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Mapping land use/cover using remote sensing and GIS techniques: A case study of rahat micro watershed of Nagpur district, India

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Abstract
Land use/land cover (LULC) information is essential for the selection, planning and implementation of management strategies to meet the increasing demands for basic human needs and welfare of the ever growing population. This paper illustrates the status of land use/land cover in the Rahat micro-watershed of Nagpur district of Maharashtra was carried out during the year 2010-11 using an integrated approach of remote sensing and Geographic Information System (GIS). Mapping land use/cover in IRS-P6 LISS-IV data and SOI toposheet (1:50,000 scale) were used for Land Use/Land Cover Mapping of soils. The inventory data of land resources were evaluated using GIS and thematic maps were prepared. The land use/land cover classes identified are single crop, double crop, wasteland, forest and habitation. The study indicates that 80.90 per cent area of the watershed is under cultivation. The habitation exhibits light blue with coarse texture on the satellite data and covers an area of 1.86 ha representing 0.51 per cent of total area of watershed. The double crop land occupies an area of 125.77 ha representing about 34.6 per cent of the total geographic area (TGA) of the watershed. The single crop land occupies an area of 168.02ha representing about 46.3 per cent of the total geographic area (TGA) of the watershed.

Keywords: soil profile, cation exchange capacity, lateritic soil, medium soil and coastal saline soil

Introduction

Watershed is a hydrological unit bounded by natural ridges and allows the runoff due to rainfall to drain in a well-defined drainage pattern of streams flowing within the watershed boundary. Conventional approaches used for mapping of natural resources for are time consuming, and have low repetitive value. The advent of satellite remote sensing and GIS has opened new dimensions in mapping and monitoring of natural resources. The unique capability of space based sensors to provide a wide range of information available in electromagnetic spectrum in a synoptic and more frequent manner has made this technology an inevitable tool in the sustainable development and utilization of natural resources. Satellite remote sensing has been recognized as powerful tools for mapping and monitoring of natural resources (Rao *et.al* 1996; saxena *et.al* 2000) [5, 7]. Soil, water and vegetation are most important natural resources, which are so much interdependent with each other. Sustainable management of natural resources is essential for food security, maintenance of environment and general well being of the people. Indiscriminate use of resources coupled with lack of management has, however led to the degradation, echoing the concern of the planners, researchers, general public and farmers alike (Sharma, 2007) [8]. To maintain the present level of soil productivity and to meet the demand of the future, increasing emphasisis being laid on the characterization of the soils, accurate mapping and interpretation of soil for multifarious land use. Precise scientific information on characteristics, potential, limitations and management needs of different soils is indispensable for planned development of these resources to maintain the present level of soil productivity and to meet the demands of the future. Soil resource inventory provides an insight into the potentialities and limitations of soils for its effective exploitation. It also provides adequate information in terms of landform, terrain, vegetation as well as characteristics of soils which can be utilized for land resources management and development (Manchanda *et al*. 2002) [3]. Rational utilization of land resources can be achieved by optimizing its use, which demands evaluation of land for alternative land use, ensuring its wise use.

Therefore, increased emphasis is being laid on characterization of soils, their evaluation and precise mapping using remote sensing and Geographical Information System. Remote sensing technology is powerful tool to study the resources in spatial domain in almost real time and cost effective manner. The interpreted remotely sensed image provide a wealth of information of large areas and permit lithological discrimination, identification of different landforms and land use/ land cover patterns which will help in land resource characterization. Several workers have utilized this technique for soil mapping on different terrain conditions at different scales (Srivastava and Saxena, 2004; Velmurugan *et al*., 2009) [11, 12] and on watershed basis (Solanke *et al*., 2005; Shukla *et al*., 2009; Kashiwar *et al*., 2009; Patil *et al*. (2010) [10, 9, 2, 4]. Visual interpretation of false colour composite of IRS-P6 LISS-IV data of February, 2004 with a spatial resolution of 5.8 m supported by adequate ground truth gives information on type, spatial distribution and extent of land use/land cover categories which is necessary for agricultural land use planning and management of land resources for sustainable development of watershed. Visual interpretation of false colour composite of IRS-P6 LISS-IV data of February, 2004 in conjunction with Survey of India (SOI) toposheet for physiography will help in characterization and precise mapping of soil resources. The area is associated with very gently sloping (1-3%) and moderately sloping (8-15%) lands. The drainage is essentially dendritic in nature. The natural vegetation comprises of teak (*Tectona grandis*), babul (*Acacia spp*.), palas (*Butea frondosa*), charoli (*Bachanania latifolia*), ber (*Ziziphus jujuba*) etc. The major crops grown in the area are soybean (*Glycine max*), cotton (*Gossypium spp.*), pigeonpea (*Cajanus cajan*) and sorghum (*Sorghum bicolor*) in *kharif* and wheat (*Triticum aestivum*) and gram (*Cicer arietinum*) in *rabi* under irrigation or stored moisture. Nagpur mandarin (*Citrus reticulata* Blanco) is the main fruit crop of the area. The importance of the watershed based land use planning for sustainable utilization of natural resources is widely recognized. The evaluation of land resources and generation of map information using Geographical Information System (GIS) through various thematic maps in the watershed helps in optimum utilization and management of land resources according to its capability for agricultural planning of the watershed. The Rahat micro-watershed occurs in the Katol tehsil of Nagpur district, Vidarbha region of Maharashtra is predominantly under rainfed farming with erratic rainfall distribution associated with low crop productivity and needs site specific information in terms of soil characteristics, their productivity potentials and limitations for land resources development and management.

2 Material and Methods

2.1. Study Area

Geographically, the Rahat micro-watershed is located between 78° 33' to 78° 36'E longitudes and 21° 04' to 21° 06'N latitudes in Katol tehsil of Nagpur district, Maharashtra. The total area of the watershed is 363.02 ha. The study area falls in the SOI toposheet No. 55 K/12. The general elevation of the area ranges from 500 to 525 m above mean sea level (MSL). Digital data of IRS-P6 LISS-IV of February, 2004 with a spatial resolution of 5.8 m was used in the present study. The standard false colour composite (FCC) was generated with the combination of green, red and infrared bands. Satellite image of the study area is shown in fig. 1

2.2 The details of the satellite data

Satellite	sensor	Spatial resolution(m)	Path –row	Month of acquisition	Season
IRS-P6	LISS-IV	5.8	P201- R100	February 2004	Rabi

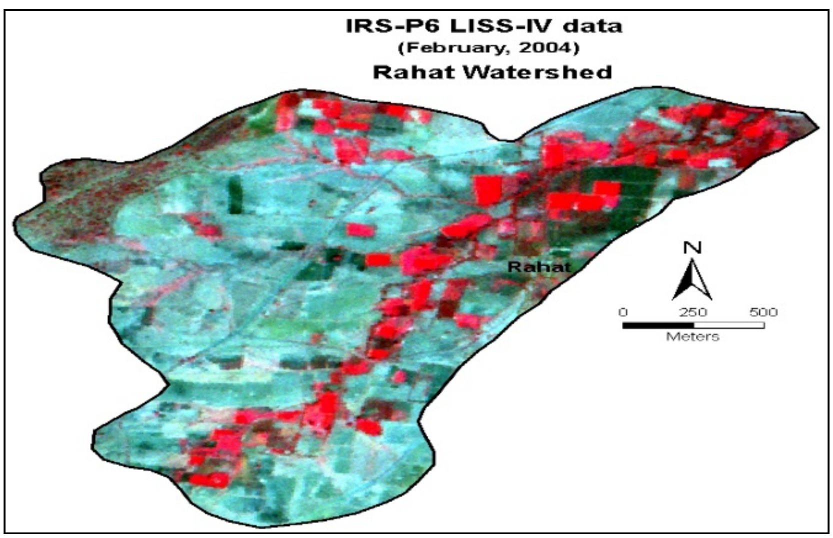

Fig 1: IRS-P6 LISS-IV data of Rahat micro-watershed

The climate of the area is sub-tropical dry sub-humid with well expressed summer (March to May), rainy season (June to October) and winter (November to February). The mean annual temperature is 26.9°C and mean annual precipitation is about 1050 mm of which nearly 90 per cent is received during monsoon. The relative humidity is high during monsoon period (75 to 88%) and low during other pre-monsoon period (30 to 40%).

2.3 Collateral Data

Survey of India (SOI) Toposheet No. 55 K/12 (1:50,000 scale) was used to collect topographic and location information. The Toposheet was used to prepare base map for different landforms, generation of slope and drainage for planning the traverse route for ground truth collection.

2.4 Remote Sensing Data Interpretation

The methodology followed for the interpretation of the IRS-P6 LISS-IV data is essentially the standard v66isual interpretation technique based on the tone, texture, pattern, shape, size, association etc. The other ancillary data such as toposheet and other available information (reports, maps etc.) were used for preparation of land use/land cover and physiography maps. Screen digitization was done to prepare various thematic maps. The interpretation methodology (Fig. 2) comprised of following steps.

- Geo-referencing of imagery with reference to SOI toposheet using ArcGIS software.
- Systematic interpretation of false colour composite (FCC) using image characteristics *viz.* tone/ colour, texture, shape, pattern and size for identification of different landforms, land use/ land cover and to generate pre-field image interpreted base map.
- For physiographic delineation, contours were digitized from SOI toposheet and transferred as layer on satellite image. Satellite data was interpreted and physiographic units *viz*. plateau, isolated mound, pediment and alluvial plain were delineated. Through ground truth, each image interpretation unit *viz.* land use/land cover were verified.
- Satellite data was interpreted for various land-use/land cover classes like agricultural land, wasteland, habitation and waterbodies. Further subdivision of agricultural land into single crop, double crop was based on interpretation of both *kharif* and *rabi* season data.
- Correlation of image interpretation units with the ground truth observations.
- Random field checks to verify and validate the soil, land use and their boundaries.
- Finalization of land use/land cover maps with necessary changes after field verification.
- The final output of land use/land cover of soil was prepared using Arc GIS software. Using the interpreted maps (Land use/land cover maps prepared from toposheet and satellite data), the area was traversed to identify different landform units and present land use/land cover classes.

3. Results and discussion

Different thematic maps *viz.* land use/land cover of soil were prepared using IRS-P6 LISS-IV (February, 2004) data on 1:50,000 scale in conjunction with SOI toposheet (1:50,000 scale) and verified in field during ground truth. The characterization of different land resources is discussed below.

3.1 Land Use/Land Cover mapping

The visual interpretation of IRS-P6 LISS-IV FCC led to the identification and delineation of different land use/land cover categories (table 1). The area under different land use/land cover classes with image characteristics are given in fig.1. The major land use /land cover classes identified are cultivated land (single crop and double crop), waste land (with or without scrub) and moderately dense forest. The study indicates that 80.90 per cent area of the watershed is under cultivation. Agricultural land is described as the land primarily used for farming and for the production of food, fibre, and other commercial and horticultural crops. It includes land under crops (irrigated and unirrigated, fallow, plantations etc). In the study area, agricultural land includes agricultural plantations and croplands. Cropland includes those lands with standing crop as on the date of the satellite overpass. The crops can be of either Kharif or Rabi or Kharif Rabi seasons. The wasteland, moderately dense forest and habitation constitute 11.1, 7.5 and 0.5 per cent of the total area respectively.

3.1.1 Single crop

Single crop mainly occurs on very gentle slope of plateau, pediment. The single crop land exhibits greenish blue with diffuse checker board pattern on satellite data of February month and occupies an area of 168.02 ha representing about 46.3 per ent of the total geographic area (TGA) of the watershed.

3.1.2 Double crop

Double crop mainly occurs on very gently sloping alluvial plain of the watershed and exhibits dark red and brown, bold checker board pattern on IRS-P6 LISS- IV FCC of February month. This indicates area under rabi and perennial crops. The double crop land occupies an area of 125.77 ha representing about 34.6 per cent of the total geographic area (TGA) of the watershed.

3.1.3 Wasteland

Wasteland may be described as degraded land underutilized lands most of which could be brought into productive use with proper soil and water management practices [Ghosh etal 1996] [1] or the land which is deteriorating due to lack of appropriate water and soil management or on account of natural causes [Saha *et al*. 1990] [6]. Wastelands can result from inherent/imposed disabilities such as by location, environment, chemical and physical properties of the soil or financial or management constraints. Wasteland occurs on plateau, pediment and isolated mound and could be delineated and mapped using satellite data as it exhibits very light blue with medium texture, very light greenish blue tone, medium texture and dark brown with medium texture on these physiographic units, respectively. Wasteland occupies an area of 40.29 ha representing about 11.10 per cent of the total geographic area (TGA) of the watershed.

3.1.4 Habitations

The habitation exhibits light blue with coarse texture on the satellite data and covers an area of 1.86 ha representing 0.51 per cent of total area of watershed.

3.2.5 Moderately dense forest

These are the areas bearing an association predominantly of trees and other vegetation types (within the notified forest boundary). In the satellite image, such forest is identified by Very dark red with blue patches medium texture Moderately dense forest occupies an area of 27.08 ha representing about 7.5 per cent of the total geographic area (TGA) of the watershed.

Table 1: Land use/land cover map of Rahat micro-watershed.

Map Symbol	Land use/land Cover	Image Characteristics	Area	
			Hectares (ha)	% of TGA
1	Single crop	Greenish blue with diffuse checker board pattern	168.02	46.3
2	Double crop	Very dark red with dark green bold checker board pattern.	125.77	34.6
3	Wasteland	Light greenish blue tone, medium texture	40.29	11.1
4	Moderately dense forest	Very dark red with blue patches medium texture	27.08	7.5
5	Habitation	Light blue, coarse texture	1.86	0.5
	Total		363.02	100

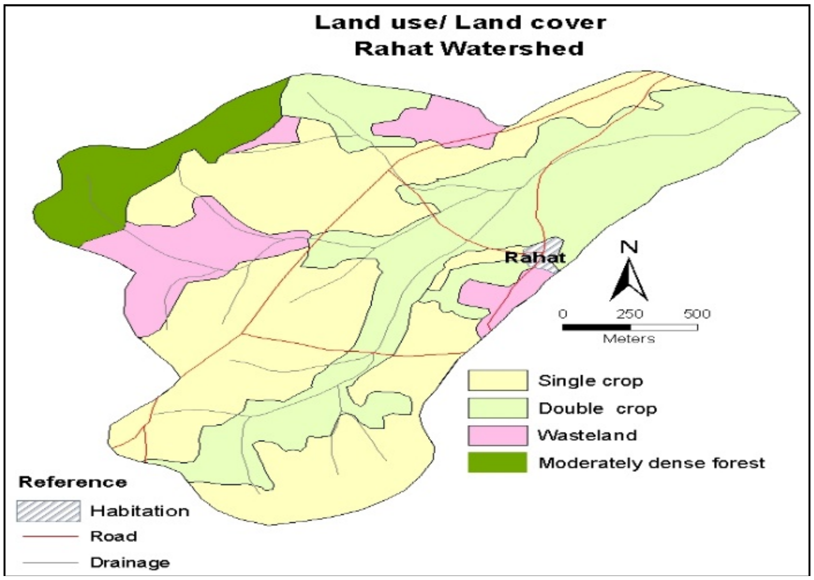

Fig 5: Land use/land cover map of Rahat micro-watershed

4. References

1. Ghosh S, Sen KK, Rana U, Rao KS, Saxena KG. Applications of GIS for Land-Use/Land-Cover Change Analysis in a Mountainous Terrain. Journal of the Indian Society of Remote Sensing. 1996; 24:193-202.
2. Kashiwar DY, Nagaraju MSS, Rajeev Srivastava, Jagdish Prasad, Ramamurthy V, Barthwal AK. Characterization, evaluation and management of Salai watershed in Nagpur district of Maharashtra using remote sensing and GIS techniques. Agropedology. 2009; 19(1):15-23.
3. Manchanda DS, Singh SK. Water retention characters tics of some Vertisole of Rajasthan. Journal of the Indian Society of Soil Science. 2002; 49(3):124-146.
4. Patil SS, Nagaraju MSS, Rajeev Srivastava. Characterization and evaluation of land resources of basaltic terrain for watershed management using remote sensing and GIS. Indian journal of soil conservation. 2010; 38(1):16-23.
5. Rao APVP, Naidu MVS, Ramavatharam N, Rao GR. Characterization, classification and evaluation of soils on different landforms in Ramachandrapuram mandal of Chittor district in Andra Pradesh for sustainable land use planning. Journal of Indian Society of Soil Science. 1996; 56:23-33.
6. Saha SK, Kudrat M, Bhan SK. Digital Processing of Landsat TM Data for Wasteland Mapping in Parts of Aligarh District (Uttar Pradesh), India. International Journal of Remote Sensing. 1990: 11:485-492.
7. Saxena RK, Verma KS, Chary GR, Rajeev Srivastava, Barthwal AK. IRS-1C data application in watershed characterization and management. Int. J. Remote Sens. 2000; 21:3197-3208.
8. Sharma JC, Chaudhary SK. Land use, nutrient indexing and soil fertility mapping of Mandhala watershed in Shiwalik foot hills of Himachal Pradesh-A GIS approach. Agropedology. 2007; 17(1):41-49.
9. Shukla EA, Jagdish Prasad, Nagaraju MSS, Rajeev Srivastava, Kauraw DL. Use of Remote Sensing in Characterization and Management of Dhamni Micro-watershed of Chandrapur District of Maharashtra. Journal of the Indian Society of Remote Sensing. 2009; 37(1):129-137.
10. Solanke Preeti C, Srivastava R, Jagdish Prasad, Nagaraju MSS, Saxena RK, Barthwal AK. Application of remote sensing and GIS in watershed characterization and management. J. Ind. Soc. Remote Sensing. 2005; 33(2):239-244.
11. Srivastava R, Saxena RK. Techniques of large scale soil mapping in basaltic terrain using satellite remote sensing data. Int. J. Remote Sens. 2004; 25:679-688.
12. Velmurugan A, Guillen Carlos G. Soil resource assessment and mapping using remote sensing and GIS. J. Ind. Soc. Remote Sens. 2009; 37:511-525.