LAND SUITABILITY STUDY IN LAND DEGRADED AREA DUE TO MINING IN DHANBAD DISTRICT, JHARKHAND.

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ABSTRACT:

Mining is one of the strong anthropogenic factors influencing the environment. The mining and related activities effect extraction of rocks, disruption of rock continuity, groundwater regimes, etc, resulting into crushing and mixing of various rocks, leading to the formation of new loose anthropogenic deposits and during which enable the change in the characteristics of natural landscape. GIS and Remote sensing technology have assumed great importance in studying land degradation. With the development of the technology, it has assumed a configuration in which GIS is capable to accept large volumes of spatial data, derived from a variety of sources including remote sensing. The development of intelligent GIS, in which the concepts and techniques of artificial intelligence and database systems are integrated, represents a major new field of research. Geographic data is represented using different types of data models, however a basic difference exists between vector and raster types. Combining geological, geographical and satellite image derived information in the form of natural resource database holds great potential for monitoring mining areas. This concept is fast becoming an indispensable tool for environmental monitoring and planning. Since monitoring involves periodic assessment, cover conditions in an area and its remote sensing works as a practical and often used way to monitor. Mining damages land condition (land use, geomorphology, geological characteristics, soil type, etc) so seriously leading to the disturbance of natural resources. Dhanbad district is one such area, which has suffered seriously and is still suffering with this problem. The present study reveals that the natural resource analysis had been conducted based upon the Land Evaluation principle following parametric approach in which the variables in the thematic maps are individually rated to obtain new reclassified maps. In the present study, Land Suitability classes had been derived by overlying weighted maps on geomorphology, land use, drainage density, soil, slope and water potential. Areas for better land use management were identified. Nearly one fourth of the area is not suitable for agriculture. Another one fourth is highly suitable, whereas, moderately and marginally suitable classes denote 34% and 12% of the total area, respectively.

1. INTRODUCTION

Rapid growth in industrialization and population necessitated greater exploitation of natural resources to meet the basic requirements of the community as per societal preferences. Especially, in the complex scenario of ever enlarging industrial sectors, to sustain the requirements of a fast growing nation, mining of fossil fuels, other essential ores and minerals has naturally turned out to be a major activity. Needless to mention that Dhanbad district has a long history of coal mining activities, which is dated back to a century. Due to unplanned mining before nationalization, an appreciable amount of ecological disturbances in and around mining areas in this District has been witnessed. Ilogg (1988) has attempted to model land resources using GIS and simulated various derivative models to address the resource base. He has selected five factors among a series factors such as soil, groundwater, elevation, slope and coarse degree of surface according to the magnitudes of their role in land. Rao (1995) had studied land use and land cover (LULC) of Jharia coalfield by way of analyzed impact of coal mining on land use and land cover of the field. He has considered different years data of satellite and analysis the changes in the various land use units. Rathore and Wright (1993) has studied surface mining impact in Dhanbad district through different satellite imageries. GIS is widely used to evaluate sustainable land management (FAO, 1993; Skidmore et al., 1997; Antonio, 1997; Hans Hurni, 1997 and Julian Dumanski, 1997). Wherein all land units were weighted separately and modeled together to generate required thematic information. Land use analysis and allocation of land for suitable land use has been attempted by Tomlin et al., (1988). Based on the allocation model constricted on land resource information and ecological resources, he has observed that GIS output was appreciable.

2. STUDY AREA

Dhanbad is one of the resource rich districts in Jharkhand, situated in northern part of the state. Damodar and Barakar rivers mark as natural boundaries at northern and southern part of the district respectively. It has total geographic area of about 2057 sq. km and extent from 86^{o} 06’ 11” E to 86^{o} 50’ 26” E longitude and from 23^{o} 38’ 58” N to 24^{o} 03’ 30” N latitudes (**Fig 1**). This was one of the smallest districts in the state with eight community development blocks. Two major rivers flowing in the District, viz., Damodar and Barakar dominate the drainage network of the District. Significant tributaries of Damodar are Katri nadi, Khudia nadi, Ghi nadi and Irji nadi.

2.1 Data Products Used

Study area is partly covered by 73 I and 72 L toposheets. About nine numbers of 1:50,000 toposheets cover the entire study area (73I/1,2,5,6,9,10,13,14 and 72L/8) in parts. Aerial photographs (in 1: 50,000 scale) were used for the preparation of some of the thematic maps such as, land use, land degradation, etc for some specific areas. The following is the list of Satellite data (**Table 1**) used during the study.

2.2 Geology

Major portion of Dhanbad district is covered by metamorphic rocks. These include rock types of Chotanagpur granite and gneisses of Achaean age. Sedimentary rocks covering portions of southern and eastern part of the District are mainly composed of Gondwana formations.

2.3 Soil

There are about 12 classes of soil sub-groups covering the entire Dhanbad district. Most of the soil sub-groups are in-situ in nature, generally, called as sedidentary soils. Based on the sources of the origin, these soils are classified into two major soil landscapes viz., Granite-gneiss and Gondwana landscapes. As far as the texture is concerned, the above soil sub-groups have been categorized into four texture types viz., sandy loam, sandy clayey loam, loam, and clayey loam.

2.4 Land Use Mapping

The functional approach of land use classification is activity-oriented such as agriculture, grazing, forest development and urban use. The minimum mapping unit adopted by United State Geological Survey (USGS) (Witmer, 1978) for this scheme ranges between 4 ha. to 16 ha. Several organizations in India follow their own scheme for using remotely sensed data. At National Remote Sensing Agency (Anon, 1990) has been developed which is found to be adequate to extract information from imagery on 1:250,000 scale. In Dhanbad district, agriculture is the dominant land use, mining is the significant activity in this region. **Fig 2** shows the quadtree map of land use pattern of the Dhanbad district. About 70.01% of the total area is occupied by cropland that represents both Kharif and Rabi season cultivation. Though mining area occupies only around 2.95% of the area, it is a prominent land use unit in southwestern part. Some of the mining associated areas are also noticed around eastern part of the district. Most of the settlement is noticed in the southern part. The northern part is covered by forest and scrub lands. Details are presented in **Table 2.**

2.5 Land Capability Classification

Land Capability classification, recommended in the Handbook of Agriculture (Anon, 1980) was used in the present study. This classification system is based on the systematic arrangement of different kinds of land according to those properties that determined the ability of the land to produce crops on a virtually permanent basis.

2.6 Methodology

When performing an Land Suitability analysis, some factors may weight more heavily in the decision-making process than others (Anon, 1995a). Using up to 20 quadtree layers, the multi-criteria overlay allows one to assess the relative importance of each data layer (criterion) by assigning a weight to each data layer. In addition, a score is assigned to each element in the data layer to define its suitability or lack thereof.

3. RESULTS AND DISCUSSION

Based on the suitability analysis, the district was classified into five categories viz. highly suitable, moderately suitable, marginally suitable, currently not suitable and permanently not suitable. **Table 3** present details on area coverage of each suitability classes. **Fig 3** shows the land suitability map for agriculture in the study area. Currently not suitable area falls into forest and wasteland categories. Forest area is not suitable for agricultural purpose but some of the wasteland categories are currently not suitable, if some reclamation work is planned in future it will become suitable for agriculture. All permanently not suitable areas fall into built-up land and mining zones.

In the present study, nearly one fourth of the area is not suitable for agriculture. Another one fourth is highly suitable, whereas, moderately and marginally suitable classes denote 34% and 12% of the total area, respectively.

3.1 Reference

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S.No	Satellite	Path	Row	Sensor	Date of Pass	Remarks
1.	IRS-1B	20	51	L2A2	22-11-90	Paper print
2.	IRS-1B	20	51	L2A2	18-03-93	
3.	IRS-1B	20	51	L2A2	18-03-93	
4.	IRS-1B	20	51	L1	18-03-89	
5.	IRS-1B	20	51	L1	24-10-93	
6.	ERS-1	842	196	5.3GHZ	05-02-93	
GEOCODED						
7.	IRS-1C	106	55	LISS 3	04-03-98	Topo No. 73I/5
8.	IRS-1C	106	55	LISS 3	04-11-97	Topo No. 73I/5
9.	IRS-1A	20	51	L2A2	02-04-88	Topo No. 73I/6
10.	IRS-1A	20	51	L2A2	16-04-90	Topo No. 73I/6
11.	IRS-1A	20	51	L2A2	16-04-90	Topo No. 73I/2
12.	IRS-1A	20	51	L2A2	20-04-88	Topo No. 73I/2

Table 1. List of Satellite Data

Class	Land use units	Area (sq.km)	Area (%)
1.	Settlement	163.03	7.92
2.	Industrial area	6.61	0.32
3.	Kharif	1201.95	58.42
4.	Double crop	279.19	13.57
5.	Plantation	0.37	0.02
6.	Degraded forest	183.43	8.92
7.	Forest Plantation	2.79	0.14
8	Scrub land	53.07	2.58
9.	Grazing land	13.50	0.66
10.	Mining area	60.73	2.95
11.	Barren rocky	9.13	0.44
12.	Salt affected land	0.60	0.03
13.	Inundated land	4.70	0.23
14.	Tank/Reservoir	3.40	0.17
15.	Rivers	74.76	3.63
	Total	2057.26	100.00

Table 2 Land use pattern and details

Sl.No.	Suitability	Area (sq.km)	Area (%)
1.	Highly suitable	513.04	24.94
2.	Moderately suitable	697.01	33.88
3.	Marginally suitable	246.67	11.99
4.	Currently not suitable	252.16	12.26
5.	Permanently not suitable	266.59	12.96
6.	Water bodies	81.79	3.98
Total of 6 classes		2057.26	100.00

Table 3 spatial distributions of Land Suitability classes

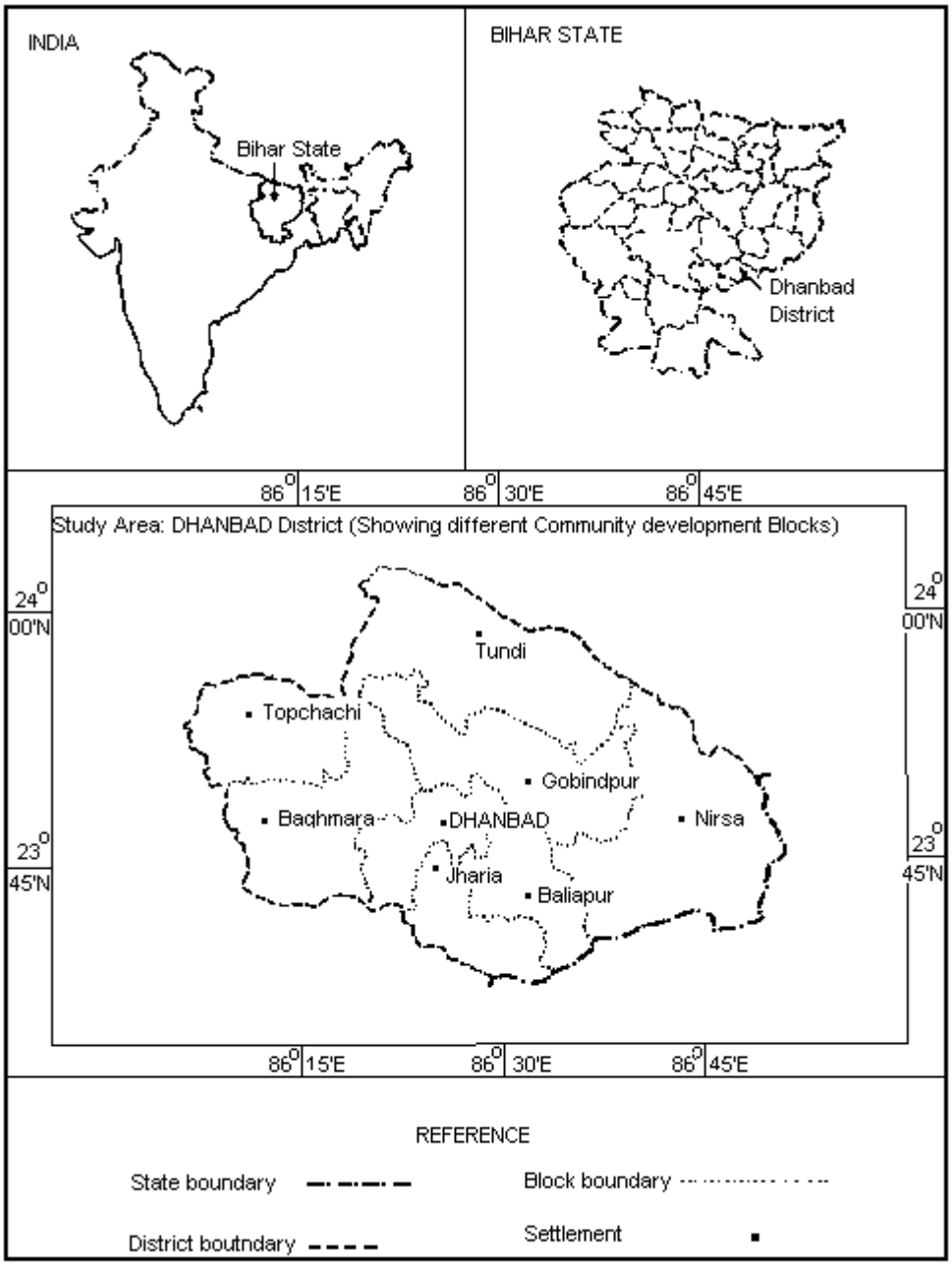
INDIA
Bihar State
BIHAR STATE
Dhanbad
District
86° 15'E
86° 30'E
86° 45'E
Study Area: DHANBAD District (Showing different Community development Blocks)
24° 00'N
23° 45'N
Tundi
Topchachi
Gobindpur
Baghmara
DHANBAD
Nirsa
Jharia
Baliapur
REFERENCE
State boundary
Block boundary
District boutndary
Settlement

Figure 1

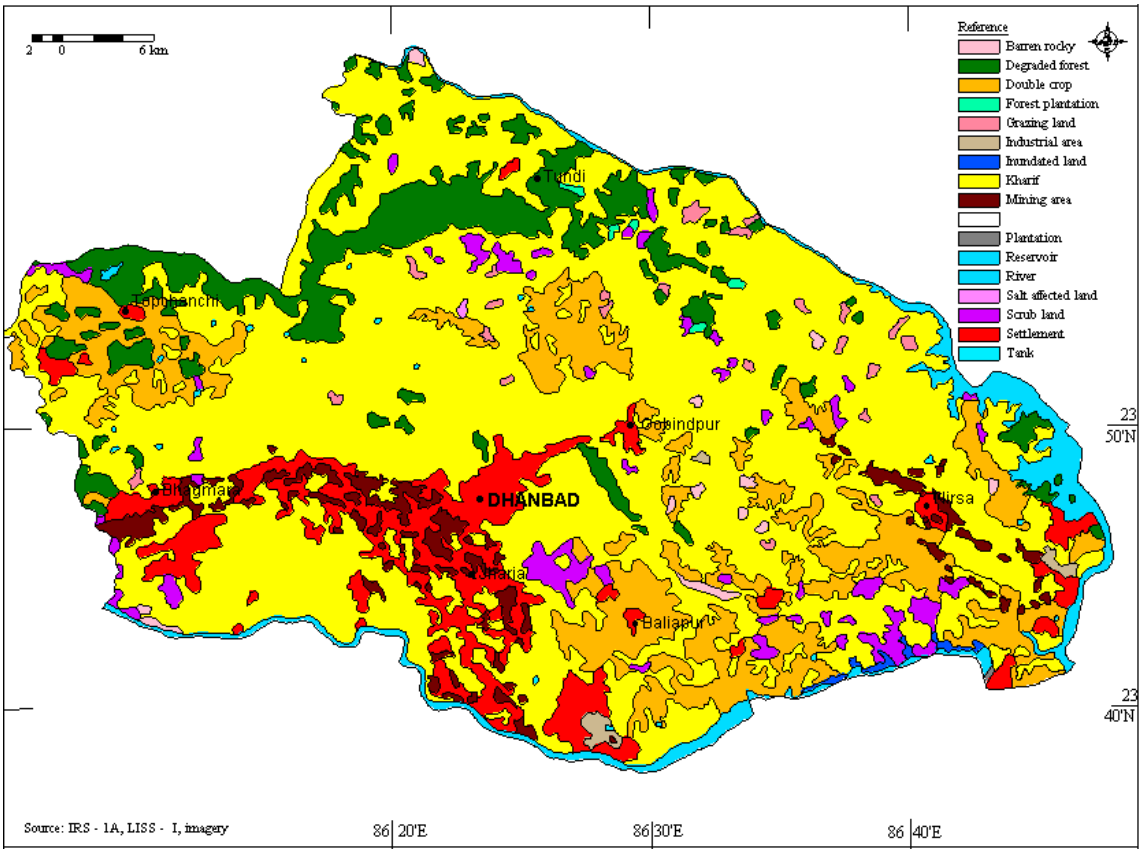

Figure 2

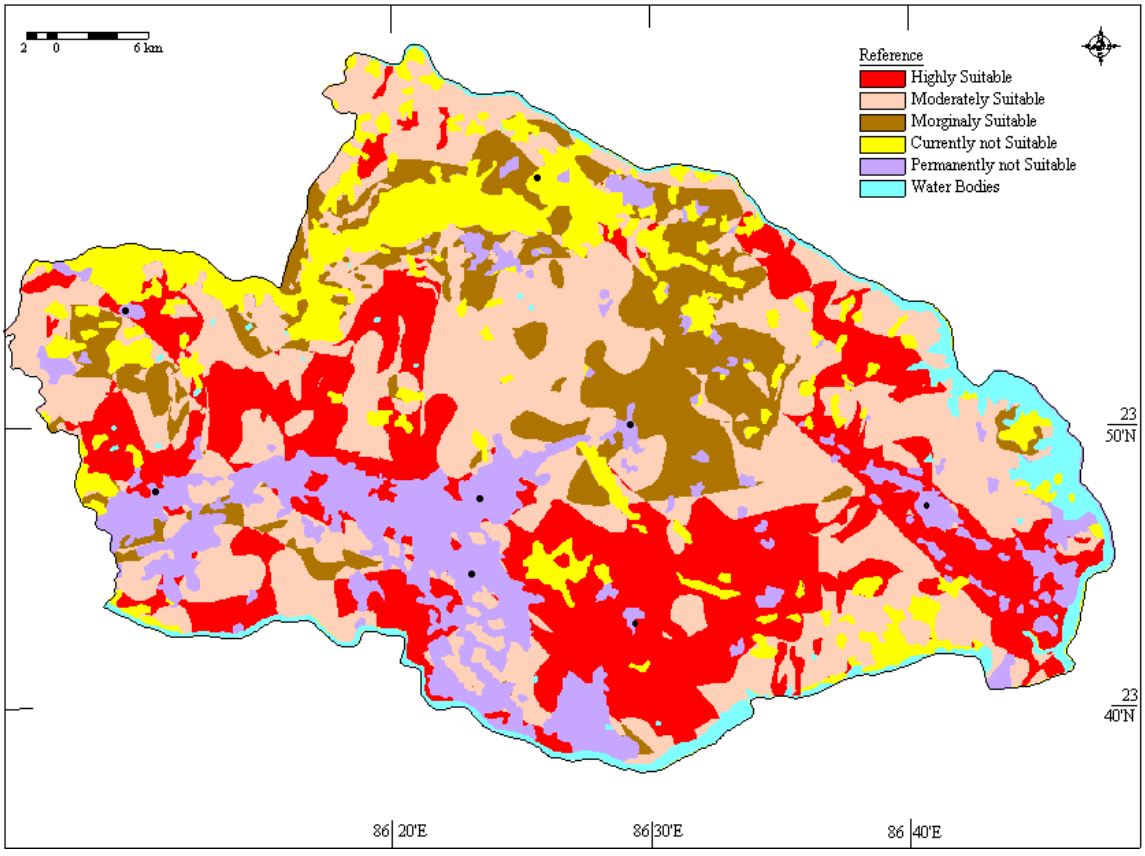

Figure 3