RESEARCH REVIEW JOURNALS
Volume-03
Issue-08
August-2018

ISSN: 2455-3085 (Online)
RESEARCH REVIEW International Journal of Multidisciplinary
www.rrjournals.com [UGC Listed Journal]

Physical and Cultural Change Detection Through Remote Sensing and GIS Techniques: A Case Study on Surrounding areas of Churni River, West Bengal

[*1]Pinki Hira, & [2]Dhiraj Sarkar

[*1]*Guest Lecturer, Department of Geography, Krishnagar Women's College, Nadia, West Bengal, India*
[2]*Contractual Lecturer, Department of Geography, Berhampore Girls' College, Murshidabad, West Bengal, India*

ARTICLE DETAILS

Article History
Published Online: 07 August 2018

Keywords
Agricultural Land**,** Built-up area, Land use & Land cover, Remote Sensing & GIS, Toposheet.

[*]**Corresponding Author**
Email: pinki.hira11[at]gmail.com
dsarkar292[at]gmail.com

ABSTRACT

Now a day Remote Sensing and Geographical Information System (GIS) is widely used technique to analyse physical as well as cultural geographical elements. In this paper an attempt has been made to study the changes in land use and land cover of surrounding areas of Churni River for fourteen year time period 2004-2017. The study was carried out through Remote Sensing and GIS approach using Toposheets, Resourcesat-2, LANDSAT images, Google Earth Pro software. The techniques of supervised classification of Satellite image has been used to prepare Land use and Land cover map. The change of Land use and Land cover are a result of long-term interaction between humans and natural environment. The study revealed that the built-up area expanded very high rate. On the other hand areas under agricultural land, water bodies, vegetation have decreased due to the rapid increasing of population during the study period.

1. Introduction

The term land use was first used by Stamp (1948). It can be understood as a secondary concept as "land use" also includes the use of "land cover" by humans plus the social, economic, political or cultural "function" of land cover (Aspinall and Hill 2008). Food and Agriculture Organization of the United Nations (1998) defines that land use "is characterized by the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it". Thus, this expression "establishes a direct link between land cover and the actions of people in their environment". FAO (2000) defines land cover as "the observed bio-physical cover on the Earth's surface". As such, land cover reflects the real (de facto) land cover, in other words what grows on the examined plot, what can be "seen". Land plays an important role in the determination of man's economic, social and cultural progress. Landforms are the topographic features on the Earth's surface.

With the invent of remote sensing and Geographical Information System (GIS) techniques, land use/cover mapping has given a useful and detailed way to improve the selection of areas designed to agricultural, urban and/or industrial areas of a region (Selcuk et al., 2003). Change detection is a study that utilizes images or maps of different years for the same area. Through this study it is easy to find out the impact the River has caused, or is causing or will be manifesting to the surrounding environment. The district of Nadia is situated in the heart of Bengal and on the left bank of the Bhagirathi-Hugli river. The district is regarded as the "the land of rivers". The main river of the district is Jalangi, Churni, Mathabhanga and Ichamati. It has been opined that the Churni is most probably an artificial canal, not a true river. Local history says, during the 17th century the river Churni was dug by the orders of Maharajah Krishna Chandra, the King of Nadia as a moat against the Bargees of Maharashtra. Only 80 years ago, in the 1930's, it was the major trade route inside undivided Bengal.

2. Objectives

Main objectives of the research study are:

i. To prepare land use and land cover map of the surrounding areas of Churni River, West Bengal.
ii. To identify the River course shifting over the time.
iii. To indicates the Topographical Elevation of the study area.
iv. To determine the extent of inter-class changes of land use and land cover.

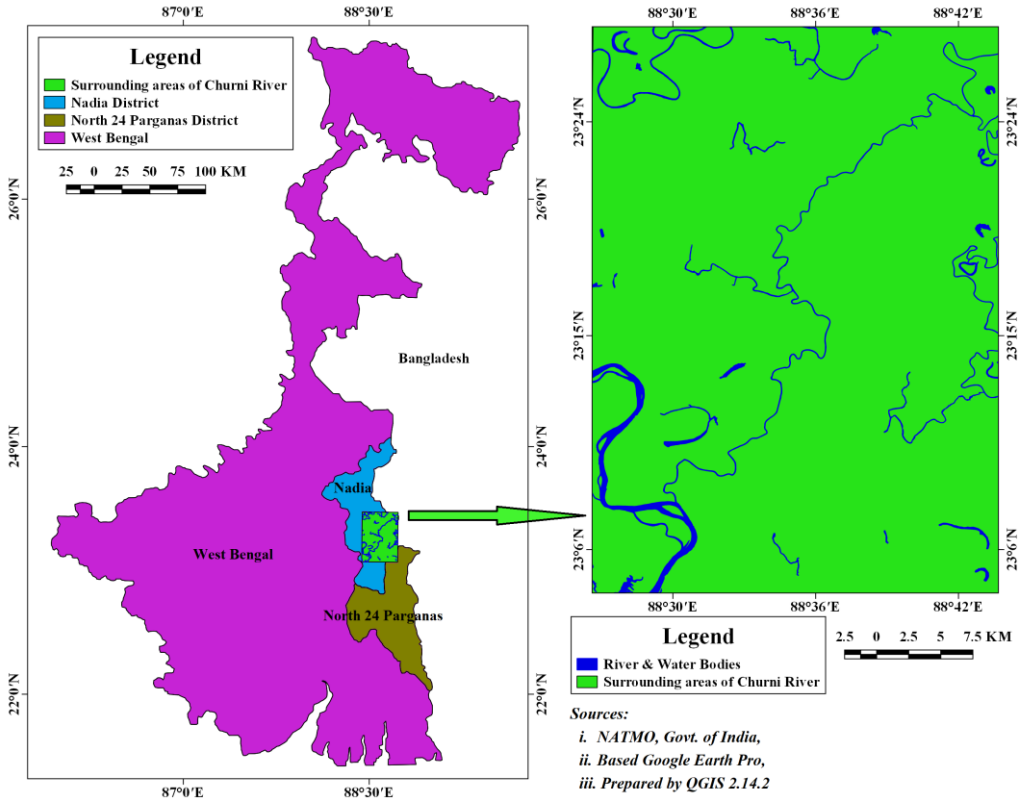
3. Study area

This study was conducted in Nadia and North 24 Parganas districts, West Bengal which is located between 23˚04'N - 23˚28' N latitude and 88˚26'E - 88˚44' E longitude. The Churni is a distributary of the Mathabhanga river. The Mathabhanga originates from the right bank of the Padma at Munshiganj in Kushtia district in Bangladesh. It bifurcates near Majhdia in Nadia district, creating two rivers, Ichhamati and Churni. The Churni flows through Shibnivas, Hanskhali, Birnagar, Aranghata, Ranaghat, and finally joins River

Bhagirathi-Hooghly near Chakdaha. The entire area is completely blanketed by a sequence of quaternary sediments of Ganga-Bhagirathi river system. The climate of the study area is moistly humid and subtropical monsoon. The average rainfall is 140-160 cm and annual average temperature is 25˚-30˚C.

Soil is composed of recent Gangetic alluvial soil. Climate of the study area is moistly humid and subtropical monsoon. These climatic regions are affected by the occasional flood, thunder storm during monsoon and occasional drought.

Fig. 1: Location Map of the Study area (Churni River & its Surrounding)



4. Database, Methodology & Techniques

4.1 Database

This study is mainly based on both primary and secondary data which have been collected from the Topographical maps, Satellite Images and different Municipality office, C.D. Block Office, B.L. & L.R.O. office of Nadia and North 24 Parganas Districts of West Bengal. Various published reports i.e. District Human Development Report, District Census Handbook, Various Magazines, Journals and Articles has also been used.

Table-1
List of Satellite Images & Topographical Maps

Sl. No.	Satellite Image	Topographical Map
1	L3_SAT_10B_V1_88.25E23.25N_F45E07	F45E07
2	L3_SAT_10B_V1_88.25E23N_F45E08	F45E08
3	L3_SAT_10B_V1_88.5E23.25N_F45E11	F45E11
4	L3_SAT_10B_V1_88.5E23N_F45E12	F45E12

4.2. Methodology and Techniques

To satisfy the objectives of this study, mainly Remote Sensing and GIS software have been incorporated. Several Techniques, Methods and Software have also been used here such as...

i. GPS handset & Google Earth pro software have been used for location analysis and land use map preparation.
ii. The techniques of Supervised classification of Satellite Image have been applied for Land use and Land cover map.
iii. Digital Elevation Model introduced here to represent 3D view of the study area.
iv. Cross Section Elevation Profile with the help of Google Earth Pro has been prepared.
v. TNT mips 2015, QGIS 2.14.2, Geographical Information System Software have been used to prepare relevant maps and diagrams.

Table- 2

Techniques & Software used for Relevant Maps and Diagrams

Relevant Maps and Diagrams	Techniques & software used
1. Location Map	QGIS 2.14.2, Google Earth Pro
2. Land Use & Land Cover Map	Supervised Classification by QGIS 2.14.2
3. River Course Shifting Diagram	TNT mips 2015, QGIS 2.14.2
4. Contouring Maps	QGIS 2.14.2 & DEM file created by Google Earth Pro
5. 3D view of Landscape	QGIS 2.14.2 & DEM file created by Google Earth Pro
6. Cross Sectional Profile	Google Earth Pro & QGIS 2.14.2

5. Results and Discussion

5.1 Land use & Land cover change of the Surrounding areas of Churni River

As land use pattern is a geographical manifest of natural and human activities. The land cover and land use categories are naturally common in the riverine flood plain of West Bengal. Figure 2 represents the changing pattern of land use and land cover of the study area during the period of 2004 - 2017. To prepare LULC maps and detect changes, the following four broad categories were considered:

- Vegetation
- Built Up Areas
- Water body
- Agricultural Land and Fallow land

LULC of the entire study area has undergone significant changes during the study period. Built-up area or settlement area has gained substantial area. During the same period vegetation category has lost the maximum coverage, similarly agricultural land and open fields or fallow land also witnessed negative growth in spatial coverage. As stated by Abbas et al. (2010), more recent significant effects of land use change include urban sprawl, soil erosion, soil and land degradation, salinization and desertification.

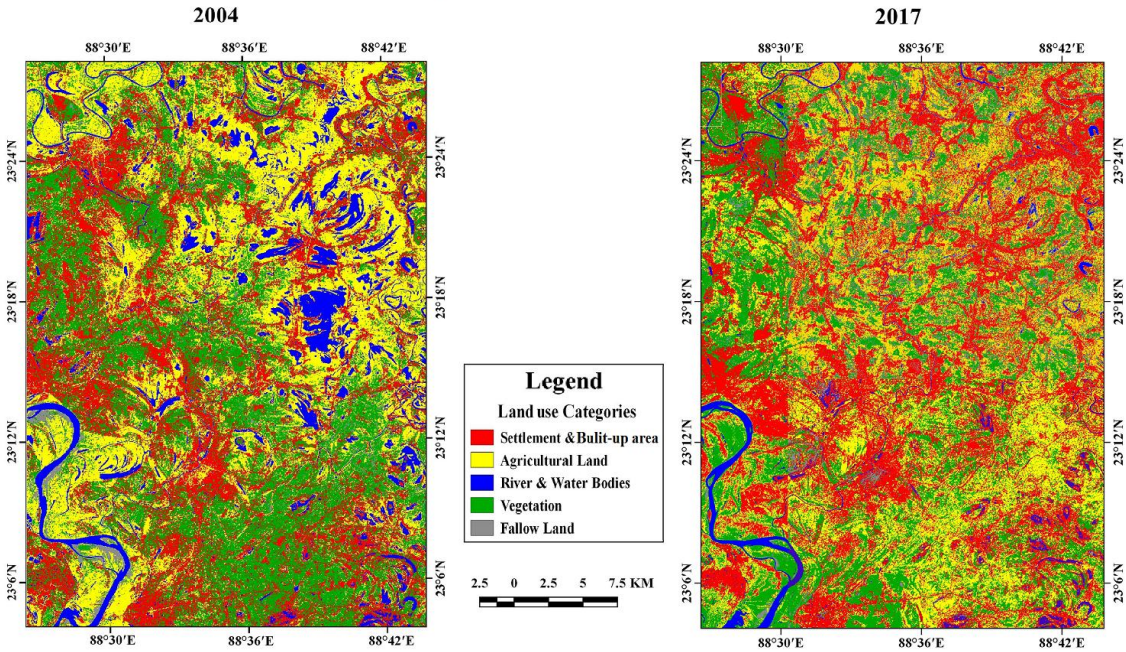
5.1.1 Built-up area & Settlement area

These appear as built-up areas of human habitation and construction. It includes land used mainly for non-agricultural constructional purposes, viz. buildings cities, towns, villages, industrial and commercial complexes, transport, communication and utilities. It has a typical coarse and molted texture. In the study area the cluster of settlements found mainly in Chakdaha, Ranaghat, Krisnanagar, Krishnaganj, Haskhali Badkulla and Birnagar. In 2004 the concentration of settlement is low as compared to 2017, where the concentration of settlement increased at high level (fig. 2).

5.1.2 Agricultural Land & Vegetation

These are primarily used for farming. These are identified by their characteristic regular shape and associated with water bodies, river, channel, pond etc. Maximum part of the study area is covered by the cultivated land due to its plain topography, fertile soil and the area can be easily accessed for

Fig. 2: Land Use & Land Cover Map of the Surrounding areas of Churni River, 2004 - 2017



Sources: i. Image Processing of LISS-III & Resourcesat-2, ii. Prepared by QGIS 2.14.2

irrigation. But the agricultural land decrease due to human interference in the recent time (fig. 2). Major crops of the study area are paddy, jute, potato, mango, banana etc.

Vegetation comprises of thick and dense canopy of all trees that predominantly remain green throughout the year. They show irregular shape and smooth texture. These are found mainly near the river side.

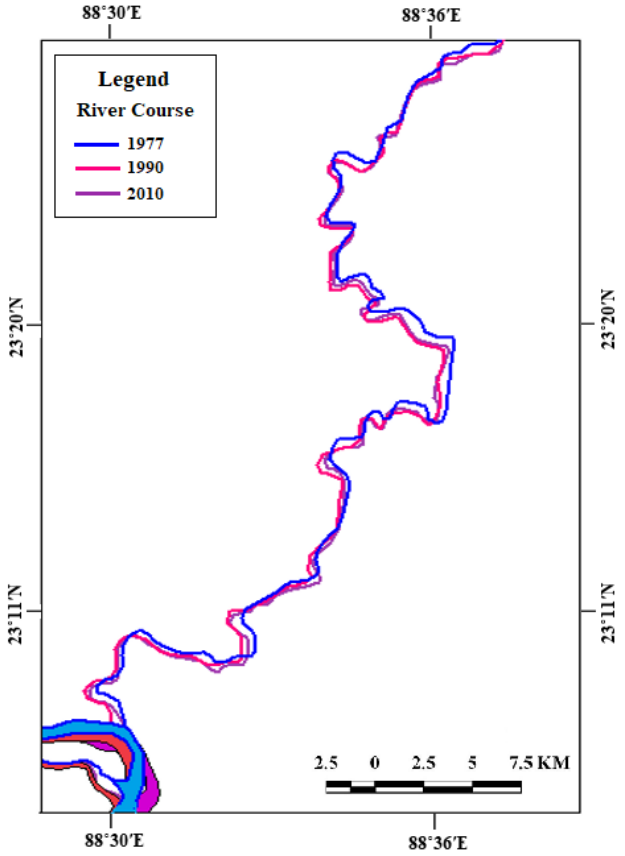
5.1.3 Fallow Land & Water Bodies

These are annually and seasonally waterlogged areas, some lands are locally known as bill and topographically these are natural shallow depressions mostly inundated during monsoon and remain waterlogged as drainage is very poor. These are identified by grey colour (Fig. 2). The swinging nature of the river Bhagirathi-Hooghly has left many ox-bow lakes at Kaliganj, Nakashipara, Muragachha etc. These are seasonally cultivated land because these lands are submerged in the rainy season. These are mainly floodplain area. Mainly wheat, paddy, vegetables are cultivated in this area.

5.2 Identification of Churni River course Shifting (1977-2010)

River is dynamic in nature. Rivers always undergone through change in its shapes and alignment by continuous changing their hydrodynamic and morpho dynamic processes, depending upon the slope, terrain characteristics, structural parameters, climatic variations, vegetal cover etc. with due course of time (Pan, 2013). The Churni used to flow through Bengal on a direct north east to south west course and join the River Hoogly near Payradanga, Nadia district. However, it has changed its course. The Churni River has experienced numerous large and small changes to its main course and large changes found mainly the lower part of Churni River at Payradanga. From figure 3 it can be seen that the Hooghly and also the Churni River channel has a tendency to shift eastward direction. To show the shifting of river Churni the maps of the year 1977, 1990, 2010 respectively are used. River course in 1977 is represented by dip blue colour, river course in 1990 is represented by red colour and 2010 is represented by violet colour. It also reveals that major changes are found in Payradanga, where river Churni meets with Hooghly river and Aranghata. The changing mainly occurs due to erosion of river. Due to human interference, agricultural practice, illegal industrial practice the course of river Churni changes it's channel.

Fig. 3: Churni River Course Shifting, 1977 - 2010



Sources: i. Image Processing of LISS-III & Landsat- 7, MSS, ii. Prepared by QGIS 2.14.2

5.3 Elevation change identification of the study area

In that map of contouring and elevation from sea level (Fig. 4) shown various colour combination of brown colour, where the highest elevation from sea level is 22.57mt. and the lowest elevation from sea level is 1.47mt. The term relief meaning the difference in elevation of any part of the earth's surface or relative vertical inequality of land surface. It is clear that the height is very low in the lower part of Hoogly river, and maximum height is found in the upper part of the study area. General slope of the area is north to south with an inclination towards south-east. It is also clear from the 3D views of Topographical Elevation Map (fig. 5). Figure no 4 & 5 indicates that Krishnanagar, Ranaghat, Krishnaganj, Santipur contains 17.57mt elevating villages. Settlement areas are mainly found in the higher elevation areas. Less settlement is found in the lower part due to newer terraces of the river Bhagirathi-Hoogly and these areas are also flood prone area. At the lower part of the study area is mantled by recent alluvium consist mainly of silt, the middle part of the study area mainly consist of alluvium with high silt and the upper part of consist of older alluvium soil.

Fig. 4: Contouring and Topographical Elevation of the Surrounding areas of Churni River

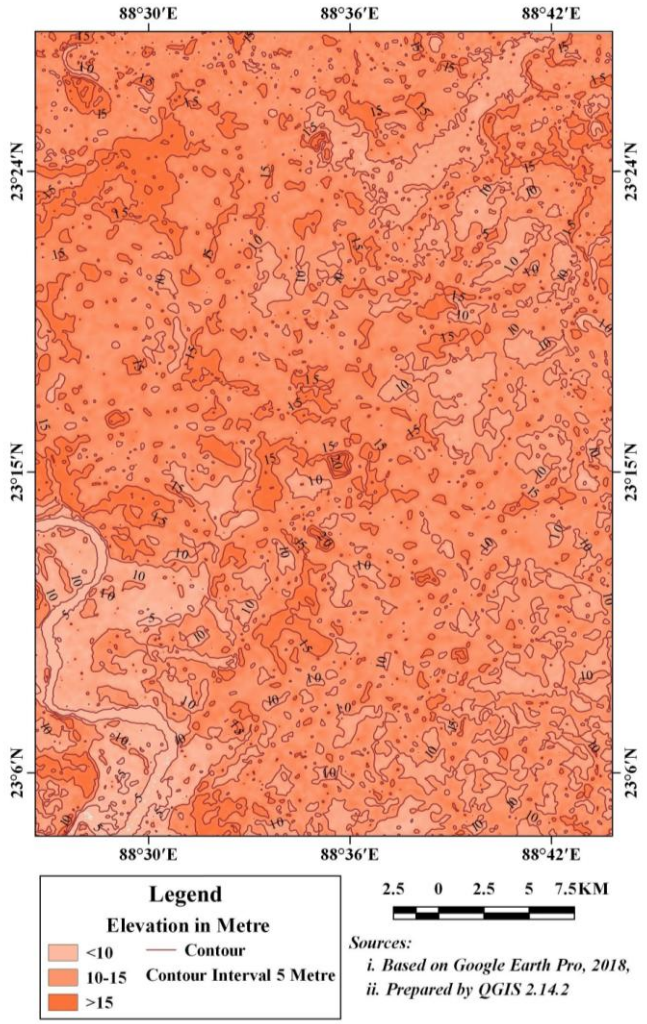
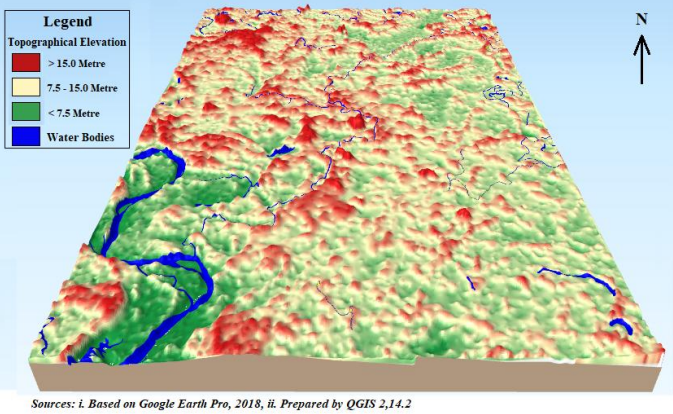


Fig. No. 5: Topographical Elevation of the Surrounding areas of Churni River



Sources: i. Based on Google Earth Pro, 2018, ii. Prepared by QGIS 2,14.2

5.4 Cross Sectional Profile of Surrounding areas of Churni River

Contours are lines joining places of equal height above sea level, they also tell us how much the land slopes and drawing a cross section through the contour lines shows what the landscape looks like (fig. 6). To show the Cross Section Elevation profile we have drawn four section lines namely AB, CD, EF and GH then draw profile based on Google Earth Pro software. The entire study area lies within the moribund sector of the Ganga Delta. All the river flow through the study area is gentle, flat and the general aspect is that of a vast level alluvial plain though some uneven landforms can also be found. From (Fig. 6) it is clear that in the cross section elevation profile diagram for AB line the highest value is 20mt and the lowest value is 5mt. From the contour map we have seen AB line passes through Krishnanagar, Majhdia, Krishnaganj. In the cross section elevation profile diagram for CD line the height value is 20mt and the lowest value is 6mt. CD line passes through Badkulla, Garuapota, Dalaigram, Bhayna. In the cross section elevation profile diagram for EF line the height value is 22mt and the lowest value is 3mt. EF line passes through Natun Char krishnabati, Balagargh, Ranaghat, Chakdah, Dhantala. In the cross section elevation profile diagram for GH line the height value is 20mt and the lowest value is 1mt. GH line passes through Jitat in Hoogly, Payradanga, Akaipur. In that profile the minimum value is very low as compared to others because in that area river Bhagirathi-Hooghly joined river Churni and it is new alluvial plain area, water logged area.

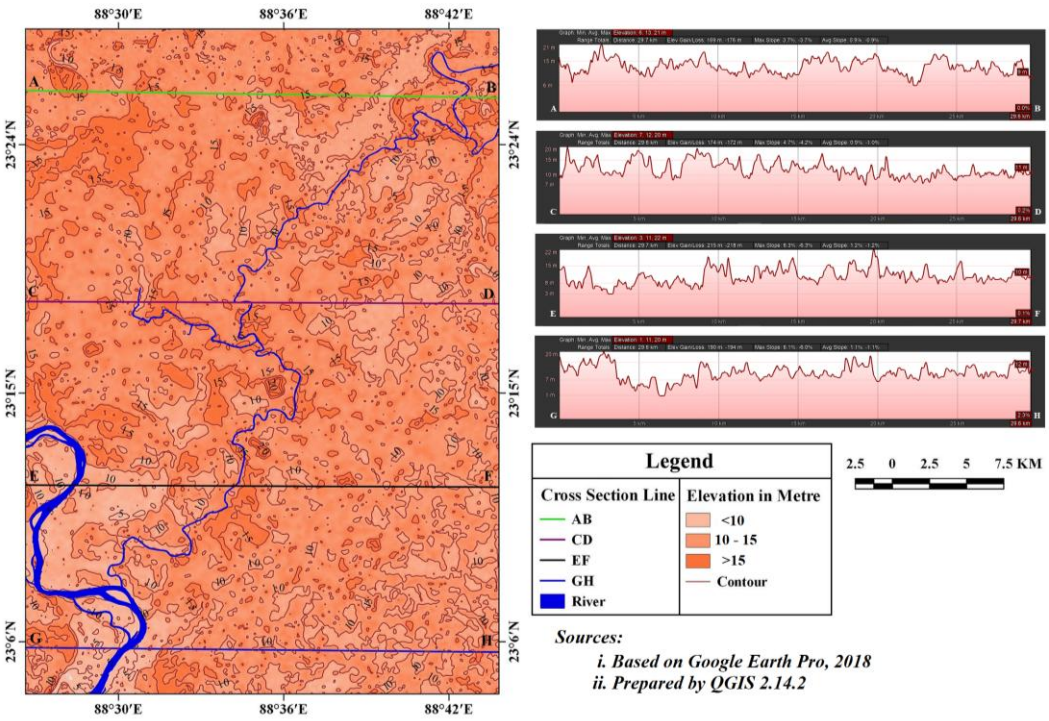
Table- 3

Topographical Elevation of different Cross Section line of the Surrounding areas of River Churni, West Bengal

Sl. No.	Cross Section Line	Max. Elevation	Min. Elevation	Length in Ground
1	AB	21 M	6 M	29.6 KM
2	CD	20 M	7 M	29.6 KM
3	EF	22 M	3 M	29.7 KM
4	GH	20 M	1 M	29.6 KM

Source: Based on Google Earth Pro, 2018

Fig. 6: Cross Sectional Elevation Profile of the Surrounding areas of Churni River



6. Conclusion

The study was carried out in some parts of Nadia district and North 24 Parganas. The study clearly established that the Remote Sensing and GIS is a powerful tool for mapping and evaluation of land use/land cover changes in some categories such as built-up lands, cultivated lands, forest lands, water bodies, fallow land and uncultivated lands of a given area. During the study period between the years 2004 to 2017 significant changes of land use and land cover recorded some interesting observations. It is also helpful for macro and micro level planning. The study revealed that the major changes occurred in agricultural land and built up area. Built-up area or Commercial areas are found to occupy the highest area compared to other categories. It is also observed that the river Churni has a tendency to shift eastward direction.

Author Contributions

Pinki Hira, & Dhiraj Sarkar contributed equally.

References

1. Ashraf, M. (2014). An Assessment of Land Use Land Cover Change Pattern in Patna Municipal Corporation over a Period of 25 Years (1989-2014) Using Remote Sensing and GIS Techniques. *International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization),* 3, pp. 16782-16791. Retrieved February 11, 2018.
2. Aspinall, R, J. & Hill, M, J. (2008). Land use change: science, policy and management, *CRC Press*, Boca Raton. Retrieved March 5, 2018.
3. Basu, T. & Saha, S.K. (2017). The Analysis of Land Use Land Cover Changes Using Geoinformatics and Its Relation to changing population Scenarios in Barasat Municipality in North Twenty Four Parganas, West Bengal, *International Journal of Humanities and Social Science Invention*, 6(8), pp. 01-13. Retrieved February 11, 2018, from www.ijhssi.org
4. Bicik, I., Kupkova, L., Jelecek, L., Kabrda, J. (2015). Land Use Changes in the Czech Republic 1845-2010, *Springer International Publishing Switzerland,* pp. 7-27. Retrieved February 20, 2018, from www.springer.com
5. Chang, Y., Hou, K., Li, X., Zhang, Y. & Chen P. (2017), Review of Land Use and Land Cover Change research progress, *IOP Conf. Series: Earth and Environmental Science*, pp. 1-6. Retrieved April 2, 2018, from http://iopscience.iop.org/article/10.1088/1755-1315/113/1/012087/meta
6. EarthExplorer - Home, Retrieved June 11, 2018, from https://earthexplorer.usgs.gov/
7. FAO (1998). Terminology for integrated resources planning and management. Retrieved February 11,

2018, from http://www.fao.org/sd/eidirect/land/EPre0081.htm.

8. Gashaw, T., Bantider, A. & Mahari, A. (2014). Evaluations of Land Use/Land Cover Changes and Land Degradation in Dera District, Ethiopia: GIS and Remote Sensing Based Analysis, *International Journal of Scientific Research in Environmental Sciences*, pp. 199-208. Retrieved May 3, 2018, from http://dx.doi.org/10.12983/ijsres
9. GLCF: Landsat Imagery, Retrieved May 12, 2018, from http://www.landcover.org/data/landsat/
10. GPS Visualizer: Assign elevation data to coordinates, Retrieved July 11, 2018, from http://www.gpsvisualizer.com/elevation
11. Kuchay, S. & Ramachandra, T, V. (2016). Land Use Land Cover Change Analysis of Uttara Kannada, *Imperial Journal of Interdisciplinary Research,* 2(4). Retrieved March 15, 2018, from http://www.onlinejournal.in/
12. Li, C., Yin, J. & Li, L. (2011). Research Overview on Urban Land Use Change Based on Remote Sensing Images, *International Journal of Environmental Science and Development,* 2(1), pp. 45-48. Retrieved March 14, 2018.
13. Pan, S. (2013). Application of Remote Sensing and GIS in studying changing river course in Bankura District, West Bengal, *International Journal of Geomatics and Geosciences*, 4, pp. 149-163. Retrieved April 2, 2018.
14. Patidar, S. & Sankhla, V. (2015). Change Detection of Land-use and Land-cover of Dehradun City: A Spatio-Temporal Analysis. *International Journal of Advanced Remote Sensing and GIS*, 4(1), pp. 1170-1180.
15. Rajat, J, S. & Kumar, M. (2015). Monitoring land use/cover change using remote sensing and GIS techniques: A case study of Hawalbagh block, district Retrieved on April 4, 2018, from http://technical.cloud-journals.com/index.php/IJARSG/article/view/Tech-409
16. Almora, Uttarakhand, India, *The Egyptian Journal of Remote Sensing and Space Science,* 18(1), pp. 77-84. Retrieved May 5, 2018.
17. Selcuk, R., Nisanci, R., Uzun, B., Yalcin, A., Inan, H., & Yomralioglu, T. (2003). Monitoring land-use changes by GIS and remote sensing techniques: case study of Trabzon, pp. 1-11, Retrieved February 20, 2018, from http://www.fig.net/pub/morocco/proceedings/TS18/TS18_6_reis_el_al.pdf 5.
18. Sreenivasulu, G., Jayaraju, N., Pramod, M.K. & Lakshmi, T.P. (2013). An Analysis on Land Use/Land Cover Using Remote Sensing and GIS–A Case Study In and Around Vempalli, Kadapa District, Andhra Pradesh, India, *International Journal of Scientific and Research Publications*, 3(5). Retrieved May 3, 2018. from www.ijsrp.org
19. TCX Converter - The multi converter tool, Retrieved June 07, 2018, from http://www.tcxconverter.com/TCX_Converter/TCX_Converter_ENG.html
20. Verburg, P, H. & Veldkamp, A. (2001). The role of spatially explicit models in land-use change research: a case study for cropping patterns in China, *Ecosystems and Environment,* pp. 177-190. Retrieved April 6, 2018.
21. Welcome to Bhuvan | ISRO's Geoportal | Gateway to Indian Earth Observation, Retrieved June 21, 2018, from http://bhuvan.nrsc.gov.in/data/download/index.php

