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Research Paper :

Studies on water quality analysis

S.L. SURYAWANSHI, S.H. BHUTADA, M.D. ABUJ AND V.T. BOMBALE

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See end of the article for authors' affiliations

Correspondence to:
S.L. SURYAWANSHI
Department of Soil and Water Conservation, Aditya College of Agriculture Engineering andTechnology, BEED (M.S.) INDIA

ABSTRACT

The research study was carried out at Malegaon watershed of Nasik district. The study was undertaken to develop action plan of Land Resource Development Plan (LRDP) map. The base maps such as watershed boundary, drainage network were prepared with the help of Survey of India (SOI) topographical map. The satellite data of IRS-1B (LISS-II) of 11th November 1993, 30th January 1994 and 8th May 1994 of the study area were used for generating land use/land cover map. The land use/land cover map indicates that 35.07% was *kharif* cultivated land and 4.32% was the double crop land. The land capability map was developed automatically in GIS using AML by assuming and standardizing the soil parameters. The prepared land capability map shows classes III, IV, VI and VII in the study area. The LRDP map was prepared by making the unique combination of land capability map with the land use map which suggests the intensive agriculture, double crop, horticulture, agro-horticulture and silvi-pasture.

Key words : Land use map, Land capability map, Arc macro language

Over exploitation of watershed resources due to increase in population has resulted in their degradation. Both natural resources and socio-economic situation are integral parts of any watershed and should be given equal attention. Integrated management of natural resources on watershed basis is a rational and sound approach for sustainable development to realize national goals such as food security, poverty alleviation, and welfare of weaker section of the society.

With the launch of number of Indian and International remote sensing satellites, it has become easier and quicker to acquire high resolution image and data of any location in the globe and of a particular time. The remotely sensed data has the advantage of providing synoptic view and large area coverage, which impart knowledge about the condition on earth surface that change overtime.

Rao *et al.* (1997) undertook a study in Neelkanthpuram Watershed with the objective of generating action plans for sustainable development of land and water resources through the integration of information on soils, land use/land cover, slope and hydrogeomorphology using GIS approach. Pandit *et al.* (1999) carried out a case study of Nasik district (M.S.) using remote sensing and GIS based integrated watershed development. Sidhu *et al.* (1998) prepared various layers of maps like watershed and sub-watershed boundaries, hydrogeomorphology, soil, land use / land cover, slopes by interpretation of satellite data IRS-1B bands-2,3 and 4. Using the 'UNION' module all these maps were combined to generate action plan which shows that the major area (53.8%) of the watershed is under afforestation. Murthy *et al.* (2000) planned village level action plans for land and water resources development, which required higher scales for planning. The action items for plan implementation were either area specific or local specific and to identify the end beneficiaries. Bhagavan and Raghu (2000) adopted Remote Sensing techniques for integrated watershed management IX-plan for watersheds proposed under National Watershed Development Project for Rainfed Areas (NWDPRA).

METHODOLOGY

The information provided by the satellites in combination with other sources of information can be integrated through Geographic Information System (GIS) to quantify various parameters for efficient management of land and water resources in watershed.

Study area:

The study area covered the Malegaon watershed of Nasik Tehsil, which is located in the south-western part of Nasik district (Maharashtra) and lies between $72^0$28' to $73^0$37' E Longitude and $20^0$00' to $20^0$05' N Latitude. The watershed covers an area of 5022.97 ha. Physiographically, the area can be divided into alluvial plain, undulating upland, plateau plain, high plateaus, foot slope followed by the hill slopes. The general elevation ranges from 538 m to 1245 m above MSL. The general slope of the area is from north-west to south-west. The study area has sub-tropical, semi-arid monsoon climate with average annual rainfall of 1100 mm and mean maximum and minimum temperatures of 34^{0}C and 10^{0}C. Relative humidity is very low except during south-west monsoon season and wind speed is moderate.

Data used:

The satellite data of IRS-1B (LISS-II) of path number 30 and row number 54 covering Nasik tehsil were collected for the three date of pass *viz.*, 11th November 1993, 30th January 1994 and 8th May 1994. For the generation of thematic/derived maps, both digital data on Computer Compatible Tape (CCT) as well as geocoded outputs on 1:50,000 scale were used. Topographic map and soil survey report from All Indian Soil and Land Use Survey for the part of the study area were used as collateral data.

Generation of land use / land cover map:

The classification of image was done for preparation of land use/land cover map. The supervised classification was carried out for the satellite data of November 1993, January 1994 and May 1994. In supervised classification, the identity and location of some of the land cover types, such as urban, agricultural wetland and forest are known through a combination of fieldwork, maps and personal experience.

Generation of land capability map:

An Arc Macro Language (AML) was used to design and develop a package in GIS for automatic generation of land capability map. The terms or parameters such as depth, texture, erosion, slope and permeability were assumed while generating the land capability map. However, the soil in the study area existed in association with the other soil categories. The soil series in the study area were Wadholi, Mahirawani, Adgaon, Dhondegaon, Illunja, Nasalgaon, Talegaon, Manoli, Talyachiwadi, Kotamgaon and Masrul.

It is necessary to prepare the algorithm for each of these parameters so that we can allocate the capability classes. Land allocation in a particular capability class was done on the basis of standardization of the above parameters, which showed the kind of limitations that can be accepted for a particular class. Thus, the standardization of the parameters was carried out on the basis of the values recommended by the United State Department of Soil Conservation Service (SCS) so that we can understand for a particular parameter which class of the land capability has to be given (Suresh, 2004). The standardization was further also helpful in preparing the weightages for these factors.

The soil is the dominant factor in the land capability classification. Therefore, the spatial and non-spatial data of the soil were taken into consideration for generation of the layer. For automatic generation of the land capability map, the input parameters were the soil codes and their corresponding data file in *.dat format (INFO files). With the help of the available information about the soil, the parameters were standardized as per their categories. Based on the standardization of the parameters, the criterion for land capability map generation was prepared. Based on the criterion, the soil category of the study area was assigned with the appropriate weightages for calculating land capability classes.

Generation of land resource development plan (LRDP) map:

The development of the LRDP map was carried out using the ARC/INFO. The action plan that is land resource development map was then prepared by combining the land capability map, which represents the various characteristics of the soil with their limitation with the land use/land cover map using the UNION command.

After integration of land capability class and land use/land cover categories, LRDP categories were generated. For this purpose, each land use category was integrated with each land capability classes and the resultant combination was the land resource development map. After this unique combination, the INFO file for LRDP was created which consists of LRDP-CODE and respective category in the LRDP.

RESULTS AND DISCUSSION

The results obtained from the present investigation are discussed below :

Land use / land cover map:

The land use/land cover map was classified considering nine classes (Fig. 1). The results were validated with the ground actual data. Table 1 indicates the areas under different classes of land use/land cover. The results has demonstrated the potential of remote sensing techniques for monitoring the changes in land use efficiently and economically (Pandit *et al.*1999). The results, which were found in the land use map, were justified with the IMSD project report available at RRSSC, Nagpur and were found to be similar to each other (Anonymous, 1996). Table 2 shows the different levels of classes observed in study area.

Land capability map:

The land capability classes of the study area include class-III, class-IV, class-VI and class-VII (Fig. 2). Table

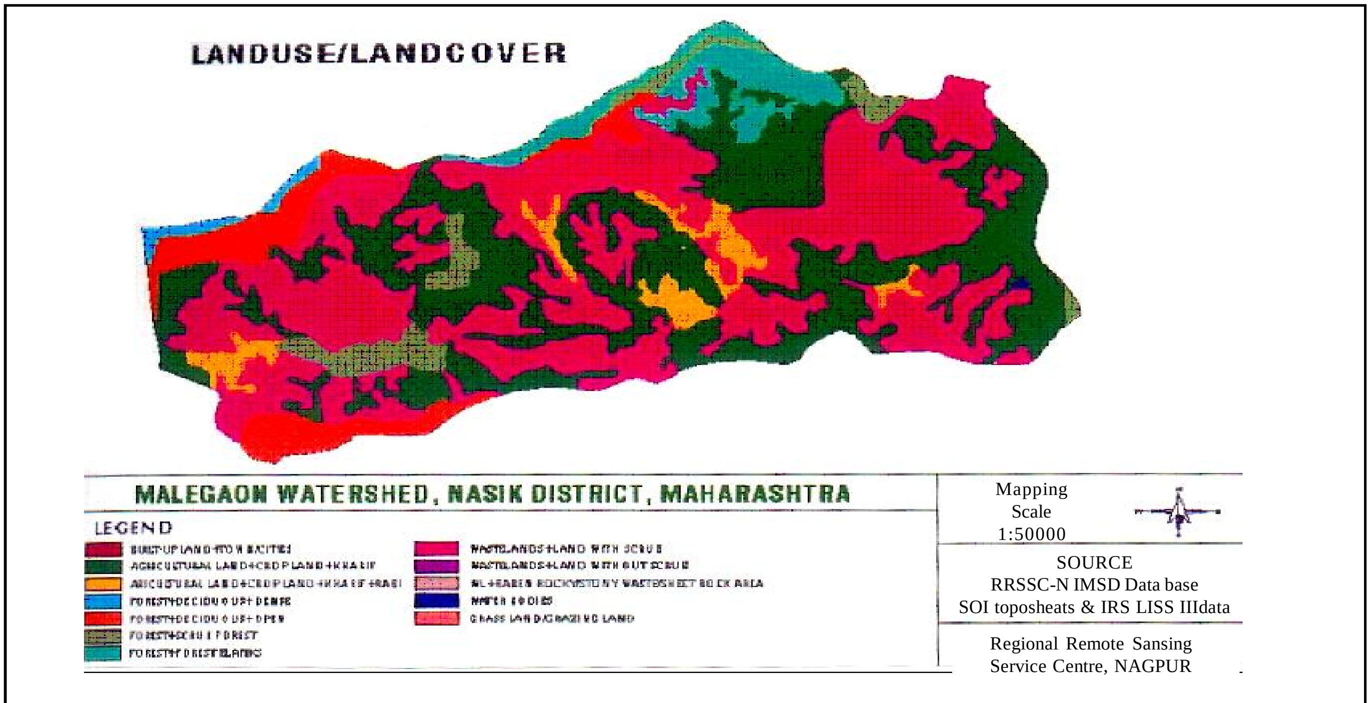

Fig. 1 : Land use / land cover map

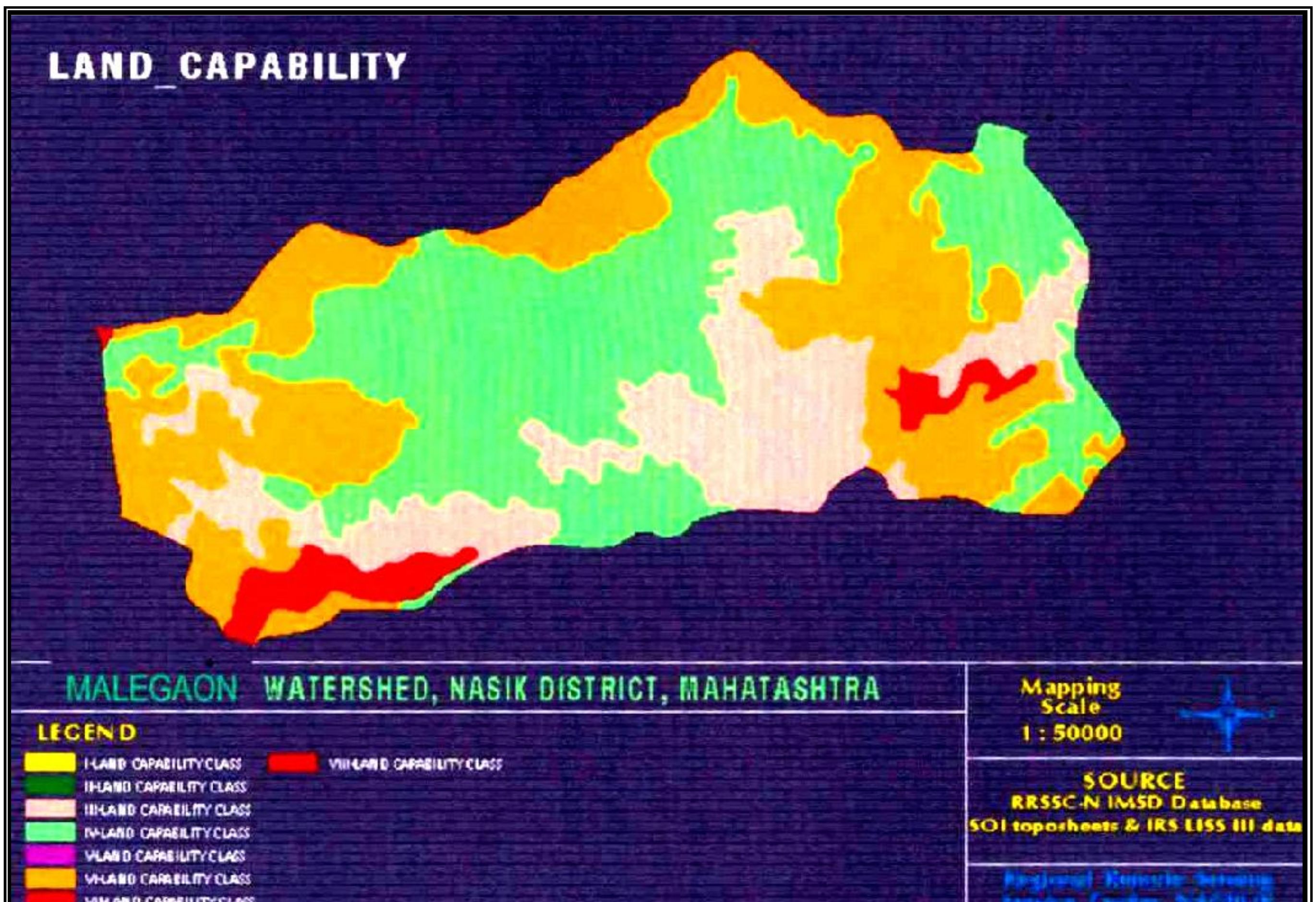

Fig. 2 : Land use / land cover map

Table 1 : Areas under different classes of land use/land cover

Sl. No.	Land use/land cover	Area (ha)	Percentage of the total area
1.	Agricultural land: crop land + *kharif*	1761.16	35.06
2.	Agricultural land: crop land + *kharif* + *rabi*	216.35	4.31
3.	Forest + deciduous + dense	44.23	0.88
4.	Forest + deciduous + open	343.62	6.84
5.	Forest + Scrub forest	217.18	4.33
6.	Forest + forest blank	267.85	5.33
7.	Waste lands + land with scrub	2169.58	43.19
8.	Water bodies	2.18	0.04
9.	Others	0.82	0.02
	Total	5022.97	100.00

Table 2 : Different levels of classes in the study area

Level-1	Level-2	Level-3	Map symbol
	Town / cities		1
Built up land	Villages		2
	Crop land	Kharif	3
Agricultural land		Kharif+Rabi	5
		Dense	10
		Open	11
Forest	Deciduous	Scrub forest	12
		Forest blanks	13
Waste lands	Land with scrub		20
Water bodies	Rivers/streams/lakes /nala / tanks		25

Table 3 : Area under different land capability classes

Sl. No.	Class	Cultivability	Area (ha)	Percentage of the total area
1.	III	Cultivable	1059.80	21.10
2.	IV	Cultivable	2058.75	40.99
3.	VI	Uncultivable	1701.20	33.87
4.	VII	Uncultivable	203.22	4.04
	Total		5022.97	100.00

3 indicates the areas under different land capability classes of the study area. The results, which were found in the land use map, were justified with the IMSD project report available at RRSSC, Nagpur and were found to be similar to each other (Anonymous, 1996). The land capability classification is developed as a method to assess the extent limitation such as erosion risk, soil depth, wetness and climate that creates objection in the agriculture activities for crop production (Pandit *et al.*, 1999).

Land resource development plan (LRDP) map:

Based on the capabilities of the composite units and other determinants like socio-economic conditions, the optimum land resource development plan was suggested. Table 4 indicates the combination, which was obtained by the integration of land capability map with the land use categories.

The land use plan suggested categories consists of Intensive agriculture, Double crop, Horticulture, Agro-horticulture, Afforestation, Agro-forestry and Silvi-pasture (Fig. 3). The land resources development plan depicted alternative land use practices through double cropping,

Table 4 : Combinations of land resource development plan map

Land use category	Land capability class	LRDP
3	3	Double crop
3	4	Agro-horticulture
3	6	Horticulture with soil conservation
3	7	Horticulture with soil conservation
5	3	Intensive agriculture
5	4	Intensive agriculture
5	6	Intensive agriculture
5	7	Intensive agriculture
10	4	Conservation measures/forest protection
10	6	Conservation measures/forest protection
10	7	Conservation measures/forest protection
11	3	Afforestation
11	4	Afforestation
11	6	Afforestation with soil conservation
11	7	Afforestation with soil conservation
12	3	Afforestation with soil conservation
12	4	Afforestation with soil conservation
12	6	Afforestation with soil conservation
13	3	Afforestation with soil conservation
13	4	Afforestation with soil conservation
13	7	Afforestation with soil conservation
20	3	Agro-horticulture
20	4	Horticulture with soil conservation
20	6	Silvi-pasture
20	7	Plantation of fuel wood trees/fast growing trees
25	Any category	Water bodies

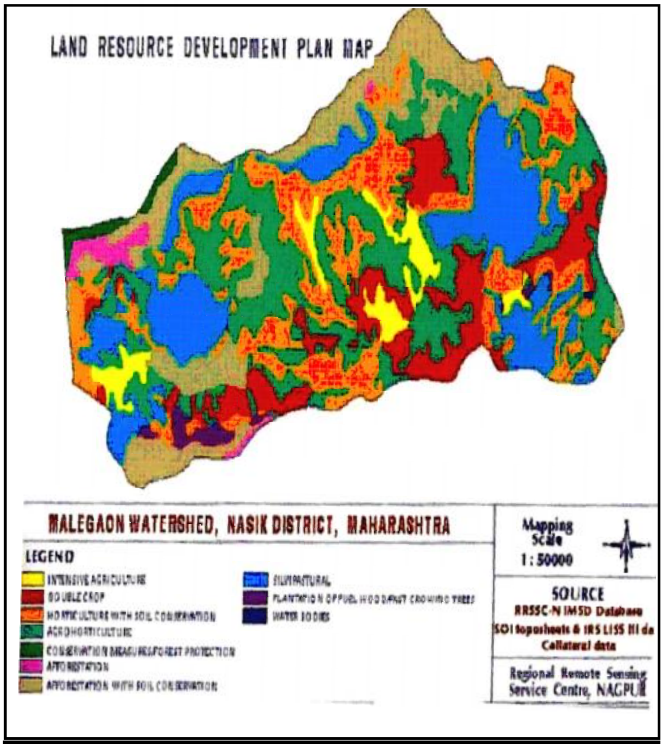

Fig. 3 : Land resource development plan (LRDP)

Table 5 Area statistics of land resource development plan

Sl. No.	Suggested land use development plan	Area (ha)	Percentage of the total area
1.	Intensive agriculture	216.27	4.30
2.	Double crop	518.28	10.32
3.	Horticulture with soil conservation	1158.21	23.06
4.	Agro-horticulture	1265.66	25.20
5.	Conservation measures/forest protection	44.23	0.88
6.	Afforestation	73.71	1.47
7.	Afforestation with soil conservation	755.35	15.04
8.	Silvi-pasture	932.99	18.57
9.	Plantation of fuel wood/fast growing trees	55.72	1.11
10.	Water bodies	2.55	0.05
Total		5022.97	100.00

horticulture, afforestation, fuel and fodder plantation and silvipasture along with appropriate soil conservation measures like nala straightening, farm bunding, trenching and khus plantations (Pandit *et al.*,1999). Table 5 shows the area statistics proposed under different land use. The results, which were found in the land use map, were justified with the IMSD project report available at RRSSC, Nagpur and were found to be similar to each other (Anonymous, 1996).

Conclusion:

The land use/land cover map indicates that 1761.57 ha (35.07%) was *kharif* cultivated land and 216.76 ha (4.32%) was the double crop land.

The land capability classes found in the study area with the help of GIS integration were class-III, class-IV, class-VI and class-VII.

The LRDP map suggests intensive agriculture, double crop, horticulture, afforestation and silvi-pasture.

Authors' affiliations:
S.H. BHUTADA, Department of Farm Machinery and Power, Aditya College of Agriculture Engineering andTechnology, BEED (M.S.) INDIA
V.T. BOMBALE AND M.D. ABUJ, Department of Soil and Water Convervation, Aditya College of Agriculture Engineering andTechnology, BEED (M.S.) INDIA

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