

Driving Forces of Landuse and Landcover Changes in the North-eastern Part of Dhaka Conurbation

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ABSTRACT: The study identifies decadal landuse and landcover (LULC) changes during 1988-2017 in north-eastern Dhaka conurbation of Bangladesh. Driving forces behind the changes in the study area have also been investigated. In this study, LULC changes were studied using two Landsat sensors. GIS post-processing technique was used for satellite image classification, while an in-depth literature review was conducted to identify the drivers of land cover change. Accuracy for the classified maps ranged from 79 percent to 86 percent. It was found that agricultural land decreased 47.02 percent while homestead vegetation land cover has increased about 88 percent in the last thirty years (1988-2017). The in-depth analysis result indicates that Dhaka metropolitan area expansion, increased population, internal migration, ongoing housing development projects, and lack of proper landuse and land management implementation are the main drivers of LULC changes in the study area. The development control approach needs to be incorporated into the on-going development projects and activities in the eastern region of greater Dhaka to maintain ecological balance and a green environment of the region.

Keywords: Landuse and landcover change, Driving forces, North-eastern Dhaka conurbation, LANDSAT imageries

INTRODUCTION

Land is a limited resource comprising the entire ecosystem (e.g., soil, water, and the associated plants and wildlife) and its proper use is, therefore, a matter of highest importance to its inhabitants (Sam, 2014; Ganasria and Dwarakish, 2015). Landuse and landcover (LULC) is the physical structure and features of the land on the earth's terrestrial surface (Yulianto et al., 2016) that refers to landuse (Nanda et al., 2014). Human activities and natural alteration of the earth's surface are known as LULC change (Hassan et al., 2016; Kidane et al., 2019). LULC change is a vital part of global change (Rai et al., 2017) that can be triggered by natural and socio-economic factors (Yesuph and Dagneu, 2019). The topology of landuse relies primarily on different land practices by individuals. Landuse changes have influenced many regional and global environments (Gaillard et al., 2018). Therefore, LULC change plays a significant role in worldwide sustainable growth and ecological changes (Parsa and Salehi, 2016). The earth's surface changes have escalated globally due to anthropogenic events' rapid growth (Chagnon et al.,

2014). For example, population pressure and land demand for different uses directly impact land resources (Raihan and Kaiser, 2012). Besides, land misuse causes various forms of land degradation that affect ecosystems and biodiversity (Bishaw, 2001).

The geographic information system (GIS) and remote sensing (RS) are generally recognized as handy tools (Erasu, 2017) for landuse mapping and LULC analysis as well as urban planning research because of the cost-effectiveness and high performance of these systems (Parsa and Salehi, 2016). In amalgamation, they can support a critical investigation and decision-making in earth's changes within the shortest possible time with reasonable precision (Roy et al., 2015). Landsat sensors' spatial, spectral, and temporal resolution increased with time, making spatial data more appropriate (Roy and Inamdar, 2019) for broad-scale classification of various landscape components (Butt et al., 2015). Access to the USGS (United State Geological Survey) website is easy and there are a lot of online tutorials on how to classify these satellite images correctly.

The global population's future is an urban one (UN, 2019), and more than half of the world population currently resides in built-up areas (Cohen, 2006; Goldewijk and Ramankutty, 2009). Urbanization significantly impacts the ecosystem's goods and services (Raj and Azeez, 2010), one of the

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principal factors behind establishing landuse changes and land transformation in the modern world (Nuissl and Siedentop, 2020). For example, in the developing world, the rate of urbanization is higher than in the developed world (Rahman et al., 2011).

Land degradation and population growth have a unique interaction. Bangladesh is a densely populated (Paul et al., 2013) rural agrarian country (Akter et al., 2014; Islam, 2020). The population density is fifty times greater than that of the USA and six times greater than China (NLZR, 2014). It is projected that the nation has just 0.129 acres of per capita property (Islam and Hasan, 2011). Climate changes, increased population, rural-urban migration, increased agricultural production has brought a great deal of pressure on Bangladesh's land resources (Herrmann and Svarin, 2009; Rahman et al., 2017b). Again, the country's arable per capita decreases day by day (NLZR, 2014). It is alleged that around one percent of the country's agricultural land is converted into non-farming uses every year (Halim et al., 2014). Such services are settlement, developing residential areas, brick fields, small industries, etc. Bangladesh is now facing enormous urbanization challenges (Rana, 2010 and Hussain, 2013), where the UN estimates that Bangladesh's metropolitan population will cross 36 million people within the next 20 years (Wu et al., 2019).

Dhaka is known worldwide as a haphazard city for inappropriate landuse and urban development (Uddin et al., 2014) and also one of most vulnerable cities considering growing impact of disasters (Rahman et al., 2018). Greater Dhaka (which is residing almost in the middle of the country, Dhaka, Narayanganj, Gazipur and Narsingdi districts) makes an important economic cluster as it finds itself with the presence of four city corporations, several industrial zones including the one that earns maximum remittance for the country, the ready-made garment sector (Kulsum and Moniruzzaman, 2021) was rapidly urbanized by a significant farmland reduction (Dewan and Yamaguchi, 2009; Dewan et al., 2012). Over the last two decades, the west part of Dhaka faced rapid land and landuse changes due to rapid industrialization and urbanization, leading to alarming pollution in land, water, air, and sound (Raihan and Kaiser, 2012). The eastern zone is an under-developed, flood-prone area with some rural settlements (RAJUK, 2016; Ullah and Enan, 2016;

Morshed, 2017). In this area, large-scale land has been transformed to bareground through landfilling (Hassan and Southworth, 2017; Ullah and Enan, 2016) ignoring flood action plan (FAP-8A) (Jahan et al., 2013). By 2035, the eastern part of Dhaka will undergo significant LULC changes, with an estimated population of 1.08 million (RAJUK, 2016).

The north-eastern region of Dhaka has currently experienced several changes in landuse and landcover. Low flood plain area and agricultural land filled with sand for different large-scale residential projects, which cause environmental stress and degradation. The form of Dhaka city extension causes the area worryingly. The research expects to identify the nature and degree of LULC changes in the north-eastern part of Dhaka Conurbation from 1988 to 2017 using remote sensing and GIS techniques with Landsat Imageries. The study also investigates the driving forces behind the land use dynamics that accelerate changes in the study area's land cover.

MATERIALS AND METHOD

Study Area

The study area is located in the north-eastern part of the capital Dhaka (Figure 1), which covers three administrative districts, Dhaka, Gazipur, and Narayanganj. The area is a terrace from one to ten meters above the surrounding floodplain (Rashid et al., 2006) located in a geosyncline basin (Imam, 2005). The soil types of the study area are dominated by deep red-brown terraces soils of Madhupur tract and noncalcareous alluvium soils of the floodplain (Rasheed, 2016). The average temperature varies from 28°C to 32°C in summer and falling 20°C in winter (NLZR, 2016). Seasonal hazards like torrential rainfall, wind blow called "*kalboishaki*" and hailstorms happened (RAJUK, 2013). The study area is now in front of significant environmental risk due to ongoing development projects, including *Jolshiri* and *Purbachal* new township, three highways *Kaliganj-Ulkhola-Abdullahpur*, and *Gazipur-Bhulta*, and *Tongi-Ghorashal*, which play a decisive role to expand settlement rapidly. Again, *Beel Belai* is a unique physiographic feature located in the north-eastern, which stored the rain flow from the upper side of the Madhupur Tract. The climate of the *Beel Belai* is colorful and is populated by plentiful fauna (Jahan et al., 2018). The Google historical satellite images

can easily understand that the region lost its largeness due to gradual siltation. The study area's surrounding river is going through a massive change and losing its present size due to human interception (Alam, 2018), and the places with a great deal of deforestation and anthropogenic activities within the study area are experiencing an excessive increase in the particulate matters (PM_{2.5}) concentration in lower atmosphere

(Kulsum and Moniruzzman, 2021). Moreover, the lifeline of the area, the Shitalakshya River, appears to be the worst victim of pollution as hundreds of tons of garbage and industrial effluents are being dumped into the river basin every day (Ahmed et al., 2010). These points and views contain notable importance to choose for this study.

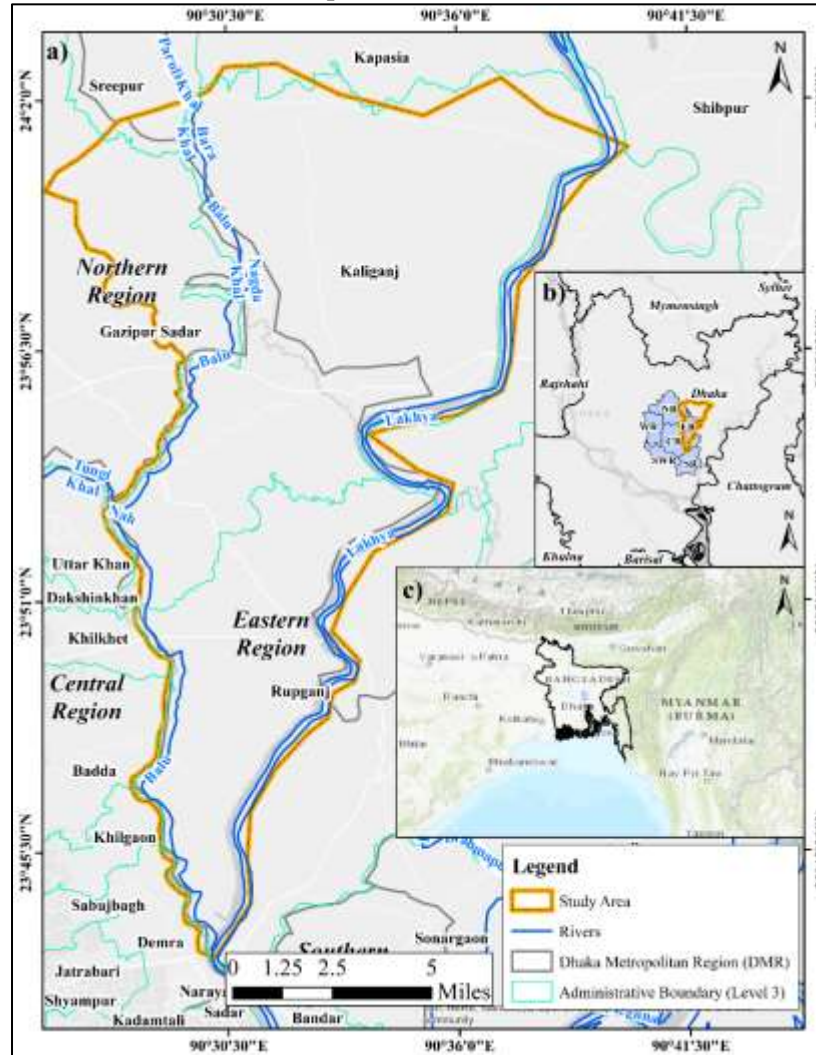


Figure 1: The Map (a) Showing the Location of the Study Area (Electron Gold with Dot Line Color) with Administrative Level Boundary (level 3) (Tourmaline Green with Dot Line Color); (b) The Inset Map Represents the Location of the Study Area in Dhaka Division (Black color bold line) and Dhaka Metropolitan Region (Sky Blue Color); (c) The Inset Map Shows the Location of Bangladesh (Denotes in Black Color) in the World.

Data Source

The research was conducted using a mixed-methods approach, including spatial data analysis and an in-depth assessment of the current literature on land cover change in greater Dhaka. Gregory et al. (2021) approach is used to identify the fundamental cause of land cover changes in the study area. Google

Scholar, Scopus, Web of Science, and Science Direct, including books, peer-reviewed papers, and published reports, are used for literature search. The literature search was conducted using various combinations of the following keywords: the driver of land-use change in Bangladesh, causes of land use and land cover change, population impact on Dhaka, urbanization and

landuse change, the effect of rural-urban migration, internal migration in Bangladesh, unplanned development, and transportation in Dhaka. This study evaluated only English-language publications published before 2021. After analyzing the available literature, the rapid expansion of the Dhaka metropolitan area, unplanned urbanization, vast nature of increasing population and migration, ease of accessibility with Dhaka city, the gap in constitution and acts related to landuse and environment are found as primary drivers of landcover change in the study area.

Landsat TM and OLI/TIRS sensor images for 1988, 1997, 2007, and 2017 were acquired from Global Visualization Viewer (GloVis) platform (Table 1). These images were selected based on the date of acquisition, spatial resolution, availability, and minimum cloud cover. All satellite images are acquired between mid-January to the end of February because the river course and agricultural field can easily be understood during this season. Similar image acquisition dates are essential for land cover classification (Lu et al., 2004).

Table 1: Characteristics of Remotely Sensed Data Used in the Study

Sensor	Platform	Acquisition date (dd/mm/yyyy)	Spatial resolution (m)	Path/Row	Row	Cloud cover
TM	LANDSAT 5	2/19/1988	30	137	44	0
TM	LANDSAT 5	2/19/1988	30	137	43	0
TM	LANDSAT 5	1/26/1997	30	137	43	0
TM	LANDSAT 5	1/26/1997	30	137	44	0
TM	LANDSAT 5	2/23/2007	30	137	44	0
TM	LANDSAT 5	2/23/2007	30	137	43	0
OLI/TIRS	LANDSAT 8	1/17/2017	30	137	43	1.37

The methodological framework employed in this study to accomplish both aims is depicted in Figure 2.

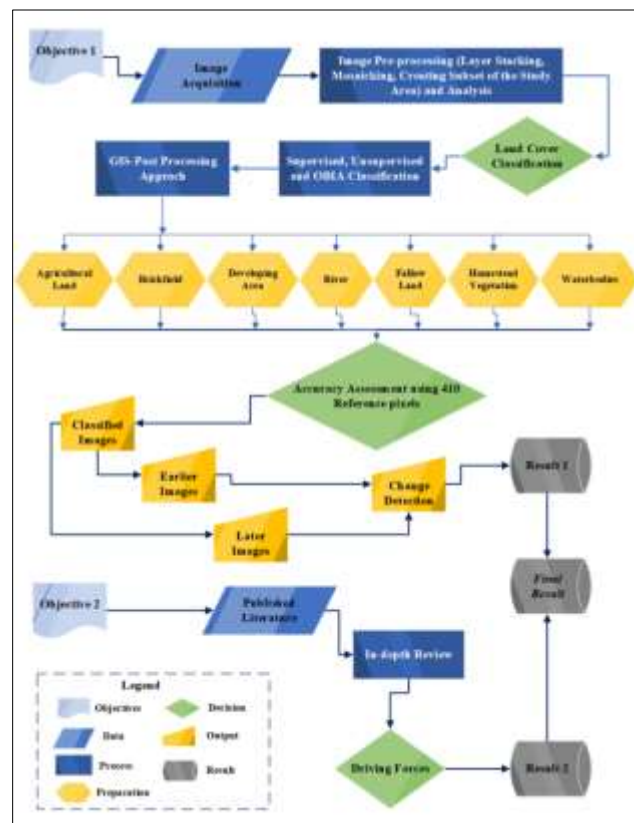


Figure 2: Methodological Framework of this Research. Different Shapes Denote Research Objectives, Data, Process, Preparation, Decision, Output, and Result

Image Pre-processing and Classification

ERDAS IMAGINE 2014 was used for layer stacking (function combines spectral bands from a single-band raster) the satellite images. For Landsat 5, bands were added in B3, B2, B1, B4, (B3=Red, B2 =Green, B1=Blue, B4 = near-infrared). This standard was used for study area images of 1988, 1997, and 2007. Compositing order tried for 2017 image is B4, B3, B2, B5 (B4=Red, B3 =Green, B2 =Blue, B5 = near-infrared). In this study, two satellite images (Row 44 and 43) were mosaicing for 1988, 1997, and 2017. After completing layer stacking, satellite images are clipped using the area of interest (AOI) in the ERDAS IMAGINE 2014 platform. In this study, GIS post-processing method was implemented to classify satellite images. GIS post-processing combines supervised, unsupervised, and object-based image analysis (OBIA) methods, delivering better outcomes than a single approach (Thapa and Murayama, 2011). To perform unsupervised classification, 75 classes with 12 iterations and 95 percent convergence value were selected, and later this recodes into seven classes (Table 2). Fifteen samples for each class total of one hundred five training samples were selected to create the signature file for supervised classification in ERDAS IMAGINE 2014. The multi-resolution segmentation algorithm (scale parameter=10; shape =0.1; compactness=0.98) used in eCognition Developed 64 platform for OBIA land classification. Final land cover area computing and mapping were done using ArcMap 10.7 platform.

Table 2: Landuse and Landcover Classification Scheme (NLZR, 2014)

Class name	Description
Agricultural Land	Crop field
Brick Field	The area where bricks made
Developing Area/New Residential Projects	New land-filled area for residential purpose
Fallow Land	Abandoned land
Homestead Vegetation	Residential, commercial, industrial, transportation, roads, and mixed urban, rural, and vegetation
River	Tributaries, stream
Water body	Open water, lakes, pond, <i>khal</i> , and reservoirs

Land Cover Change Analysis and Post Classification Accuracy Assessment

This study used a post-classification modification method. Three-time periods covering a ten-year period were utilized to compare the classified images: 1988–1997, 1997–2007, and 2007–2017. The percentage changes in landcover categories were calculated using Eq. 1. This equation was adapted from Kindu et al. (2013).

$$\text{Percentage of Land Cover Change} = \frac{(\text{Area}_{\text{final year}} - \text{Area}_{\text{initial year}})}{\text{Area}_{\text{initial year}}} \times 100 \quad (1)$$

Where area refers to the entire area covered by each land cover type, positive values denote a rising trend, while negative values suggest a falling trend.

An auto accuracy assessment was conducted in ArcMap 10.7 to prepare kappa coefficients, producer's accuracy, user's accuracy, and overall accuracy. More than four hundred reference pixels were selected stratified random sampling compared with reference raw satellite images of 1988, 1997, 2007, and 2017. Stratified random sampling is most widely used for land cover accuracy assessment (Stehman, 2009 and Hasan et al., 2020)

RESULTS

Accuracy Assessment

The precise evaluation shows that the average precision of the LULC maps for 1988, 1997, 2007, and 2017 was 79 percent, 81 percent, 84.76 percent, and 86.87 percent, with corresponding kappa of 0.74, 0.76, 0.82, and 0.84, respectively (Table 3). According to Quader et al. (2017), a kappa scores up to 0.75 ensures that the resulting LULC details precision is suitable. The producer accuracy of agricultural land cover ranges from 80-93 percent, whereas user accuracy ranges from 76-88 percent from 1988 to 2017. For homestead, vegetation land covers both producer and user accuracy showing 80 percent, the highest value. Again, producer's and user accuracy of water bodies, rivers, fallow land, brickfields, and developing area land covers range from 75 to 100 percent.

Table 3: The Producer, User, Overall Accuracies, and Kappa Statistics of Post Classified Images

Year of images	Land cover class														Overall accuracy (%)	Kappa statistics
	AL		HV		WB		River		FL		BF		DA			
	PA (%)	UA (%)	PA (%)	UA (%)	PA (%)	UA (%)	PA (%)	UA (%)	PA (%)	UA (%)	PA (%)	UA (%)	PA (%)	UA (%)		
1988	80	76	75	79	75	75	85	89	80	76	-	-	-	-	79.00	0.74
1998	85	81	80	76	85	77	90	90	65	81	-	-	-	-	81.00	0.76
2007	87	88	73	80	93	81	87	79	80	93	87	100	87	88	84.76	0.82
2017	93	88	80	80	87	76	73	85	87	93	93	100	93	88	86.87	0.84

Note: TM- Thematic mapper; OLI/TIRS- Operation land imager/Thermal infrared sensor; AL-Agricultural land, WB-Water bodies; FL-Fallow land; BF-Brickfield, DA-Developing area; PA-Producer accuracy; UA-User Accuracy.

Area of Landuse and landcover (LULC) Class

In this study, a total of seven LULC types (i.e., agricultural land, homestead vegetation, waterbodies, river, fallow land, brickfield, developing area) were extracted from the year 1988 to 2017 satellites imageries (Table 4). Agricultural land was the significant LULC type at the start of the research period (1988), accounting for 70.9 percent of the study landscape, followed by homestead vegetation (25.1 percent), waterbodies (0.6 percent), rivers (3.4 percent), and fallow land (0.1 percent). Again, agricultural land and homestead vegetation likewise accounted for most LULC type in 1988, accounting for 70.7 percent and 25.1 percent, respectively. A small amount of the study area was covered by water bodies, rivers, and fallow ground. The general scenario altered in 2007. Compared to 1998 and 1997, homestead vegetation (34.6 percent) is rising, whereas agricultural land (58.3 percent) is declining. Waterbodies (0.8 percent), rivers (3.2 percent), brickfields (0.5 percent), and developing areas (1.7 percent) occupied the remaining portion. In 2017, homestead vegetation remained the largest LULC (47.5 percent). Agricultural land (37.5 percent) and developing area/ new residential development projects (9.6 percent) were the study area's second and third most prevalent LULC categories, respectively.

The smallest part of the area was inhabited by other LULC types (i.e., water bodies, rivers, fallow land, and brickfields).

LANDUSE AND LANDCOVER (LULC) CHANGES

Over the first (1988-1997), second (1997-2007), third (2007-2017), and total (1988-2017) study periods, the change result indicated a significant decline in agricultural and fallow land (Table 5). Between the second and third periods, the total agricultural land transformed was 16.17 percent (Figure 3). Agricultural land continued to change by around 37% and 47% during the third and total periods. Similarly, fallow land decreased by 80.42 percent in the first period, 88.46 percent in the second period, 49.71 percent in the third period, and 70.35 percent in the total period. On the other hand, homestead vegetation increased in all four periods by 0.14 percent, 37.86 percent, 36.56 percent, and 88.01 percent respectively. Throughout the selected periods, water bodies and rivers exhibit a modest growing and declining tendency. In the third quarter, the LULC class developing area/new residential projects and brickfields showed a rising trend, accounting for 478.24 percent and 15.16 percent respectively.

Table 4: Summary of LULC Classes in the Study Area during 1988-2017

Land Features	Area of LULC different study years (in percent)			
	1988	1998	2007	2017
Agricultural Land	70.9	70.7	59.3	37.5
Homestead Vegetation	25.1	25.1	34.6	47.2
Water Bodies	0.6	0.6	0.8	1.2
River	3.4	3.3	3.2	3.9
Fallow Land	0.1	0.3	0.0	0.0
Brickfields	-	-	0.5	0.5
Developing Area/New Residential Projects	-	-	1.7	9.6

Table 5: LULC Changes Statistics between 1988-1997, 1997-2007, 2007-2017 and 1988-2017

Land features	Decadal LULC Changes (in percentage)			
	Area change (1988-1997)	Area change (1997-2007)	Area change (2007-2017)	Area change (1988-2017)
Agricultural Land	0.16	-16.17	-36.70	-47.02
Homestead Vegetation	0.14	37.86	36.56	88.01
Water Bodies	-6.40	26.54	60.92	117.55
River	3.24	-2.43	21.82	15.13
Fallow Land	-80.42	-88.46	-49.71	-70.35
Brickfields			15.16	
Developing Area			478.24	

Note: Area calculated in percentage

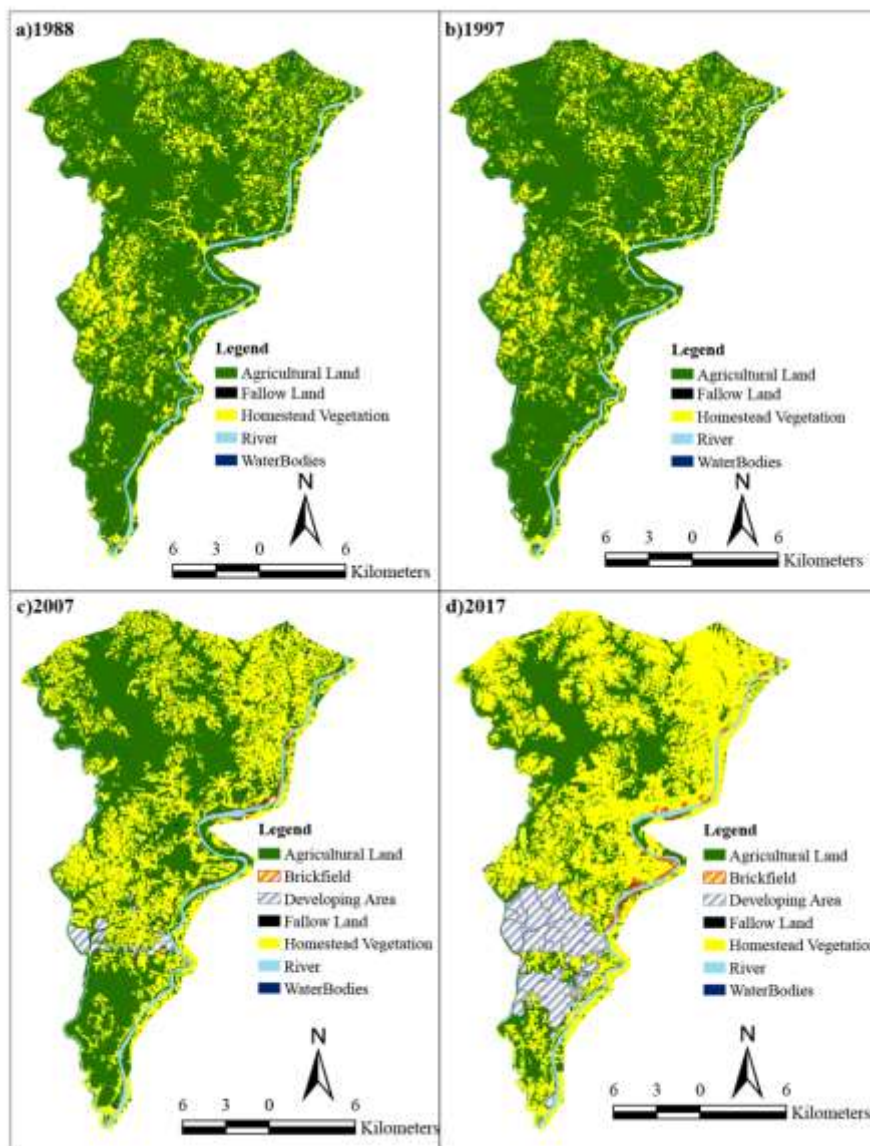


Figure 3: Landuse and Landcover (LULC) Maps from 1988 to 2017 in the Study Area. The Green Color, Gold Color Overlay Symbol, White Color Overlay Symbol, Black Color, Solar Yellow Color, Blue Color, Dark Navy Color Represents the Agricultural Land, Brickfield, Developing /Built-up Area, Fallow Land, Homestead Vegetation, River, and Water Bodies, Respectively.

DRIVING FORCES OF LANDUSE AND LANDCOVER CHANGE

Anthropogenic events, natural events, climate change, and sea-level rise (SLR) are the significant factors that play a vital role in landcover changes (Lambin et al., 2001; Rahman et al., 2017a; Swapan et al., 2017). Comprehensive underlying drivers are influencing each area's landcover changes in Bangladesh. These drivers differ by country and region. Several factors influence changes in LULC in the study area.

Rapid Expansion of Dhaka Metropolitan Area

Dhaka is becoming older as well as its area is expanding (Ahmed and Bramely, 2015). Dhaka has two historical expansion patterns: old Dhaka or historic core and the northern expansion (Nilufar, 2010). Geographically, Dhaka City is started growing with an upward preeminence. Now RAJUK (Capital Development Authority) planned to include north and north-eastern parts and south and southeastern parts into Dhaka city, and this has been addressed as Dhaka Metropolitan Region (DMR) (RAJUK, 2016). The expansion of these regions may significantly influence the LULC changes in the study area. Again, Dhaka city is expanding to meet its additional utility by destroying the hinterlands like agricultural lands and wetlands.

Unplanned Urbanization

Urbanization in Bangladesh is regionally unbalanced. Overall, in the eastern part of the nation (i.e., east of the Jamuna-Padma-Meghna River), nearly thirty-four percent of the population lives in a town or urban centers, compared to seventeen percent in the Western areas (UNFPA, 2016). The expansion rate of Dhaka is irregular. The study site is located in the east of Dhaka, and it is influenced by haphazard urbanization (Venables and Bird, 2018; Ahmed et al., 2019). The study area already occupies this urban growth process. *Purbachal* new township and *Jolshiri* housing projects are remarkable examples of it. These places will function as a growth center for urban in the future. Again, the study area's central zone faces this growth primarily due to its easy accessibility to Dhaka. The urbanization process changes the physical environment of the study area and the human environment. For instance, agricultural lands and

wetlands are being filled with sand for this settlement project (Jahan et al., 2013; Rahman et al., 2017c).

Vast Nature of Increasing Population and Migration

From the World Bank report, more than five percent of the country's urban population lived in the capital during 1961, but this had climbed up to 37 percent in 2019 (World Bank, 2020). Between 1971 and 2015, Dhaka Megacity more than trebled in population, a growth that was fueled by massive migration and natural increase (Ahmed et al., 2014). The increased population (Dewan and Yamaguchi, 2009) and migration to the urban area are causing landcover changes in the study area (Rahman et al., 2017b). Due to easy accessibility in the informal sector in Dhaka city (Alamgir et al., 2009), more and more people migrate to the neighborhood area. The national rural-urban migration is more than four percent, whereas Dhaka singly accounts for more than 5 percent (Martin et al., 2013). Therefore, massive in-migration for a prolonged period resulted in a too high density of people, buildings, industries, and other activities and facilities, putting immense pressure on the healthy growth of Dhaka City (Jahan, 2012; Marshall and Rahman, 2013).

Ease of Accessibility with Dhaka City

The study area is surrounded by a sound communication system, which connected it with Dhaka city. The road network for *Purbachal* and *Jolshiri* housing projects opened the whole east region for more private investment (The Dhaka Tribune, 2019). Because of the growing demand for land in the area, some buyers are grabbing agricultural land, flood zones, lakes, and canals (Alam, 2018). Again, many people are fond of life in quiet and peaceful places. The study area has a green ecosystem (Rahman et al., 2017c and Jahan et al., 2018) that attracts people. As a result, many people are buying land to build settlement there. Moreover, three major highways (Kaliganj-Ulukhola-Abdullahpur, Gazipur-Purbachal-Bhulta, and Tongi-Ghorashal) in the study area will play a decisive role to expand settlement rapidly.

Lack of Supportive Policies

The Bangladesh government adopted several acts to improve the environment, protect the environment's natural state, and change sustainable landuse and landcover. However, in the study area, the rules and regulations are not adequately implemented. In

Bangladesh Constitution, the state said that it protects the environment for future citizens by improving the quality of the environment (Farooque and Hasan, 2004). However, the newly adopted settlement projects in the study area are developed by filling agricultural land, wetlands and cutting down rural vegetation. Again, agricultural land is prohibited for other purposes rather than agriculture (NLUP, 2001). But in the study area, agricultural land is decreasing, and settlement is increasing. National Water Policy (1999) promotes protecting water bodies and stops unplanned construction in riverbank areas. But in the study area, many brickfields are seen near riverbank side, affecting the local environment and agricultural productivity. Again, interventions such as filling wetlands to develop settlements in the study area are also observed. In the study area, the new residential township such as *Purbachal*, *Jolshiri* housing projects show negligence on the wetlands and water-related issues according to Bangladesh Water Act (2013). Bangladesh's agriculture policy aims to promote sustainable agricultural production, maintenance of land productivity, and development. But a significant concern is that, in the study area, a substantial portion of agricultural land is converted into settlement and many other purposes. These changes will immediately impact the local ecosystem, including temperature, population density, and flora and fauna.

DISCUSSION

This study detects LULC changes in the north-eastern part of Dhaka conurbation using Landsat imagery. From 1988 to 2017, a GIS post-processing method was utilized to categorize, map, and identify changes in LULC categories. Because it is a mix of many approaches, the GIS post-processing technique results in a more accurate mapping (Thapa and Murayama, 2011). Overall accuracy and kappa values for this research area range between 79 to 87 percent and 0.74 to 0.84, respectively. According to Sousa et al. (2002), the kappa value indicates a significant outcome for those categorized pictures.

The quantitative outcomes of a 30-year change analysis divided into three periods (1988-1997, 1997-2007, and 2007-2017) indicated the significant changes in the various LULC classes during the last three decades. In general, agricultural land has declined in the study period, but the built-up area has been increased. Huq and Rahman (2020) also found a

similar finding, although their research was conducted from 2010-2017. Again, Hassan and Southworth (2017) have analyzed for the north-eastern section of Dhaka indicates a growing tendency in the built-up areas and a declining trend in agricultural land. Due to the uninterrupted rise of population in the Dhaka Metropolitan Development Plan region, urbanization, and migration, settlement in the Rupganj and Kaliganj Upazilas has expanded (Ullah and Enan, 2016; Venables and Bird, 2018; Mortaja and Yigitcilar, 2020).

On the other hand, development projects in the vicinity of Nagari of Kaliganj Upazila, Rupganj Sadar, and Daudpur unions of Rupganj Upazila have changed agricultural land cover (Huq and Rahman, 2020). Over 2400 hectares of the low-lying region and agricultural land have been converted into communities for the Purbachal township project in the study area (Alam, 2018). As a result, the land surface temperature in those urbanized areas increased by 2 degrees Celsius (Trotter et al., 2017). Numerous brickfields were spotted in the riverside area of Dhaka's north-eastern portion. According to Jerin et al. (2016) and Parvez et al. (2018) black smoke from brickfields significantly impacts the local ecology and agricultural productivity.

Once again, an in-depth literature review was done to determine the factors contributing to variations in LULC changes in the study area. Semeraro et al., (2021) took a similar strategy in their review study. This study has found that the rapid expansion of the Dhaka Metropolitan Area, unplanned urbanization, vast nature of increasing population and migration, ease of accessibility with Dhaka city, negligence of constitution, and acts related to landuse and environment are the major drivers of LULC changes in the study area. The megacity is lagging for its previous unplanned growth (Swapan et al., 2017), led by the authority's very apathetic attitude (Kalam, 2009). In north-eastern side of Dhaka, private developers fill up low-lying areas that blockage the surface runoff on the eastern lower part of the town, leading to high water logging around the city during monsoon season (Alam, 2018; Ahmed et al., 2019). Industrialization is growing alarming beside the riverbanks, which produced a high chemical wastage (Mallick, 2013; Hussain, 2018) that polluted the Shitalakshya- Balu River (Ahmed et al. 2010; Rahman et al., 2017c; Jahan et al., 2018). Several brickfields

also produce toxic fumes, and particulates pollute the atmosphere and warm up the air in Dhaka's eastern part (Saha and Hosain, 2016, Kulsum and Moniruzzaman, 2021). The infrastructural establishment is rising rapidly due to unfriendly policies, rules and regulations, and law ambiguity (Alam, 2018). In some cases, the existing policy itself is contradictory and antagonistic, not strictly controlling urban expansion.

CONCLUSION

This study area has experienced a rapid change, while agricultural land and vegetation cover have been altered due to settlement expansion. Landcover change has damaged the environment and caused unforeseen atmospheric changes. Filling agricultural, floodplain, and vegetative areas with sand for settlement purposes has unintended consequences. The long-term effects, such as waterlogging and increasing temperature, will become more evident with time. A notable change is coming in Bangladesh's physical structure with time. Bangladesh's physical structure is undergoing a significant transformation as time progresses. People's predisposition to migrate towards the center increases like drug addiction. They relocate to the city to make more money, live in a better environment, and pursue better educational opportunities. Dhaka is highly demandable for its comparatively better-earning condition, living facility, and educational institutions. Every day, thousands of people move to this metropolis, increasing the city's population. This enormous urban expansion is also affecting the adjacent areas. The northern edge of this area has high-yield agricultural land with several wetlands. Farmlands and wetlands safeguard the environment and provide numerous ecological services (Thiere et al., 2009; Alam, 2014). To maintain environmental balance, the least amount of vegetation is necessary. That's why the government should take a more sensible role in new urban planning and development management over the area.

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