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Evaluation of Morna river catchment with RS and GIS techniques

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Abstract
Remote Sensing (RS) and Geographic Information System (GIS) is a powerful tool in evaluation of watershed in terms of comparison of land use, water bodies, settlements, etc., over time periods. Morna catchment was selected for the study of Land use and land cover and to simulate the changes over the period of sixteen years. The study was conducted through remote sensing approach using SOI toposheets and Landsat imageries of different years from 2000 to 2016. Idrisi Selva and GIS software was used to prepare the thematic maps. During the last 15 years the change in other land use categories is negligible. The percentage of open forest is decreased because of human population growth and conversion of forest into agricultural land. Water bodies cover only 0.77% of the total area in the year 2000 which increased to 1.61 in 2016 due to construction of reservoir. Settlement is also increased by the rate (0.11), which is very obvious due to human population growth.

Keywords: Morna Catchment, Land use, Land cover, GIS

Introduction
An information on land use/land cover and possibilities for optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. This information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population.
Land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental changes. The advancement in the concept of vegetation mapping has greatly increased research on land use land cover change thus providing an accurate evaluation of the spread and health of the world's forest, grassland, and agricultural resources has become an important priority.
Remote Sensing (RS) and Geographic Information System (GIS) are now providing new tools for advanced ecosystem management. The collection of remotely sensed data facilitates the synoptic analyses of Earth - system function, patterning, and change at local, regional and global scales over time; such data also provide an important link between intensive, localized ecological research and regional, national and international conservation and management of biological diversity. Therefore, attempt was made in this study to map out the status of land use land cover of Morna River Catchment between 2001 and 2016 using RS and GIS.

Materials and methods
Study area
Morna is tributary of Koyna River, which is one of the major tributaries of river Krishna in Maharashtra. This catchment lies in Satara district of Maharashtra state in western India, between17º24' to 17º50' N Latitude and 73º46' to 74º0' E Longitudes. The total area of watershed is 13,285.13ha. In this watershed, area under agriculture is about 4946.23 ha. Majority area of the watershed is covered under II, III, IV, VI and VII land capability classes. Length of Morna River is 24.25 km. Location map of study area is shown in fig. 1.

Data Collection and Pre-processing
Varieties of data were collected from various sources such as,
1. Satellite images were downloaded from LANDSAT imageries (ftp.glcf.umd.edu) and used for land use land cover preparation.
2. Toposheets of study area were obtained from GIS unit cell, Commissionorate of Agriculture, Pune, which were used for the validation of boundary of watershed.

Land use/Land cover
Land use/Land cover is one of the most important thematic inputs in watershed study as it provides the present status of land utilization and its pattern.

The change in land use/land cover is very dynamic so satellite remote sensing is widely used for its mapping. Land use refers to human's activities and various practices are carried out on land. Whereas land cover refers to natural vegetation, water bodies, rock/soil, artificial cover and others are resulting due to land transformations. Land use encompasses several aspects of human's relationship to the environment e.g. activity, ownership and land quality. Land use/Land cover map was derived from satellite images downloaded from LANDSAT imageries (ftp.glcf.umd.edu) and earth explorer. Interpretation of multi-season satellite data had been carried out to generate the land use land cover map of study area. Thematic mapping of the different land use/ land cover classes was achieved through supervised classification.

Results and discussion

The land use and land cover characteristics of the study area described using land use/land cover (LU/LC) maps and the statistics generated on this aspect. The LU/LC in the study area was classified in to six classes: (i) Water bodies (ii) Fallow land (iii) Dense forest (iv) Cultivated area (v) Open forest and (vi) Settlement. The findings of present investigation are presented in table 1. Most of forest lands are dense and open forest. But day by day forest lands are converted to built-up areas (settlements, road etc.) It may be because of increasing human population.

In 2000, Land use land cover pattern of Morna river catchment revealed that majority of land of KR-27 watershed was comes under Agriculture Land class (5549.38 ha). It was 41.85 percent of the total area of watershed. Next dominate class was dense forest (3291.67) which covers about 24.82 percent of total area followed by fallow land (2922.10 ha, 22.03 percent), open forest (1069.54 ha, 8.07 percent), settlement and wasteland (326.39 ha, 2.46 percent) and water bodies (191.86 ha, 0.77 percent). It is inference that almost 58 percent of the land was covered by major two classes agriculture and dense forest, which are most vulnerable for flood condition.

The Land use land cover pattern of Morna river catchment undergone various changes which as as follows, Land use land cover pattern of Morna river catchment revealed that majority of land of KR-27 watershed was comes under cultivated area class (5843.32 ha). It was 44.06 percent of the total area of watershed. Next dominate class was settlement (2948.41) which covers about 22.23 percent of total area followed by fallow land (2340.21 ha, 17.65 percent), open forest (1115.69 ha, 8.42 percent), dense forest (797.80 ha, 6.02 percent) and water bodies (215.98 ha, 1.63 percent). Land use Land cover maps of Morna river catchment for year 2000, 2003, 2007, 2013 and 2016 are presented in figures 2, 3, 4 5 and 6 respectively.

Comparison of data

During the last 15 years the change in other land use categories are negligible. The percentage of open forest is decreased because of human population growth and conversion of forest into agricultural land. Water is one of the most indispensable resources and is the elixir of life8. Water bodies included wetlands, ponds, streams and rivers. Water bodies cover only 0.77 % of the total area in the year 2000 which increases to 1.61 in 2016 due to construction of reservoir. Settlement is also increased by the rate (0.11), which is very obvious due to human population growth. Comparative analysis of land use land cover represented in fig 7.

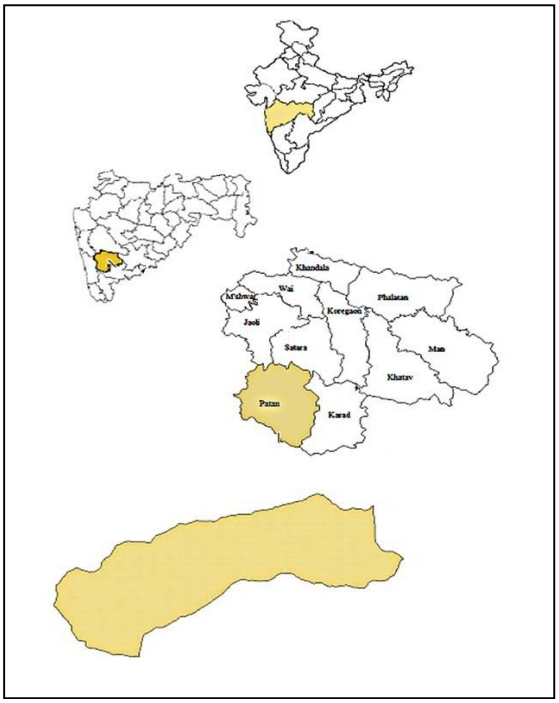

Fig 1: Location of Study Area

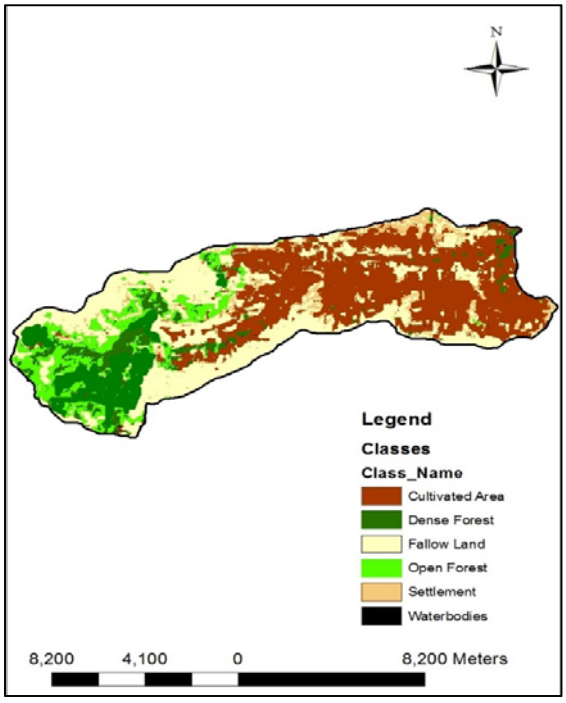

Fig 2 : Land use Land cover map for year 2000

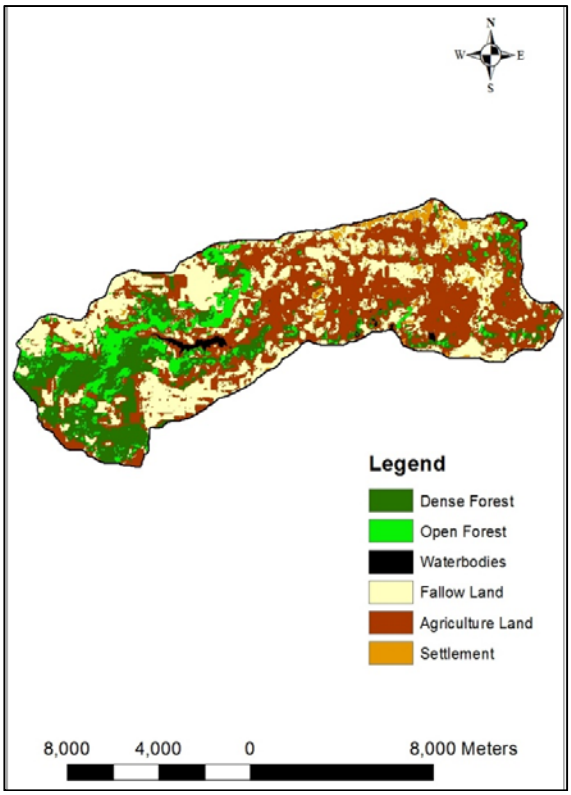

Fig 3 : Land use Land cover map for year 2000

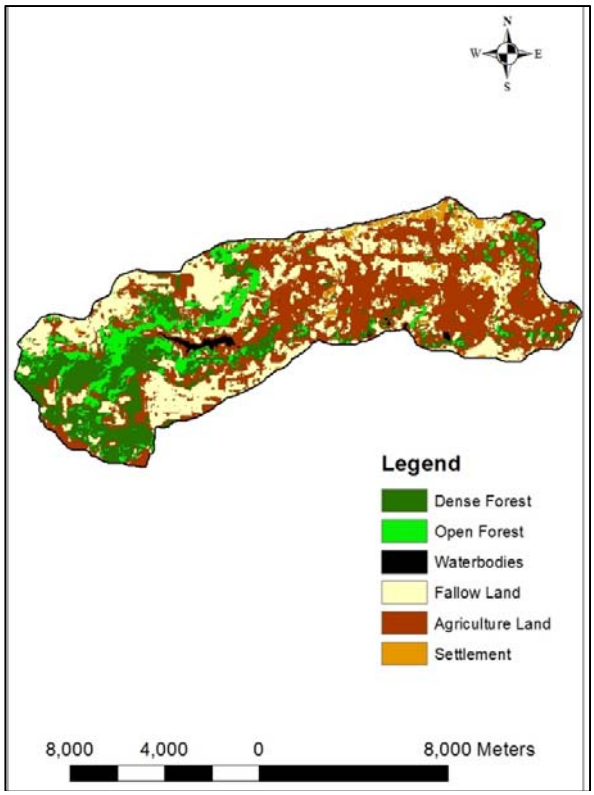

Fig 4: Land use Land cover map for year 2000

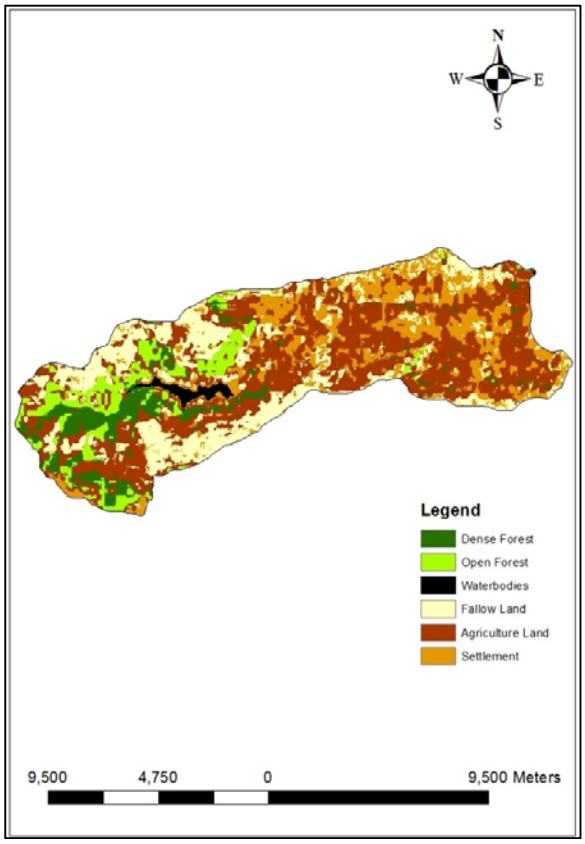

Fig 5: Land use Land cover map for year 2000

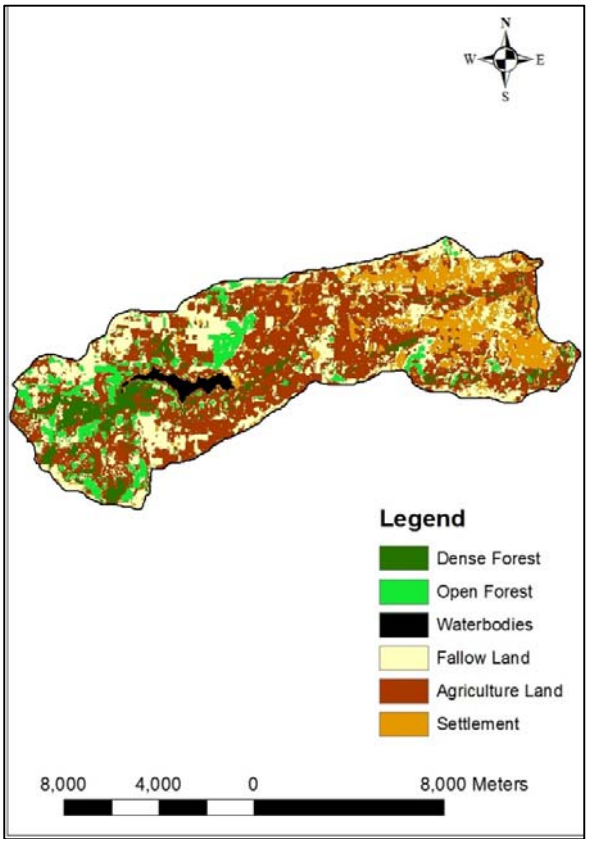

Fig 6: Land use Land cover map for year 2000

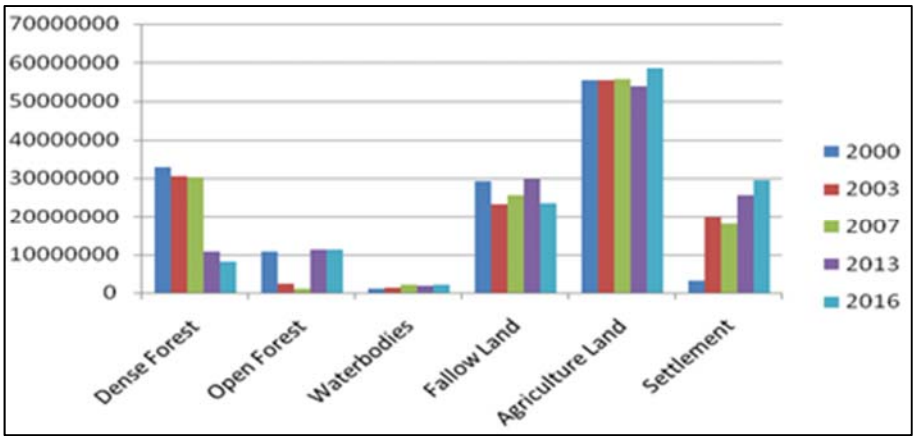

Fig 7 : Comparative analysis of Land use Land cover for different years

Conclusion

The application of Remote Sensing and Geographic Information System in forest resource management through the identification, classification, assessment and interpretation of different land use and land cover classes has been amply demonstrated. The study has revealed that remotely sensed data (imageries) are important and extremely useful in mapping and monitoring the dynamics of land use/land cover in tropical rain forest. GIS analysis has shown the capabilities of GIS to solving spatial problems and to providing information that aid decision making. The area under dense forest found reduced over the period of fifteen years and water bodies increased to negligible extnt.

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