegetation, and Barren land from 8,346.2 ha (1990) to 6,519.5 ha (2020). Another study revealed that wetlands were 8,072 ha (1992) and 7,023.72 ha (2015) (Rahman, Rashid and Iqbal, 2021). It indicates that Savar Upazila's water bodies are no longer connected, potentially causing severe waterlogging. Because wetlands are now unable to hold a large amount of rainwater, this wetland shift may result in urban flooding.

In this study, dramatic changes are found in the Built-up area. It has increased by 8,716.6 ha (2020) from 3,337.3 ha (1990), where it was 3,347.6 ha (1992) and 7,9340.5 ha (2015) (Rahman, Rashid and Iqbal, 2021). The built-up area has included a commercial, residential area, transportation, industrial infrastructures, and brickfields except for the rural area. Rural to urban migration, ribbon development along highways, and good transportation facilities have worked as influential factors to trigger changes

(Chowdhaury, 1990; Hasan, Hossain and Ahmad, 2017). It helps many people to come to this Upazila for job-seeking and other purposes. So, the land value in this Upazila has also increased faster (Sharif and Esa, 2013). The study reveals that the built-up area has grown over the reduction of Cropland, Waterbody, and Wetland areas, indicating direct threats to food security and freshwater scarcity. Moreover, urbanization is expanded dramatically in the rapid and unplanned way, and unsustainably. Among the six LULC categories, a little significant change has been noticed in the Waterbody, including rivers, ponds, lakes, reservoirs, and other areas with flowing water (water persistence of 12 months/year) decreasing from 1,499.1 ha (1990) and 1,146.3 ha (2020). Moreover, it has been reduced due to riverine areas filling up with sand, river embankment, developed settlement, and infrastructure. It was also found from the literature that waterbodies are decreasing from 1203.2 ha (1992) and 1123 ha (2015) (Rahman, Rashid and Iqbal, 2021).

Land use land cover (LULC) conversion of different categories such as (a) change in Cropland, (b) change in the Built-up area, (c) change in a Waterbody, and (d) change in Wetlands in Savar Upazila, Dhaka during the last three decades from 1990 to 2020 is shown in figure 5. The maps have revealed the LULC categories gain from others or converted into other types of LULC categories. Barren land and Vegetation have not changed significantly. One of them has decreased, and another has increased its area below 1% due to afforestation and rural homestead gardening.

Various land categories to discover land reform over the last three decades, a conversion matrix was developed, which shows that (Table 6):

i. About 27.78% area of Cropland converted into the Built-up area and 14.2% area under Vegetation, 1.96% area under Waterbody, and 7.06% area under Wetlands;
ii. Approximately 25.99% of the Barren land area transferred to Cropland, 25.55% to the Built-up area, 6.31% to Wetlands, and 1.22% to Vegetation;
iii. About 23.18% of Vegetation area converted into Cropland and 18% under the Built-up area, 9.29% into Barren land and the rest of them slightly under Waterbody and Wetlands;
iv. About 15.15% Waterbody converted into Cropland and 1.16% into the Barren land, 9.5% area into the Built-up area, 30.85% into Wetlands; and
v. About 25.98% of Wetlands converted into Cropland and 2.67% under Barren land, 18.25% into the Built-up area, 9.05% in Vegetation, 5.95% of the area under Waterbody.

Table 5: From 1990 to 2020, the area and amount of transition in various land use land cover (LULC) categories in the Savar Upazila.

Land use land cover (LULC) categories	*1990*		*2020*		*Comparative Change (1990-2020)*	
	hectare (ha)	*%*	*hectare (ha)*	*%*	*hectare (ha)*	*%*
Cropland	10105.6	35.3	7009.9	24.5	-3095.7	-10.8
Barren land	2403.4	8.4	2132.8	7.5	-270.6	-0.9
Built-up area	3337.7	11.7	8716.6	30.5	5378.9	18.8
Vegetation	2900.8	10.1	3068.3	10.7	167.5	0.6
Waterbody	1499.1	5.2	1146.3	4.0	-352.8	-1.2
Wetlands	8346.2	29.2	6519.5	22.8	-1827.3	-6.4
Total	28593.4	100.0	28593.4	100.0	0.0	

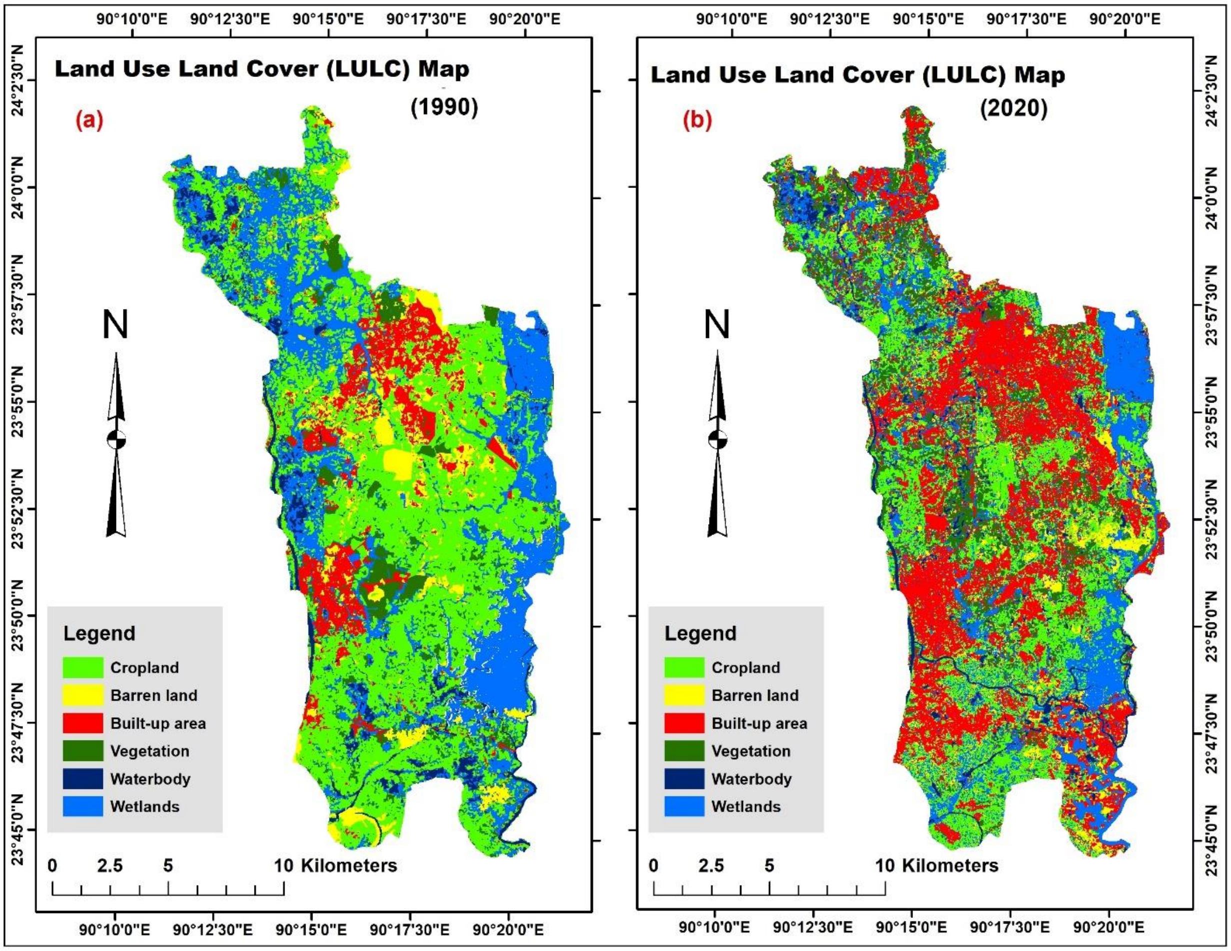

Figure 3: Land use land cover (LULC) classify maps of the Savar Upazila (a) in 1990 and b) in 2020 (Based on Landsat TM and ETM+ Satellite Imagery).

Table 6: Land use land cover (LULC) conversion matrix showing land enforcement (in %) of Savar Upazila.

Land use land cover (LULC) categories		*Year 1990*					
		Cropland	*Barren land*	*Built-up area*	*Vegetation*	*Waterbody*	*Wetlands*
Year 2020	Cropland	40.93	25.99	0	23.18	15.15	25.98
	Barren land	8.07	40.02	0	9.29	1.16	2.67
	Built-up area	27.78	25.55	100	18	9.5	18.25
	Vegetation	14.2	1.22	0	49.46	0	9.05
	Waterbody	1.96	0.91	0	0.06	43.34	5.95
	Wetlands	7.06	6.31	0	0.01	30.85	38.1
	Total	100	100	100	100	100	100

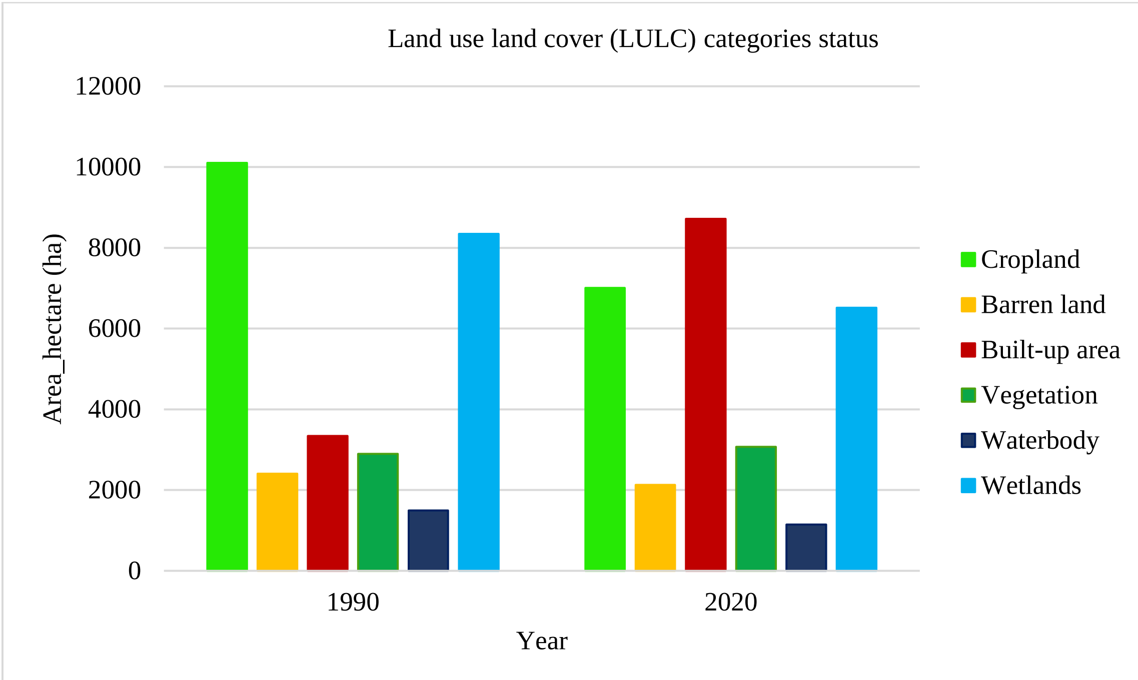

Figure 4: Land use land cover (LULC) categories status in the Savar Upazila from 1990 to 2020

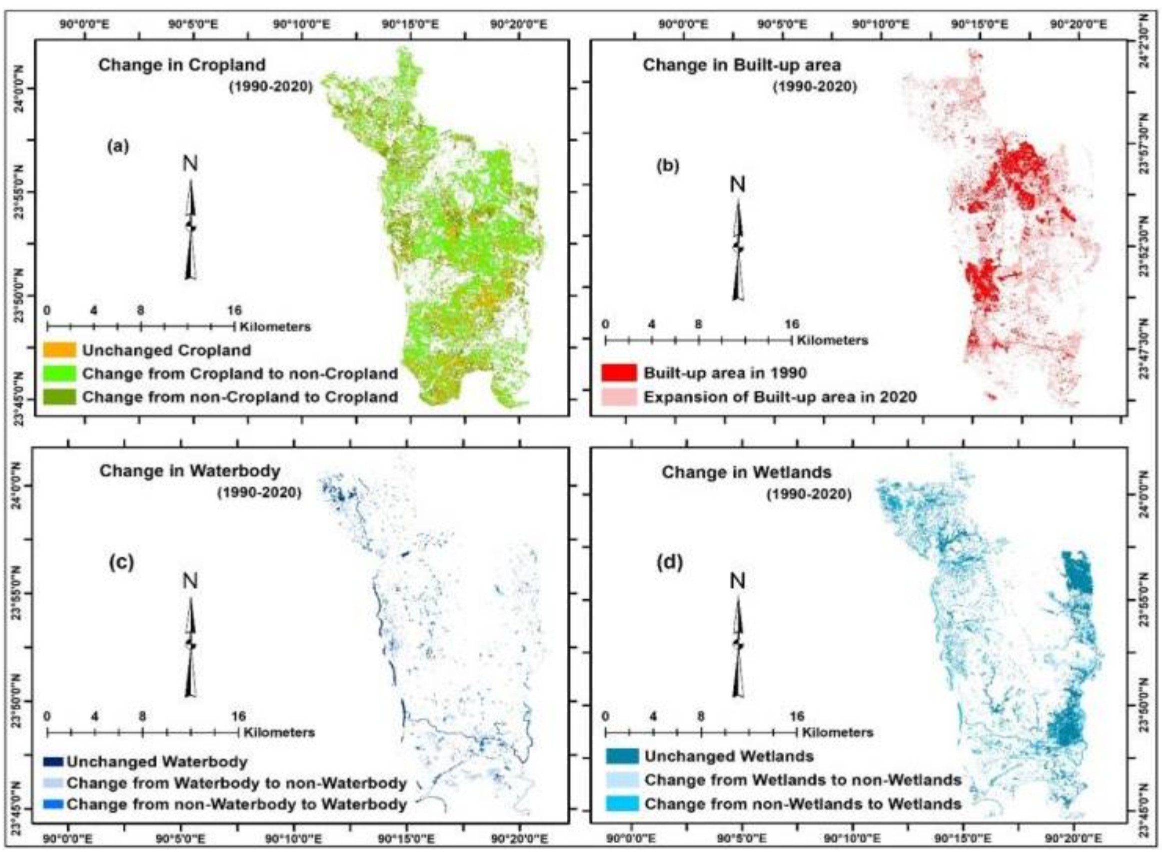

Figure 5: Land use land cover (LULC) conversion of different categories such as (a) change in Cropland, (b) change in the Built-up area, (c) change in a Waterbody, and (d) change in Wetlands in Savar Upazila, Dhaka during the last three decades (1990-2020).

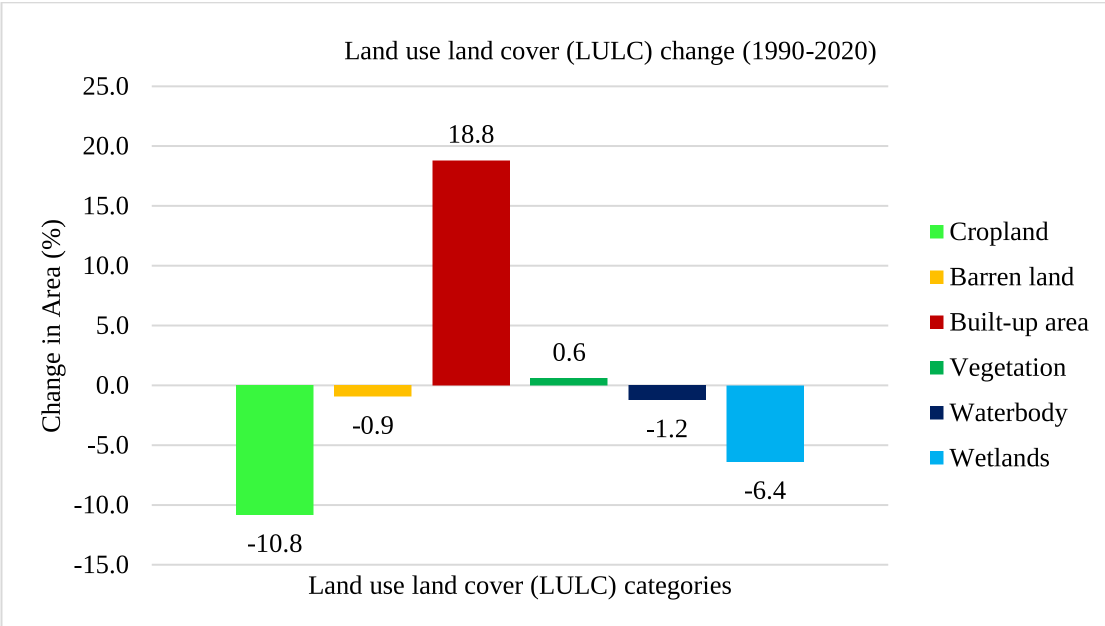

Figure 6: Land use land cover (LULC) change in the area (%) (1990-2020).

Conclusion

The growth of secondary city's built-up area is a growing concern to infrastructure development planned way. Furthermore, it has become a significant part of a country for economic activities and others production services. So, it will require sufficient well-designed data to make proper mapping and planning. Remote sensing and GIS techniques play an essential role in categorizing and quantifying landforms data of this secondary city which was not possible with traditional methods. The study shows that the dominant area is Cropland. The size under Cropland has decreased by 10.8% (3095.7 ha) due to developing infrastructures such as brickfields, artificial afforestation, and clear cropland to barren for development activities from 1990 to 2020. The second dominant class of land in the area is Wetlands, which decreased by 6.4% (1,827.3 ha) due to a built-up alteration area, Cropland, and Vegetation. It indicates that Savar Upazila's water bodies are no longer connected, potentially causing severe waterlogging. Because wetlands are now unable to hold a large amount of rainwater, this shift in wetlands may result in urban flooding. The third dominant class of land in the study area is the Built-up area which has increased more than 1.5 times than before 18.8% (5,378.9 ha) due to the expansion of the industrial infrastructure of the Savar Upazila during the last three decades.

Urbanization, Ribbon development along highways, and good transportation facilities have worked as influential factors for the observed changes. It helps rural to urban migrants who come to this Upazila for job-seeking and other purposes. So, the land value in this Upazila has also increased faster. The fourth land-use area is Vegetation rising by 0.6% (167.5 ha) due to afforestation and rural homestead gardening. The fifth category was Barren land which has decreased 0.9% (270.6 ha). The sixth class was Waterbody, which has reduced by 1.2% (352.8 ha) due to riverine areas filling up with sand, river embankment, developed settlement, and infrastructure.

Overall, the study reveals that the built-up area has been increasing over the reduction of Cropland, Waterbody, and Wetland areas, indicating direct threats to food security and freshwater scarcity. Moreover, urbanization is expanded dramatically in the rapid and unplanned way, and unsustainably too. Hence, the government should take comprehensive research on geospatial analysis and science-based planning which is vital for planning to achieve the sustainable development goals of the country's secondary cities.

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Authors' Declarations and Essential Ethical Compliances

Authors' Contributions (in accordance with ICMJE criteria for authorship)

Contribution	Author 1	Author 2
Conceived and designed the research or analysis	Yes	Yes
Collected the data	Yes	No
Contributed to data analysis & interpretation	Yes	No
Wrote the article/paper	Yes	No
Critical revision of the article/paper	No	Yes
Editing of the article/paper	No	Yes
Supervision	No	Yes
Project Administration	No	Yes
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