Land use and Land Cover Change Detection of Ganakbari Mauja in Savar Upozila

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GJHSS-B Classification : FOR Code: 120504

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Abstract- The aim of this work is to study the changes in land use in the study area in manner that can aid quick and useful decisions for the purpose of land development, administration and planning for a sustainable environment. The main objective of the study is to analyze the land use changes in Ganakbari Mouza. This study has used mainly primary and secondary data. Stratified random sampling was used for primary data, and secondary information (data) was collected from various secondary sources. Findings revealed that in liner pattern of growth which is taking in haphazard manner. Irresponsibility of RAJUK and other related development authority is the main cause of this haphazard growth. Lack of land use policy, zoning regulation and other controlling rules and laws are also responsible for this uncontrolled and unplanned development. But as a potential area of development, Ganakbari may play an important role in whole region. It may also the role of an efficient and suitable satellite city for the megacity Dhaka. It is concluded that remote sensing and GIS tools provide an outstanding platform from which accurate information on Land use changes and patterns can be obtained and that Ganakbari area of Dhamsona union has experienced tremendous changes in land use, so efforts should be made to regularly update available data in order to control further development.

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I. Introduction

L and use referred to as man's activities and the various uses which are carried on land. Land cover is referred to as natural vegetation, water bodies, rock/soil, artificial cover and others resulting due to land transformation. And digital change detection is the process that helps in determining the changes associated with land use and land cover properties with reference to geo-registered multi temporal remote sensing data. The use of remotely sensed data (satellite and aerial) to detect changes in Land use as well as precise and accurate analysis using GIS is widely preferred over other conventional survey techniques because the method is very efficient for assessing the change or degrading trends of a region, from a small city of about 200,000 in 1947. Dhaka has grown into a crowded metropolis of over 4 million people by 1987. During the 1960's and the city's annual rate of population growth was nearly 10 percent, being, one of the highest for any city in the world (Fouzder, 2005). The acceleration rate of population growth in and around the DMA makes a tremendous pressure on land and on urban infrastructural services. Dhaka city is growing very rapidly towards its west and north-west direction. The fringe areas are being changed due to numerous causes and land use is changing. The causes responsible for such change is like rapid population growth, diminution of interesting agricultural sector, there is strong tendency of urban expansion in the suburban Ashulia, just lying outside the DMA. Ashulia union, as a developing peripheral area has a great potentiality and efficiency to be established as a well-designed industrial town. Its influences and linkages are speeded over a broader scale because of its good communication network. With the inclusion of study area is into the jurisdiction of the RAJUK in 1989. It has received further impetus to growing a rapid manner. The transformation of land use and its potentialities in the northwest and west fringe of the city of Dhaka will be identified. As an agro-based country, this region also not poles apart from any other region, but after construction of "Asian Highway" in 1996, a tremendous change has been transpired here and modified the aspect of this region. This road provides multi dimensional advantages and promotes interactional trade and socio-economic development of this region. Moreover in 1985, Savar was included into the greater Dhaka city and declared as an industrial area by the RAJUK. Since, savar had located close to Dhaka and Asian Highway passes through hit. The area becomes an important place of urbanization. In one hand a number of industries are being established here. Due to the impact of advanced transportation network and communication systems rapid land use changes, reduction of agricultural land, development of local economy, increase of employment opportunity, increase of demand for land can be seen. This area is located within the jurisdiction of greater Dhaka but RAJUK is not condemned about it. That's why most of the housing projects are constructed in this area along the highway without following any rules and regulations. In this connection we conducted research on land use and land cover change detection of Ganakbari Mauja in Savar Upozila.

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II. Objectives of the Study

To analyze the land use changes in Ganakbari Mouza and prepare a land use map of the study area.

III. Methodolgy

Ganakbari Mouza is at Dhamsona Union in Savar Upzilla of Dhaka District is our study area. In this study the necessary data and information were collected from the primary and secondary sources. For primary data, stratified random sampling was used to draw respondent interviewed. Stratified Random Sampling was selected for this study because it reduces the chances of having an unrepresentative sampling. Stratification is based on certain stratums. The secondary data and information were collected from various sources like published materials in the form of books, conference proceedings, journal, and thesis. Studies and office work of both government and semi government office and few unpublished reports will be reviewed to prepare a conceptual frame work for the study. The satellite data was enhanced using histogram equalization in ERDAS Imagine 9.3 to improve the image quality and to achieve better classification accuracy. During the survey period various land use will be observed and ground truth of this union. Local people opinion will be collected from a questionnaire survey about the land use changes of the Ganakbari Union.
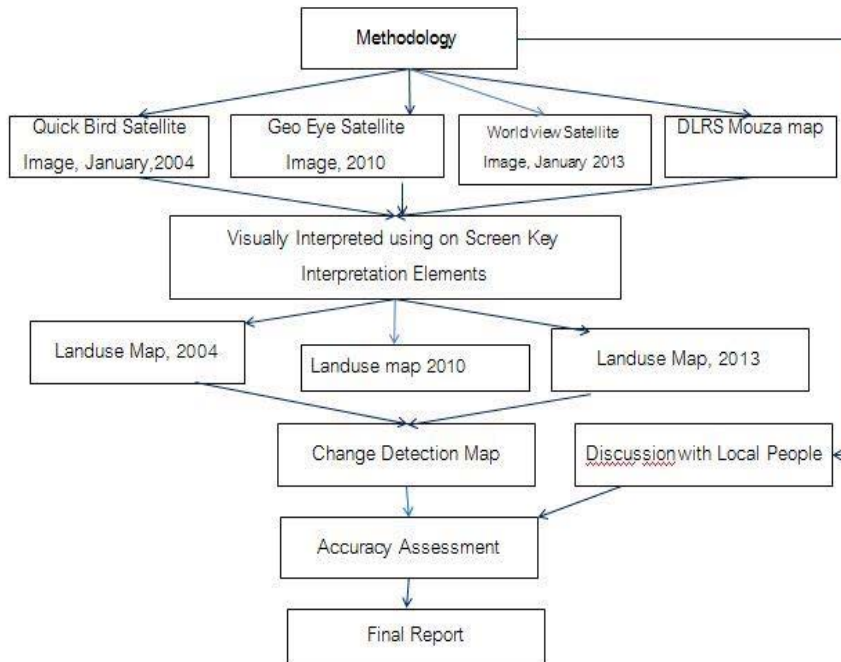
Flow chart depicting the change detection method
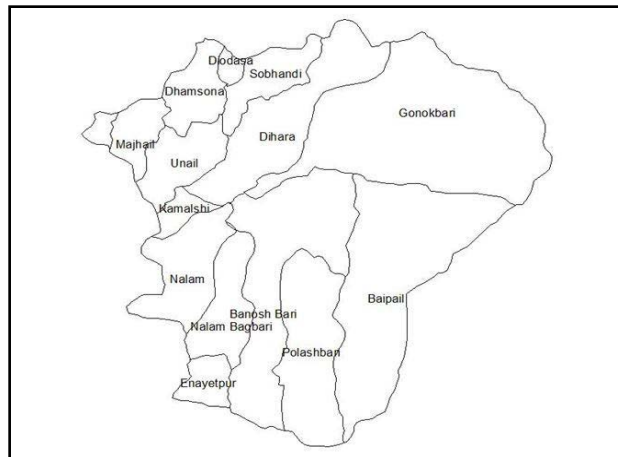
Figure 1 : Flow chart of the methodology

Figure 2 : In a map Ganakbari Mouza

Figure 2 illustrated that in a map details scenery of Ganakbari Mouza and one of the 14 mouza of Dhamsona union as well as Ganakbari.

Table 1 : At a glance Ganakbari Mouza

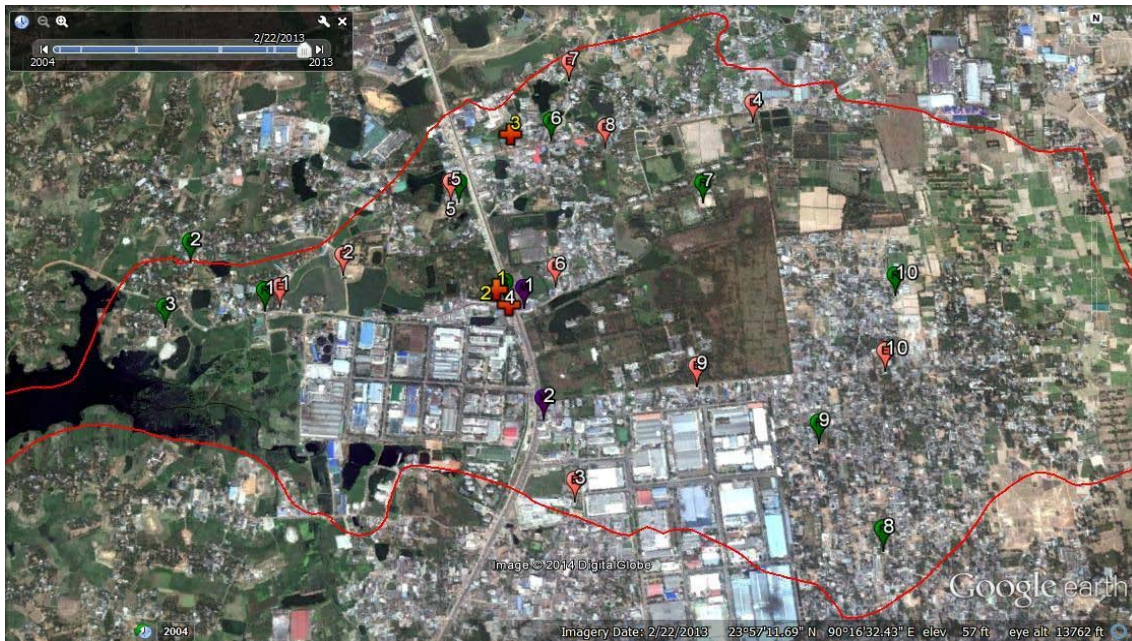| Content of Ganakbari Mouza	Details	Content of Ganakbari Mouza	Details
Area	2096 acre	Number of educational institution	10
Total population	12500	Number of Religious institution	10
Literacy rate	42 %	Number of industry	47
Public health care	3	Super market	2

Figure 3 : The satellite image of Ganakbari Mouza

Figure 3 showed in satellite image, the position of 10 educational institution as red 'E', 10 religious institution as green 'R', 2 super market as violet 'M', 3 public health care as red '+'.

IV. Results and Discussions

a) Land use and Land Cover Change Detection

Land use in Ganakbari mouza: Ganakbari area is connected with several important roads which influence other areas. Baipail-Tangail highway plays a very significant role on the changing characteristics of the land use pattern in this area.

Comparison on land use among 2004, 2010 and 2013: Land use in Ganakbari drastically changes in last ten years. In 2004 most of the land of Ganakbari was being used for agricultural as well as industrial purposes. There were vast vacant land and water bodies. But at 2013 it was observed that vacant land and water bodies have been reduced. Vast area under agricultural use has been transformed to residential ones which have been aggravated by rapid population growth. The demand for more space arising out of rapid growth of housing, food production, market expansion, communication, commerce, industries etc. is going to exert even more competing pressure on land; and this will play significant roles in land use change of Ganakbari in future.
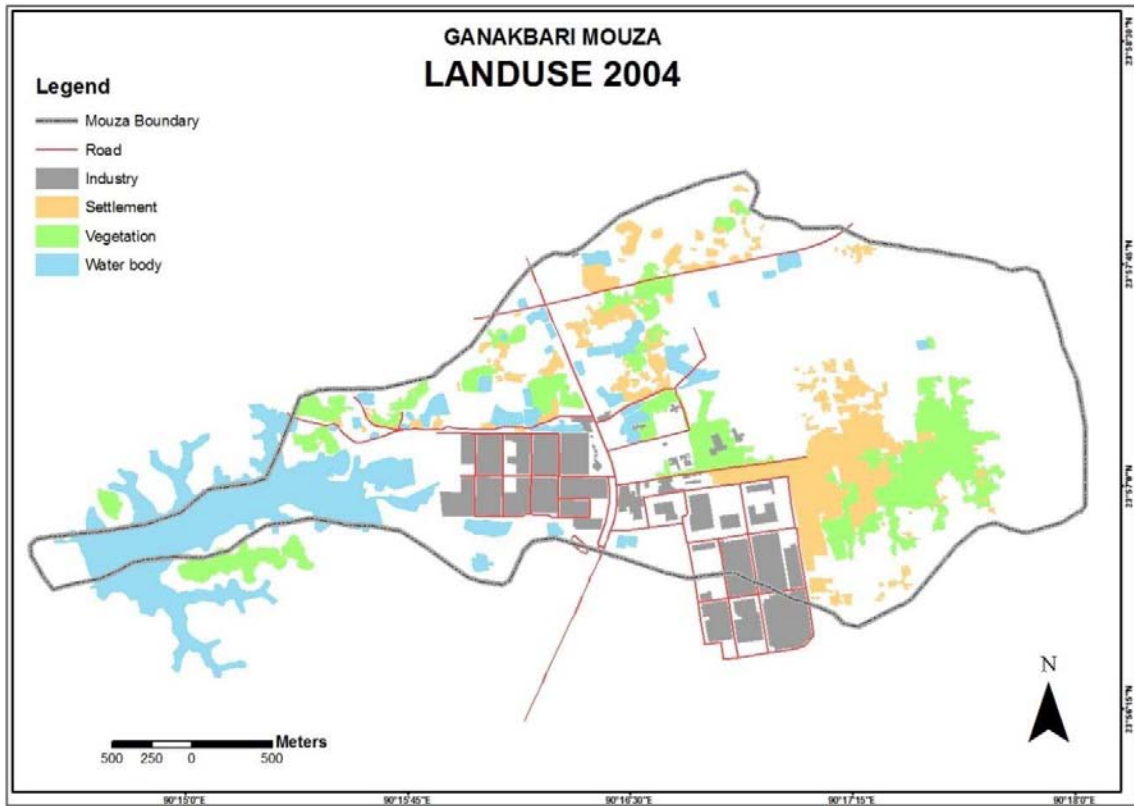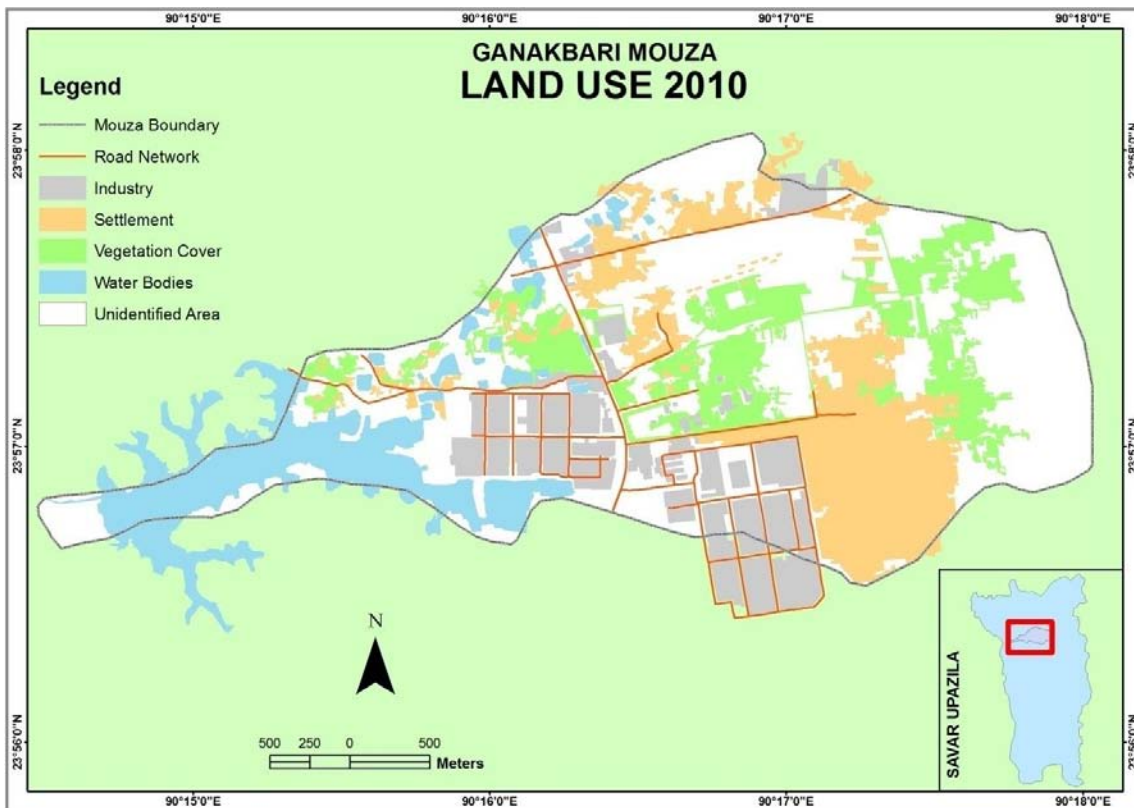
Figure 4 : Land Use Pattern in 2004

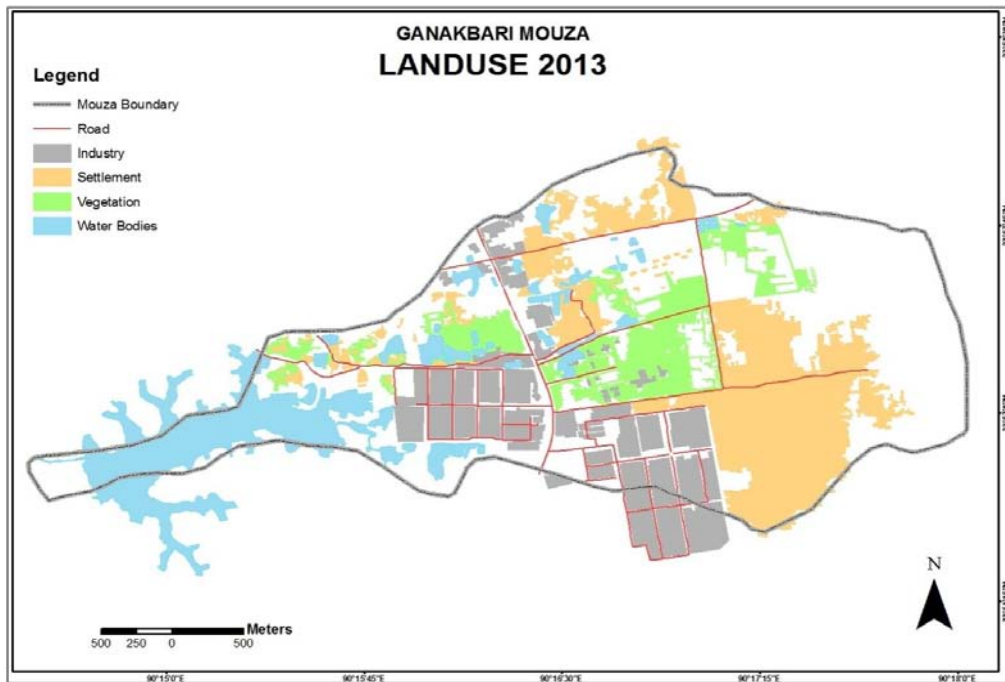*Figure 5 :* Land Use Pattern in 2010

Figure 6 : Land Use Pattern in 2013

From the above figures (4-6), confirm that the land use has been changed mainly for settlement, industry and commercial sites, water bodies and vegetation areas.

Land use Change in Vegetation or Agricultural Lands: The agricultural land is gradually deceased because to 1) continuation of urbanization process and its impact upon the agricultural land 2) location and distance from the edge of the city 3) distance from the Dhaka–Tangail high way which is national arterial road and 4) the physical quality of the land in the study area.

Table 2 : Changing pattern of agricultural land area 2004 -2013

Feature	2004	2010	2013
Vegetation	213 acre	201.20 acre	184 acre

Land use Change in Settlement: In Ganakbari highland are associated with human settlement and the lowlands are used in agriculture purposes. In the floodplains of northern and western side of Ganakbari, many settlements are existence. The present settlement in Ganakbari is randomly distributed, with few buildup concentrations in high terrains. But on the basis of topography characteristics water supply situation and transport system has led to highly scattered population distribution with a distinctly dispersed pattern of settlement and due to scarcity of raised lands along with the increase pressure of population, the compact patterns of settlement throughout the area has been created. The flood free highland in Ganakbari has been focus point for organized housing in the manner of cooperative housing societies for the migrated workers of DEPZ. Major concentration housing society has been observed along the Dhaka-Tangail highway. Some of these residential districts have been established around the DEPZ area. Actually the maximum area of Ganakbari mouza is under DEPZ and atomic energy research institute. Many bare lands are found inside AERI area. The eastern and western side of Ganakbari is very populated area. Maximum people of there are migrated and garment workers changing pattern of settlement area 2004 -2013.

Land use change in industry and commercial sites: Industrial development pattern has in influence over the whole system of an urban area. Due to centrifugal migration of industry and commerce, more and more industries quit from the core city and get themselves placed in the sub urban township like Dhamsona union, more specifically in Ganakbari mouza. Even two decades ago, Ganakbari was rural areas which serve only the agricultural product but the scenario has drastically changed. Commercial land use in Ganakbari mainly consists of market and some sort of shopping center, which includes small shop, retail and wholesale trading. The major concentrations are located mainly in DEPZ area and have expanded in a liner from beside the Nabinagar-Tangail highway.

Land use change in water bodies: There is no river in the study area. There are some ponds. The ponds were cut at 1992-94 to take the soil from here, and make the DEPZ area in higher position. Due to population increasing, the ponds and low lands are filled up and new infrastructures are being built. At 2004, the water

bodies of the study area were 322 acres, which has been decreased to 317.51 acre at 2010. This process is ongoing and became 289 acres at 2013. As it is an industrial area, many people is migrating themselves daily to work in these industries. So the water bodies of this area are being filled up and new rooms are built up. So the water bodies are being reduced.

b) Findings

Having completed the stage of database implementation, user friendly analysis is made possible in the GIS environment. The program presents an interface, which enables the user to make a choice based on the user's aims and objectives. The real strength of GIS comes in when a relational database in linked with the graphics in real time. A good GIS allows the user to select attributes in the database and to view the results on an interface displayed which can be printed as hard copy. These operations are carried out in this work and some of the results are as displayed and discussed below.

c) To Analyze the Land use Changes in Ganakbari Mouza

The main features of the study area Ganakbari are industry and commercial sites, vegetation area, water bodies and settlement. Here are given the change detection for these features individually-

Change Detection for Industry and Commercial Sites: In the study area there is being built high infrastructures, which are used for factories and commercial building like market, cinema hall, bazaar, showroom, pharmacy, grocery shops etc. At 2004 the total area used for industry and commercial work was 186 acres. Again that rose at 2010 with the area of 265.57 acre. At 2013 it has been increased to 284 acres. So it is clear that the areas which were bare or low land or agricultural land became exchange with factories and commercial infrastructures. With the help of GIS application the change detection for industries and commercial sites have been found out. To analyze the Land use change detection of Ganakbari mouza it has been individually worked for the features. Here the industrial areas change detection is given-
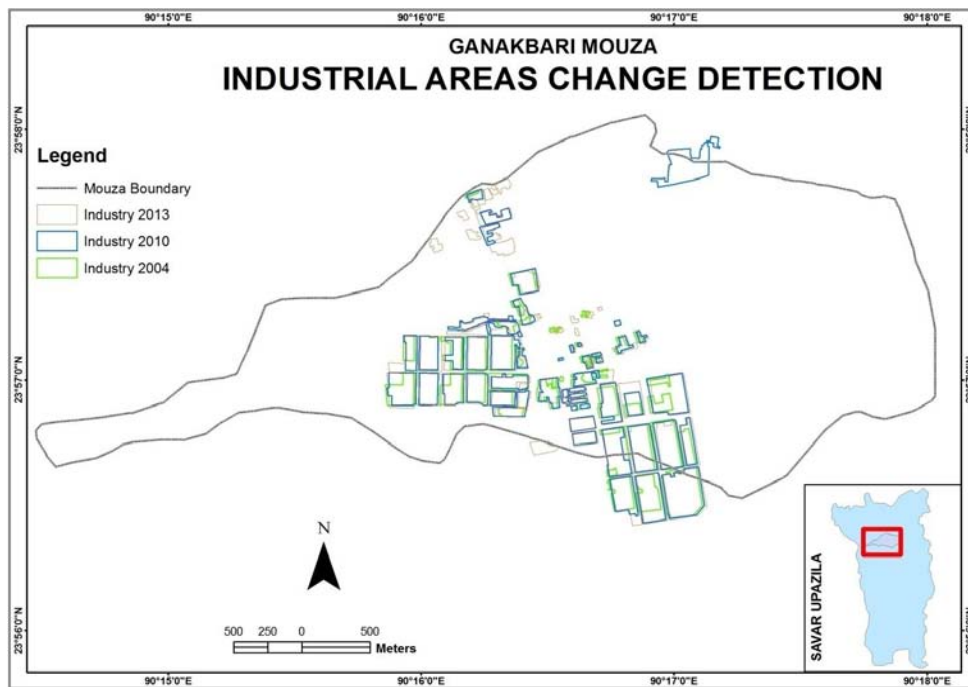

Figure 7 : Change detection for industry and commercial sites

Change Detection for Vegetation Areas: Ganakbari mouza was a green vegetation area two decades ago. At 1993 the DEPZ industrial area was starting to build up the factories. As a result the vegetation areas were cut down to make the space. As the research is worked with the time period between 2004 and 2013, so, it is described about the deforestation for this time interval. At 2004 the total area under vegetation cover was 213 acres, which was reduced to 201.20 acre at 2010, and at 2013 it became to 184 acres. So it is clear that the vegetation cover areas are being decreased for making the space for new migrated people. With the help of Google Earth and ArcGis the change detection for Vegetation areas have been found out. To analyze the land use change detection of Ganakbari mouza it has been individually worked for the features. Here the vegetation areas change detection is given-
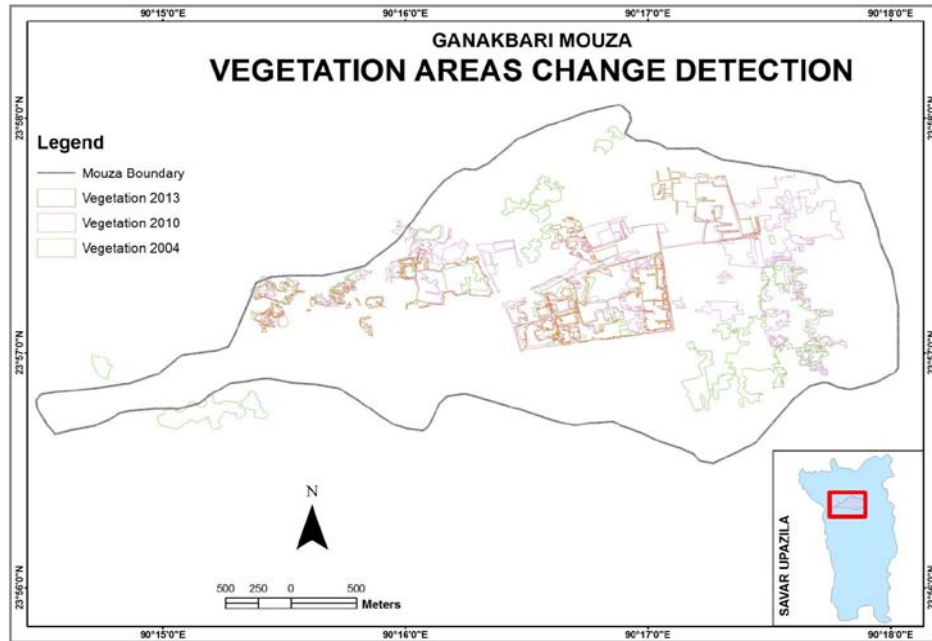
Figure 8 : Change detection for the vegetation areas

Change Detection for Water body's area: There is no river in the study area. There are some ponds. The ponds were cut at 1992-94 to take the soil from here, and make the DEPZ area in higher position. By the passing of time the position of Ganakbari area has increased. As a result these ponds are being filled to make over place for the extended people as well as for the newly migrated peoples. At 2004, the water bodies of the study area were 322 acres, which has been decreased to 317.51 acre at 2010. This process is ongoing and became 289 acres at 2013. As it is an industrial areas, many people is migrating themselves daily to work in these industries. So the water bodies of this area are being filled up and new rooms are built up. So the water bodies are being reduced. Here the water bodies areas change detection is given below in figure-
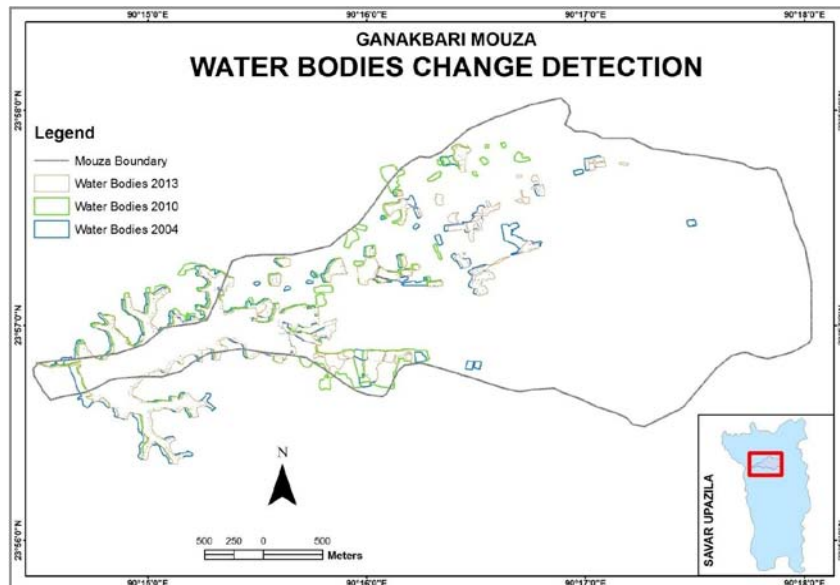

Figure 9 : Change detection for the water bodies

Change Detection for Settlement area: Maximum area of Ganakbari mouza is under DEPZ and Atomic Energy Research Institute. Many bare lands are found inside AERI area. Settlement is the feature that changed most. At 2004 the settlement area in Ganakbari mouza was 174 acres. It became double at 2010 within 6 years. That means it was 380 acre at 2010. Again at 2013 it raised up to 441 acres. So it is clear that the population of Ganakbari mouza is increased in alarming rate. To make space for the people of this area, the bare and low lands

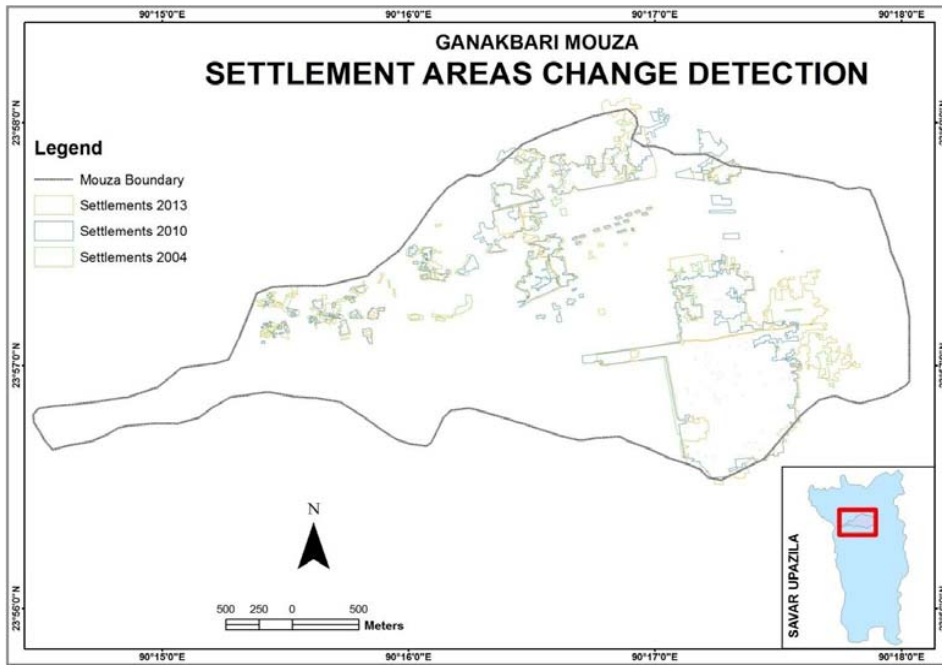are filled up. New houses are built up. Here the settlement areas change detection is given below in figure-

Figure 10 : Change detection for the settlement areas

d) To Prepare a Land use Map of the Study Area

I have prepared the map where the main features water bodies, vegetation areas, industrial areas, settlement areas as well as the educational institutions, religious institutions, medical centers, super market, roads have been shown. In this land use map, the vegetation areas are shown in green colour, industries and commercial areas are shown in ash colour, water bodies are shown in blue and settlements are shown in orange colour. Again the educational institutions are shown as yellow point, religious institutions are shown in blue stars, medical centers are in red+sign and super markets are shown in green points.

The land use map of the study area is given below:

Figure 11 : Land use map of the common features of Ganakbari mouza

V. Recommendation for the Future Land use

Policy to control further commercialization: Taxation policy is recommended aiming at controlling commercial use of building is four times then that for residential use. This difference of taxes for residential and commercial use of buildings should be mire widened in order to discourage expansion of commercial land use. Through the low land is of agriculturally high value thus this type of land has to be saved. In recent year this kind of land is being used for industrial purpose mainly for super market. On the other hand this type of land is also being engulfed by land filling. Of the low land is converted into the residential or commercial uses the agricultural intensity will be decreased. So, necessary steps have to be taken for saving the high agricultural value land. In the study area sporadic land uses are found. There should be provision for land use zoning. Agricultural, industrial, residential and commercial area should be zoned for better utilization of land and escaping from the noxious environment condition.

Guidelines to regulate the residential growth: Though the population of the study area is increasing day by day and housing facilities are very essential for the over population, the agricultural land is being used for the residential uses. So, some following steps should be taken-

➤ The Municipality should prepare a plan for housing for the newly built up areas as soon as stated in DMDP;

➤ Existing build up areas should be restricted for further development by enacting strict rules and regulation;

➤ The housing in the too much congested areas should be relocated in the newly built up areas by providing them incentives and necessary compensations;

➤ After relocate some housing in the planned areas the remaining housing states should be serviced with necessary civics facilities and the internal roads should be widened or constructed where necessary by the concerned authority;

➤ Zoning should be introduced in the newly built up areas and should follow strictly by the developers;

➤ The person who seeks the pitfall and take the advantage of the rules by illegal persuasion should be punished firmly by the concerned authority;

➤ Needed to coordination of plot distribution between the high medium and low income group;

➤ Construction of buildings must follow the modern technologies. More emphasis should be given on height density thus constructing the high rise buildings up to 10 storied for the middle class people to accommodate more and more people and reducing the pressure of population growth in the area;

➤ People will be discouraged to construct buildings in a close proximity of Baipail-DEPZ Highway. They should maintain the rules of 50 meters distance from the highway while taking any initiative of construction of residential buildings.

a) Summary

Ganakbari is the top most important area under Savar Upzilla. Dhaka EPZ is situated here. Many people work in the factories here. Information on land use/land cover in the form of maps and statistical data is very vital for spatial planning, management and utilization of land. Remote sensing data and analysis techniques are now providing detailed information for detecting and monitoring changes in land cover and land use. This research work showed that the land use change of Ganakbari Mouza within 2004 to 2013. Agricultural land has been decreased because of making settlement for the garment workers. To conserve our environment, we should take sustainable development planning.

The urbanization process of an area is directly related to the population change in a given time. The size of population may due to annual growth rate of increase of migration rate. The population change in Ganakbari plays a significant role in transformation of large scale land use, in response to the increased modification of rural land for urban use.

Sporadic residential land use is increasing in the study area by engulfing high value agricultural land, population growth, flood free high land, transport facilities, infrastructures development and industrial establishment. Those are the main factor for this fringe area development.

Agro based settlement pattern was the main character of the study area. But now residential areas occupy 48% of land. This area is practicing the growth of mixed land use. Agro land fallow land are gradually shifting to mainly commercial, industrial and residential exercise and result a colossal pressure on the society economy environment in this area. The study also examined that the growth pattern of Ganakbari over the past decades using maps and spatial analytical capabilities of GIS. Survey research will used to identify the socio economic characteristics of the population found in these areas. An analysis on how population change affects the land use pattern, socio economic condition and infrastructural development of Savar using the data of past periods.

Thus the study reveals with the major findings of trend of population changing, socio economic changing, development trend on Ganakbari (from 2004-2013), its existing land use pattern, land use changing

pattern and impact of such type of changes on the area and some consequent recommendations.

The land use transformation process in Ganakbari has been started after 1993; basically it took place along the Baipail-Tangail highway. This study has tried to find out the changing land use trend of the site, the factor responsible for such type of changes, the problems arises for land use changes and its impact on physical, social, and living environment. Some recommendation to overcome the problem resulting from huge land transformation has been presented here existing trend to development and existing policy measure.

Due to unplanned growth and expansion of settlement, industrial and commercial establishment the community is facing numerous problems, which are influencing present physical, socio-economic and environmental condition. Some steps should be taken to overcome all of the short coming related to deviation of agro land, environmental degradation, hortage of utility facilities, lack of monitoring system, lack of active supervision of regulation for industries, lack of public open space and health care centers etc.

It can be say that there has been a rapid growth of spontaneous sub-urban settlements in Ganakbari between the last few decades due to high demand for housing. Rural to urban migration and urban to sub-urban migration are responsible for the increasing land-housing demand in this area. Infrastructure like road network, gas, and electricity influence the location of these spontaneous haphazard settlements. It is also show that the unplanned development and growth of these settlements is not sustainable in the long term.

For controlling large scale land use trans-formation and develop a planned sub urban township in Ganakbari. Government agencies have to play a vital role in term of policy formulation and proper implementation. Beside this monitoring cell and annual auditing system should be directly exercised by RAJUK. NGOS also have a significant importance to participate such type of sustainable development activities such as, enhance environment and public awareness building. Through this way a sustainable sub urban development is possible in Ganakbari.

VI. Conclusion

A gradual and almost imbalanced pattern of growth took place in the suburban township. In first two decades the growth was proportionately slow; but in last two decades the growth, flood free high land, transport facilities, infrastructures development and industrial establishments. This growth has caused great impact on inhabitant's socioeconomic status. The growth also affects the land value and increase the life expectancy. Here it is found that in liner pattern of growth which is taking in haphazard manner. Irresponsibility of RAJUK

and other related development authority is the main cause of this haphazard growth. Lack of land use policy, zoning regulation and other controlling rules and laws are also responsible for this uncontrolled and unplanned development. But as a potential area of development, Ganakbari may play an important role in whole region. It may also the role of an efficient and suitable satellite city for the megacity Dhaka. If this rapidly unplanned and haphazard growth cannot be controlled as possible as soon, it will be threaten for the sustainable development of the area in near future. A national body on suburban land use planning policy formulation, effective coordination and guidance. A local level land use planning and implementation body is also needed to be set up in this area. It is required to determine the land use change in this area on a continuous basis and control the unplanned use of land by strong regulation like "ZONING". The GIS technology has been employed to assist decision-makers by indicating various alternatives in development and conservation planning and by modeling the potential outcomes of a series of scenarios. It should be noted that any task begins and ends with the real world. Data are collected about the real world. After the data are analyzed, information is compiled for decision makers. Based on this information, actions are taken and plans implemented in the real world. It is concluded that remote sensing and GIS tools provide an outstanding platform from which accurate information on Land use changes and patterns can be obtained and that Ganakbari area of Dhamsona union has experienced tremendous changes in land use in between 2004 and 2013, so, efforts should be made to regularly update available data in order to control further development.

a) Limitations

To conducting this research work on land use transformation, there are shortcomings have been faced like time limitation, man power limitation, financial limitation, spatial limitation, unavailable secondary and primary data, Lack in covering all the aspect relating the study, Lack of co-operation during survey etc.

b) Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

VII. Acknowledgment

a) Copy Right

All authors declared that the work described has not been published before (except in the form of an abstract or as part of a published lecture, or thesis) that it is not under consideration for publication elsewhere; that if and when the manuscript is accepted for publication, the authors agree to automatic transfer of the copyright to the publisher.

b) List of Abbreviation

AERI: Atomic Energy Research Institute

DMA: Dhaka Metropolitan Area

DEPZ: Dhaka Export Processing Zone

DMDP: Dhaka Metropolitan Development Plan

ERDAS: Earth Resources Data Analysis System

GIS: Geographical Information System

RAJUK: Rajdhani Unnayan Kartripakkha

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