Geo-informatics based Evaluation of Natural Resources of Micro Watershed sunder IWMP, Tripura

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Abstract- Remote sensing and GIS is effectively used in mapping and monitoring of natural resources available in the watershed for their proper and judicious utilization. The state has been facing problems of geo-hazards, land degradation, shifting cultivation, difficult terrain condition, besides inadequate road communication network connecting various parts of the state and lack of basic amenities and infrastructure in many parts. Keeping the above problems in view and their impact on environment and ecology a number of mission-mode projects have been initiated and executed. Integrated Watershed Management Programme (IWMP) is one among them. IWMP funded by the Ministry of Rural Development (MoRD), Government of India (GoI) is under implementation countrywide since 2009-10. The projects under the programme are implemented phase wise and evaluation of each phase namely; Preparatory Phase, Work Phase and Consolidation Phase is mandatory. Sustainable management of natural resources and sustainable production system and livelihood are the two core objectives of the programme as well as of each project. This paper is an attempt to present the findings of the changes occurs in study area related to micro watersheds, there Land Use and Land Cover (LULC) profile in three micro watersheds of Tripura state using Remote Sensing satellite imageries of two seasons.

Keywords: Remote sensing, GIS, Natural Resources, IWMP, LULC, Sustainable management

1. INTRODUCTION

Land and Water is a vital natural resource for the survival of life. Both becoming scare in most part of the world. In order to meet the growing demand for food, fuel and fodder of ever increasing population, land and water resources need to be optimally utilized for increase approach production and availability of food, fodder and fuel; restore ecological balance. The concept of Watershed development is seeks the development and management of the resources in the watershed so as to achieve higher production that can be sustained without causing any deterioration in the resource base or causing no ecological imbalances. It requires timely and reliable information on available land and water resources, which could be derived from space borne multispectral data.

The management of land and water resources is a complex task to on account of its dynamic behaviour. GIS has evolved as a highly sophisticated data management system to put together and store the voluminous data typically required for such studies. Thus, remote sensing and GIS together provide information base for efficient management of land and water resources.

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The natural resource data generated under GIS environment help to conserve and manage watershed properly to achieve sustainable development particularly, in ecologically fragile areas in order to meet the living standards of the rural communities. The restoration of ecological balance and the productivity of various land-based activities, which can indirectly generate gainful employment to the rural poor, can be achieved through the effective use of this reliable decision support system.

A Land Use Land Cover analysis (LULC) was conducted for three MWS of two districts namely Dhalai and Khowai of Tripura. This work carries 3 MWS projects and it is an end term evaluation phase of IWMP. Determination of land cover change was sought for demographic correlation. Project boundaries were taken from Project Implementing Agencies (PIA). The satellite data was processed using ArcGIS and ERDAS as well as Excel. The period of LULC analysis covered roughly a ten year time frame from 2006 to 2016. As expected, the results showed an increase in Urbanization, Forest cover area while decreasing in Waste Land/Barren Land. The implications of a shift away from an agricultural community toward an urban community can now be discussed in the light of land use and land cover change data. Nowadays the use of satellite imagery has become one of the strongest tools for classifying, analysing, processing and interpreting the complex systems of the earth and the anthropogenic influences that continue to pressure the earth limited resources. Knowledge of Geographical Information System (GIS) and requires for processing, analysing and interpreting satellite data which acquires from the various process of Remote Sensing. Digital change detection techniques by using multi-temporal satellite imagery helps in understanding landscape dynamics. The present study illustrates the spatio-temporal dynamics of land use/cover of sample MWS of Dhalai and Khowai districts, India. IRS P6 satellite imageries LISS III& IV data of two different time periods 2006 and 2016.

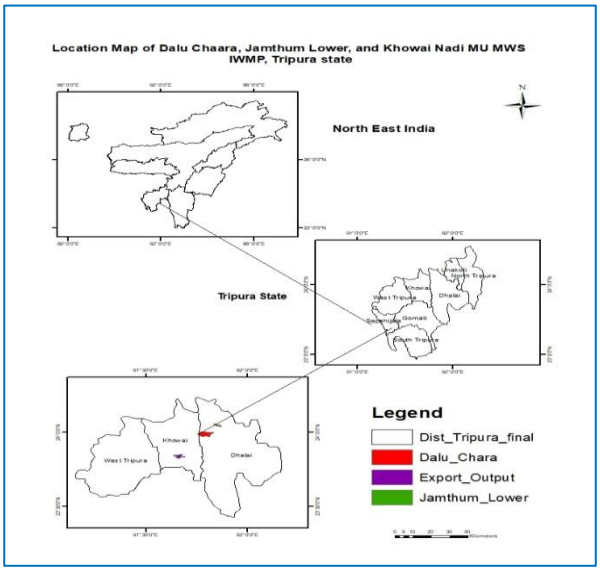
2. AIM

The main aim of the study is to prepare the geo-informatics based land use and land cover maps of End Term Evaluation of Watersheds under IWMP projects for two seasons.

3. OBJECTIVES

The different objectives of watershed management programs are:

- To identify the changes occurs in study area related to micro watersheds, there LU/LC profile.
- To generate Land Use Land Cover classes of major categories at Level – III for the period between 2006 and 2016.
- To prepare Land Use and Land Cover map of 2006 and 2016 for analysing the changes.



4. STUDY AREA

Dhalai and West Tripura districts lie in the Middle part of the Tripura State. Districts have three IWMP projects (Project I, II and III). Out of ten projects, three has been chosen as study area. The name of the projects is Dhalai-IWMP-I, Khowai- IWMP- I, Khowai- IWMP-II. The IWMP Project-I of DHALAI district is a composition of five micro watersheds. The IWMP Project- II of KHOWAI-I is a composition of four micro watersheds and KHOWAI-II is IWMP Project-III composition of three micro watersheds.

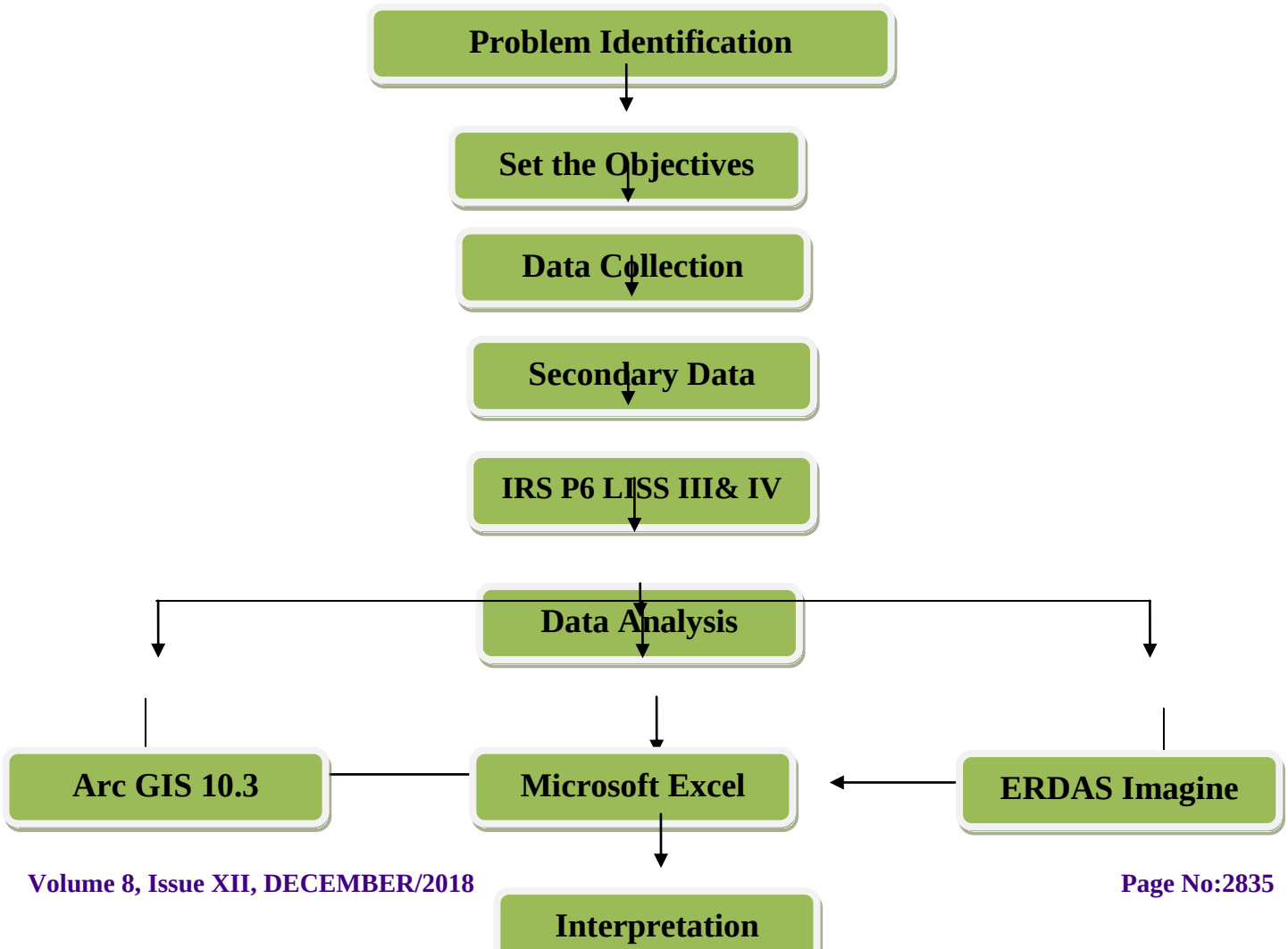
From each IWMP project (Project I, II and III), one micro watershed has been selected as study area. The micro watersheds (MWS) are namely; Dalu Chhara MWS, Jamthum Lower MWS and Khowai Nadi MU MWS.

5. METHODOLOGY

For the study, satellite images (IRS P6, LISS III &IV data) of DHALAI IWMP project I, KHOWAI, IWMP-I and KHOWAI, IWMP-II watersheds of TRIPURA were acquired for two references year 2006 and 2016. Project boundary has been obtained from PIA.The following methodology is adopted to achieve the project objectives.

- Geo-referencing the NRSC satellite imageries Of 2006 and 2016
- Create the land use/ land cover map for the multi-temporal data 2006 and 2016.
- For ground truth information taken from Google earth and GPS data.
- Compared the results of the land use/ land cover maps between two reference year
- Identified the changes in the study area.

Methodology flow chart



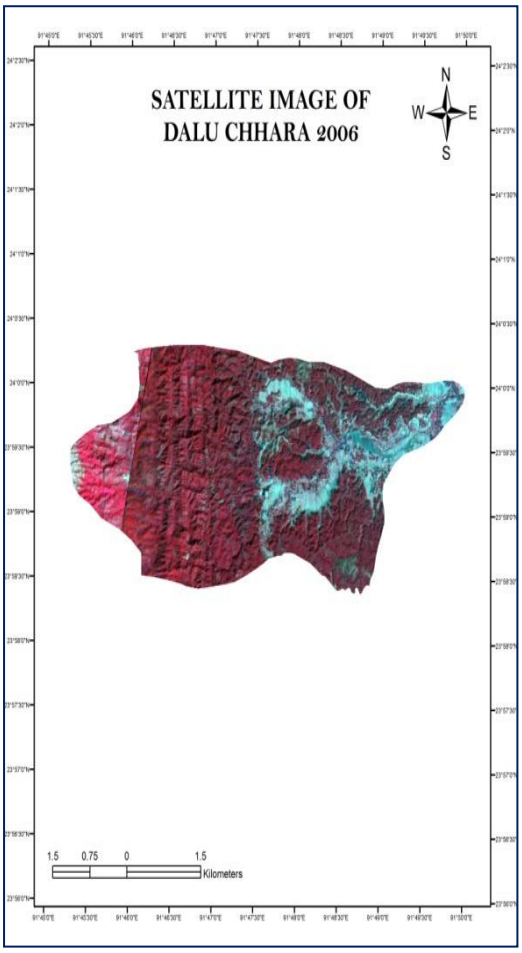
6. RESULTS AND CONCLUSIONS

6.1 Land Use/Land Cover detection and analysis

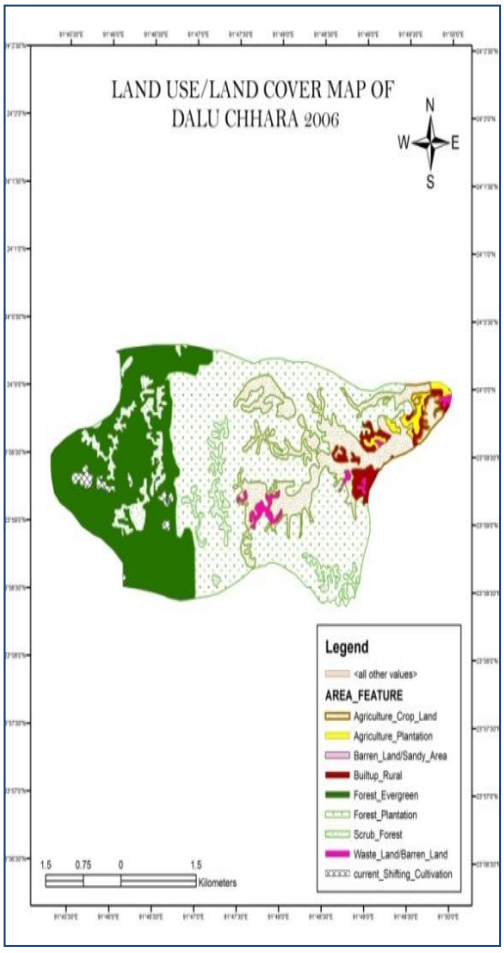
To work out the land use/land cover classification, supervised classification method with maximum likelihood algorithm was applied in the ERDAS Imagine 2014 Software. Maximum likelihood algorithm (MLC) is one of the most popular supervised classification methods used with remote sensing image data. This method is based on the probability that a pixel belongs to a particular class. The basic theory assumes that these probabilities are equal for all classes and that the input bands have normal distributions. Ground verification was done for doubtful areas. Based on the ground truthing, the misclassified areas were corrected using recode option in ERDAS Imagine. Five land use/cover types are identified in the study area viz., (i) vegetation (ii) agricultural land (iii) barren land (iv) built-up land (v) water body.

I. Dalu Chhara MWS

Land Use / Land Cover Map of Dalu Chhara MWS for 2006

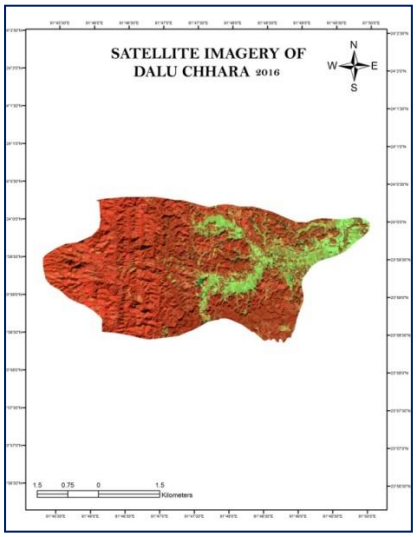


Map 1

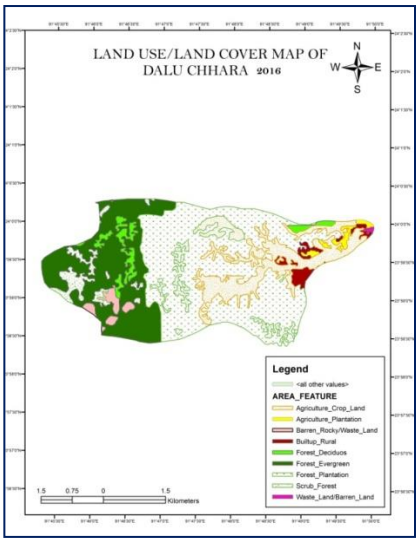


Map 2

Land Use / Land Cover Map of Dalu Chhara MWS for 2016



Map 3



Map 4

Table: 1

SL.NO	LAND USE/LAND COVER CLASSES	Area in Hectare		Change in Hectare	Area in %		Change in %
		2006	2016	2006-2016	2006	2016	2006-2016
1	Agriculture Crop Land	267.95	284.05	16.1	14.35	15.21	7.50
2	Agriculture Plantation	21.46	22.50	1.04	1.15	1.21	0.48
3	Barren Rocky/Wastelands	00.00	31.90	31.90	00.00	1.71	14.86
4	Built-up Rural	45.19	41.23	3.96	2.42	2.21	1.85
5	Forest Deciduous	00.00	58.19	58.19	00.00	3.12	27.11
6	Forest Evergreen	505.03	458.59	46.44	27.04	24.56	21.64
7	Forest Plantation	860.43	848.17	12.30	46.07	45.42	5.73
8	Scrub Forest	131.70	120.34	11.36	7.05	6.44	5.29
9	Barren Land /Scrub Land	19.11	2.43	16.68	1.02	0.13	7.77
10	Current Shifting Cultivation	16.59	00.00	16.59	0.89	00.00	7.73
11	Barren Land/Sandy Area	0.07	00.00	0.07	0.01	00.00	0.03
TOTAL		1867.40	1867.40		**100**	**100**	

Resultof Dalu Chhara MWS

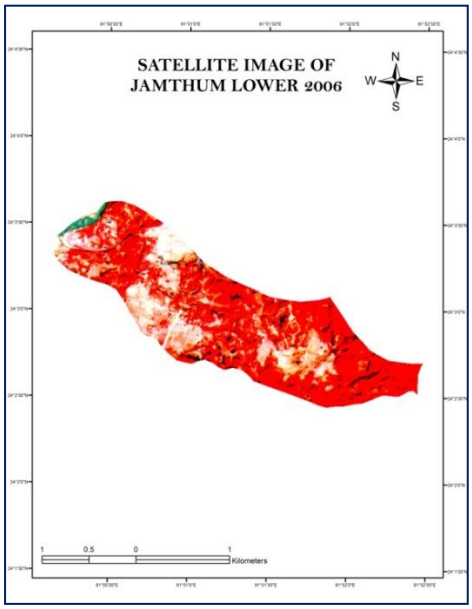
The Land use/Land cover map for the year 2006 and 2016 is prepared. Total area of watershed DALU CHHARA is 1867.40hectare. The analysis result shows that in the year 2006 the area falling under

evergreen forest was 505.03 ha, reduces to 458.59 hain year 2016 and scrubs forest 138.70 ha to 120.34 ha, which shows negative remark.

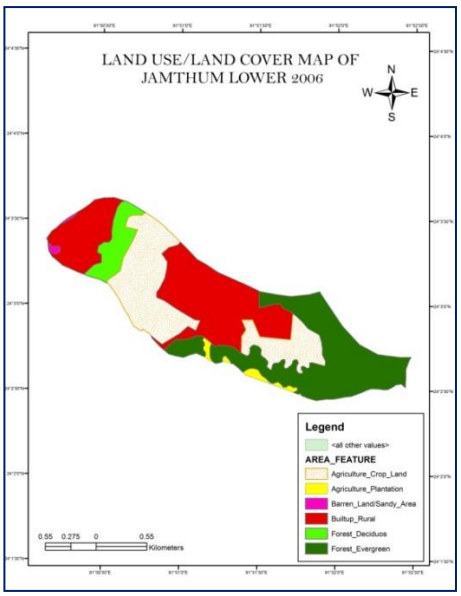
And scrub land reduces 19.11 ha to 2.43 ha in 2016 and forest deciduous area increases 0 ha to 58.19 ha in year 2016, which is positive change in watershed area.

II. Jamthum Lower MWS

Land Use / Land Cover Map of Jamthum Lower MWS for 2006

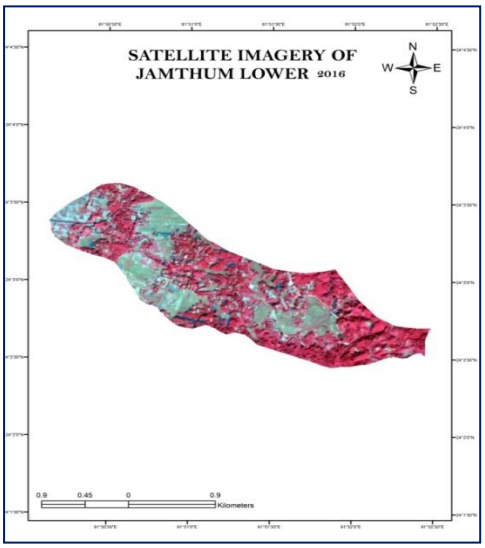


Map 5

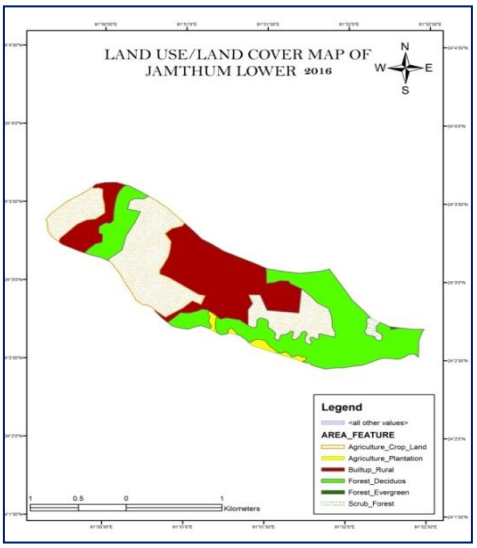


Map 6

Land Use / Land Cover Map of Jamthum Lower MWS for 2016



Map 7



Map 8

Table: 2

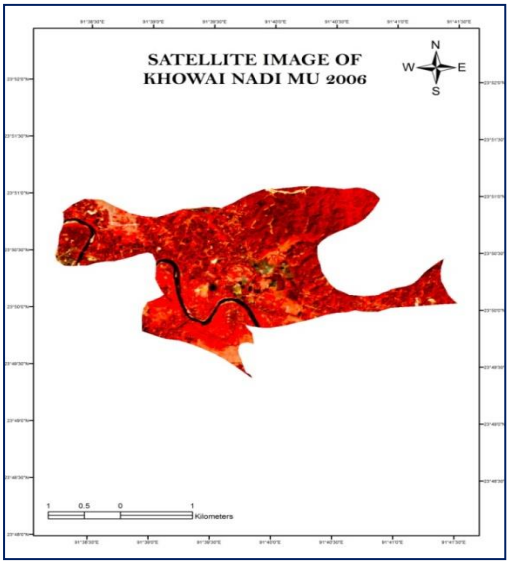
SL.NO	LAND USE/LAND COVER CLASSES	Area in Hectare		Change in Hectare	Area in %		Change in %
		2006	2016	2006-2016	2006	2016	2006-2016
1	Agriculture Crop Land	94.66	114.56	19.9	27.13	32.82	8.06
2	Agriculture Plantation	4.98	4.95	0.03	1.43	1.42	0.01
3	Built-up Rural	123.21	104.65	18.56	35.31	29.98	7.52
4	Forest Deciduous	21.17	121.81	100.64	6.07	34.92	40.78
5	Forest Evergreen	103.64	0.18	103.46	29.70	0.05	41.92
6	Scrub Forest	0.00	2.86	2.86	0.00	0.82	1.16
7	Barren Land/Sandy Area	1.34	0.00	1.34	0.38	0.00	0.54
TOTAL		349.00	349.01		100.00	100.00	

Result of Jamthum Lower MWS

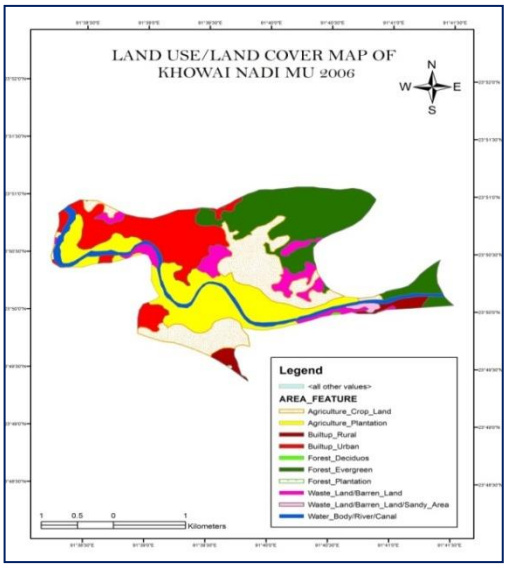
The Land use/Land cover map of JAMTHUM LOWER for the year 2006 and 2016 is prepared. Total area of watershed JAMTHUM LOWER is 349 hectares. The analysis result shows that in the year 2006 the area falling under Evergreen Forest was 103.64 ha, reduces to 0.18 ha in year 2016, Evergreen Forest change into Forest Deciduous. Change in Forest Deciduous is 100.64 ha and Evergreen Forest is 103.46 ha.whichis negative remark.Agricultural Crop Land area was 94.66 ha in 2006 which become 114.56 ha in 2016.

III. Khowai Nadi MU MWS

Land Use / Land Cover Map of Khowai Nadi MU MWS for 2006

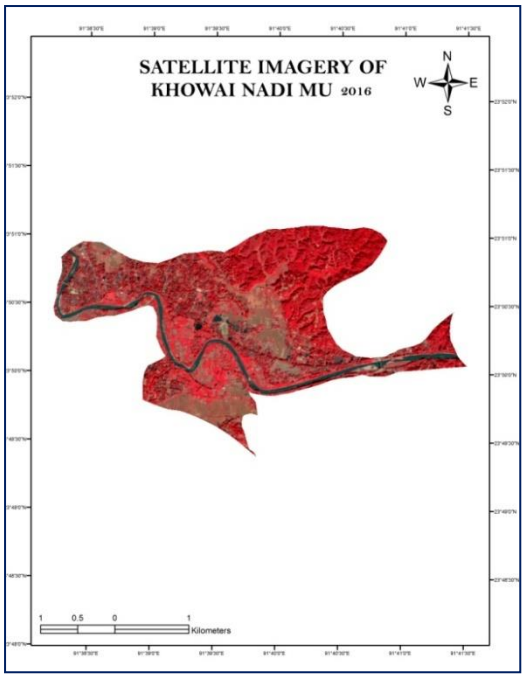


Map 9

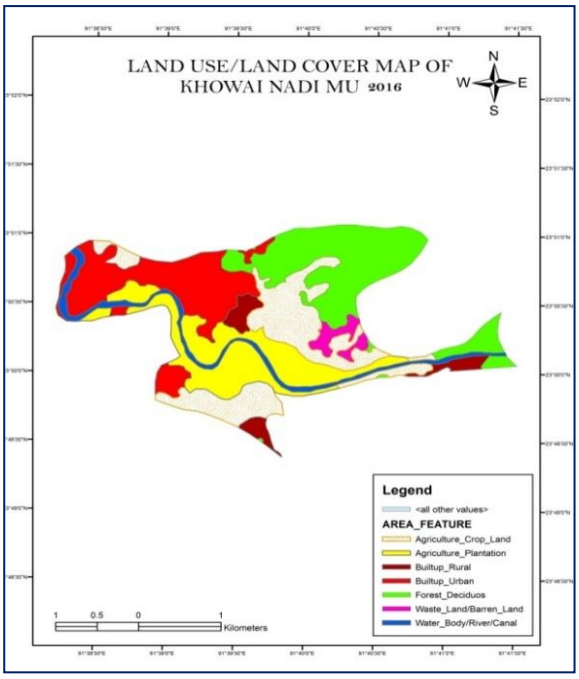


Map 10

Land Use / Land Cover Map of Khowai Nadi MU MWS for 2016



Map 11



Map 12

Table: 3

SL.NO	LAND USE/LAND COVER CLASSES	Area in Hectare		Change in Hectare	Area in %		Change in %
		2006	2016	2006-2016	2006	2016	2006-2016
1	Agriculture Crop Land	146.61	162.63	16.02	19.46	21.60	3.42
2	Agriculture Plantation	166.72	155.98	10.74	22.13	20.72	2.29
3	Built-up Rural	18.95	32.03	13.08	2.51	4.25	2.79
4	Built-up Urban	137.46	156.02	18.56	18.24	20.72	3.96
5	Forest Deciduous	0.47	186.85	186.38	0.06	24.82	39.81
6	Barren Land/Scrub Land	55.28	18.32	36.96	7.34	2.43	7.90
7	Water Body/River/Canal	40.89	40.98	0.09	5.43	5.44	0.02
8	Barren Land/Sandy Area	4.09	0.00	4.09	0.54	0.00	0.87
9	Forest Evergreen	181.94	0.00	181.94	24.25	0.00	38.87
10	Forest Plantation	0.26	0.00	0.26	0.03	0.00	0.06
TOTAL		752.83	752.83		100.00	100.00	

Result of Khowai Nadi MU MWS

The Land use/Land cover map of KHOWAI NADI MU for the year 2006 and 2016 is prepared. Total area of watershed KHOWAI NADI MU is 752.83 hectare. The analysis result shows that in the year 2006 the area falling under Evergreen Forest was 181.94 ha completely change in year 2016, Evergreen Forest change into Forest Deciduous.Area of Forest Deciduous becomes 186.85 ha in 2016.

Barren Land area was 59.37 ha in 2006 which become 18.32ha in 2016. Built-up urban area was 137.46 ha in 2006 become 156.03 ha in 2016.

6.2 CONCLUSIONS

Result of Land use/Land Cover analysis of Micro watersheds in Tripura State clearly indicate the different types of land cover in that area which are used for different purposes. In this study, Land Use/Land Cover map for the period of 2006 and 2016 was prepared which shows different results for that area (Tables). All three MWSs are showing positive results as the main aim and objectives of IWMP projects. Agricultural land and vegetation has increased and barren land and waste lands are decreased in the study areas.

In the view of above information, it presents a clear picture of land cover where it was before in 2006 and where it is in current year 2016. This is the change in Land Use and Land Cover which covered roughly a ten year time frame.

Inanalysing the prospect of Barren Landof the total area we come to the results that people get idea of utilizing a waste land as an Agricultural activity which is a good symbol in growth of economy. Andtheimproved economy leads to improved living standard and upgraded approach to life. When successful approaches are recorded or knowledge is spread, people know how to deliver the best outcomes.As expected, the results showed an increase in Urbanization, Forest cover area while decreasing in Waste Land/Barren Land. The implications of a shift away from an agricultural community toward an urban community can now be discussed in the light of land use and land cover change data.

REFERENCES

[1] Li Xiubin, “A Review of the International Researches on Land Use/Land Cover Change” Institute of Geography, Chinese Academy of Science and the State Planning Commission of P.R. China Beijing.

[2] N.C. Gautam. “LU/LC classification” Center for Land Use management, Cluma Publication Series-3. NRSA Lib.

[3] James R. Aderson Ernest E Hardy, John T. Roach, and Richard E. Witmer “A Land Use and Land Cover Classification System for Use with Remote Sensing Data” Geological Survey Professional Paper 964.

[4] Zubar Ayodeji Opeyemi. “Change Detection in Land Use Land Cover Using RS and GIS Data(A Case Study of Ilorin and Its Environs in Kuwara State.)”