

# Original Research Article

## Land Use and Land Cover Changes and its Impact on the Flood Plain of Bhagirathi River; A Case Study of Eastern part of Purba Bardhaman District

### ABSTRACT

**Aims:** The present study is related with the land use and land cover changes which influence the nature of floodplain. In this study, how land use and land cover change influences the geomorphic features in a flood plain and its drastic effect. The present research work is going to identify the changes of geomorphic features through land use and land cover changes over four decades.

**Place and duration of the study:** The study area located between 24°00'00"N to 23°16'15"N and 88°12'00"E to 88°28'00"E, Bhagirathi river, one of the major distributaries of river Ganga is giving birth to river Hooghly after meeting with Jalangi, near the place Purbasthali (88°23'4.74" E & 23°24'45.3" N) forming the course of 120 miles. It also is having a predominant role in formation of Ganga-Brahmaputra delta.

**Methodology:** Entire analysis made by GIS techniques through the uses of Toposheet (SOI- Scale 1:50,000) and Satellite data (2002, 2008 & 2016). Changes of river courses detect by superimposition river channel through various kinds of GIS software.

**Result:** The study reveals that entire area changes their LULC pattern which reflect the entire flood plain.

**Conclusion:** Land use and Land cover change important issues of human interference over entire surface of the Earth. Land cover means to the physical and cultural cover over the surface of the Earth including Natural vegetation, water bodies, soil etc. Land use is more difficult to identify. For the necessity of human livelihood human always have been modifying the land in different ways.

*Key Word: Land use and Land cover, human interference, floodplain, River Cut Off, Sedimentation, and Morphometry.*

### 1. INTRODUCTION:

The term Land Use and Land Cover depicts two different directions, Land Use utilizes for the economic purposes and Land Cover indicates natural uses. In Geomorphology, various methods are used for LULC measurement. Due to changing of geomorphic features in a large temporal scale it also affects the uses of land utilization. Morphometrical changes are most important aspect to geomorphological studies. It also affects the present land use and land cover changes in the present context. River discharge (Sen P.K., 1993, Geomorphological Analysis of Drainage Basin, The University of Burdwan) condition may affect the change of morphometry, high-level discharge may affect the surrounding landform of the river bank, may influence the change of morphometric features.

## 1.1 Literature Review:

- Sen, P.K., 1993 focused in his book entitled "Geomorphological Analysis of Drainage Basin", River Discharge condition may affect the change of morphometry, high level discharge may affect the surrounding landform of the river bank, may influence the change of morphometric features.
- Knighton, D., 1984 tried to describe on his book entitled, "Fluvial Forms and Process", that there are two types of flow pattern: laminar & turbulent flow, which indirectly changes the morphometric pattern.
- Das, B., Mondal, M., Das, A., International Journal of Geometrics and Geoscientists (2012) attempt to explain monitoring of Bank Link Erosion of River Ganga, Malda District and West Bengal: using RS and GIS compiled with Statistical Technique.
- Gustauson, M., Kolstrup, E. (2006), tried to use GIS technique for analyzing the geomorphological character of landscape in their paper, entitled "A new symbol and GIS based detailed Geomorphological Mapping System Development: Renewal of A scientific discipline for understanding landscape development."
- Das, K., Adak, K., Samanta, K., (2014) in their article, entitled - "Hydrodynamic changes of river course of part of Bhagirathi – Hugli in Nadia district - A Geo informatics appraisal" has mentioned that "The erosion and deposition processes are active due to change in river course. At the bend of the river, the flowing water dashes straight into the outer bank and erodes it into a steep river cliff. The water piles up on the outside of the bend because of the centrifugal force. A bottom current is set up in a corkscrew motion and is hurled back into mid-stream and inner bank. Thus, deposition occurs in the inner bank forming the very gentle slip-off slope".
- Schumm (1963) and Snow (1989). Leopold et al. (1964) proposed that the degradation of river channels could be attributed to the changes in its hydrologic regimes and its channel plan form pattern is also influenced by the character of hydraulic region.
- Constantine and Dunne, (2008), suggested that the size frequency distribution of ox-bow lakes within the flood plains can be predicted using channel sinuosity studies.
- Maiti, S., Ghorai, D., Satpathy, R., Bandyopadhyay, J., delineated in his paper, "Monitoring of Land Use and Land Cover Change Over the Years Due to River Course Shifting; A Case Study on Ganga River Basin Near Malda District, West Bengal Using Geo-Informatics Techniques.", change detection is the measure of the distinct data frame work and thematic change information that can guide to more tangible insights into underlying process involving land cover and land use changes than the information obtain from continuous change.

## 1.2 Objective:

Present study will try to fulfill the following objectives:

1. To study the changes of geomorphic features to assess the river behaviour.
2. To analyse the Land Use Land Cover Change and its Present effect on active flood plain.

## 2. DATA BASE & RESEARCH METHODOLOGY:

The same physical process and laws that operate today operated throughout Geological time, although not necessarily always with the same intensity as now (W.D. Thornbury, 1954). The integrated approach to research methods in geomorphology includes field observation, office observation and theoretical work (Singh, 1998).

Entire analysis has been shaped on the basis of secondary data. These data have been collected from Toposheet images and Satellite image analysis of 1970 Sol Map & 2002, 2008 & 2016 Satellite Images.

Those data has been taken from various sources which are attached bellow. These paper aims to assess the changes of geomorphic features and the Land Use Land Cover Patterns also detect their effect on flood plain.

All data are analyzed from scanned Toposheet 1970 and from LandSat ETM+ of 2002 ,2008 LISS-iii of 2016.

**Table No: 1 Data Source used in the Analysis**

Source of Data Base	Type of Data Base	Remarks
Survey of India	Toposheet No.- (79A/1,79A/2,79A/5,79A/6,79A/7)	R.F:1:50000 Date-1970
Global Land Cover Facility (GLCF)	Enhanced Thematic Mapper (Landsat Image)	Spatial Resolution 30meter
United State of Geological Survey (USGS)	Advanced Spaceborne Thermal Emission and Reflection Radiometer (Aster)	Spatial Resolution 30meter
National Remote Sensing Centre (NRSC) Bhuvan Store	Linear Image Self Scanning (Resourcesat LISS-III)	Spatial Resolution 23.5meter

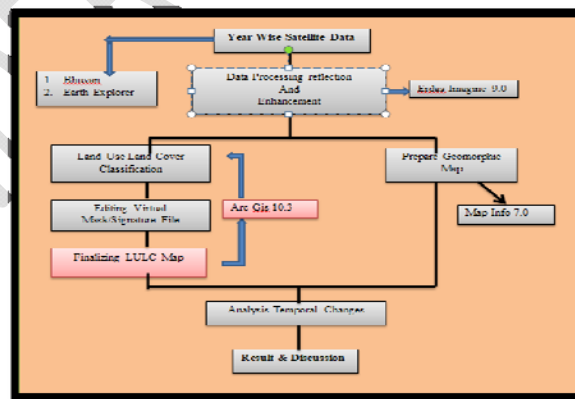
In this planned study the following Remote Sensing and GIS Software are being used –

1. Arc GIS-10.3
2. Q-GIS-3.4
3. Erdas Imagine–9.3
4. Map Info-7.0

### 3. RESULT & DISCUSSION:

#### 3.1 Geomorphic Mapping:

A Geomorphological Map is method to show the earth different features particularly the landforms. As the study area belongs to the alluvial flood plain so the existed features mainly Swamp, Marshy land, Cutoff Meanders, Ox-Bow Lake, Meander Scrolls.



**Fig No. 1 Flow chart of Methodology**

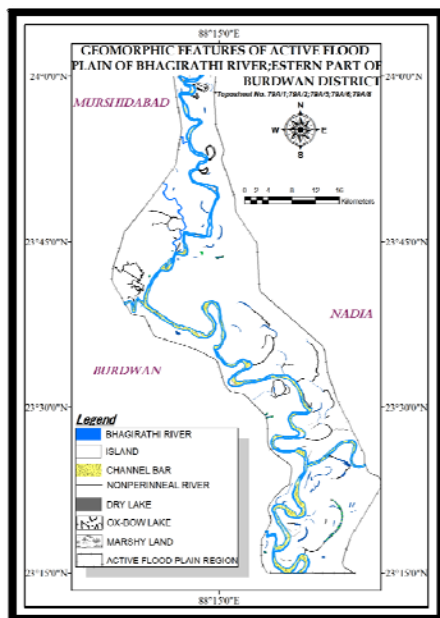


Fig No. 2 Geomorphologic map of 1970

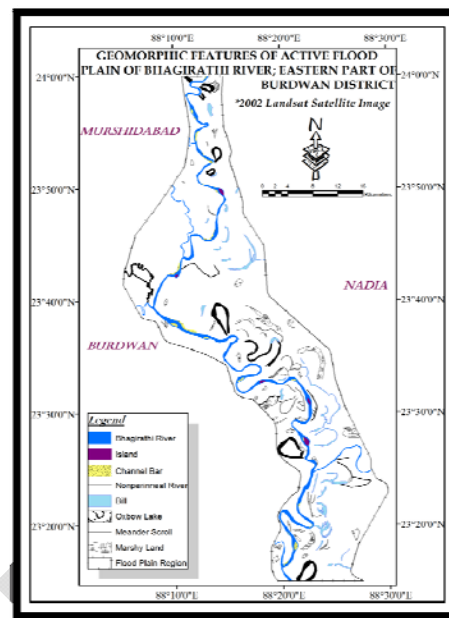


Fig No. 3 Geomorphologic map of 2002

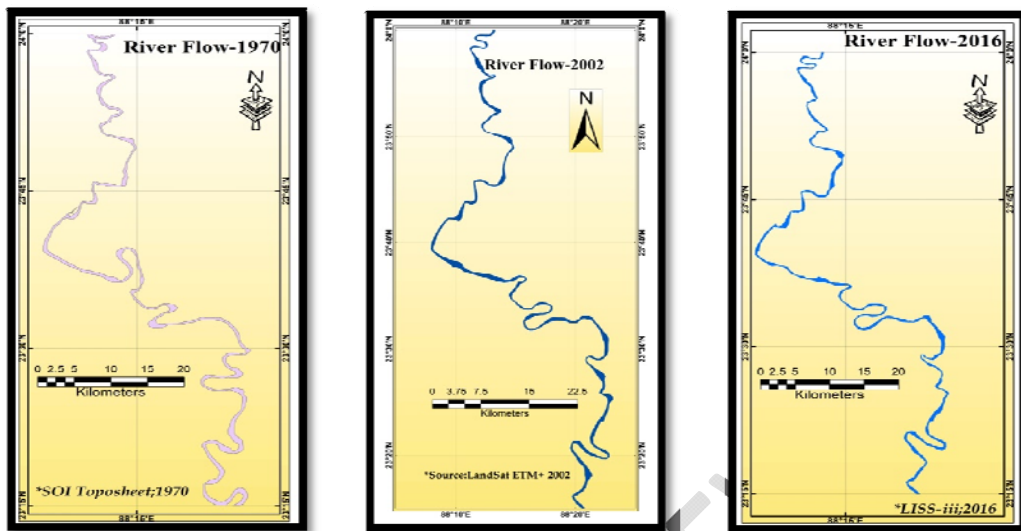
Table 2. Major geomorphic features at a glance

Sl. No.	Geomorphic Features	Extension	Source	Year	Remarks
1.	River Meander	88.234-23.655	SOI	1970	Extension is Decimal Degrees Format
2.	Marshy Land	88.431-23.371	Toposheet	1970	
3.	Cut of Meander	625645.379-2617495.556	LANDSAT	2002	
4.	Ox Bow Lake	635502.202-2593419.054	ETM+	2002	Extension is UTM Format
5.	Non- Perennial River	613041.573-2623635.81	LANDSAT	2002	

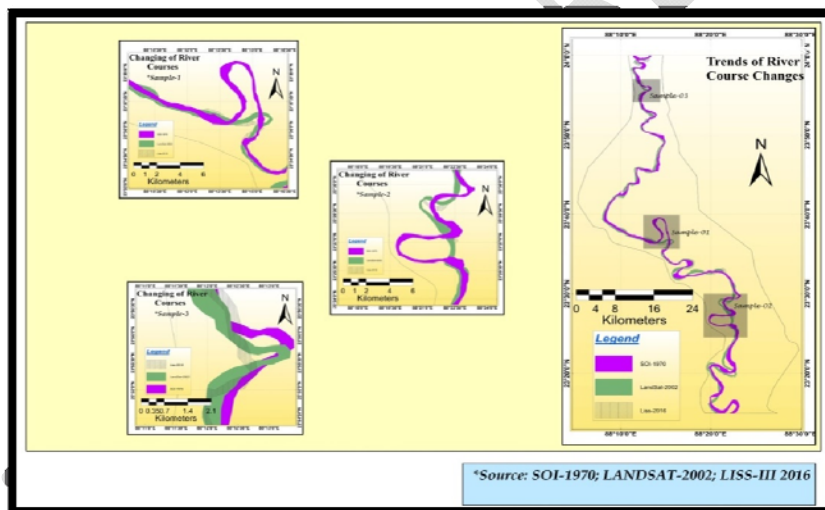
\* Prepared by author

### 3.2 Rivers Course Change:

This study was conducted along the river line track of the Bhagirathi, which are frequently changed. For this changing area is affected by floods, bank erosion and sedimentation, it also changed the land use land cover pattern beside the river bank.



**Fig No. 4 Changes of river courses in different years**



**Fig No. 5 Temporal changes of River Courses**

### 3.2 Land Use and Land Cover Change:

Generally there have three types of technique for preparation Land Use & Land Cover map.

1. Analog Method, visual interpretation of LULC map
2. Digital Technique, Classify tone or same colour spectral value by using software.
3. On Screen Interpretation Technique, combination of visual and digital technique.

Land Use Land Cover change is one of the most important techniques to measure the way of land utilization. There have so many techniques to measure the way of landutilization.

In this study usingmaximum likelihood technique to creat unsupervised classification. Here we calculate major LULC classes to delineate result of river shifting.

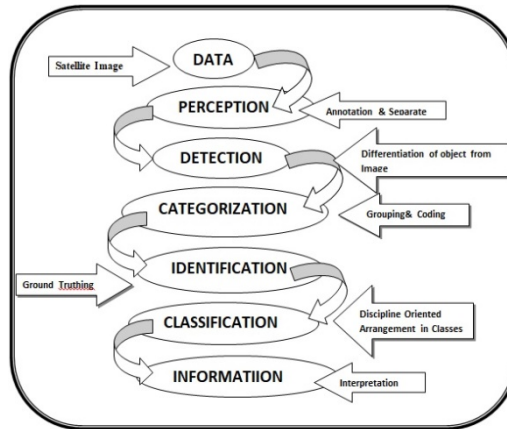


Fig No. 6 Flow Chart of Image Classification

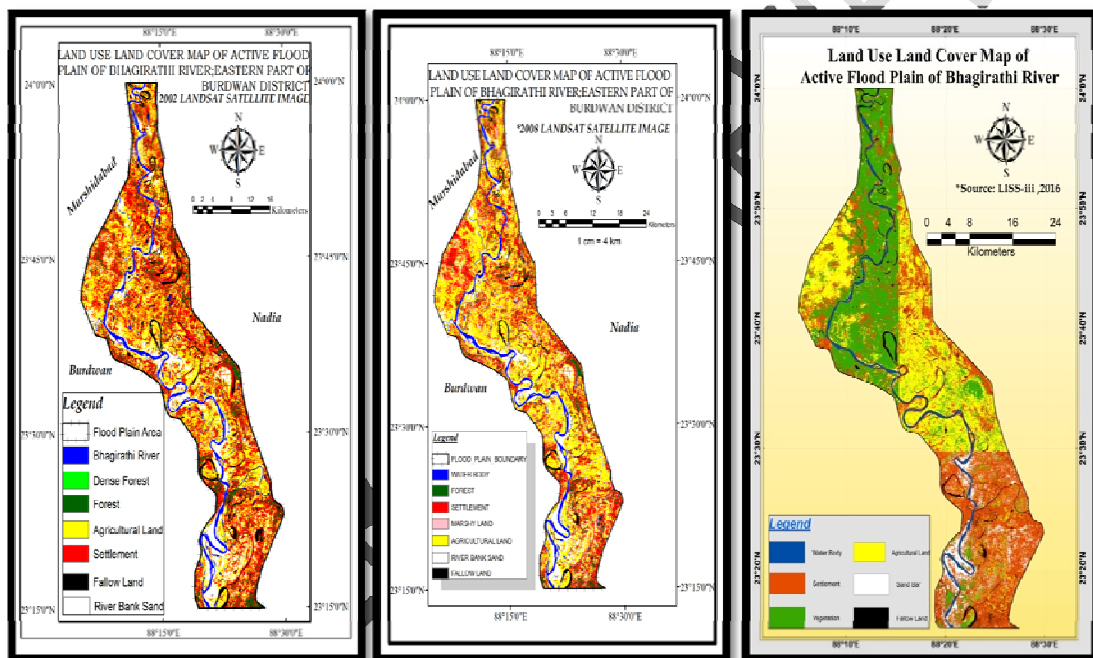


Fig No. 7 Year wise change of Land Use and Land Cover pattern of Bhagirathi River

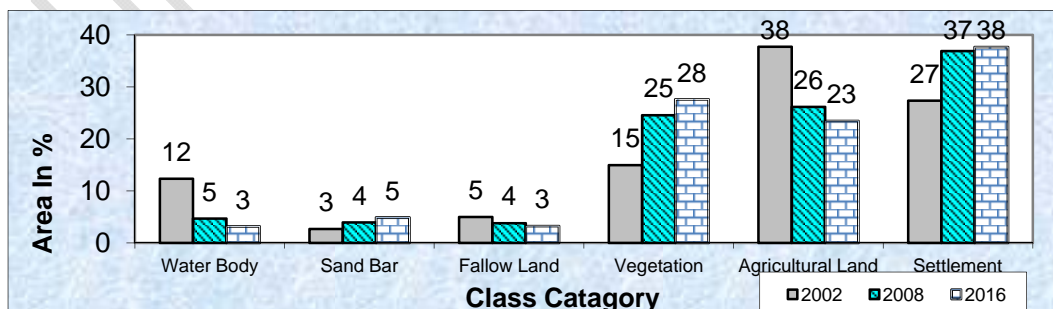
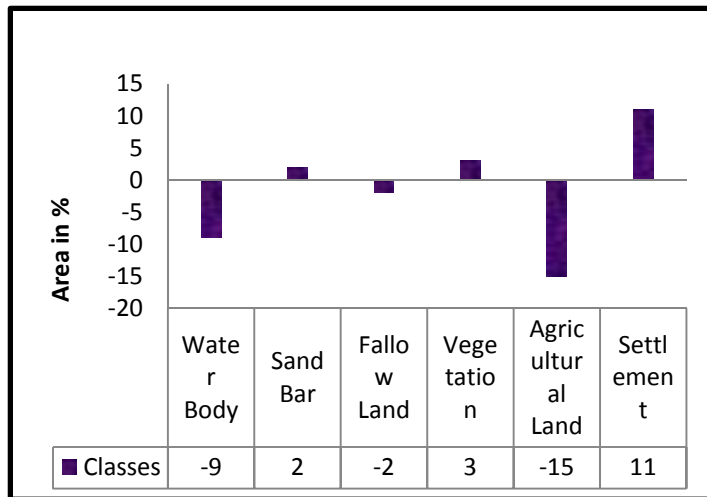


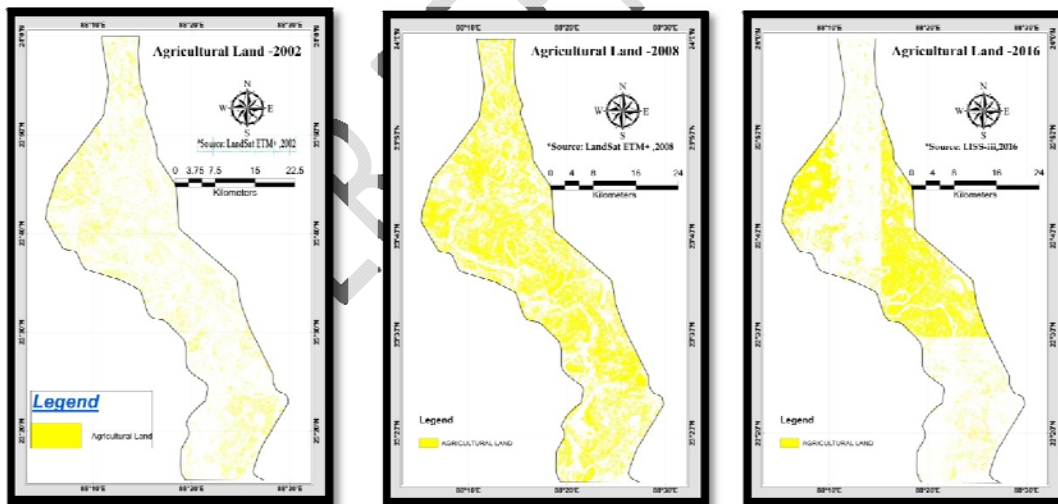
Fig No. 8. Comparative Analysis of Temporal Changes of LULC Map in Bhagirathi River Active Flood Plain Region-2002, 2008 & 2016.



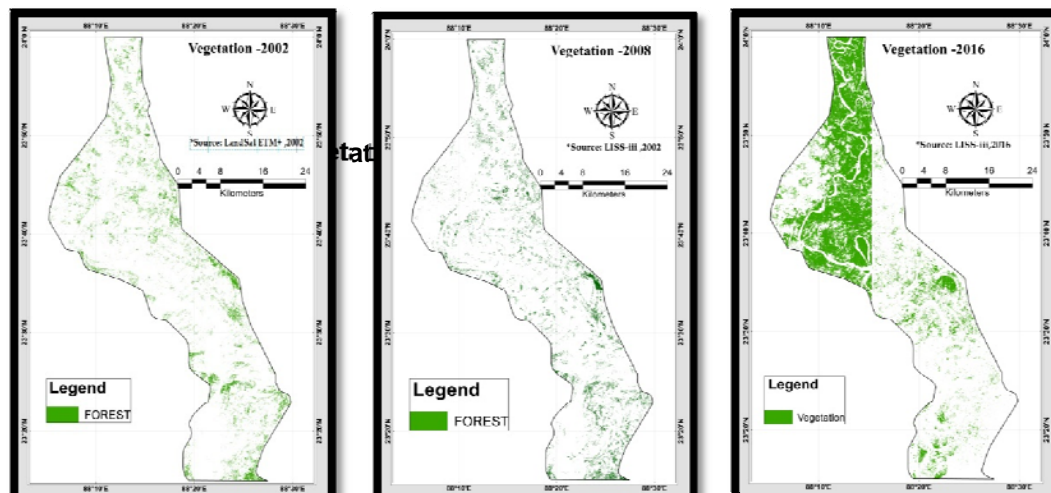
As per the above analysis among the major LULC components, its depict that from 2002 to 2016 water bodies and agricultural lands are being collapsed due to rapidly shifting of river and the other hand settlements are grown up through the touches of modernization, in the present context more or less 15% area of agricultural land mainly affected in Ketugram, Kalna and Katwa blocks. And also Waterbody, fallow land are decreasing near about 9% due to huge amount of river shifting at Noya chaur in Katwa Block and Pakir Chor in Purbasthali block and highly uses of land for development purpose. Whereas sand bar is increased for lack of water and a huge amount of sedimentation and vegetation are increased 3% due to tree plantation along the river bank in Ketugram and Katwa block for reducing the river bank erosion and settlement also being increased 11% due to the enhancement of growth of rapid population in Purbasthali and Kalna also for the uses of fertile land beside the river bank. For that reason, land use and land covers like vegetation, agricultural land, and settlements are affected too much, it means land covers are changed over the time period.



**Fig No. 9 Temporal changes of LULC components**



**Fig 10. Year Wise Agricultural Pattern**



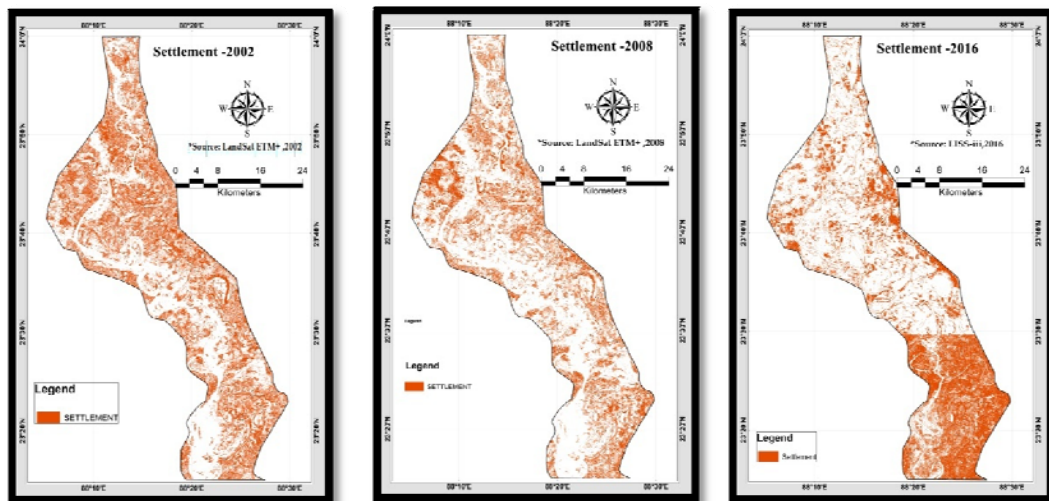


Fig 12 .Year Wise Settlement Patches

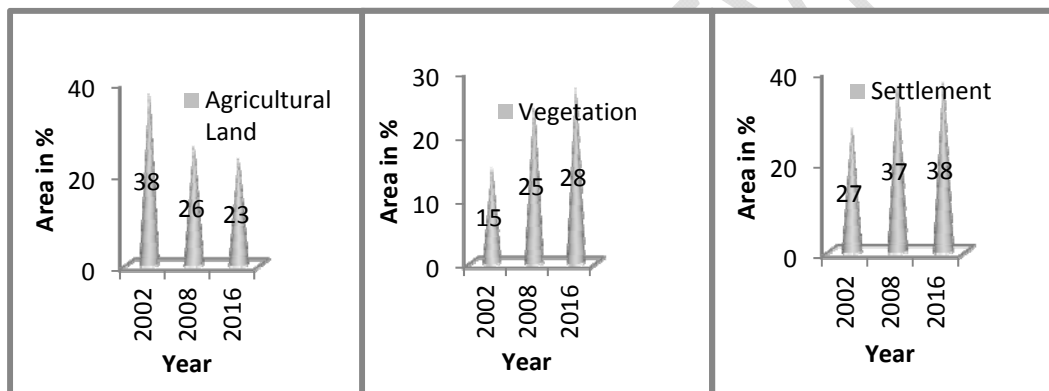


Fig 13. Temporal changes of Agricultural Pattern, Vegetation & Settlement



**Photograph 1.** Noyachor Ox-Bow Lake Used for Fishing Purposes. **Photograph 2.** Pakhir Chor in Purbasthali Block, use for Tourist spot.

It's a characteristics of a perennial river is that one side destroyed and the other side is formatted. As the river in meander stage so the river side erosion continuously increased so



that the land use land cover continuously changes such as Ketugram losses 3.42 sq. km area where as Purbasthali gain 22.23 sq km area due to the deposition of river eroded material.(Misra. S., Changing Morphometry of Bhagirathi River; a Case Study of Eastern Part of Burdwan District, 2018, 2279-543X).

#### 4.0 CONCLUSION:

The research work demonstrates the geomorphic changes as well as changes of the characteristics of the land. Major focus was made to appropriate classification of land which was change through the period. However, the river courses changes is noticeable due to rapidly growth of settlement from 2002-2016, whereas agricultural lands was decreased due to the changes or river courses and anthropogenic factors was played vital role. The river cut off area are used as an agricultural land such as Noyachor, Kaligang, Pakhir Chor. The Bhagirathi River courses shifted simultaneously towards east direction in between 1970-2016. So that's why LULC pattern also being changed. River erosion is also increased which effect those areas which is situated beside the river so proper planning and management must be needed.

#### REFERENCES:

1. Constantine, J. A. and Dunne, T. "Meander cutoff and the controls on the production of oxbow lakes." The Geological Society of America 36(1) (2008): 23 – 26.  
Available: [https://www.researchgate.net/profile/Jose\\_Constantine/publication/249521157\\_Meander\\_cutoff\\_and\\_the\\_controls\\_on\\_the\\_production\\_of\\_oxbow\\_lakes/links/546494920cf2837efdb3dabf/Meander-cutoff-and-the-controls-on-the-production-of-oxbow-lakes.pdf?origin=publication\\_detail](https://www.researchgate.net/profile/Jose_Constantine/publication/249521157_Meander_cutoff_and_the_controls_on_the_production_of_oxbow_lakes/links/546494920cf2837efdb3dabf/Meander-cutoff-and-the-controls-on-the-production-of-oxbow-lakes.pdf?origin=publication_detail)
2. Das, K. , Adak, K. , Samanta, K. "Hydrodynamic changes of river course of part of Bhagirathi – Hugli in Nadia district - A Geo informatics appraisal." International Journal of Geomatics and Geosciences Volume 5, No 2 (2014).  
Available: <http://www.ipublishing.co.in/jggsarticles/volfive/EIJGGS5024.pdf>
3. Das, B., Mondal, M., Das, A., Monitoring of bank line erosion of River Ganga, Malda District, and West Bengal: Using RS and GIS compiled with statistical techniques., International Journal of Geometrics and Geoscientists, Volume 3, No 1, (2012).  
Available: <http://www.ipublishing.co.in/jggsvol1no12010/volthree/EIJGGS3120.pdf>
4. Gustavsson, M., Kolstrup, E. "A new symbol and GIS based detailed Geomorphological Mapping System Development: Renewal of A scientific discipline for understanding landscape development." Elsevier; Geomorphology (2006): 90-111.  
Available: [https://pure.uva.nl/ws/files/3804251/41638\\_Gustavsson\\_et\\_al\\_Mapping\\_System.pdf](https://pure.uva.nl/ws/files/3804251/41638_Gustavsson_et_al_Mapping_System.pdf)
5. Knighton, D. Fluvial Forms and Process . Edward Arnold, (1984).
6. Leopold, L. B. and G. M. and Miller, J. P. Wolman. Fluvial Processes in Geomorphology. California: W. H. Freeman, (1964).
7. Maiti, S. , Ghorai, D. , Satpathy, R. , Bandyopadhyay, J. , "Monitoring of Land Use and Land Cover Change Over the Years Due to River Course Shifting ; A Case Study on

Ganga River Basin Near Malda District, West Bengal Using Geo-Informatics Techniques", International Journal of Reserch in Advent Technology, Vol-2, (2014). Available: [https://www.researchgate.net/publication/274315245\\_Monitoring\\_of\\_Land\\_Use\\_Land\\_Cover\\_Change\\_over\\_the\\_Years\\_Due\\_to\\_River\\_Course\\_Shifting\\_A\\_Case\\_Study\\_on\\_Ganga\\_River\\_Basin\\_near\\_Malda\\_District\\_West\\_Bengal\\_Using\\_Geo-informatics\\_Techniques/download](https://www.researchgate.net/publication/274315245_Monitoring_of_Land_Use_Land_Cover_Change_over_the_Years_Due_to_River_Course_Shifting_A_Case_Study_on_Ganga_River_Basin_near_Malda_District_West_Bengal_Using_Geo-informatics_Techniques/download)

8. Misra. S., Changing Morphometry of Bhagirathi River; a Case Study of Eastern Part of Burdwan District, 2018, 2279-543X.  
Available: <http://www.dynamicpublisher.org/gallery/59-ijssr-d758.pdf>
9. Sen, P. K. Geomorphological analysis of drainage basins. The University of Burdwan, Burdwan, (1993).