

Land-Use & Land-Cover Change Detection Using Remote Sensing & GIS and Planning Appraisal: A Study on Goda Mouza, Purba Bardhaman, West Bengal, India

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Abstract: Change is a natural process and it is no doubt time-relative. Jean Brunhes's idea of 'principle of activity' asserted that everything is changing or dynamic in nature and another American scholar Ms. E.C.Semple defines geography as the study of the irresistible man and the unstable earth. Therefore, it is clear that nothing is static but dynamic and ever changing that may be height of the Great Himalaya or the depth of the Pacific, those changes may be positive or negative. The inquisitive mind and sharp analytical eyes can detect or monitor those changes that are occurring around us in a given space-time framework. The land use and land cover are also changing at varying rates in response to the human activities on that particular segment of the earth's surface. The present paper highlights and analyses the changing pattern of land-use and associated land cover changes in the Goda area with the help of Remote Sensing (RS), GIS & GPS techniques. It also provides useful information regarding the limitations of those aforesaid techniques to understand the pattern of land use and land cover changes in the area and at the same time about the planning appraisals of the study area.

Keywords: Land use-Land cover, Dynamic, Remote sensing, GIS, Planning.

1. INTRODUCTION

Since the beginning of human civilization, mankind has lived in a close relationship with nature. While mankind interdependence on environment is greater than that of any other organism; his restless pursuit of progress, comfort and security has resulted in increased stress on the environment which led to land use/land cover changes over a period of time (Jaiswal, Saxena, & Mukherjee 1999). Change detection is the procedure of discovering and observing the difference in a body or phenomena by visualizing at difference times (Singh, 1989; Mouat et al., 1993, cited in Patidar and Sankha, 2015). Land-use Land-cover is an important component in understanding the interactions of the human activities with the environment and thus it is necessary to monitor and detect the changes to maintain a sustainable environment (Sreenivasulu, Jayaraju, Kishore, and Lakshmi Prasad 2014).

The knowledge of Land-use and Land-cover is important for many planning and management activities as it is considered as an essential element for modeling and understanding the Earth's features. The development activities, dynamic usage of land, increasing growth of population and varying occupation pattern of the society has resulted in reduction of land dedicated to agricultural activities (Shah, 2012). Repetitive nature of the satellite imagery data, positioning information provided by the Global Positioning System, and usefulness of GIS software provide effective methods for analysis of Land-use and Land-cover change detection in less time, at low price and with a better precision. In this present study, an investigation has been carried out in the North-Western part of Burdwan Municipality, in Goda area to detect the change of Land-use and Land-cover from 1952 (as per land records prepared by LR department) to 2017 with the help of Remote Sensing, GIS and GPS technology and

highlight the limitation of the aforesaid techniques and some planning appraisal has also made.

2. OBJECTIVES

The main objectives of this present study are

- i. To detect Land-use & Land-cover change from 1962 to 2017 in Goda Mouza.
- ii. To highlight the limitation of Remote Sensing & GIS technique in image interpretation through visual identification.
- iii. To make some planning appraisal for the study area.

3. ABOUT THE STUDY AREA

The present study area Goda Mouza (JL NO-41, RS NO-1586) is located in the North-Western part of Burdwan Municipality under Burdwan-1 C.D. Block of East Bardhaman district in the Indian state of West Bengal. The geographical location of the area is defined by the latitude $23^{\circ}14'50''\text{N}$ to $23^{\circ}16'30''\text{N}$ and Longitude $87^{\circ}49'40''\text{E}$ to $87^{\circ}51'10''\text{E}$ (Figure: 1). The area contains approximately 433 hectares. Before going depth of the study area, it is quite interesting to mention the story behind the evolution of the term "Goda". According to Austric and Dravidian language, 'Da' means 'Water' (Chowdhury, 1994). If the name of a place is end with 'Da' it denotes the place is located along a river, pond or any kind of water-body. It is believed that in ancient time Goda is located in the middle region of *Behula-Balloka-Damodar* River (Chattopadhyaya, 2000) and it is a low laying area.

The unique character of this area is one part of Goda has rural character (under Belkash Panchayat) and other part is urban character (under Burdwan Municipality, 26 no word). So, a definite line of rural-urban fringe is found here and it is very important to identify the rapidly changing land-use land-cover pattern in such a rural-urban transition area.

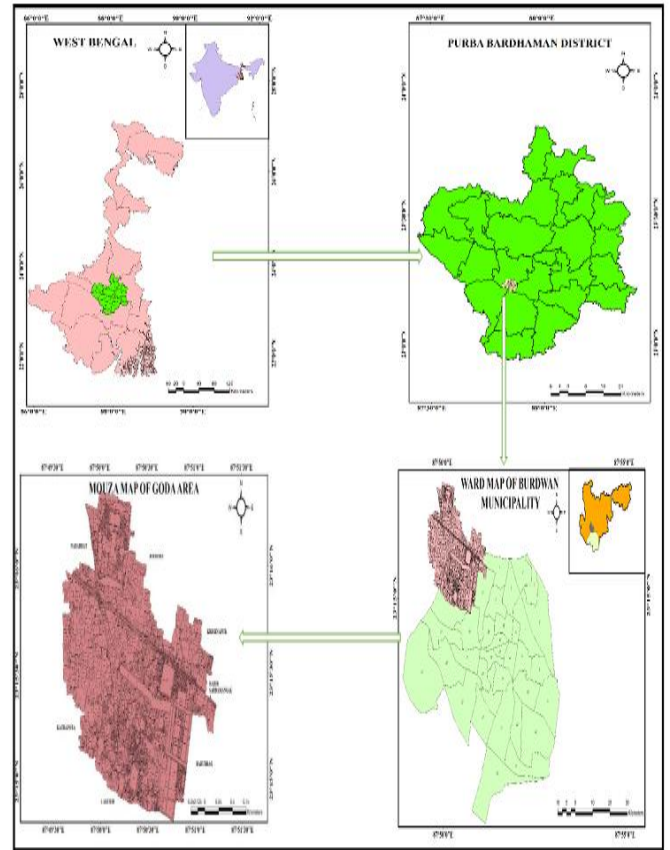


Figure 1: Location Map of the study area

4. DATABASE & METHODOLOGY

The base map of the study area collected from the District Land and Land Reform Department, prepared by the authority of Government in 1954-62 under the West Bengal Estates Acquisition Act, 1953. To detect the land-use land-cover change Google Earth image dated 24/10/2001 and 14/12/2010 were used tied with regular and intense field verification made in 2017. GPS coordinate of the extreme corner of the area is also collected during the field survey. Secondary data related to population of the concerning area is collected from the Census of India.

To fulfill the objective of the study land-use & land-cover change detection, ARC GIS 10.3 and Erdas Imagine 2014 is very powerful engine for extracting the area of interest, identification of land-use & land-cover layers from satellite image and calculation of area statistics for a micro level study.

At first, the Cadastral map and Google Earth image is Geo-referenced by define projection in WGS_1984_UTM_Zone_45N and rectification using GPX file format. After that, the boundary of the base map is overlying in the Google Earth Image and extracted the Area of Interest. Various land-use and Land-cover classes interpreted in the study area includes vegetation land, agricultural land, built up land, water-body and fallow land by manually identified the features in that image based on the image attribute and heads-up digitization (demarcating the outline of the features) in ARC-GIS shape-file format. Areal data of each land-use land-cover classes are obtained from attribute table using calculate geometry tool (Figure: 2).

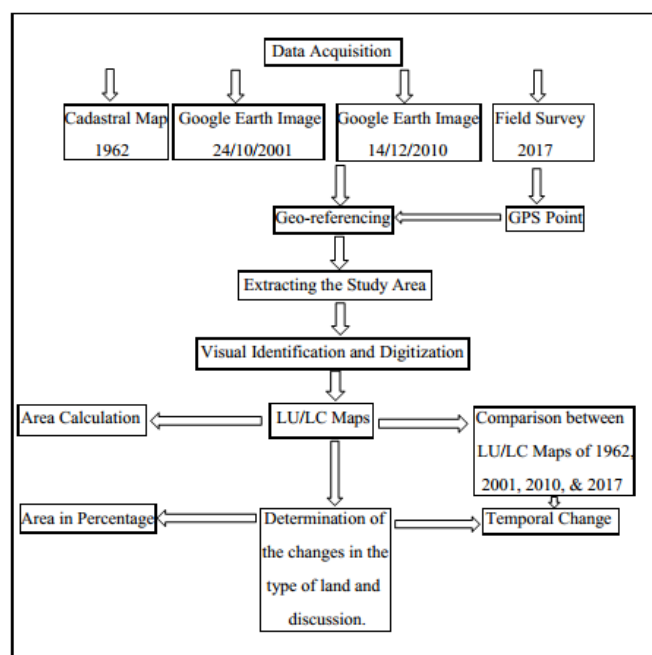


Figure 2: Database & Methodology Flow Chart

5. LIMITATION OF REMOTE SENSING & GIS TECHNIQUE

Image interpretation through visual identification of surface feature is very reliable method if the analyst is very familiar with the condition of the study area and intense ground truth verification. It is more time consuming than programmed methods. Various types of errors are also found in the degree of correspondence between observation in map or image and reality in ground. Such types of error are associated with how we define and categorize the classes

which in turns depend on the resolution of the reference map or image. As for example, if a built up area is buried under vegetation or a water-body (pond, Lake, reservoirs) is covered with 'water hyacinth' this masking materials are invisible in the satellite image and cannot be identified accurately as exist in the reality without ground truth verification.

6. FINDINGS

The outcomes and verdicts of this study are very attention grabbing and fascinating. The findings are summarized in the Table No: 1 and Figure No.3 & 4 .The land is unremittingly altering due to the activities of irresistible human and economic functions.

6.1. LANDUSE & LANDCOVER CHANGE IN BETWEEN 1962-2001

In 1962 the entire Goda area are rustic, agrarian, natural and simple in character. Maximum land is devoted for agricultural practice (52.76%) and covered with vegetation (19.12%) and water-body (13.77%) with least fallow land (8.98%). Few scattered settlement was found (5.37%) in that time. From 1962 to 2001, within a long time-span major and drastic change occur in this area. Agricultural land was decreased from 52.76% to 50.89%. Vegetation cover and water-body was also reduced in 14.77% and 6.62% respectively and most of this area was converted into fallow land and built-up area. As for example, a huge water-body in Goda named 'Nahar (meaning 'river' in Arabic) has closed and converted into a fallow land. In this time span National Highway (NH-2) constructed in the western part of this area.

6.2. LANDUSE & LANDCOVER CHANGE IN BETWEEN 2001-2010

From 2001 to 2010 coverage of Built up area increased from 9.55% to 21.45%. On the other hand agricultural land is decreased from 50.89% to 27.76%, as huge portion of land has sold for Renaissance Township and Burdwan Health City project under Burdwan Development Authority and other constructional work. Land under vegetation cover has increased from 14.78% to 24.82% in between 2001-2010 because the vacant/fallow land is covered with vegetation due to natural process. Land under water-body and fallow land has slightly increased.

6.3. LANDUSE & LANDCOVER CHANGE IN BETWEEN 2010-2017

During the field survey in 2017, it is observed that enormous change in land-use and land-cover has occurred. The rustic landscape moving away from villages and is set to soon become more urban. From 2010 to 2017 land under built-up area has positively changed from 21.45% to 31.37%

and the population is simultaneously increased (Fig: 5). Coverage of fallow land is also increased from 18.95% to 29.56%. Land devoted to agriculture concentrated in few areas covering only 12.02% of land. Vegetation cover has decreased from 24.82% to 19.54%. Percentage of land under water-body is slightly increased from 7.01% to 7.51% due to reclamation of some wetlands.

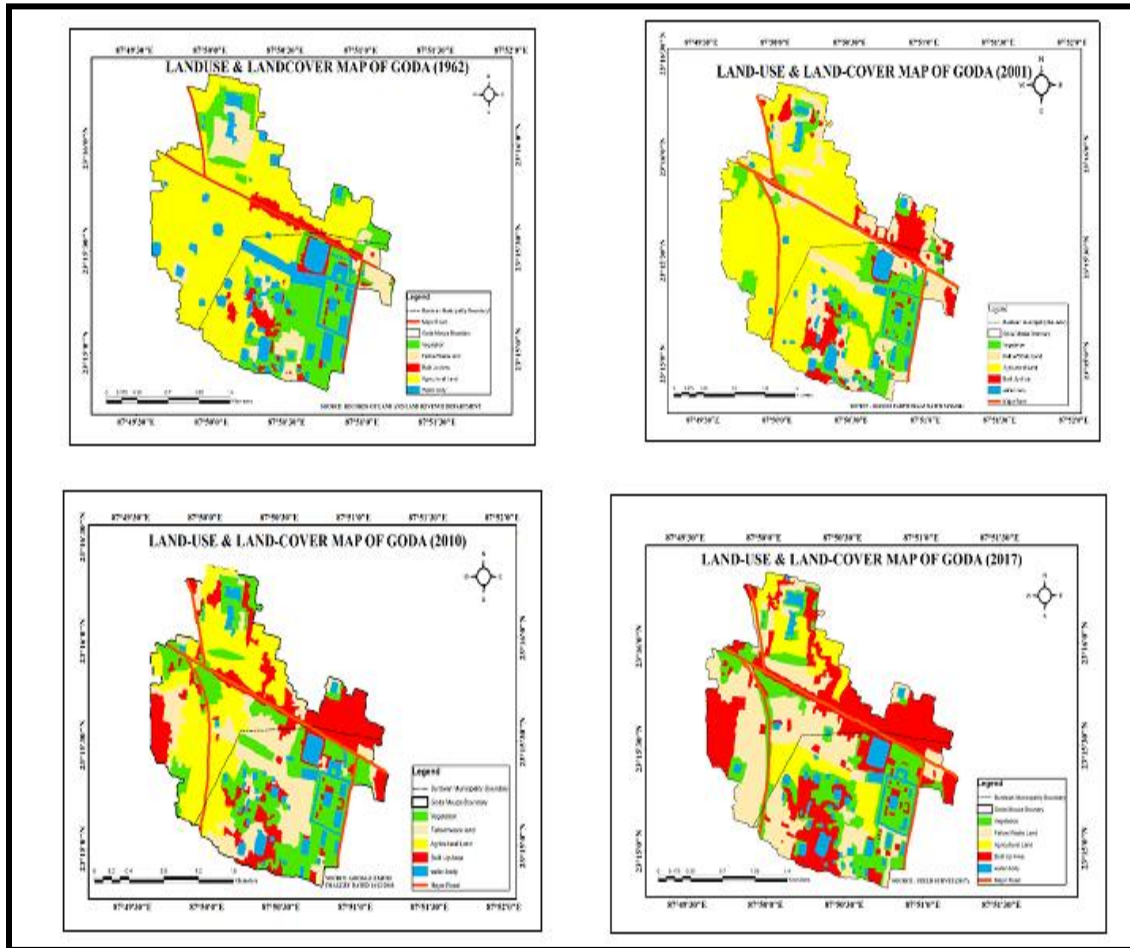


Figure 3: Land-Use Land-Cover Map (1962-2017)

Table No 1: Area Under Land-Use Land-Cover (1962-2017).

Land-use Landcover Category	1962		2001		2010		2017	
	Hectare	%	Hectare	%	Hectare	%	Hectare	%
Agricultural land	234.18	52.76	225.59	50.82	123.5	27.82	53.78	12.11
Fallow/Waste land	39.84	8.97	80.49	18.13	84.01	18.92	130.99	29.51
Built up Area	23.84	5.37	42.72	9.62	95.1	21.42	138.99	31.31
Vegetation	84.85	19.11	65.68	14.79	110.02	24.78	86.59	19.50
Water-body	61.14	13.77	29.37	6.61	31.22	7.03	33.5	7.54
sum=	443.85	100	443.85	100	443.85	100	443.85	100

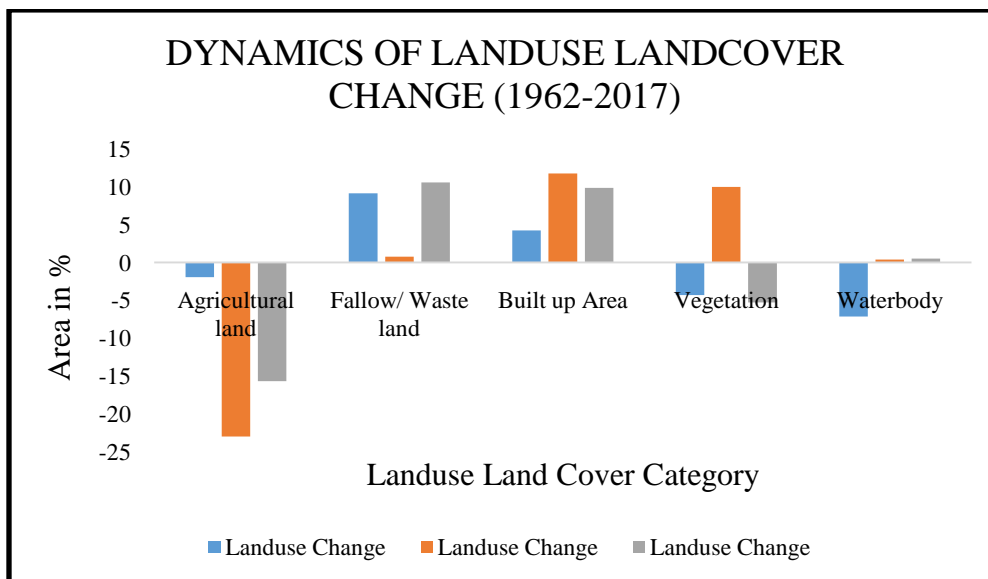


Figure 4: Land-Use Land-Cover Change Dynamics.

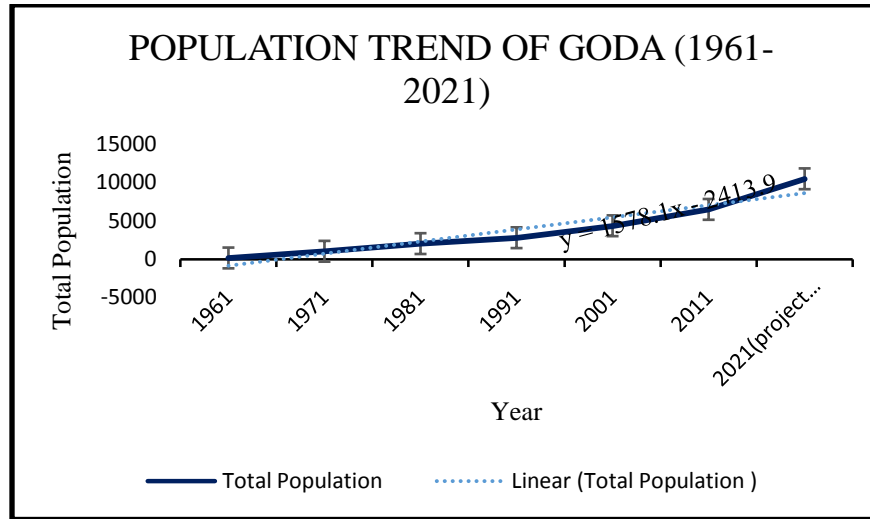


Figure 5: Population Growth Trend of Goda

Source: District Census Handbook Bardhaman (1961, 1971, 1981, 1991, 2001, 2011)

7. PLANNING APPRAISAL

Planning part is very important irrespective of space-time context for the growth and development of any area. Goda is no exception. Like all newly emerging urban units, there are some inherent problems and potential way out to replace those problems are as follow.....

7.1 EXISTING AND ONGOING PROJECT

Various types of developmental project are implemented and works of the project are continuing. Satellite Township project at Mouzas Goda, Nababhat, Katrapota, and Isufabad has been planned to check the unplanned, messy, and congested growth of residential area in and around Burdwan town covering 104 hectares plots of land. The Burdwan Development Authority has also acquired 24.28 hectares of land adjacent to NH-2, at Goda mouza for setting up a multi facility health care infrastructure (Health City Project) to meet the growing demand of sophisticated health care services in and around Burdwan town. The work is under progress which includes land development, primary utilities, primary roads, construction of mother and child care hospital, transport management etc (Source of Information: Burdwan Development Authority).

7.2 FUTURE PROBLEMS

The growing population and their ever increasing demand and corresponding anthropogenic activities continuously changed the land-use & land-cover pattern and have resulted shrinking the areas of land under agriculture, vegetation, and water-body. Land-use/land-cover change modifies the capability of ecosystem to provide services including biodiversity and other resources such as food, fiber, and water for human society in both the present and future. Unsustainable land-use/land-cover change directly affects biodiversity (Chase et al. 2000, Cited in Khan, Colivras, Rahaman 2014). Due to changes in the land, Goda area may exposed to various type of environmental, social, and economic problem, those include-

i. degraded land, ii. Garbage disposal, iii. Solid waste disposal, iv. Shortage of drinking water and open-air space, v. unplanned drainage and associated water logging, vi. Shrinkage of cropland stopped the agricultural practice and workers are forced to engage informal temporary type of work. Some people are self-employed running their grocery shop, *bidi*-binding factory and others work as *Rajmistri* (Mason), construction labors, toto-driver, rickshaw puller, *bidi*-binding worker, household maid. They are termed as casual marginal labor as they engage in work in temporary basis.

7.3 PROPOSED PLANNING

Goda Mouza located in the fringe area of Burdwan town. Leap-frog growth of the city along the transport route has been changing the land use pattern of Goda. It is a means of diverting development pressure away from the edge of built-up areas, promoting urban regeneration and protecting 'open' countryside from sprawl (Gallent et al., 2006, cited in Gallent & Shaw, 2007). This area has a population of 6483 and characterized by high level declined of agricultural land and vegetation cover, particularly in the western portion of this area. Due to loss of agricultural land high-level marginality and unemployment and associated low income and skill create misery among the people. So, a multifunctional planning approach is needed to implement in this area. Multi-functionality suggests how different activities might be beneficially combined, to find inclusive and integrated responses to development pressure (Gallent & Shaw, 2007). Wood & Ravetz (2000) have argued that the rural-urban fringe is a landscape with great potential for enhanced multi-functional use. An integrated fringe strategy, they suggest, could embrace: . . . agriculture combined with woodlands, wildlife, and small holding; woodlands combined with leisure, education, wildlife, smallholding and low-impact housing; leisure combined with education, smallholding, woodlands and wildlife (Gallent & Shaw, 2007).

Besides this protect and rejuvenate those areas which are vulnerable to change. Ensure proper and timely delivery of basic services to the local people. Rejuvenate the fallow and waste land and increased the land under green. Moreover, construction of new building or house should be plan wise without degrading the environmental balance. This proposed planning appraisal may ensure sustainability in the life of people and environment.

8. CONCLUSION

Remote Sensing and GIS makes inaccessible area accessible and shows the horizontal & vertical pattern of distribution and layout of the spatial units. Application of Remote Sensing and GIS techniques using the method of visual identification and interpretation of satellite imagery is a very effective and useful mechanism irrespective of some limitation to determine the direction and magnitude of land use and land cover change. In Goda area undesirable decline of cropland and forest cover, deteriorated wetland, increasing fallow land, unplanned urban sprawl with lack of urban amenities, increasing marginality among the local people and its associated environmental, social, and economic

complication should be reconsidered by the Government before planning new policy.

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