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Inventory of Degraded Lands of Palamau District, Bihar – A Remote Sensing Approach

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ABSTRACT

In this study, an attempt has been made for the identification, categorisation and mapping of degraded lands in Palamau district of Bihar using remotely sensed data (IRS-1A, false colour composite, on 1:50,000 scale). It was observed that water erosion is the main cause of land degradation affecting 6.27 per cent area of the district, of which 5.22 per cent is subjected to severe to very severe erosion and remaining 1.05 per cent is moderately to severely gullied land. Degradation due to rock quarries, mine spoils and dumps accounted for only 0.01 per cent of the district area. Degraded lands were mostly confined to agricultural areas (4.76%) followed by forest lands (1.10%) and open-scrub/pastures (0.42%), respectively. Subdivision-wise categorisation of degraded lands was also attempted for efficient location-specific reclamation planning and easy monitoring.

Introduction

Land degradation is a global phenomenon. India ranks very high among the developing countries in respect of both the extent and severity of land degradation (Yadav, 1996). Accelerated land degradation over extensive areas has become a subject of serious national concern only in recent years. However, the statistics of degraded lands in India projected by different authors and agencies differ widely (National Commission on Agriculture, 1976; Bhumbla & Khare, 1984; Das, 1985; the Government of India, 1994), primarily because of lack of systematic surveys, different methods and approaches employed for identification, characterisation and classification of such lands. So, to regenerate the potential of these areas, to ease the intense demographic pressure on our limited land resources and to sustain the impressive improvement in crop production since the "green revolution" with the indigenous scientific knowledge, it is seriously warranted to map the degraded lands critically and most efficiently so as to acquire reliable data about them.

More recently, remote sensing has been used in India as an efficient tool for land resource inventoring and their monitoring (Venkatratnam, 1984; Goyal *et al.*, 1988; Karale *et al.*, 1988 and Ahmed *et al.*, 1996). In the present study, an attempt has been made for

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identification, categorisation and mapping of degraded lands of Palamau district of Bihar using remotely sensed data.

Study Area

Palamau district of Bihar is a part of Chotanagpur Plateau confined to 83°52' to 85° E longitudes and 23°20' to 24°40' N latitudes and cover an area of 8,02,291 ha (Fig. 1). The district comprises of two sub-divisions, namely, Daltanganj and Latehar, covering an area of 4,36,231 and 3,66,060 ha, respectively. In the north, river Son separates it from district Shahabad. River Koel and its tributaries Auranga and Amanat drain the district forming a dendritic drainage pattern flowing from the south to the north.

Physiographically, the district can be divided into three major units, viz., hill and escarpment zone, piedmont plain and alluvial plain. The soils on the hills and escarpments are mostly shallow while in depression/valleys, these are deep to very deep. The soils in the piedmont plain zone range from moderately deep to very deep following the toposequence. Area near Son river is a part of alluvial plain characterised by very deep soils and is most productive also.

Climatically, the district comes under monsoonal sub-tropical zone characterised by mean annual precipitation of 1250 mm and mean annual temperature of 25.1°C. Elevation ranges from 250 to 400 m above MSL. Gneisses and granites are the predominant rocks of the area. The other geological formations are schists, shales, limestones, dolorites and pegmatites. Coal, bauxite and dolomite also occur at a number of places.

Sal (*Shorea robusta*) is the predominant species among the natural vegetation. The common associates are tendu (*Diospyros tomentosa*), palas (*Butea monosperma*), sidha (*Lagerstroemia parviflora*), salai (*Boswellia serrata*), jharberi (*Zizyphus nummularia*), chakwad (*Cassia accidentalis*), lantana (*Lantana camara*), bamboo (*Bambusa arundinacea*), kans (*Saccharum spontaneum*) and lappa (*Aristida hystrix*). A few exotic plants also exist in the area, namely, teak (*Tectona grandis*), eucalyptus (*Eucalyptus teraticornis*), Australian babool (*Acacia auriculiformis*) and vilayati babool (*Prosopis juliflora*).

This area is predominantly monocropped rice zone. The other important crops are maize, wheat, barley and millets. According to the revenue records, 78.3 per cent area of the district is rainfed and the rest 21.7 per cent is supplemented with irrigation.

Methodology

In order to identify and map degraded lands in Palamau district, IRS-1A satellite imagery (FCC, band 4, 3, 2) acquired on April 9, 1989 on 1:50,000 scale were used. Available report pertaining to the area, (Anonymous, 1993), published by the All India Soil & Land Use Survey, Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India, have also been used to categorise the degraded lands.

The imagery was first annotated for important points for reference with the help of Survey of India topographical maps. Based on the image characteristics and tonal variation, satellite scenes were visually interpreted for various degradation types and tentative map of degraded lands of the district was prepared. A general traversing of the area was undertaken to verify various categories of degraded lands. The tone and texture of land degradation types were recorded involving 3-tier system, viz., land use at first level abbreviated by capital alphabet followed by a numerical representing the kind of problem identified and finally severity of problem indicated by a small alphabet (Table 1). Scattered sample strips were selected and traversed again to cover various land use types, physiography and degradation categories. A final correlation was established by incorporating the findings of the sample-strip analysis (Fig. 2), and thus a final map of the area was prepared. Lastly, boundaries from the imageries were transferred to the Survey of India topographical maps. Area under different mapping units was computed.

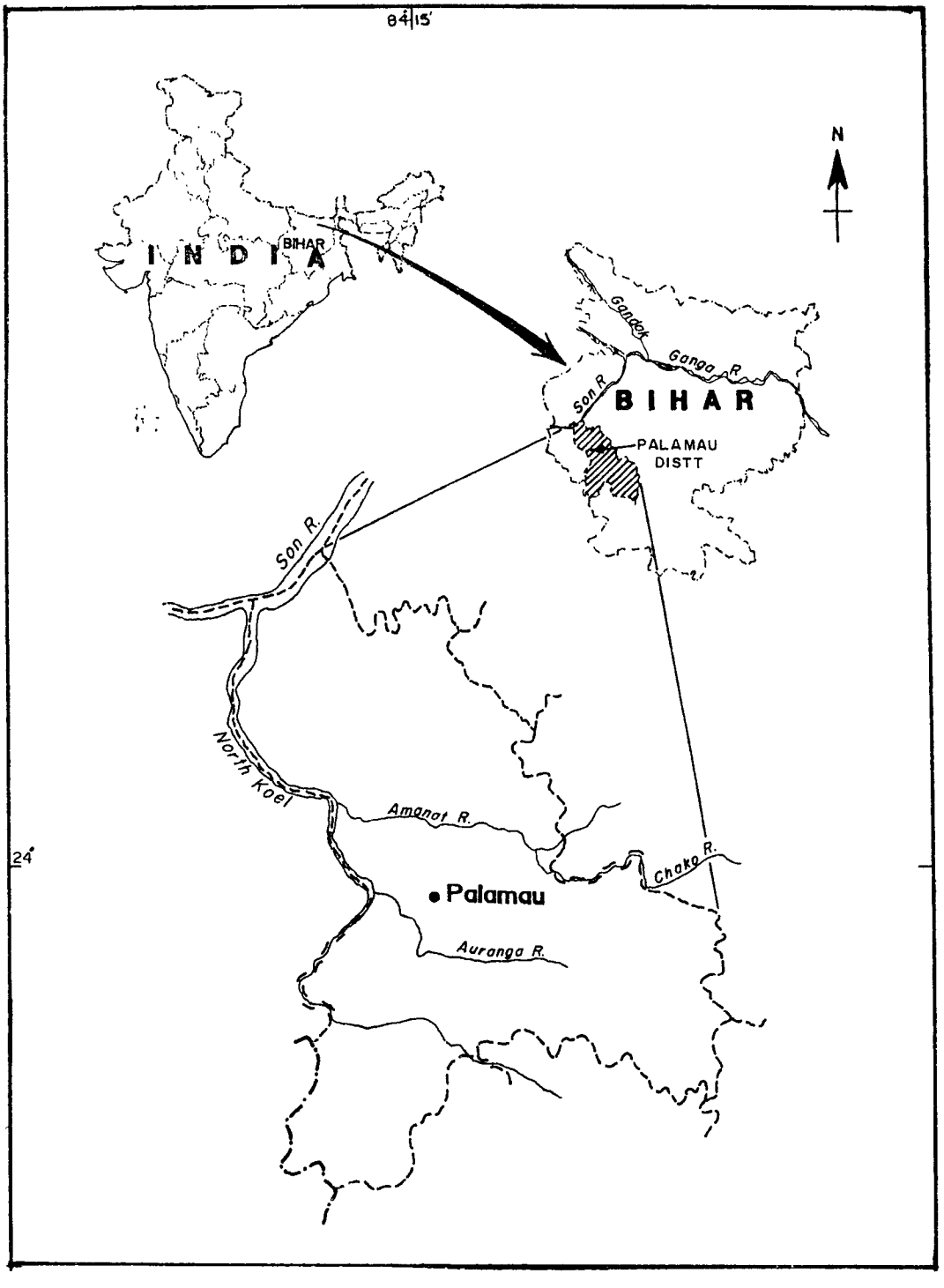

Fig. 1. Location map of District Palamau, Bihar.

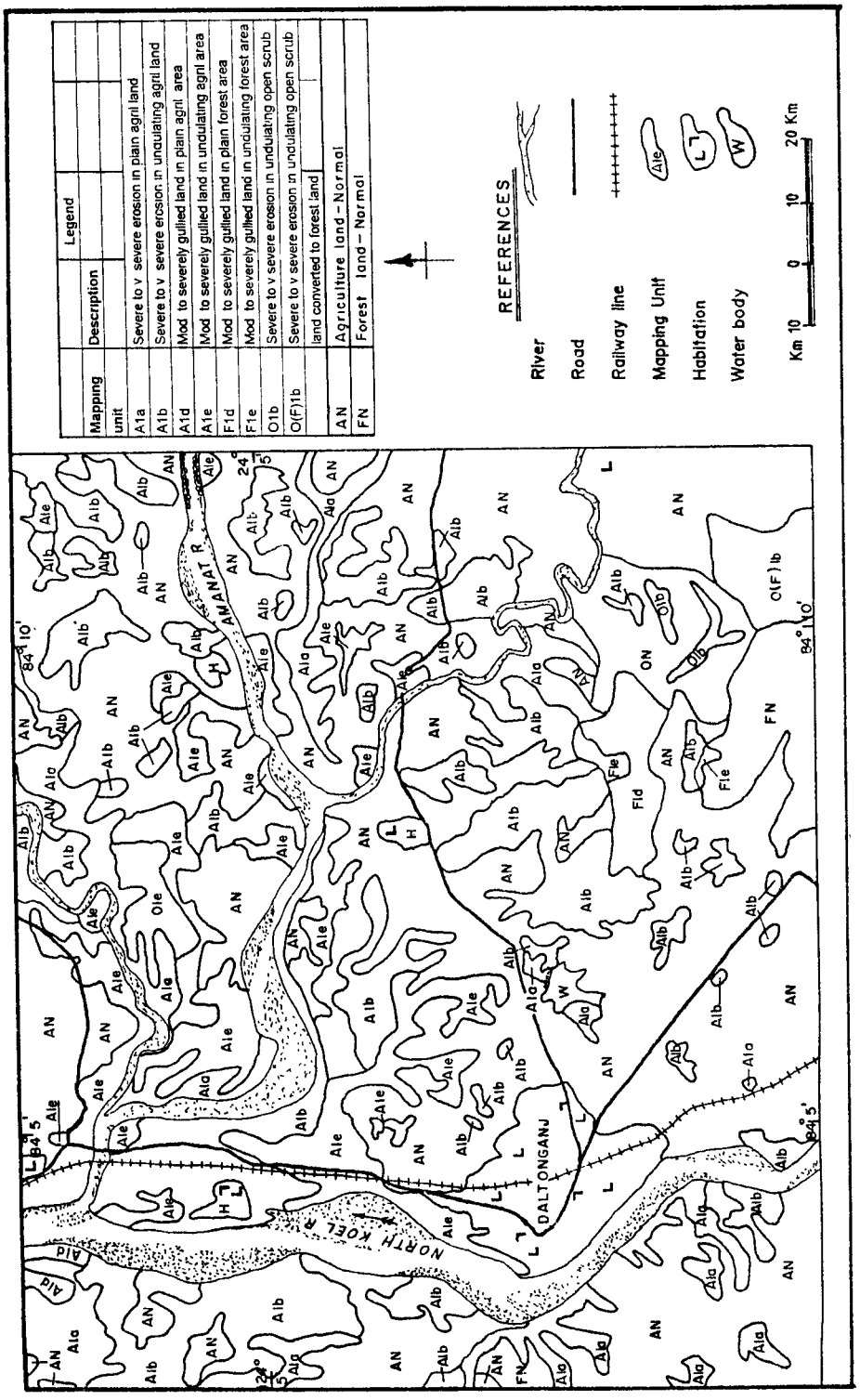

Fig. 2. A sample strip showing degraded lands of District Palamau, Bihar

Table 1. Identification key for image interpretation

Sl. No.	*Major land use & code*	*Image characteristics*	*Type of land degradation*	*Image characteristics of degradation types*	*Mapping unit*	*Description of mapping unit*
1.	Agriculture (A)	Yellow to whitish yellow, smooth to irregular	a) Severe to very severe b) Moderate to severely gullied land	a) Yellowish white to creamy, smooth to irregular b) Bright white, Smooth to irregular	A1a A1b A1d A1e	Severe to very severe erosion in plain agricultural land Severe to very severe erosion in undulating agricultural area Moderate to severely gullied land in plain agricultural area Moderate to severely gullied land in undulating agricultural area
2.	Forest (F)	Reddish to brown and black, smooth to irregular	a) Severe to very severe water erosion b) Moderate to severely gullied land	a) Whitish to yellowish white with red/brown mottles, smooth to irregular b) White to bright white with red and brown mottles	F1a F1b F1c F1d F1e F(A)1b	Severe to very severe erosion in plain forest area Severe to very severe erosion in undulating forest area Severe to very severe erosion in hilly forest area Moderate to severely gullied land in plain forest area Moderate to severely gullied land in undulating forest area Severe to very severe erosion in undulating forest area converted into agricultural land
3.	Open scrub (O)	Brown to grey with white brown coarse mottles	Severe to very severe water erosion	White to bright white, smooth to coarse, mottled with brown to grey	O1a 01b 01c 0(A)1b 0(F)1b	Severe to very severe erosion in plain open scrub/ pasture land Severe to very severe erosion in undulating open scrub land Severe to very severe erosion in hilly open scrub land Severe to very severe erosion in undulating open scrub land converted to agriculture Severe to very severe erosion in undulating open scrub land converted to forest land
4.	Open cast mined area	Bluish to grey and brown/ black	Coal mine dumps and spoils	Greyish to black with brown to dark brown mottles, irregular, coarse	6b	Degradation due to rock quarries, coal mines, apoils and dumps

Results and Discussion

In Palamau district of Bihar, water erosion was found to be the main cause of land degradation. It was observed (Table 2) that out of the total 6.28 per cent degraded land of Palamau district, 6.27 per cent area is affected by water erosion. Based on image characteristics, this water erosion was further categorised into severe to very severe erosion (5.22 per cent area) and moderately to severely gullied land (1.05 per cent area).

Table 2. Area distribution under different mapping units.

Sl. No.	*Degradation type*	*Mapping unit*	*Area (ha)*	*Area (%)*
1	Severe to very severe water erosion	A1a	7426	0.92
		A1b	22783	2.83
		F1a	47	–
		F1b	7647	0.95
		F1c	622	0.07
		O1a	56	–
		O1b	2140	0.26
		O1c	153	0.01
		F(A)1b	8	–
		O(A)1b	214	0.02
		O(F)1b	736	0.09
	Sub total		41832	5.22
2.	Moderate to severely gullied land	A1d	43	–
		A1e	7886	0.98
		F1d	221	0.02
		F1e	311	0.03
	Sub total		8461	1.05
3.	Quarries, mine spoils & dumps	6b	70	0.01
	Total		50363	6.28

Water is undoubtedly the most feared agent of land degradation worldwide. In India, 111.26 m ha area is affected by water erosion (Vellayutham, 1992). Monsoonal sub-tropical climate (mean annual precipitation 1250 mm), deformed landscape (hills, escarpments and plain lands), poor socio-economic conditions in the district (literacy percentage of 26, and marginal and small farmers constituting 73% of the farming community) and lack of awareness among the rural farmers for correct application of conservation measures, as degradation due to water erosion is largely confined to agricultural lands (4.76%) followed by forest lands (1.10%) and open-scrub/pasture lands (0.41%), respectively (Table 3). Because, even though agriculture is the main occupation in the district, there is very little influence of modern scientific knowledge.

Mapping of various types of degraded lands according to the administrative units in the district has also been attempted (Table 4) for efficient location-specific planning and easy monitoring purposes. It is clear from this data that degradation due to water erosion is prevalent in both the sub-divisions of the district, viz., Daltanganj and Latehar. However, degradation due to the presence of rock quarries, mine spoils and dumps is concentrated in Daltanganj sub division only.

The wasteland statistics reported by NRSA (1995) for Palamau district differ extensively from what is projected here. This difference can be attributed to the reason that a geographically bigger Palamau was surveyed by NRSA having an area of 12,74,900 ha because the newly formed Garhwa district was a part of Palamau at that time.

The degraded lands in the district should be rehabilitated with due regard to long-term sustainability. Severe to very severely eroded areas can be taken care of by adopting certain measures, viz., field bunding and levelling, contour cultivation, safe disposal of excess rain water, dry farming, strip cropping and following

Table 3. Area of degraded lands under various land use classes.

Land degradation type	*Land use category*			*Total*
	Agricultural Land	*Forest Land*	*Open Scrub*	
• Severe to very severe water erosion	30209 (3.77)	8324 (1.03)	3299 (0.41)	41832 (5.21)
• Moderately to severely gullied land	7929 (0 99)	532 (0 07)	–	8461 (1.06)
• Quarries, Mine spoils and dumps	–	–	70 (0 01)	70 (0.01)
Total	38138 (4.76)	8856 (1.10)	3369 (0.42)	50363 (6.28)

proper crop rotation. On the other hand, gullies can be stabilised both by vegetative as well as mechanical measures. Fast growing forage species like *Pennisetum pedicallatum*, grasses like *Cynodon dactylon* and *Cenchrus ciliares*, legumes like siratro (*Macroplelium attropurpuream*), style (*Stylosanthes hamata*) and clitoria (*Clitoria ternatea*) and tree species like *Albizzia lebbeck, Acacia nilotica, Leucacea leucocephala* are recommended under pastoral and/or silvipastoral system. Construction of check dams, provision of outlets for excess rain water, staggered trenches, stone walling on contour lines, and controlled grazing should also be adopted as effective soil and water conservation measures.

Mining activity is confined to very small pockets. However, these drastically disturbed lands need to be reclaimed by the present generation for use by the future generation. For the effective conservation of these sites, a proper survey should have been done prior to disturbance of the area defining its hydrological, biological and soil characteristics (Riddle and Saperstein, 1978). At present, the best and most reliable reclamation treatment, according to Power and Schuman (1994), is to save and respread the original soil material after shaping and smoothing spoils to a suitable contour so that a proper cover with suitable fast growing plant species could be established as early as possible. Larger pits may be used as reservoir and fish ponds.

Table 4. Subdivision-wise degraded land distribution in Palamau district, Bihar.

Sl. No.	*Type of degradation*	*Sub-division*		*Total area (ha)*
		Daltanganj	*Latehar*	
1.	Severe to very severe water erosion	18522 (2.31)	23310 (2.91)	41832 (5.22)
2.	Moderate to severely gullied land	3402 (0.42)	5059 (0.63)	8461 (1.05)
3.	Quarries, mine spoils & dumps	70 (0.01)		70 (0.01)
	Total	21994 (2.74)	28369 (3.54)	50363 (6.28)

Note: Figures in parenthesis indicate percentage of total area of the district.

Conclusions

The study has shown that it is possible to map water erosion on agricultural, forest and open scrub lands, successfully. Severe to very severe erosion on plain, undulating and hilly landscape can be separated with the help of distinct spectral signature on satellite imagery (IRS-1A, FCC). However, mapping of rock quarries, mine spoils and dump areas was not feasible due to cartographic limitation and poor resolution of data in this regard. These results may benefit a large section of users involved in planning and management of land resources in Palamau district of Bihar.

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