International Journal of Research Studies in Science, Engineering and Technology [IJRSSET]
Volume 1, Issue 2, May 2014, PP 1-6

Change Detection Analysis of Hiranyakeshi Basin Using Multi-Temporal Remote Sensing Data and Geoinformatic Technique

Panhalkar S.S., Mali Sagar P.& Pawar C.T.
Department of Geography Shivaji University,
Kolhapur, MS, INDIA

Abstract: *Temporal land use-land cover change detection analyses of the region gives an idea about trend of the changes in land utilization of specific class during a period of time and itis also helpful to study the futuristic planning for conservation of natural resources like land, water and soil as well as social wellbeing of the society. Land use & Land cover change detection analysis has been carried out for the present study. Satellite images of Landsat-5 TM(1989), Landsat-7 ETM+ (2000) and IRS-P6 LISS-III (2007) have been used to study the temporal changes in the land use and land cover by applying superwise classification techniques in ERDAS IMAGINE 9.1 software. Satellite image classified in Forest land, Fallow land, Agriculture land, Grass land, Barren land and Water bodies classes and result shows that, in year 1989 the forest area was around 35% of the basin which was declined up to 18% in the year 2000 and again slightly increased upto 18.3% in the year 2007. In the year 1989, the agriculture land was only 16.3% which became 24.3 and 36.3% in the year 2000 and 2007 respectively. Area under water bodies also continuously increased from 0.4% to 1.6 %,Barren land is continuously decreasing and broughtunder forest and agriculture use. The analysis reveals that, due to increased irrigation facility barren land and grassland have brought under agriculture use and need to be increased the forest area for natural resource management and decline the soil erosion in the Hiranyakeshi river watershed area.*

Keywords: *Land use/ Land cover, Change Detection, Superwise classification, Soil Erosion, Conservation*

1. INTRODUCTION

The process of Land Use Land Cover Change is a dynamic phenomenon.Global, regional, and local studies of LULC have greatly increased due to advances in observation and detection methods including remote sensing and geospatial techniques. The issue of land use / land cover changes havebeen given priority in many international and interdisciplinary researches such as remote sensing, political ecology, and biogeography (Turner et al, 1995, Jensen, 2005; Turner et al, 2007).Knowledge of spatial land cover information is essential for proper management, planning and monitoring of natural resources (Zhu, A.X, 1997).It is desired input for many agriculture, Geological, Hydrological and Ecological models. In additionally,It is also useful in Disaster management. Land use and land cover analysis is important for many planning and management activities and considered as essential element for physical modeling and understanding the earth as a system. Now a daysland cover maps are prepared for planning and management purposes. Due to synoptic view, map like format and repetitive coverage, satellite remote sensing imagery is remarkable source of gathering quality of land cover information at local, regional and global scale (Csaplovics, E., 1998, Foody G.M., 2002). Relationship between natural and anthropogenetic factor with land use / land cover change can be properly assessed through multi-temporal satellite data. Change detection analysis will be very crucial in monitoring the changes and to prepare aaction plan for land resource development.

2. OBJECTIVE

The objective of the present study is to identify the temporal changes in the land use land cover in the Hiranyakeshi basin of southernMaharshtra since 1989 to 2007.

Fig.1. *Location Map*

3. STUDY AREA

The region selected for present study is Hiranyakeshi basin of southern Maharashtra which comprises an area of 720 km^2 and lies between 16° 00' N to 16° '18 N latitude and 74° 00' E to 74°30' E longitude. The basin cover parts of Ajara, western border of basin is demarcated by western ghats and slope is decreasing from west to east. Hiranyakeshi river flows from south westen to north eastern direction inAjra and Gadhinglajtahsils of Kolhapur district. Elevation of the area lies between 619 meter and 960 meter respectivelyand high steep slope occurs in the western side of basin area.

4. MATERIAL AND METHODS

In present research following satellite data has been used for temporal analysis of basin.

Table No.1. *Data table*

Sr.No	Satellite	Sensor	Date of image Accusation	Spatial Resolution (in m)	Date Source
1	Landsat 5	TM	19-11-1989	30	GLCF
2	Landsat 7	ETM+	25-11-2000	30	GLCF
3	IRS P6	LISS-III	09-12-2007	23.5	NRSA

Temporal satellite data of Landsat Thematic Mapper (TM) of year 1989, Enhanced Thematic mapper (ETM+) of 2000 and IRS-P6 LISS-III have been used for the present study. Satellite data of TM and ETM+ obtained from online Global Land Cover Facility (GLCF) website of USGS, USA of year 1989 and 2000 respectively, IRS-P6 LISS-III data gathered from NRSA, Hyderabad of year December 2007. All data sets are classified in 6 major classes(Forest, Grassland, Fallow land, Barren land, and Agriculture and Water bodies) by using tosupervise classification method in ERDAS Imagine 9.1.Classwise area calculation has been carried out over the period of time and these changes were verified by using GPS.Erdas Imagine software has been used for change detection analysis. Following chart (Fig.2) shows the general methodology of the research.

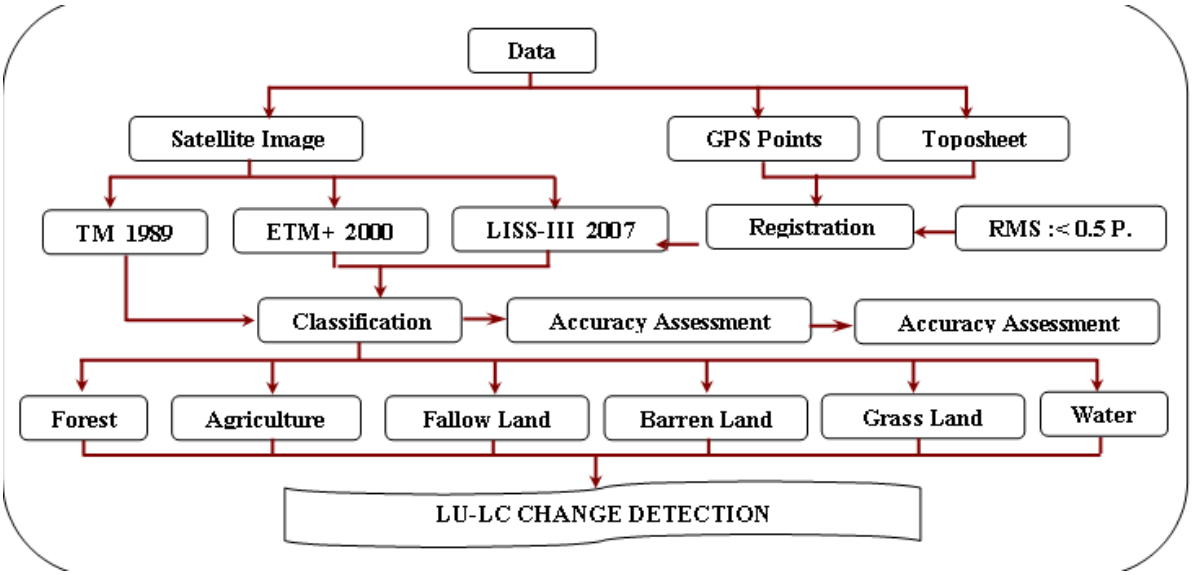

Fig 2. *Methodology chart*

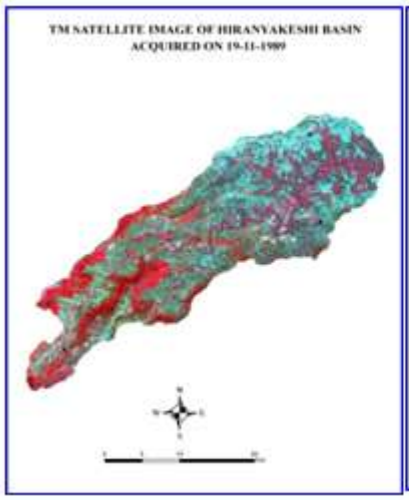

Fig.3: TM Satellite Image

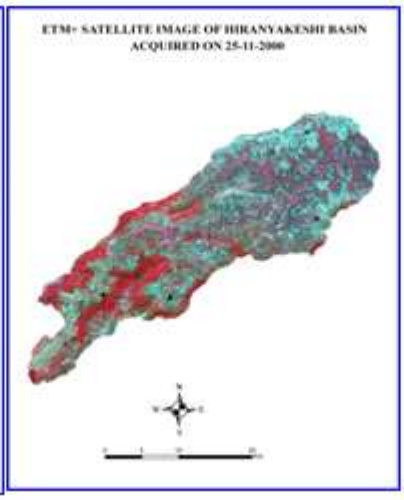

Fig.4: ETM Satellite Image

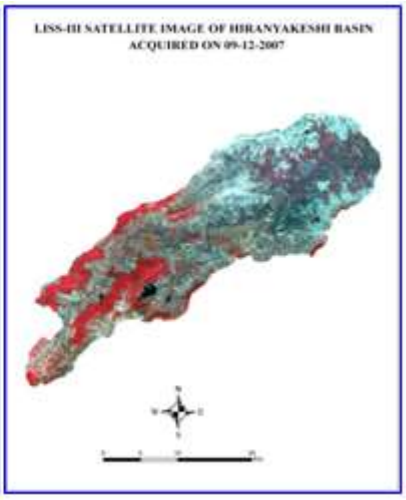

Fig.5: LISS-III Satellite Image

5. Result and Discussion

i) Analysis of Land use Land cover between 1989 to 2000

Landsat-TM of 1989 and Landsat ETM+ satellite image of the year 2000 have been classified by using superwise classification technique in 6 major classes (Table.2) and investigated the changes occurred during theyear 1989 to 2000. Analysis reveals that, in year 1989the total area under forest was 35% which has decreased by 17.2 % in the year 2000. This has been converted into agriculture, grass land and barren land (Table.2) due to anthropogenic activities. Agriculture area was 16.3 % in 1989 and it is increased by8% in 2000 and this is mainly because of improvement in irrigation facilities in the basin area. Grassland was 23.5% in 1989 which has reached up to 27.3%. It shows that around 4.3% grassland area has increased due to deforestation and human interference.

Following table (Table.2) and maps (Fig.6 and Fig.7) depict the land use / land cover changes in year 1989 and 2000.

Table.2. *TM and ETM+ Image Classification*

No	Class	TM_1989 Area in ha	TM_Area in %	ETM_2000 Area in ha	ETM+ Area in %	Area Increased/ decreased (in %)
1	**Forest**	25424.6	35.2	12961.0	18.0	**-17.2**
2	**Agriculture**	11744.2	16.3	17605.6	24.3	**8**
3	**Fallow**	703.6	1.0	1459.9	2.0	**1**
4	**Grassland**	16945.9	23.5	20043	27.8	**4.3**
5	**Water**	332.5	0.4	446.7	0.6	**0.2**
6	**Barren**	17065.2	23.6	19699.8	27.3	**3.7**
	Total	**72216.0**	**100**	**72216.0**	**100**	

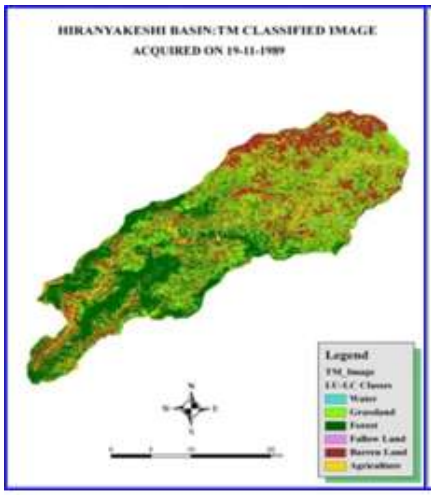

Fig. 6. *TM Classified Image*

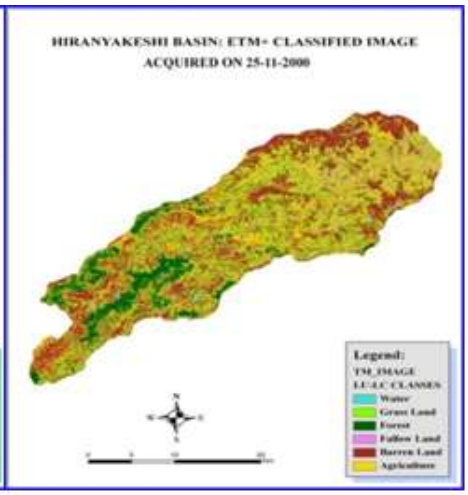

Fig. 7. *ETM+ Classified Image*

ii) Analysis of Land Use Land Coverchange between 2000 to 2007

Landsat ETM+ image of year 2000 is again compared with the IRS-P6 LISS-III satellite image of the year 2007. LISS-III has quite high spatial resolution (23.5m) than Landsat ETM+ (30m). To remove the difference between the spatial resolution of both images, IRS P6 data is again resampled with 30m resolution. In change detection analysis, comparison of images with same spatial resolution is necessary for crucial result. (Jensen, J.R., 2005).It is observed that, Forest area in year 2000 was 18% which is increased up to 18.3 % in the 2007.The insignificant change in area under forest is due to public awareness and government policy regarding forest cover. Agriculture area has been increased from 24.3 % to 36.3% (12 %). It is due to increased irrigation facility and water supply from Chitri medium irrigation project. Majority of the grassland area has brought under agriculture practices. Hence, grass land area is decreased by 11.6% during the year 2000 to 2007. Area under water bodies has been increased by1 % due to area submerged by various medium and minor irrigation projects.The barren land has increased by 2.6%, it is mainly due to conversion of grassland into barren land. Following table (Table.3) and map (Fig. 8 & Fig.9) shows the comparative result between 2000 and 2007 land use and land cover classes.

Table.3. *ETM+ and LISS-III Image Classification*

No	Class	ETM+_2000 Area in ha	ETM+_2000 Area in %	LISS_2007 Area in ha	LISS_2007 Area in %	Area Increased/ decreased (in %)
1	**Forest**	12961.0	18.0	13195.4	18.3	**0.3**
2	**Agriculture**	17605.6	24.3	26192.8	36.3	**12**
3	**Fallow**	1459.9	2.0	2126.0	2.9	**0.9**
4	**Grassland**	20043	27.8	11707.4	16.2	**-11.6**
5	**Water body**	446.7	0.6	1171.0	1.6	**1**
6	**Barren**	19699.8	27.3	17823.4	24.7	**2.6**
		72216.0	**100**	**72216.0**	**100**	

Source: Result from Image Classification through GIS Software.

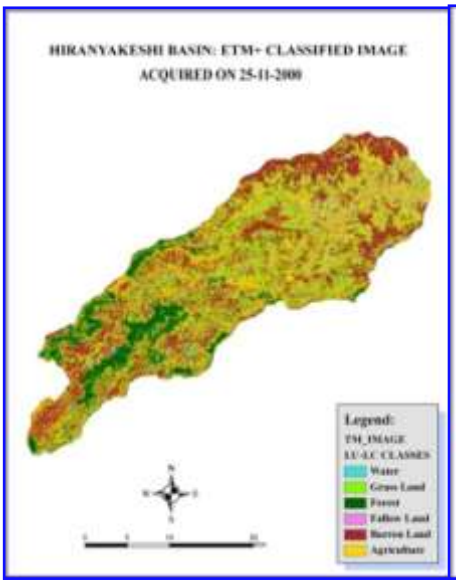

Fig 8. ETM Classified Image

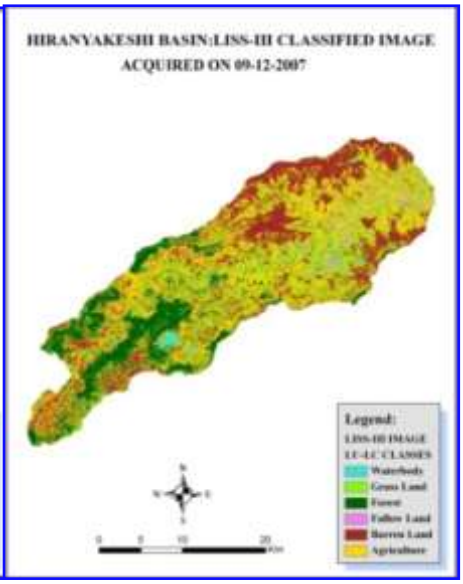

Fig 9. LISS-III Classified Image

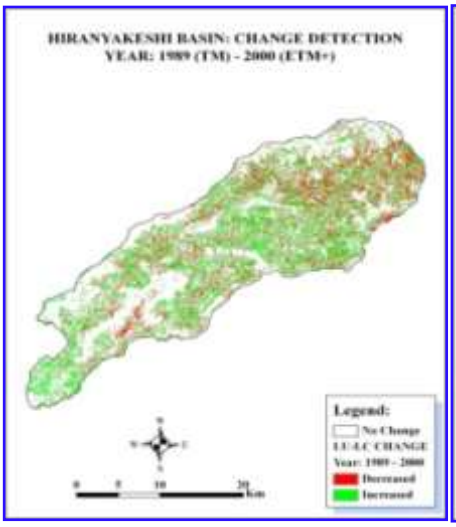

Fig. 10. *Change Detection (1989-2000)*

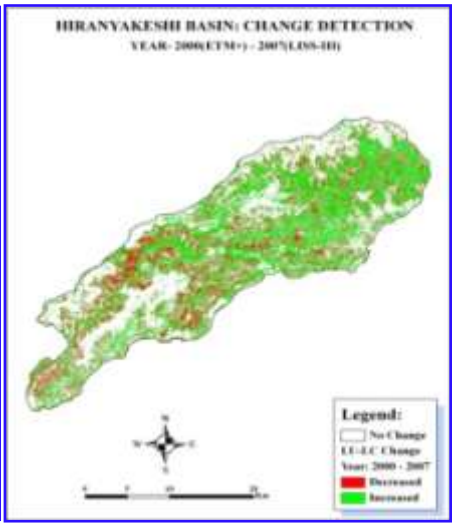

Fig.11. *Change Detection (2000-2007)*

6. CONCLUSION

The afore said analysis reveals that, due to deforestation and agriculture practices, forest area has rapidly declined in the upper Hiranyakeshi sub-basin during 1989 to 2000. Hence, the risk of soil erosion has been increased. According to the study of morphometric analysis (Panhalkar et.al, 2012), it is recommended that upper sub-basin of the Hiranyakeshi river has need be given higher priority for soil conservation practices.However, due to public awareness and people participation in govt. schemes, later on forest area is increasing after the year 2000. An irrigated area is increased due to medium and minor irrigation projects, large amount of forest and grassland areahave brought under agriculture practices. During 1989 to 2000, insignificant changes in land use land cover have been observed as compare to the year 2000 to 2007(Fig.10& Fig.11). The substantial change during the year 2000 to 2007 is largely due to increased irrigation area after the completion of Kitawade, Chikotra, Ambeoholand Chitri medium project as well as other minor irrigation projects in the basin.

ACKNOWLEDGEMENT

The present research paper is an outcome of the U.G.C. Major Research Project entitled "Watershed Development and Management in Hiranyakeshi Basin (Maharashtra): A Geoinformatic Approach". The Research team is very thankful to the U.G.C. authorities for generous funds approved for the said project. We also thankful to Department of Geography,

Shivaji University, Kolhapur for providing GIS Lab facility for research work.

REFERENCES

[1] Csaplovics, E., "High Resolution space imagery for Regional Environmental Monitoring – Status quo and future trends", International Archives of Photogrammetry and Remote Sending, 1998,Vol.32(7), pp. 211-216.

[2] Foody, G. M., "Status of land cover classification Accuracy Assessment", Remote Sensing for Environment, 2002, Vol.80, pp. 185-201

[3] Jensen, J.R., "Introductory Digital Image Processing", ARemote Sensing Perspectives. Pearson Education ,Inc, 3rd Edition, 2005.

[4] Panhalkar S.S., Mali S.P. &Pawar C.T., "Morphometric Analysis and Watershed Development Prioritization of Hiranyakeshi Basin in Maharashtra, India". International Journal of Environment Sciences,2012, Vol. 3(1), pp. 525-534.

[5] Turner II, B.L., Skole, D.L., Sanderson, S., Fischer, G., Fresco, L.O., Leemans, R. "Land use land cover change". Science/ Research plan. Stockholm & Geneva. IGBP report No.35 & HDP report No.7, 1995, pp.137

[6] Turner II, B.L., Lambin, E. &Reenberg, A., "The Emergence of Land Change Science for Global Environmental Change and Sustainability". Proceedings of National Academy of Sciences of the United States of America, 2007, Vol.104, pp. 20666-20671.

[7] Zhu, A. X., "Measuring Uncertinity in class Assignment for Natural Resources Map under fuzzy logic", Photogrammetric Engineering and Remote Sensing, 1997, Vol. 63(10). Pp. 1195-1202.