Watershed Development and its impact on LULC Changes in Bedwatti of Koppal district, Karnataka: A Geo Spatial Techniques

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Abstract

Present study focuses on analyzing the impact of watershed development on land use/land cover and cropping pattern changes using Spatial techniques. Bedwatti Sub-watershed of Koppal district in Karnataka state where Sujala watershed development project was implemented.simple method used to analysis and Methodology is used as High resolution LISS IV and Cartosat imageries were procured and analyzed by generating hybrid products to carry out change detection between 2015 and 2020. The results show that there is an increase in the areal extent of agriculture, forestand water bodies. On other hand, fallow land and waste land are significantly reduced due to watershed development,and significantly increased over a period of 5 years.Due to supply of water in the study area.

Key Words

Remote Sensing, GIS, Watershed, Land Use/Land Cover, Cropping Pattern etc,

Introduction

The scientific study and analysis of Land Use/Land Cover (LU/LC) changes involves a quantitative estimation of land use and land cover in a particular location and time. In this regard, remote sensing and GIS technologies play a major role in providing a synoptic bird view of the spatial extent of the land use and land cover at a given time.

The term land use refers to human being or man using a land for different purposes like food production, providing shelter materials, and for infrastructure development, etc.Land cover refers to the physical and biological cover over the surface of land, including water, vegetation, bare soil, etc. (Ellis, 2007). Land use, has a more complicated aspect because it involves social sciences and management principles.

Although land use and land cover are frequently used together, there is a very clear difference between these. While land cover signifies the spatial distribution of the different land cover classes on the earth's surface, and can be directly estimated qualitatively as well as quantitatively by using RemoteSensing (RS) and GIS, land use and its changes require the integration of both social and scientific methods to determine which human activities are occurring in different parts of the landscape, even when the land cover appears to be same (Lambin at al., 2001).

Landuse involves the management and modification of a natural environment into built environment such as fields, pastures, and settlements. It is defined as "the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it". Land use practices vary considerably across the world. LU/LC mapping is of a great significance in research, planning and management. Regional land use pattern reflects the character of interaction between man and environment and influence to the mankind's basic economic activities.

Application of remotely sensed data productshelp to study the changes in land cover and land use quickly and repetitively, at low cost and with better accuracy. RS and GIS provide efficient methods for analysis of LU/LC issues and tools for land use planning and modeling. Over the last few decades various techniques of LULC mapping and changedetection have been developed and applied all over the globe (Jinet al., 2013; Jia et al., 2014; Zhu and Woodcock, 2014; Zhanget al., 2014; Phiri and Morgenroth, 2017; Jin et al., 2017;Sekertekin et al., 2017; Lv et al., 2018; Wu et al., 2018).In this present study, an LU/LC change detection investigation has been carried out inBedawatti sub-watershed of Koppal district, Karnataka.

Study area

The Bedwatti Sub watershed is geographically located in Yelburga taluk of Koppal district, Karnataka state covering an area of 5438 ha. It falls under northern dry agro-climatic zone of Karnataka State. The sub watershed is located at about 21km from Koppal city. The sub-watershed consists of eight micro watersheds having undulating topography with a vast degraded land areas. The peninsular gneiss mostly covers the sub-watershed area. The predominant minerals found in the peninsular gneiss are oligoclase and orthoclase feldspar. The climate of the area is semi-arid or hot tropical type. The maximum temperature is 42.7°C during summer and the minimum 16.1°C in winter. Mean maximum temperature is 36.56°C and mean minimum temperature was 20.43°C.The average annual rainfall is 580.7 mm. It is well

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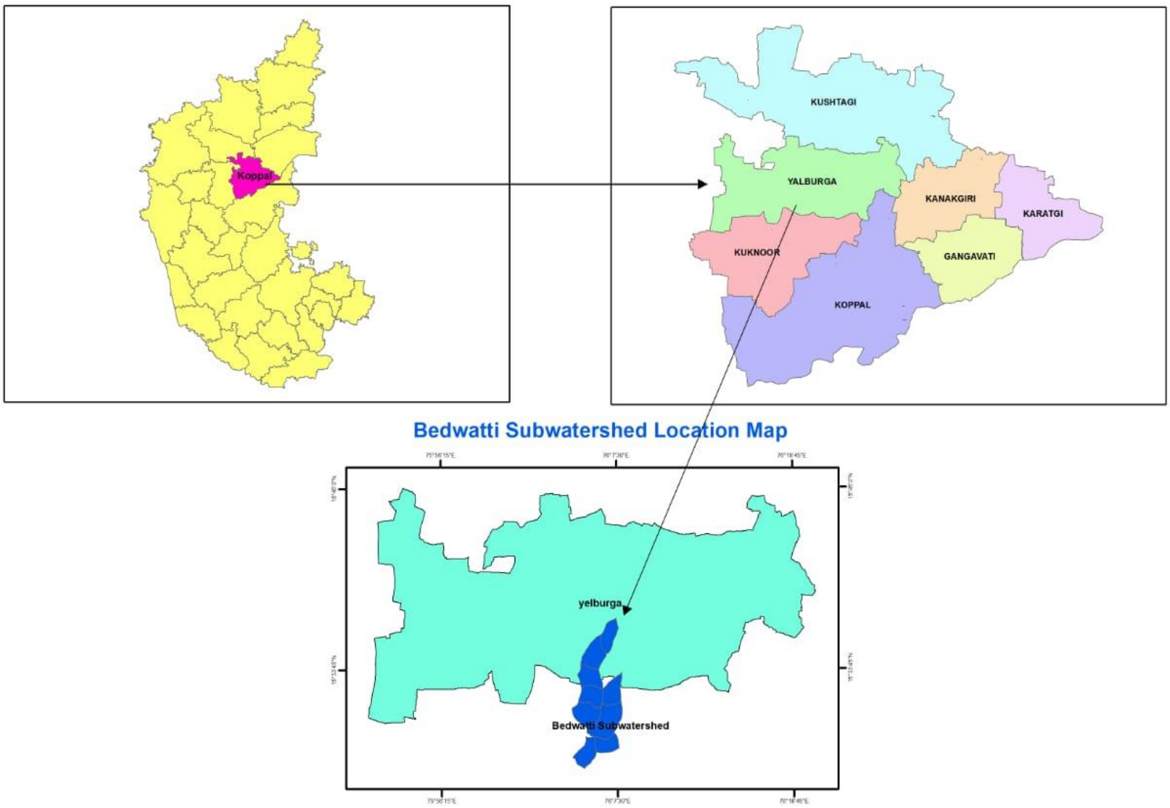
distributed with southwest monsoon (June to September months) and northeast monsoon (October to November months).



Map1: Study area

Methodology

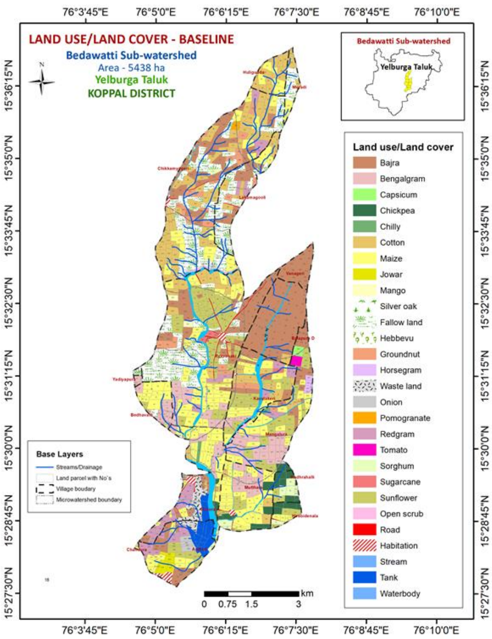
In this paper the GIS techniques were uused to show changes in LU/LC in the study area.The ERDAS Imagine software was used to geo-reference the Survey of India (SoI) Topographical Map of 1:50,000 scale in the geographic projection system with WGS84 spheroid and datum. Subsequently, the geo-referenced topographic maps were re-projected intoUTM WGS84 (43 N zone) system to carry out further spatial analyses in ArcGIS software.

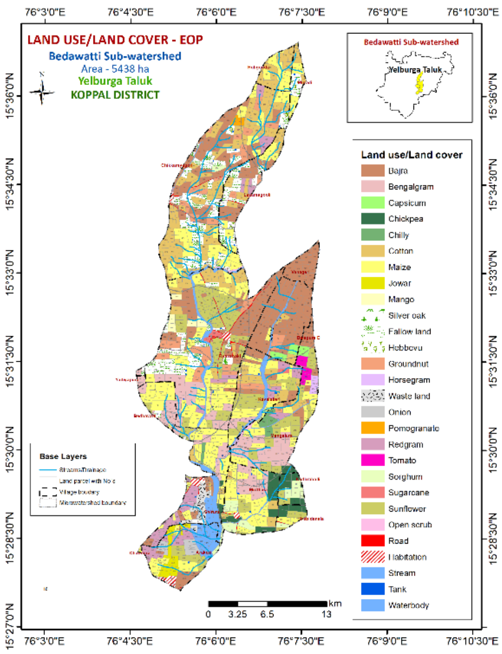
ArcGIS Desktop software was employed to generate the LULC Maps for two periods of 2015 and 2020. All the LULC features were extracted from the digitally enhanced satellite data products using on screen digitization techniques. NRSA standards were followed for the purpose and a4th level classification hae been carried out. LULC maps were validated with GPS based ground-truth data and quantitative change detection analysis has been carried out.

Results and Discussion

Totally 5438 hectors of Bedavatti Sub-Watershed was selected for the treatment and comprehensive sub-watershed development in 2015 under Karnataka Watershed Development Programme (KWDP). Several interventions like Soil and Moisture care conservation, Water harvesting structures and Promotion of Vegetative cover and Bio-mass production where taken.

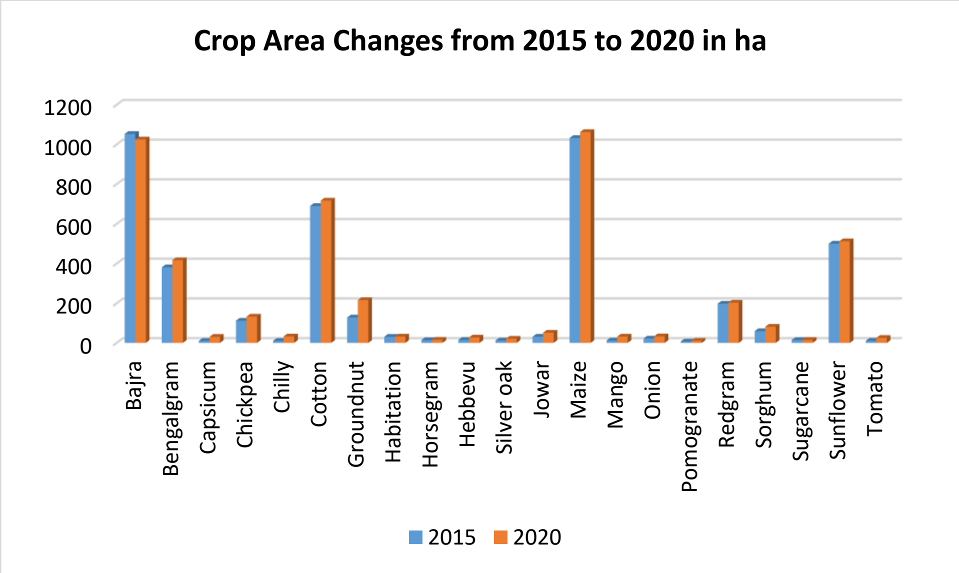
This has resulted in land and water development, agriculture development and overall environmental and socio-economic development. A change detections analysis using 2015 and 2020 satellite data products has shown significant land use land cover, crop pattern changes in the study area. The results are presented and discussed in the present study.





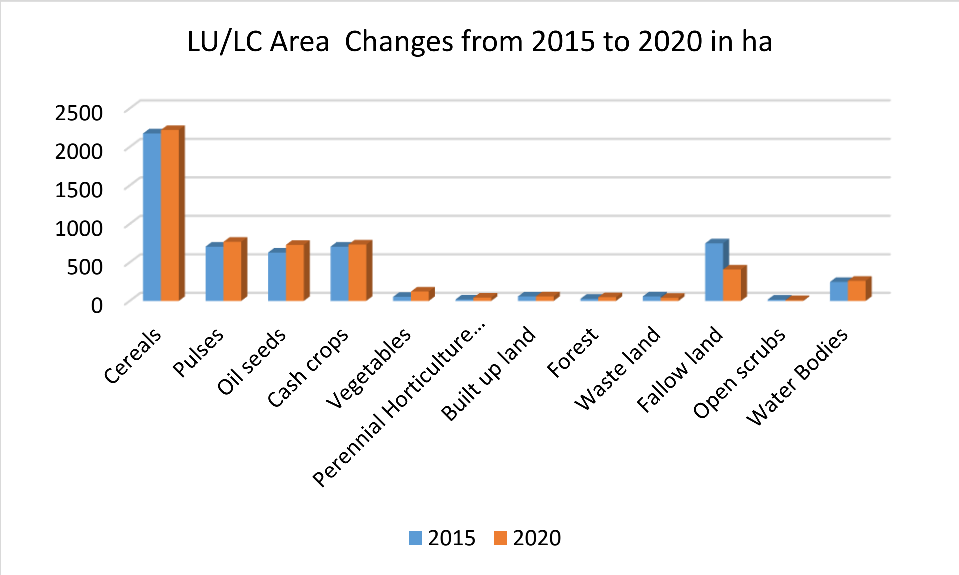
Agriculture and Horticulture Crops Statistics

	2015 Area (ha)	%	2020 Area (ha)	%	Change in Percentage
Bajra	1052.7	24.45	1025.0	21.84	-2.41
Bengalgram	380.9	8.77	416.7	8.86	0.09
Capsicum	10.5	0.24	30.5	0.65	0.41
Chickpea	111.7	2.57	132.3	2.81	0.24
Chilly	10.2	0.23	32.6	0.69	0.46
Cotton	689.7	15.88	717.0	15.82	-0.6
Groundnut	127.9	2.92	215.5	4.59	1.67
Habitation	30.8	0.70	32.0	0.68	-0.2
Horsegram	13.8	0.31	15.8	0.33	0.2
Hebbevu	15.2	0.35	27.2	0.57	0.22
Silver oak	12.2	0.28	21.1	0.45	0.17
Jowar	31.2	0.75	51.2	1.1	0.35
Maize	1032.3	23.80	1062.1	22.63	-1.17
Mango	12.2	0.28	31.8	0.68	0.40
Onion	22.0	0.50	33.4	0.71	0.21
Pomogranate	6.7	0.15	11.0	0.23	0.8
Redgram	197.6	4.53	202.7	4.23	-0.2
Sorghum	59.1	1.36	81.6	1.73	0.37
Sugarcane	14.2	0.32	15.2	0.32	0
Sunflower	499.9	11.52	511.9	10.9	-0.62
Tomato	10.8	0.27	25.1	0.53	0.26
Total	4341		4692		



Land use/Land Cover Changes Statistics

LU\LC Classes	Area in ha				% Change
	2015	%	2020	%	
Cereals	2175.3	40	2219.9	40.82	0.82
Pulses	704	12.94	767.5	14.11	1.17
Oil seeds	627.8	11.54	727.4	13.37	1.83
Cash crops	703.9	12.94	732.2	13.46	0.52
Vegetables	53.5	0.98	121.6	2.23	1.25
Perennial Horticulture Crops	18.9	0.34	42.8	0.78	0.10
Built up land	57.9	1.06	59.1	1.08	0.2
Forest	27.4	0.50	48.3	0.88	0.38
Waste land	58.7	1.07	40.2	0.73	-0.76
Fallow land	747.9	13.75	407.7	7.48	-6.27
Open scrubs	16.7	0.30	10.3	0.18	-0.12
Water Bodies	246	4.52	261	4.79	00.27



The table provides information on Land Use/Land Cover (LU/LC) classes for the years 2015 and 2020, indicating the area in hectares and the percentage change for each category. Let's critically analyze the data:

Cereals:

The area of cereals has increased slightly from 2015 to 2020 (0.82%). This indicates a stable or slightly expanding cultivation of cereal crops.

Pulses: The area dedicated to pulses has seen a notable increase (1.17%). This suggests a positive trend in pulse cultivation, possibly influenced by market demand or agricultural policies.

Oil Seeds: The area under oilseeds has also shown a significant increase (1.83%). This may reflect efforts to enhance oilseed production, possibly for economic reasons or to meet demand for edible oils.

Cash Crops: Cash crop cultivation has seen a modest increase (0.52%). This category's stability suggests a consistent focus on cash crops, possibly due to their economic importance.

Vegetables: The area dedicated to vegetable cultivation has more than doubled (1.25%). This substantial increase may be attributed to growing demand for vegetables or initiatives to promote horticulture.

Perennial Horticulture Crops: The area under perennial horticulture crops has increased (0.10%). Although a smaller increase, it may indicate efforts to enhance perennial horticulture production.

Built-Up Land:

The increase in built-up land is marginal (0.2%). This suggests moderate urbanization or infrastructure development.

Forest: Forest area has expanded (0.38%), which is positive for biodiversity and ecological balance. Conservation efforts or afforestation initiatives may contribute to this increase.

Waste Land: There is a notable decrease in waste land area (-0.76%). This could be due to land reclamation or utilization for other purposes.

Fallow Land:

- Fallow land has decreased significantly (-6.27%).
- This decline may be a concern, indicating reduced fallow periods or changes in agricultural practices.

Open Scrubs: Open scrub area has decreased, but the change is relatively small (-0.12%). This category might be affected by land-use changes or conservation efforts.

Water Bodies: Water bodies have seen a modest increase (0.27%). This may be influenced by conservation efforts, water management, or changes in hydrological patterns. The table suggests dynamic changes in land use, with some sectors experiencing growth, potentially driven by economic factors, agricultural policies, or changing consumer demands. However, the decline in fallow land raises concerns about sustainable land management practices. Understanding these changes is crucial for informed decision-making in agriculture, environmental conservation, and urban planning.

Vegetable crops show remarkable improvements for a tune of 127.3%, followed by perennial horticulture crops are showing an increase by 126.5%. Oil seeds are improved by 15.9% whereas pulses are increased by 9%. Cash crops and cereals show slight improvements of 4 and 2.1% respectively Increase in agriculture and horticulture crops is the clear indication of positive impact of watershed development interventions

Forest area is increased by 76.3% and this could be due to drainage line treatment and afforestation in both public and private lands. Water bodies have increased by 6.1% this is due to the construction of various water harvesting structure under the project. Due to socio-economic development several infrastructure developments have been taken up in the study area which has resulted in 2.1% increase in built-up land. On the other hand waste land and open scrubs are decreased by 31.5% and 38.3% respectively these decrease can be attributed to conversion of this areas into dry land horticulture has evidenced during the field surveys at different project locations under the present study. Further enhanced agriculture and double cropping practices has resulted in a reduction of fallow land by 45.5%. Detailed analysis of different crops show that Chilly (219.6%), Capsicum (190.5%), Mango (160.7%), Tomato (132.4%) show very good improvements in the study area. Bajra is slightly reduced (2.1) due to shifting cultivation towards sorghum.

Conclusion

It is evident that remote sensing and GIS techniques are very useful in delineating the spatial and temporal changes of land use/land cover and cropping pattern in a quick and cost-effective manner. The present study clearly indicates that watershed development interventions have resulted in significant variations of spatial features over a period of 5 years. Increased water availability, enhanced soil moisture, and conversion of waste and fallow lands into productive lands have resulted in increase of agricultural area and positive shifts in cropping pattern. More profitable horticulture crops and vegetable cultivation is promoted across the study area indicating the positive implications of the watershed development.

References

1]. Alphan, H., 2003. Land use changes and urbanization in Adana, Turkey, Land degradation and Development, 14, pp 575-586

2]. N.C.Anil, G.JaiSankar, M. JagannadhaRao, I.V.R.K.V.Prasad and U.Sailaja, Studies on Land Use/Land Cover and change detection from parts of South West Godavari District, A.P – Using Remote Sensing and GIS Techniques. J. Ind. Geophys. Union, October 2011, Vol.15, No.4, pp.187-194

3]. Gautam, N.C.,& Narayanan, L.R.A., 1983. Landsat MSS data for land use/land cover inventory and mapping: A case study of Andhra Pradesh, J.IndianSoc, Remote Sensing,11(3),pp(15-28)

4]. Sarma, V.V.L.N., Murali Krishna, G., HemaMalini, B., &NageswaraRao, K., 2001. Landuse/Landcover Change Detection through Remote Sensing and its Climatic Implications in the Godavari Delta Region, Journal of the Indian Society of Remote Sensing.Vol. 29, No. 1&2

[5]. Phukan P, Thakuriah G and Saikia R, LanduseLand Cover Change Detection Using Remote Sensing and GIS Techniques - A Case Study of Golaghat District of Assam, India. International Research Journal of Earth Sciences Vol. 1(1), 11-15, April (2013)

.6]. Prakasam C., Land use land cover change detection through remote sensing approach: A case study of Kodaikanaltaluk, Tamilnadu, International journal of Geomaticsand geosciences, 1(2), 150-158 (2010).

7]. Uma J. and Mahalingam B., cover changes of Land use analysis using Remote Sensing and GIS: A case study of Kanchipuram District Coastal Stretch – Tamil Nadu, International journal of Geomatics and Geosciences, 2, 188- 195 (2011).

8]. Kotoky P., Dutta M.K. and Borah G.C., Changes in land use and land cover along the Dhansiri river channel,Assam A remote sensing and GIS approach, Journal geological survey of India, 79, 61-68 (2012).

9]. Kachhwaha T.S., Temporal monitoring of forest land for change detection and forest cover mapping through satellite remote sensing, In: Proceedings of the 6th Asian Conf. On Remote Sensing, Hyderabad, 77-83 (1985).

10]. TiwariKuldeep, KhanduriKamlesh, Land Use / Land cover change detection in Doon valley (DehradunTehsil), Uttarakhand: using GIS& Remote Sensing Technique. International journal of Geomatics and Geosciences volume 2, no 1, 2011.

11]. TuhinGhosh et.al. (2001) “Assessment of Landuse/Landcover Dynamics and shoreline Changes of Sagar Island Through Remote Sensing”. 22 Asian Conference on Remote Sensing, 59 Nov 2001.

12]. Palaniyandi, M., &Nagarathinam, V (1997), “Land Use / Land Cover mapping and Change Detection using Space Borne data” Journal of the Indian Society of Remote Sensing, 25(1): pp 2733.

13]. Y.Babykalpana, LanduseLandcover change detection using remotely sensed data for Coimbatore District, India. International Journal of Scientific & Engineering Research Volume 3, Issue 5, May-2012, ISSN 2229-5518.

14]. LI.Jia-cun, QianShao-meng, ChenXue,” Object Oriented Method of Land Cover Change Detection Approach Using High Spatial Resolution Remote Sensing Data”, vol 3, IEEE transactions 2003, pp. 3005-3007.

15]. Bisht, B.S. and Kothyari, B.P. (2001). LandCover Change Analysis of Garur Ganga Watershed Using GIS/Remote Sensing Technique. I. Indian Soc.Remote Sensing, 29(3):165174.

16]. Civco, D.L. (1989). Knowledgebased land use and land cover mapping. in Proc. of the 1989 Annual Meeting of the American Society for Photogrammetry and Remote Sensing, Baltimore, MD. pp. 276291.

17]. Rajan, K.S. and Shibasaki, R., (2000). A GIS Based Integrated Land Use/Cover Change Model To Study HumanLand Interactions. In: International Archives of Photogrammetry and Remote Sensing, Vol. XXXIII Part B7 (3), pp.12121219

18]. HarsimratKaur and KaranjotKaurBrar, Land use and Land cover Change in parts of Punjab Satluj Floodplain (India): A Geospatial Analytical Overview from 1975 – 2011. International Journal of Geomatics and Geosciences volume 4, no 1, 2013.

19]. P. Kotoky, M. K. Dutta and G. C. Borah, Changes in Landuse and Landcover along the Dhansiri River Channel, Assam – A Remote Sensing and GIS Approach. Journal Geological Society of India Vol.79, January 2012, pp.61-68.

20]. Chourasia, M.R. and Sharma, P.K. (1999) Landuse/Land-cover mapping and change detection using satellite data - a case studyof Dehlon block, district Ludhiana, Punjab. Jour. Indian Soc. Remote Sensing, v.27 (2), p.115-121.

21]. Jayakumar, s. and Arockiasamy, D.I. (2003) Landuse/Land-cover mapping and change detection in part of Eastern Ghats ofTamil Nadu using remote sensing and GIS. Jour. Indian Soc. Remote Sensing, v.31 (4), pp.251-260.

22]. Sikdar, P.K., Chakraborty, S., Adhya, E. and Paul, P.K. (2004) Land-Use/Land-Cover Changes and Groundwater PotentialZoning in and around Raniganj coal mining area, Bardhaman District, West Bengal – A GIS and Remote Sensing Approach.Jour. Spatial Hydrology, v.4 (2), pp.1-24

23]. Jain, S.K., 1992. Land use mapping of Tawi catchment using satellite data. Report No.CS72, National Institute of Hydrology, Roorkee, 52

24]. Sharma, K.R., Jain, S.C., &Garg, R.K, 1984. Monitoring land use and land cover changes using landsat imager, J. Indian Soc. Remote Sensing 12(2), pp 115-121.

25]. Brahabhatt, V.S., Dalwadi, G.B., Chhabra, S.B., Ray, S.S., &Dadhwal, V.K., 2000. Landuse/land cover changes mapping in Mahi canal command area, Gujarat, using multitemporal satellite data, J.Indian Soc. Remote Sensing.p.p 221-232