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Assessment of Degraded Lands of Vidarbha Region Using Remotely Sensed Data

S G GHATOL[0] AND R L KARALE*
[0]All India Soil and Land Use Survey, Regional Centre, Calcutta
* Indian Resources Information and Management Technologies (IN-RIMT), Nagpur

ABSTRACT

Degraded lands in Vidarbha region of Maharashtra were assessed using remote sensing technique. District wise land degradation maps were generated on 1:25,0000 scale through visual interpretation of IRS 1A data supported by limited ground survey. It was observed that degraded lands occupy nearly 2.1 million ha or 21.5 per cent of the total geographical area.

The analysis of district wise land degradation statistics indicate that Yavatmal and Akola districts are graded as having most problematic lands in the region. Nagpur, Amravati, Buldana and Wardha districts are categorised as moderately problematic, whereas Gadchiroli, Chandrapur and Bhandara are districts having least problem of degradation.

Among the major land forms, the largest degraded area is associated with undifferentiated plain accounting for 1.1 million ha or 12 per cent of the total area of region, which is mostly under cultivation. It thus follows that problem of degradation is more rampant in agricultural land than forest/waste lands.

Introduction

Increasing pressure and competing demands on soil and land resources have been a consequence of exploding population in recent years. Soil and land being non-elastic resource, all the land based needs of the fast growing population has to come necessarily from limited land-mass. There is, therefore, an urgent need to control land degradation and restore the locked up production in degraded lands. This necessitates precise information on the extent and spatial distribution of the different kinds of degraded lands to plan suitable reclamation or ameliorative measures consistent with the nature and intensity of the problem as well as operational ease with which reclamation/ ameliorative measures can be carried through. Available information of degraded lands for the different regions and states mainly comes from revenue records and exploratory maps, and often lack spatial identity. In view of this, the present study was undertaken to meet the primordial need of a reliable map of degraded lands of Vidarbha region in order to assess their nature, extent and spatial distribution.

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Study Area

Vidarbha region lies between 18°45' and 21°45' north latitude and 76°0' and 81°0' east longitude in the eastern part of Maharashtra state. This region consists of 9 districts namely Amravati, Akola, Buldana, Yavatmal, Nagpur, Wardha, Bhandara, Chandrapur and Gadchiroli. It occupies a total geographical area of about 9.7 million hectares accounting for about 31.6 per cent of the total area of the Maharashtra state.

Vidarbha region has a remarkable diversity of landscape features. It comprises mainly Satpura ranges, Purna valley, Ajanta hills, Plateaus, Plains and Valleys. Satpura ranges in the northern part give rise to many small rivulets and dissected land forms. Purna valley is gently sloping with some dissections along the sides of the river Purna and its tributaries. Amravati-Badnera plateau is dominated by flat topped table lands with steep and furrowed scarp faces and rocky stony pediments. Ajanta hills are flanked with mesas and buttes giving rolling appearance. Wardha-Penganga plain is denuded and presents a familiar trappean landscape. Wardha-Wainganga basin as whole is plain but at places there are rugged hilly areas. The Wainganga basin in general gives an impression of rolling topography with some subdued hills.

The region is characterized by tropical/semi-arid and sub-humid monsoon type of climate. The annual rainfall varies from 750 to 1600 mm. The mean annual maximum and minimum temperatures vary from 30.9° to 34.0° and 20.3° to 21.3°C, respectively. The geological formations expressed in order to antiquity are older Precambrian, Cuddapah and Vindhyans, the Gondwana Lameta Group, Deccan Trap and Recent deposits.

Materials

IRS-1A, LISS-1 false colour composites (FCC) of January 1989 were used to generate land degradation map of Vidarbha region on 250,000 scale. The Survey of India (SOI) topographical maps in the same scale were used as reference. These maps further served as useful guide in locating sample areas for ground truth collection and to enable general idea about topographical and land use features of the area. Collateral information with respect to geology, geomorphology, land use, soils and erosion was collected from published reports.

Methodology

False colour composites were studied carefully under the magnascope to understand terrain features, land cover, drainage, etc. The task was to relate colour/tonal and textural characteristics and geometric pattern to specific and consistent differences on the ground. These differences are manifest on image in terms of image elements (Lillesand and Kiefer, 1979). These observations were used in making interpretation of imagery for degraded land mapping. Tentative correlation between the signatures and different categories of degraded lands was worked out from the information derived from available soil maps of the different districts and the initial rapid traverses made in the selected areas. Scene specific image interpretation keys based on the combination of relevant image elements were developed for the different areas and used for image interpretation. Subsequently field studies were carried out in selected sample areas to establish relationships among image interpretation units, soils and nature and type of land degradation. Finally, legend was formulated and maps showing land degradation units were generated for each of the districts separately.

Results and Discussion

Categories of Land Degradation

The degradation problems of Vidarbha soils are erosion, salt affliction and land dereliction due to mining, of which erosion is the major problem. Soil salinity is localised and associated with deep, highly clayey, poorly permeable soils with usually brackish groundwater. Land degradation due to mining operations is expressed in physical deformation and deposition of mined waste on the agriculture land leading to

Table 1: Aerial extent (ha) of different land degradation categories in different districts of Vidarbha

Mapping Unit	*Categories*	*Name of the Districts*									
		Amravati	*Akola*	*Yavatmal*	*Buldana*	*Nagpur*	*Wardha*	*Bhandara*	*Chandrapur*	*Gadchiroli*	*Total*
H1	e3-e4	9150			7500	9500					26150
H2	e3-e4	58050		3200	35000	21700			1500	35800	155250
H3	e3	6900		5000				17650	5200	55800	90550
H4	e2-e3							24850		6600	31450
M1	e3-e4					3550	4000				7550
M2	e3					7800	700				8500
RL1	e3-e4		7100	42700		3300	7850				60950
RL2	e3-e4		15100	43350		14400	40600				113450
RL3	e3		33950	70100							104050
RL4	e2-e3		12500	17250							29750
RL5	e2-e3		36200	56700							92900
PP1	e3-e4	1200	3800								5000
PP2	e3	5800	13850		8000						27650
P1	e3-e4	13200	3550	9750	450	7150					34100
P2	e3	55450	42250	95950	46650	130050	78900				510450
P3	e2-e3	42900	49250	92400	18450	57000	45150	33850	25900	1450	425000
P4	e2-e3		39750	75050	2600			20350	74450	24050	127400
P5	e2-e3		46300	19050					7900	2100	65350
AP1	e4	19200	15050		20050						54300
AP2	e3-e4	23050	17700		43250						84000
AP3	e2-e3	1000	12200								23200
PS	Salt	9200	1400								10600
	affected										6700
RT	e2-e3									6700	2750
D	Derelict land					1150			1600		
	Total	255100	349950	530500	181950	255600	177200	96700	117550	132500	2097050
% of the area degraded		20.88	33.14	39.24	18.81	25.91	28.17	10.42	10.76	8.88	21.56

H – Hill/hilly landscape RI – Rolling land M – Mesa PP – Piedmont plain
P – Undifferentiated plain RT – River terrace AP – Alluvial plain

Table 2: District wise problem categories and their extent (ha)

Problem Categories	*District*								
	Amravati	*Akola*	*Yavatmal*	*Buldana*	*Nagpur*	*Wardha*	*Bhandara*	*Chandrapur*	*Gadchiroli*
E2-e3	53900	196200	260450	21050	57000	45150	45200	83350	39450
E3	68150	90050	171050	54650	137850	79600	51500	31100	57252
E3-e4	104650	47250	99000	86200	59600	52450	--	1500	35800
E4	19200	15050	--	20050	--	--	--	--	--
Salt affected Soil	9200	1400	--	--	--	--	--	--	--
Derelict land			--	--	1150	--	--	1600	--
Extent of total Problematic soil/land	255100	349950	530500	181950	255600	177200	96700	117550	132500
Total geographical area of the district	1221700	1056000	1351900	967100	986400	628900	927900	1091800	1491600
% of total problematic area	20.88	33.14	39.24	18.81	25.91	28.17	10.42	10.76	8.88

Table 3: Mapping Legend

Map symbol	Description – Physiography; Soils; Degradation
H	**Hills and landscape**
H1	Lithic Ustorthents; severely to very severely eroded
H2	Lithic/Typic Ustorthents; severely to very severely eroded
H3	Lithic/Typic Ustorthents; severely eroded
H4	Lithic/Typic Ustorthents; moderately to severely eroded
M	**Mesa**
M1	Lithic Ustorthents; severely to very severely eroded
M2	Lithic/Typic Ustorthents; severely eroded
RL	**Rolling Landscape**
RL1	Lithic Ustorthents; severely to very severely eroded
RL2	Lithic/Typic Ustorthents; severely to very severely eroded
RL3	Lithic/Typic Ustorthents; severely eroded
RL4	Typic Ustorthents, Typic/Lithic Ustochrepts; moderately to severely eroded
RL5	Typic Ustorthents, Typic/Lithic Ustochrepts; moderately to severely eroded
PP	**Piedmont plain**
PP1	Typic Ustorthents; severely to very severely eroded
PP2	Typic Ustorthents, Typic Ustochrepts; severely eroded
P	**Plain (undifferentiated)**
P1	Typic Ustorthents, Typic Ustochrepts; severely to very severely eroded
P2	Typic Ustorthents, Typic/Vertic Ustochrepts; severely eroded
P3	Typic/Vertic Ustochrepts, Leptic/Typic Haplusterts; moderately to severely eroded
P4	Typic/Vertic Ustochrepts, Typic Haplusterts; moderately to severely eroded
P5	Typic Ustorthents, Typic/Vertic Ustochrepts; moderately to severely eroded.
AP	**Alluvial plain**
AP1	Typic/Vertic Ustochrepts, Typic Haplusterts; severely eroded
AP2	Typic Haplusterts; severely to very severely eroded
AP3	Typic Haplusterts; moderately to severely eroded
PS	Typic/Sodic Haplusterts; potential salt affected soils
RT	**River terrace**
	Udic Ustochrepts, Udic Haplusterts; moderately to severely eroded
D	**Derelict land due to mining activity**

secondary physical/chemical degradation.

In all 24 mapping units are identified in the area (Table-1). As may be seen it was not possible to segregate individual classes of degraded land in each case because of inherent limitation of spatial resolution (72.5 meters) of the IRS-1A, LISS-I data. Four soil erosion classes stipulated in Soil Survey Manual Anon. (1970) could be identified and mapped i.e., moderate to severe, severe, severe to very severe and very severe.

Physiographic Association and Land use

Physiographically, the degraded lands are associated with seven major land forms, namely hills, rolling land, mesas, piedmont plain, alluvial

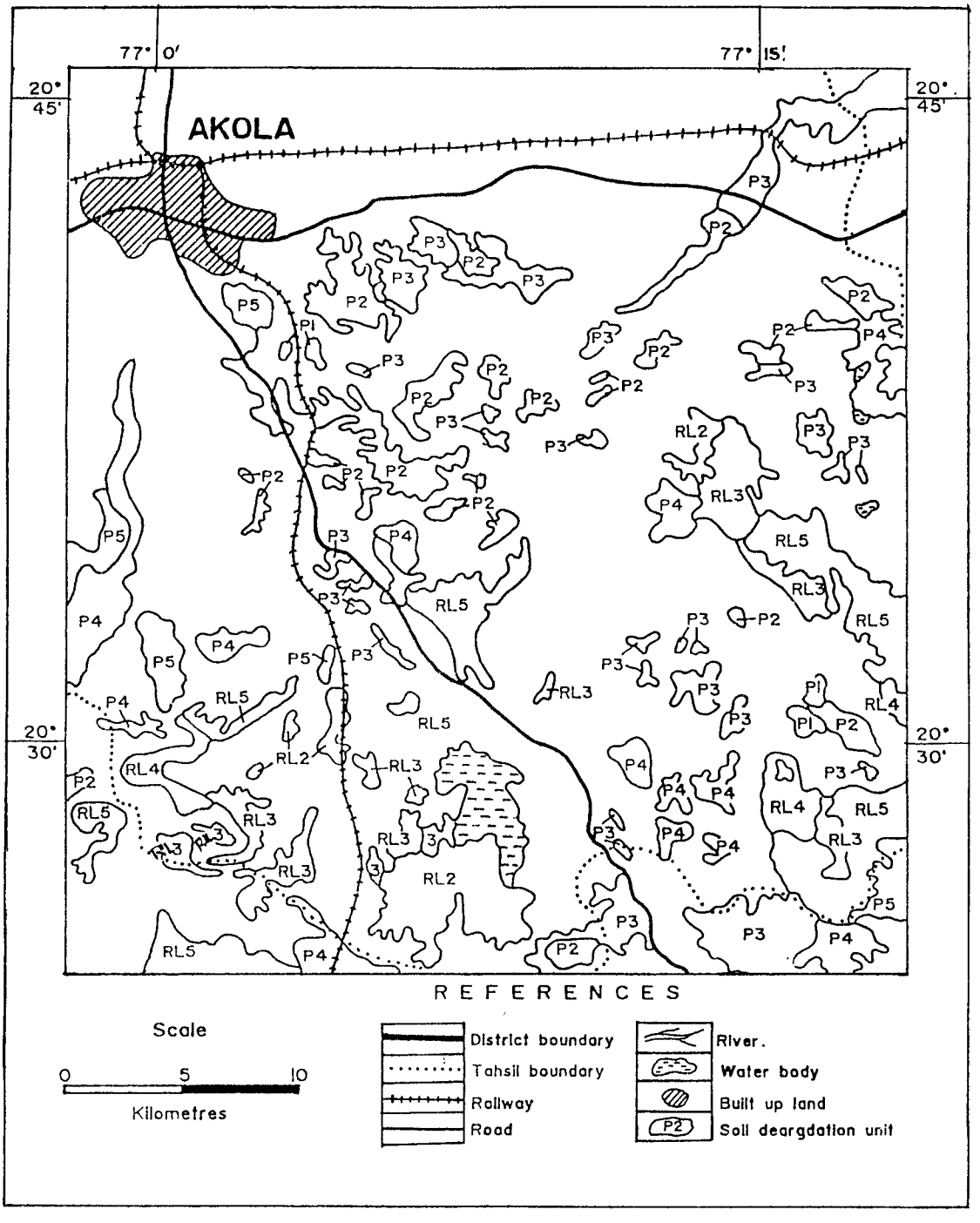

Fig. 1. Land degradation map of part of Akola district

plain, undifferentiated plain and river terrace. The largest degraded area is associated with undifferentiated plain accounting for 1.1 m ha or 12 per cent of geographical area of the region which is mostly under cultivation. It thus follows that problem of degradation is more rampant in agricultural land than forest/waste lands. The next in extent are rolling lands (0.4 m ha or 4.1 %) and hills (0.3 m ha or 3.1 %), which are mostly waste lands and degraded forests.

Inter Se Grading of the Districts

District wise degraded land categories and their extent are shown in Table-2. Considering the district-wise distribution of degraded lands in Vidarbha region, Yavatmal ranks first, followed by Akola, Nagpur, Amravati, Buldana, Wardha, Gadchiroli, Chandrapur and Bhandara in order of decreasing extent. This appears to be direct reflection of combined influence of rainfall, topography, and vegetation cover prevailing in the districts. Among the districts having mean annual rainfall of over 1000 mm (Yavatmal, Nag pur, Wardha, Gadchiroli, Chandrapur, Bhandara), Yavatmal is characterized by high relief-length ratio compared to Wardha and Bhandara and therefore conducive to severe erosion. On the other hand, Gadchiroli and Chandrapur districts have relatively more relief-length ratio than Yavatmal, but most of the high relief area in these districts is well protected by forest vegetation.

A reference to Table-2 further shows that it is in Yavatmal district where problem soils form highest percentage to total geographical area compared to other districts. On the basis of extent of degraded land areas compared to total area, the districts can be arranged in the following decreasing order: Yavatmal, Akola, Wardha, Nagpur, Amravati, Buldana, Chandrapur, Bhandara and Gadchiroli.

It follows that Yavatmal and Akola can be considered as having most problematic soils in the region. Nagpur, Amravati, Buldana and Wardha districts can be categorized as moderately problematic, whereas Gadchiroli, Chandrapur and Bhandara are the districts having least problem of degradation. The first group therefore gets highest priority for degradation control and soil management programme.

Extent of Degraded Areas

Mapping with LISS-I FCC reveals that degraded lands in Vidarbha region occupy nearly 2.1 million ha or 21.5 per cent of the total geographical area. Moderately to severely eroded soils are most extensive in the region extending over nearly 0.80 m ha accounting for about 8.25 per cent of the total area of the region. Next in order is severely eroded soils which occupy 0.74 m ha or 7.62 per cent. These are followed by severely to very severely eroded soils (0.48 m ha or 5.0 %), very severely eroded soils (0.05 m ha or 0.56%), very slowly permeable, salt affected soils (0.01 m ha or 0.1 %) and derelict land and degraded soils due to mining activity (2750 ha, 0.03 %).

Conclusion

Generation of reliable data base on degraded lands is the need of the hour for planning, monitoring and rehabilitation programme of such lands. The land degradation map and statistics reveal that an area of 2.1 million ha suffers from problems of degradation corresponding to about 21.5 per cent of the total geographical area of Vidarbha region. Soil erosion, sodicity and dereliction due to mining are the major degradational problems of which water erosion is more predominant and widespread. Sodicity and land dereliction are confined to limited areas and specific sites. The problem of land degradation is largely associated with undifferentiated plain which is mostly under agriculture.

References

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