

ASSESSMENT OF LAND USE CHANGE IN ENVIRONMENTAL ELEMENTS AVAILABLE IN THE UPAZILA (SUB-DISTRICT) SRDI MAP: A CASE STUDY OF SAVAR UPAZILA OF DHAKA DISTRICT

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ABSTRACT

Savar upazila, a sub urban area near Dhaka metropolitan, is one of the fastest growing upazila of Bangladesh. Heavy population migration and fast industrial growth is causing this upazila environmentally very vulnerable. The environmental components of this upazila is being degraded by both individual and institutional level over a longer period of time. GIS and Remote Sensing technology are used for analysis of the study. 1992 upazila SRDI map has been used as the base because the SRDI mainly focuses on the land use and land features of Bangladesh. CORONA 1953, SRDI Map 1992 and recent L8-OLI 2016 images is used to compare the changes. The research shows that the land use and land features of this area changed in every environmental sector which include increment in homestead, reduction of agricultural land, disappearance of seasonal waterbodies, newly built settlement and industries. The biggest change is seen in industrial and settlement sector by increasing it many a mile. If this trend of deterioration continues the future of land of this upazila will seriously be under immense threat because the change is so rapid that this can destroy the quality and usability of this soil in coming future.

Keywords: Land use, GIS, Remote Sensing, Environment, Urbanization

I. INTRODUCTION

Population migration and the process of urbanization are very closely interrelated with land use. These two factors directly interlinked to the change environmental elements. The urbanization rate of Bangladesh is 3.1% in 2013 (The World Factbook, 2013). This rapid increase of urbanization creates pressure on land. Fast urbanization is the effect of population explosion and rural-urban migration. Total population of the country was 114.4 million in 1991 and the percentage of urban population was 20.1, while in 2001 total population was 129.2 million (Bangladesh Bureau of Statistics, 2001). Rapid conversion of agricultural, flood flow and sub-flood flow lands into urban uses at the periphery of Dhaka city increases the demand for developing useful supply, demand and pricing models. The land use of Savar upazila saw a drastical change over the last 60 years since the Pakistan period began in Bangladesh. During this high economic growth time, the land use pattern and their protection never caught anyone's attention about how to use the land properly for the betterment of future generation and for the present betterment of the people of Savar upazila. This research will identify the present status of environmental components like water bodies, settlements, agricultural lands, river and others environmental based on the basis of SRDI 1992 base map and it will trace back to the available components of Savar upazila since the 1950s using GIS and Remote sensing tools. It traces out some loopholes in the existing practice of the utilization of environmental components usage and the other major issues related to the land use pattern of the area. It will also help us to find the types of major land use of the study area and the interventions made by the people living in this area over a longer period of time. The study will also allow us to look at the major changes occurred during that period in the environmental sector mention ably agricultural land, housing projects, water bodies, natural vegetation and the settlements pattern of the area.

II. STUDY AREA AND METHODOLOGY

STUDY AREA

Savar is geographically located between 23°44' 15.61" and 24°01'37.17" North and between 90°11'08.45" and 90°21'36.70" East. The upazila is bounded on the north by Kaliakair and Gazipur Sadar upazilas, on the south by Keraniganj upazila, on the west by Dhamrai and Singair upazilas and on the east by Mirpur and Mohammad thanas of the Dhaka City Corporation. Savar upazila is almost a rectangular shape and it is about 12 kilometers wide and 30 kilometers long with an area of 284.63 km². Savar upazila consists of 11 unions and one paurashava (municipality). In terms of its physical extent, it is an important part of the capital of Bangladesh. Its total area is almost double the size of all 90 wards (135.22 km²) of Dhaka City Corporation. Moreover, its area is approximately equal to that of Dhaka Metropolitan City (304.96 km²).

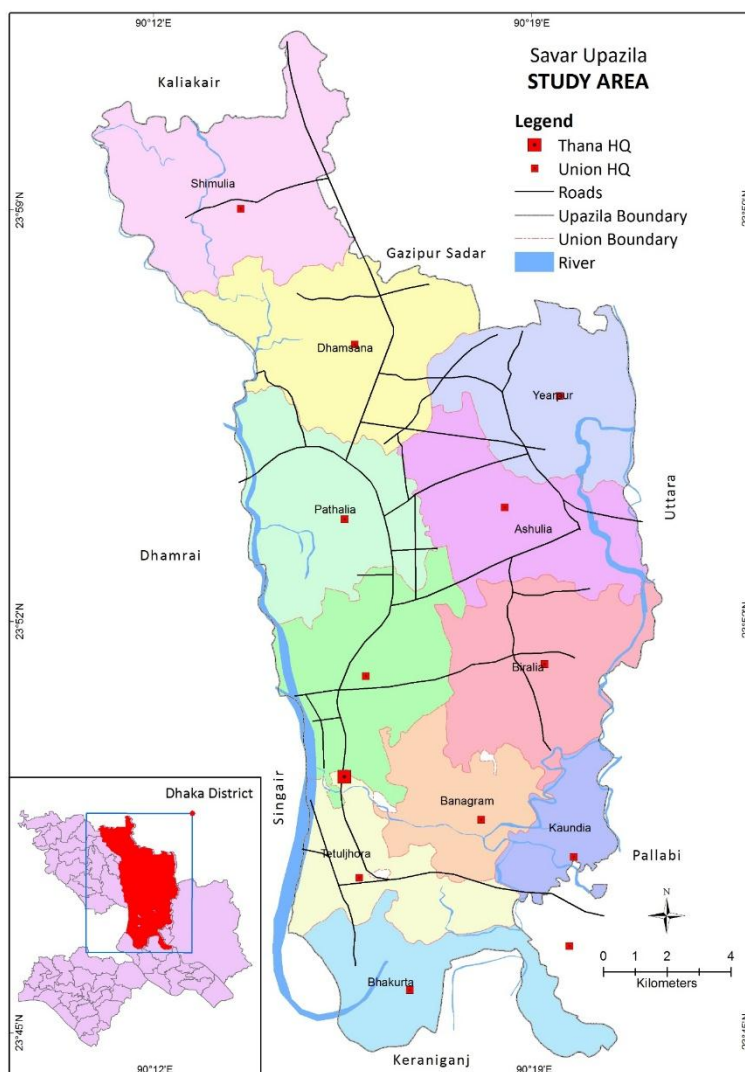


Fig 1: Location of the study area

Data use

In this study, Corona 1953 image, SRDI Map 1992 and Landsat 8 Operational Land Imager (OLI) were used for land use and land cover (LULC) classification of Savar upazila. Corona 1953 and SDRI 1992 map were manually digitized using ArcMap 10.2 software and Landsat 8 OLI-TIRS image was classified in ERDAS Imagine 2014 software.

Corona 1953 was the first operational space photo reconnaissance satellite program (www.fas.org). The project was launched to take pictures from space of the Soviet bloc countries and return the photographic film to Earth for processing and exploration.

SRDI 1992, The Soil Resource Development Institute (SRDI) is a wing under the Ministry of Agriculture and Forest. One of the main activities of the wing is to generate a detail database on soil, land, water and agro-climate. SRDI released detailed soil map in 1992 which mainly covers the type of soil and environmental components.

Landsat 8 OLI-TIRS image dated 02 Feb. 2021 was available at: <http://earthexplorer.usgs.gov>. The study area was covered by Landsat images with path 137/row 43 and path 137/row 44. The multispectral bands contain spatial resolution at 30×30 m and the panchromatic band has spatial resolution at 15×15 m.

Satellite image geometric correction

With respect original multispectral data set, the color distortion of pan-sharpening technique is significant limitation. The statistics analysis was used to evaluate the digital value and characteristic of original data before pan-sharpening transform with enhanced data after pan-sharpening transform.

Image classification and analysis

The Landsat image must be composed because it comprised many bands, i.e., 11 bands. Layer stacking was fulfilled to get an image with band combination. The process of subsetting was conducted in Arc GIS 10.2 software by using the extract by mask tools of the image based on the study area (Iqbal and Khan 2014). Digital LULC classification through the supervised classification method (maximum likelihood algorithm), based on the field knowledge, was employed to perform the classification for the year 2015. To make LULC maps of 2015, we have used supervised classification by taking care of the study area of interest as well as field survey measurements together for training and validation parts. These LULC images were then reclassified by using software Arc GIS 10.2 to compare the changes found in these years. ERDAS Imagine 15 and Arc GIS 10.2 are powerful tools for extracting the LULC, from satellite imageries. SRDI 1992 and Corona 1953 maps were manually digitized to extract the land use features for assessing change detection.

III. RESULTS AND DISCUSSION

Upazila SRDI maps are basically made for the purpose of indicating and identifying the soil types and other major features available in an environment. The main aim of this map making is to know mainly the use of lands in a particular area. The department of soil and other organizations have no specific database about the environmental elements of the any area in Bangladesh. The environmental elements are found in the upazila SRDI map are nor directly identifiable but we some need some other process and different parameters to judge about the environmental elements of this type of map. The identified environmental elements from upazila SRDI map are listed below.

Agricultural lands

Agricultural lands are easily identifiable in the upazila SRDI map. Agricultural land has the most dominant portion of all the available features in a upazila SRDI map. The greener part in the map indicates the agricultural area. The dominance of agricultural land is cleanly visible that there was once a very good time agricultural activity in the upazila. There are 46950.94 acres of agricultural land in the study area.

Homestead Vegetation

The amount of homestead vegetation is way less than the usual rate. This is because the population of this area was not that widespread during the time period when the pam was prepared. Only 8273.21 acre was occupied by the homestead vegetation. And rest of other are being used for other purposes.

Settlement

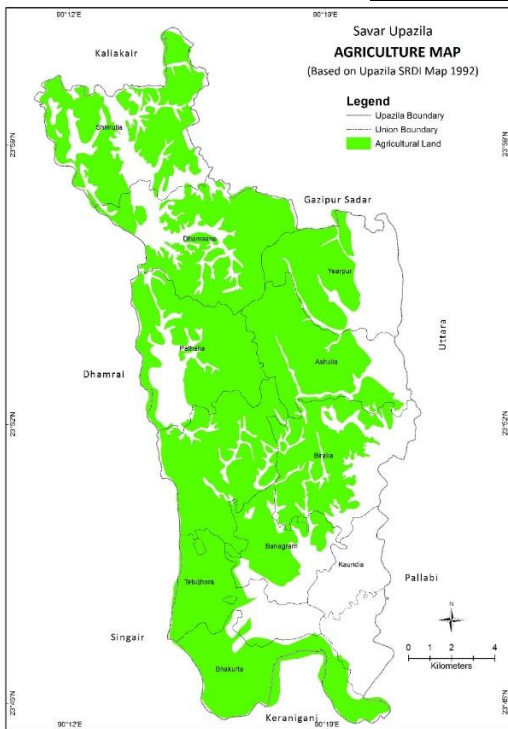
Three types of settlement are used to be found in the upazila SRDI map.

- Urban Settlement
- Sub urban Settlement
- Rural Settlement

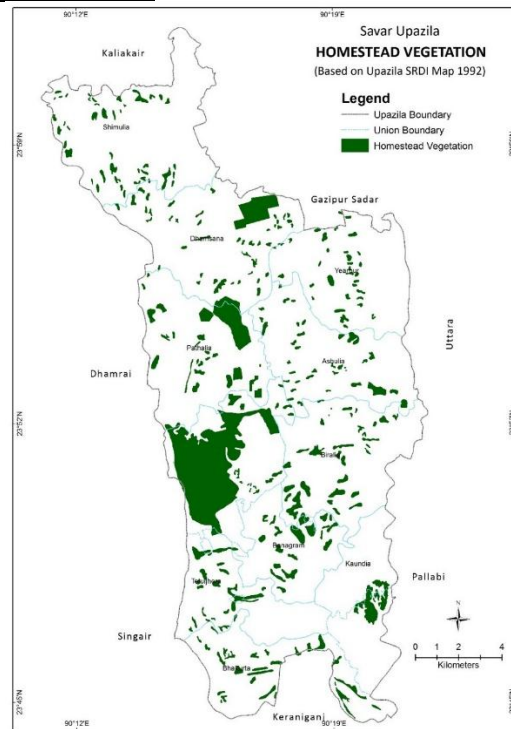
Urban settlement is 2971 acre, sub urban settlement is 1012 acre and rural settlement is 5300 acre in SRDI map, 1992. Table below shows the categorical distribution of settlement.

Table 1 Settlement types of SRDI map

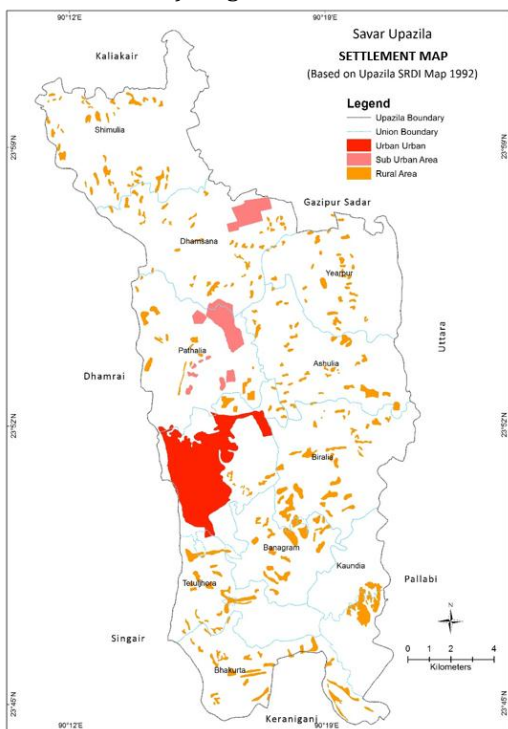
Settlement	Area (acre)
Urban Settlement	2971.32
Suburban	1012.21
Rural	5300.89
Total	9284.42



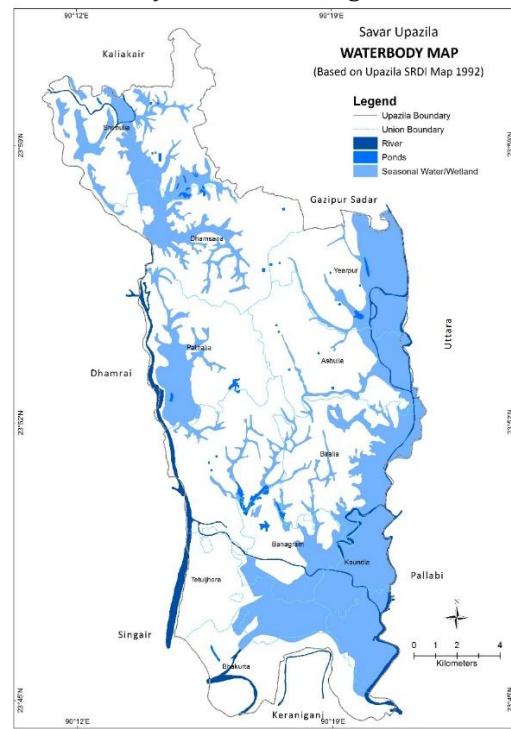
a) Agricultural land



b) Homestead vegetation



c) Settlement



d) waterbody

Table 2: Available environmental components

Type	Area(acre)
Agricultural land	46950.21
Homestead Vegetation	8272.32
Settlement	9284.56
Waterbodies	21310.67

Waterbodies

Waterbodies are mostly found in the lower region of any area, but in Savar the waterbodies are little different from other area of the country. Waterbodies are found in the middle of a long and huge landform. These areas are known as wetland or seasonal water bodies. Waterbodies have clear identification in the upazila SRDI map. Three distinct types of waterbodies are found in upazila SRDI maps.

- Rivers
- Ponds
- Seasonal waterbodies/wetland

Table 3: Types of waterbodies

Waterbody	Area (acre)
River	2424.97
Pond	527.48
Seasonal Water	18358.40
Total	21310.85

Rivers in upazila SRDI map is shown with a light blue color. In Savar upazila SRDI map there are two major rivers flowing both side of the upazila. Turag to the east and Bangsi to the west. Around 2424 acres of river area and estimates to be around 130 km long rivers are flowing around the upazila. During summer time the ponds become narrower and drier. Amounts of pond are found very little this map.

Seasonal waterbodies mean where water nearly stays nearly 6 months. In this context there are numerous waterbodies which carry 6 months' water over the years. These typically lower than the normal areas. Mostly during the rainy season and the wetland get wet and before the beginning of summer these areas get drier as it was before.

Land use change in environmental components

Savar has seen a huge in environmental and social setting over the last 40 years right after the liberation war. The economic and social growth attracted the people to migrate here from the remote corners of the country.

Changes in agricultural land

Agriculture in Savar upazila saw a huge change over the course of last 40 years after the liberation of Bangladesh. Huge number of population migration led this upazila to one of the most poilus urban area of Bangladesh. The number of population had a great impact in the agricultural activities of this upazila. In the 1950s there were less population but all the people were local, they only have to cultivate for their basic need of food. That's why the agriculture was not much wide spread here in the upazila. The table below shows the actual scenario of the agriculture of this upazila.

Table 4 Agriculture in Savar Upazila

Agricultural Land		
Year	Area	Change %
1953	30818.43	
1992	46950.94	52 %
2015	17874.22	-62%

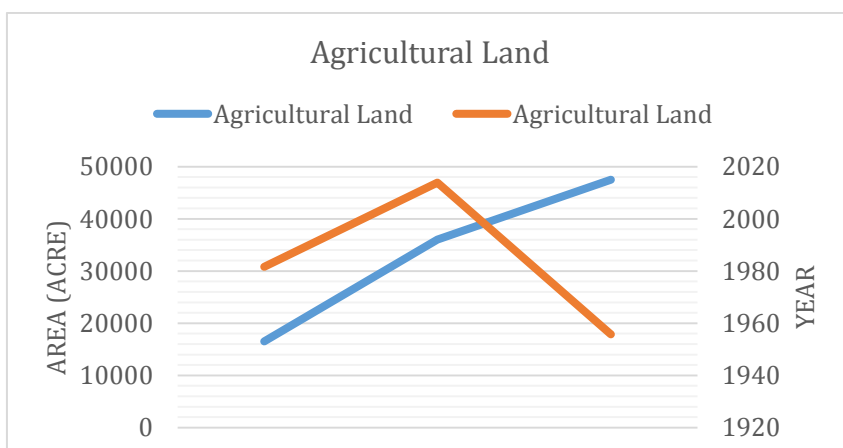


Fig 2 Change in agricultural land

In 1953, the agricultural land counts to be around 30 thousand acres, as there have been less population for the purpose of agricultural activities. Since then over the last 40 years to 1992 it saw a 52 % increase in its agricultural activities. But since the beginning of industrial and population migration began to happen in the upazila the amount of agriculture land drastically reduced to 17874 acres in space of 20 years. It saw a major jolt in the field of agriculture and cropping pattern.

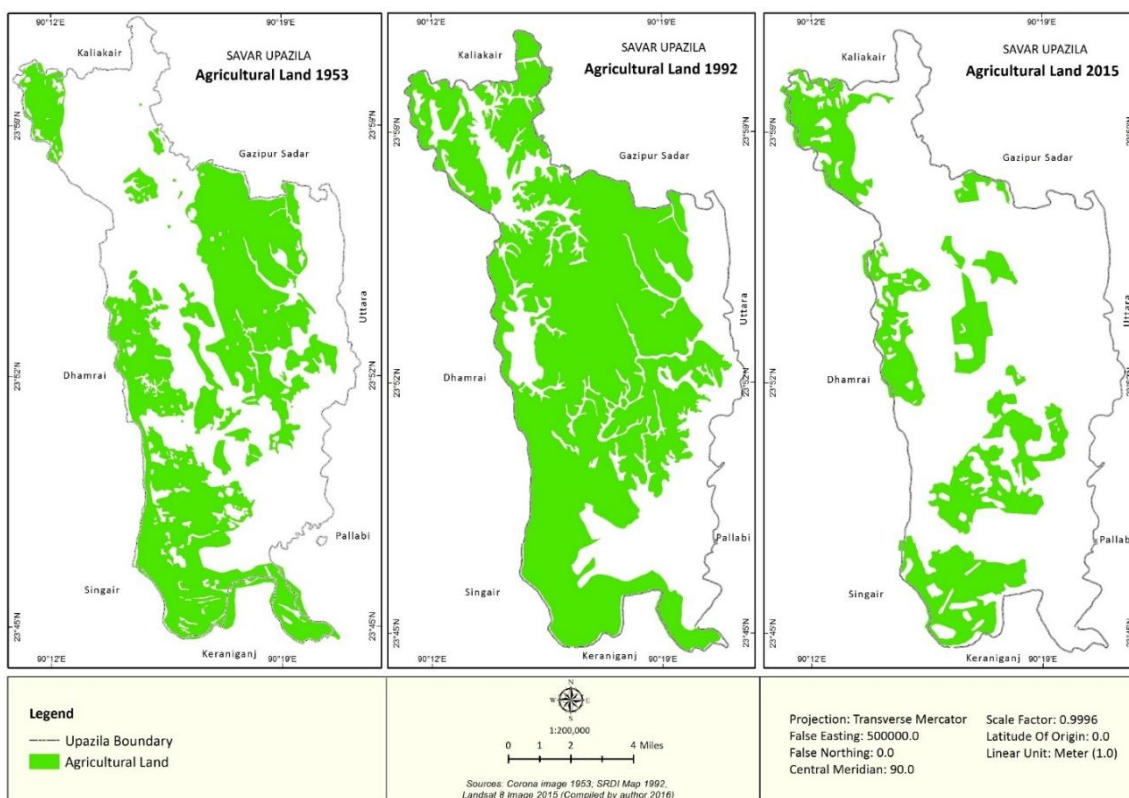


Fig 3 Agricultural change map (1953-2015)

Changes in Homestead Vegetation

The amount of homestead vegetation in the early 50s had been less as the population count was not much dense. When the population and the number of people for feeding started to increase the then the people started to spread out around the whole upazila and they chose to build their own home for their betterment and purpose. This process saw the increase in homesteads vegetation in the upazila.

Table 5 Homestead vegetation change in Savar Upazila

Homestead Vegetation		
Year	Area(Acre)	Change %
1953	4489.31	
1992	5300.89	18 %
2015	24231.70	357%

The above figure shows that in 1953 there were only 4449 acres of homestead vegetation and the amount was very minimum for a population size like this. The number of population started to increase and the number rose to 5300 acres and the growth was only 18%. But since the migration of population in this area came in a large scale people started to spread out all over the upazila to build their home and they practice homestead vegetation for it.

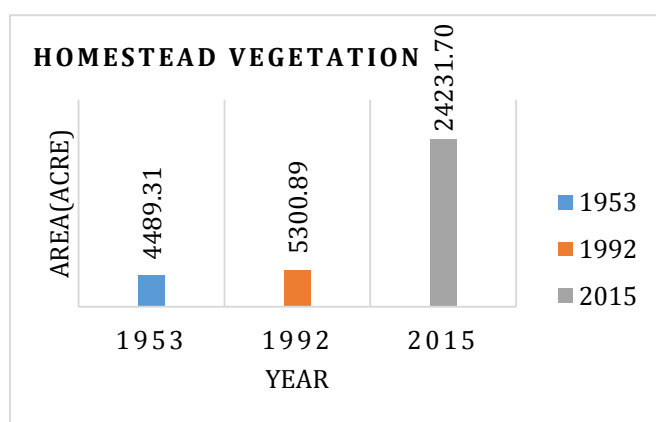


Fig 4 Change in homestead vegetation

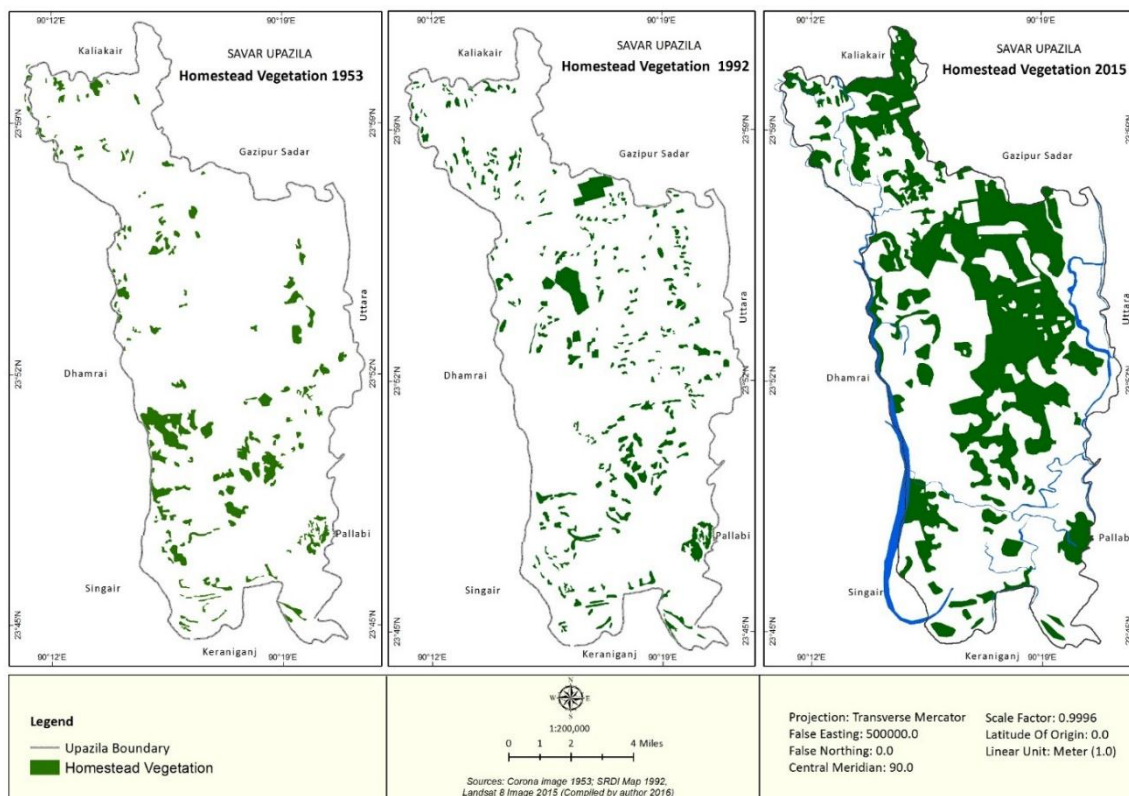


Fig 5 Homestead vegetation change map (1953-2015)

Figure 4 Homestead Vegetation Change of Savar Upazila

The map clearly shows that the amount of homestead vegetation was not that much in amount in 1953. But the 1992 map shows that the homestead vegetation started to increase along with the migration of population and finally the decade of 2010 has a great rate of increase in homestead vegetation.

Changes in Waterbodies

Savar is a upazila where two of the major rivers of Bangladesh runs though the west and east side of the upazila. The Turag river runs in the eastern part of the upazila and the other one Bangsi to the west. But the development in industrial sector, the reduction of agricultural land other major environmental factor is hampering the rivers and waterbodies very severely.

Table 6 Waterbody change in Savar Upazila

Waterbodies		
Year	Area(acre)	Change %
1953	32936.42	-
1992	21312.57	35%
2015	20372.93	4%

Table 6 waterbody change in Savar Upazila

Huge amount of water channel once ran through the middle and different sides of the upazila. During the middle of the 20th century the waterbodies were filled with water and the natural habitats were very pleasant to watch. The livelihood centered with rivers and lakes were dependable for the people of this region. But in the course of time and changes in the upazila saw the river channels and waterbodies declining greatly. Once the amount of water bodies in the 1950s in savar upazila was around 3293 acres but it saw a huge

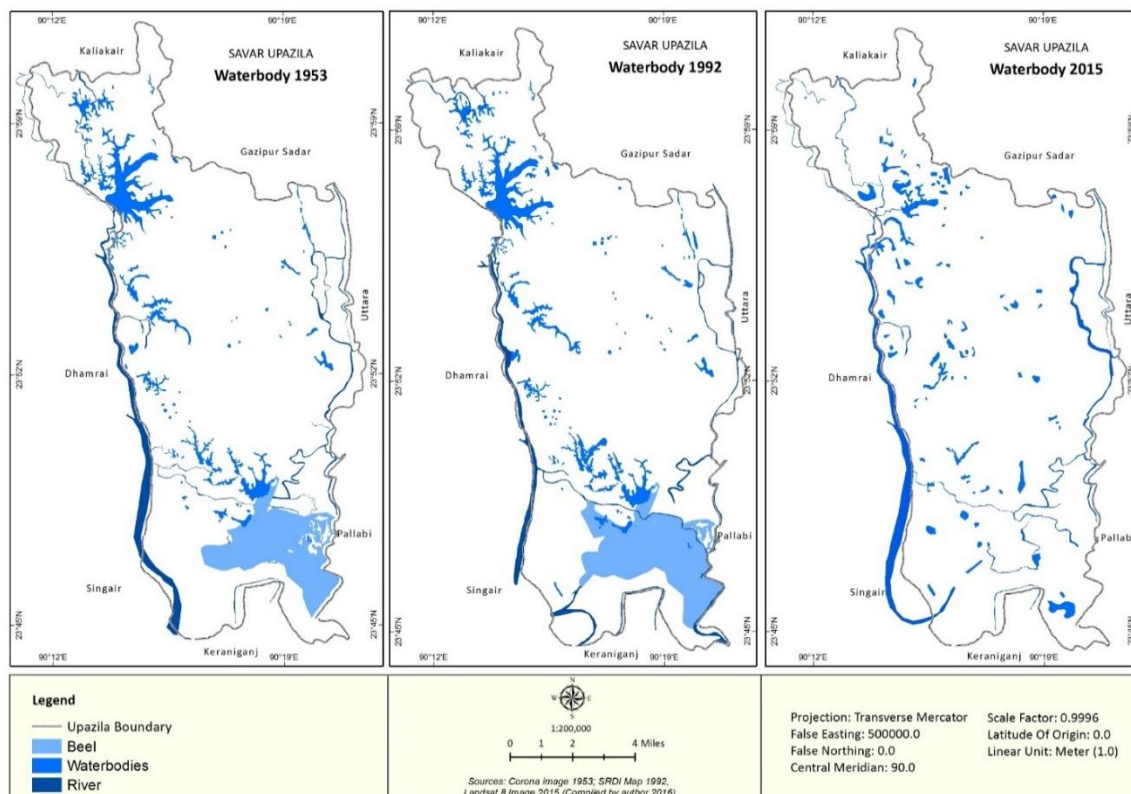


Fig 6 waterbody change map (1953-2015)

35% decline 1992 in the time of only 40 years. Since then the reduction of waterbodies found a little stability in the declination of waterbodies as most of the area where can be disturbed are already destroyed by land filing, agricultural activities, hosing developed and other different purposes are also responsible for this.

Changes in Settlement

Settlement issues is probably the most sought issues in Savar upazila. The population of this upazila is most in Bangladesh and the density of population is about 4,951/km² in this upazila, the highest for any upazila in Bangladesh.

Settlement		
Year	Area(acre)	Change %
1953	4489.31	-
1992	8272.21	84%
2015	32965.32	298%

Table Settlement change in Savar Upazila

In 1953 there were only 4489 acres of settlement existed in Savar upazila. But the next forty years saw a moderate growth in settlement and population along with the increment of household growth and migration. But the change from 1992 to 2015 number is massive. Around 300% population/settlement increased in the meantime. No upazila in Bangladesh have this kind of such change in demography and as well as in settlements

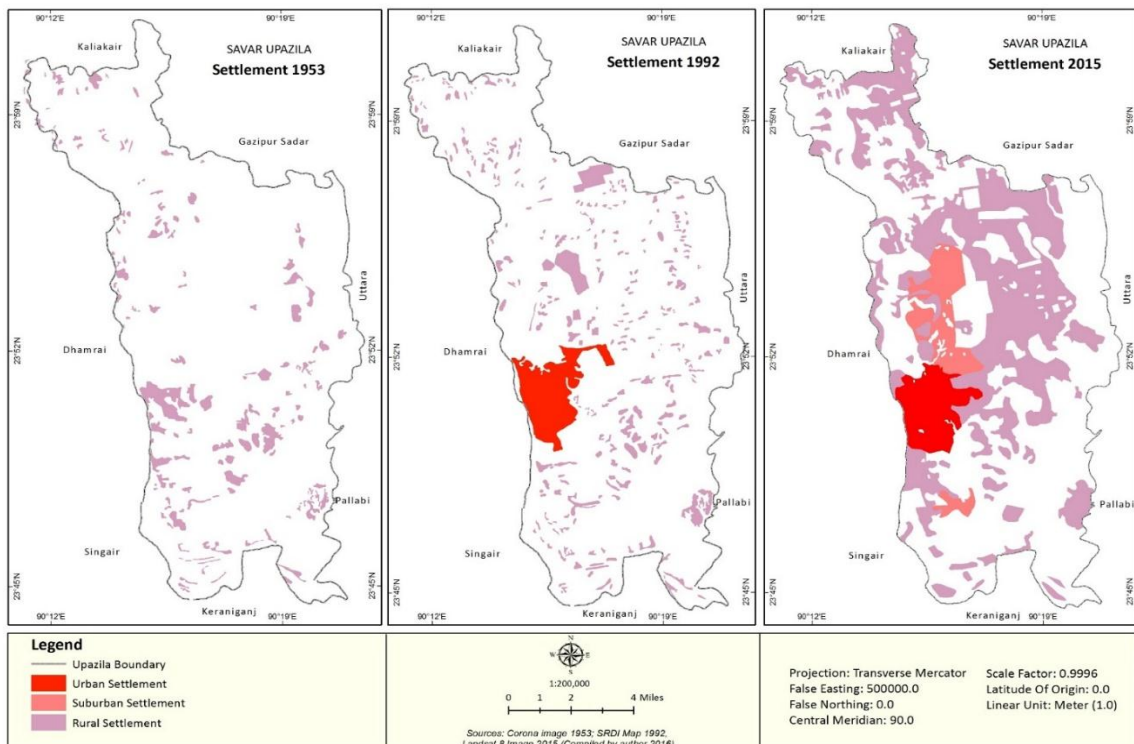
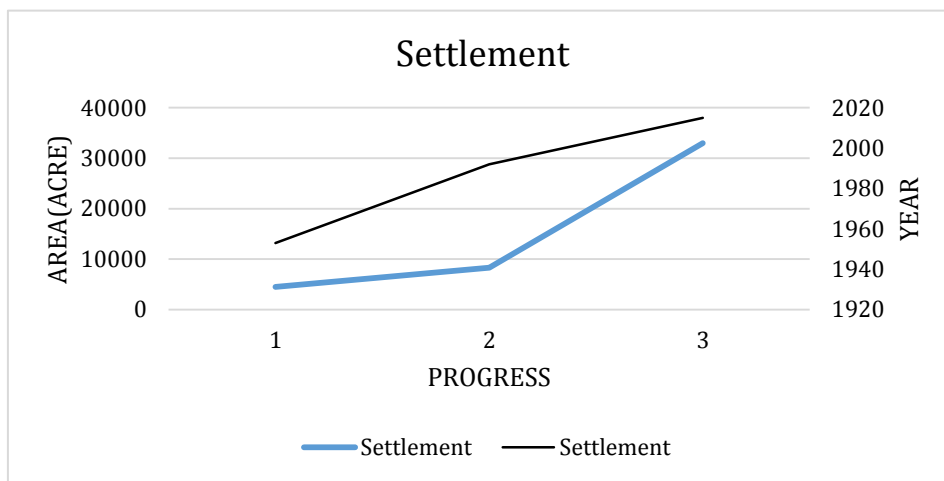


Fig 8 Settlement change map (1953-2015)

IV. CONCLUSION

GIS and Remote Sensing is a great tool for assessing land use and land cover changes. Historical documents can be compared in depth with this technology. The environmental changes in the Savar upazila is huge among all the upazila in Bangladesh. Sector like agriculture, communication, transport, waterbodies, settlements and industrial l sectors saw major growth and change in every aspect. This happens only due to the population pattern and other factors like very well placed near the Dhaka city and adjacent to the top living areas of the country. This continuous process reaching its new high each passing days.

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