

# DESERTIFICATION STATUS MAPPING OF RATLAM DISTRICT, MADHYA PRADESH USING IRS SATELLITE DATA

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**KEY WORDS:** Desertification, Land degradation, Soil and water conservation

## ABSTRACT:

Desertification is one of the world's most alarming process of environmental degradation not as a natural problem of advancing deserts, but a phenomenon of land degradation due to loss of land's biological productivity, caused by human induced factors and climate change. It affects one third of the earth's surface and over a billion people. Moreover, it has potentially devastating consequences in terms of social and economic costs. The pilot project at the behest of Ministry of Environment and Forests, Govt. of India has been taken up by the Space Applications Centre. Ratlam district of Madhya Pradesh has been included in 10 districts selected for pilot study in the country. Ratlam district is situated in the extreme western part of Madhya Pradesh. It is a part of Malwa Plateau and making boundary with Rajasthan state also. It is being affected by the desertification process of nature extending from Rajasthan side, as observed during the last few decades. Mass scale cattle grazing, lowering of ground water table, non-availability of surface water, scanty rainfall, skeletal soil, loss of vegetation cover etc., are some of the major problems of the district. Due to these problems the area is being converted into the desert alarmingly. Maps depicting landuse/landcover, process of degradation and severity of degradation of Ratlam district have been prepared on 1:50,000 scale using IRS-1C/1D LISS III data for Rabi and Kharif seasons pertaining to normal monsoon/rainfall seasons. Analysis of results for Ratlam district reveals that about 50,780 ha. area of land with scrub was affected by degradation process such as vegetation degradation (46,800 ha.), water erosion (398 ha.). Out of total geographical area 23,850 ha. of forest area was affected by vegetation degradation. Total barren/rocky area affected was about 4,230 ha out of it 140 ha. was affected by water erosion. About 407240 ha. of other category was under degradation.

## 1. INTRODUCTION

Desertification is a continuous process of land degradation leading to desert like conditions. The 1997, United Nations Conference on Desertification, UNCOD in Nairobi described desertification as the diminution or destruction of the biological potential of land. The recent definition of United Nations is "Land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors. Recently, in the 58<sup>th</sup> ordinary session, General Assembly of United Nations has declared year 2006 as "The International Year of Deserts and Desertification (IYYD)" showing deep concern over this global problem.

UN Convention to Combat Desertification (UNCCD) is a joint effort of member countries (including India to combat desertification. Two major objectives of the UNCCD are (i) to combat desertification and mitigate the effect of drought (ii) to prepare long term integrated strategy to improve productivity of land and sustainable management of land and water. UNCCD has taken up six Thematic Programme Networks (TPN). The first one, Thematic Programme Network is on Desertification, Monitoring and Assessment. The overall objective of TPN-1 is to enhance the desertification monitoring

and assessment capacities in the region through the establishment of a network and the harmonization of approaches for its conduct in the region. In India, Space Applications Centre (ISRO), Ahmedabad has been identified as the focal institutional network at the national level for desertification monitoring and assessment.

The pilot project at the behest of Ministry of Environment and Forests, Govt. of India has been taken up by the Space Applications Centre. Ratlam district of Madhya Pradesh has been included in 10 districts selected for pilot study in the country. Under the project, maps depicting landuse/landcover, process of degradation and severity of degradation have been prepared on 1:50,000 scale.

## 2. STUDY AREA

Ratlam district of Madhya Pradesh is situated on Malwa Plateau and located in the northwestern part of Madhya Pradesh. It lies between North latitude 33°05' to 23°55' and East longitude 74°30' to 75°42' (figure 2.1) covering a geographical area of 486100 ha, out of which an area of 49994

ha lies under reserved or protected forest. Ratlam is well connected both by rail and roads. It is situated on the state highway number 22 and 31. It is bounded by Jhabua, Dhar, Mandsaur, Ujjain districts of MP and Banswara district of Rajasthan. The topography of the area varies from place to place. The district has maximum area under plain flat surface with the exception of few hills and undulatory areas. The undulatory terrain has a very thin soil cover. The height of hills varies from 250 m to 600 m above MSL. Some areas are rugged in nature due to dissection by streams and rivers. The general slope of the area is towards north. Mahi and Chambal are the two major rivers in the district. Mahi river flows from western part of the district towards northwest and forms a part of Chambal Catchment whereas the Chambal flows from the central part of the district to northeast. Lithologically, the district is constituted by various flows of Deccan Trap Basalt.

The climate of the area is dry except during the southwest monsoon season. The study area receives the maximum rainfall from southwest monsoon and the rainy season begins from June to October where July is the month of maximum rainfall. The annual average rainfall in Ratlam district is 900 mm. The mean daily temperature in summer varies between 12 °C to 43 °C.

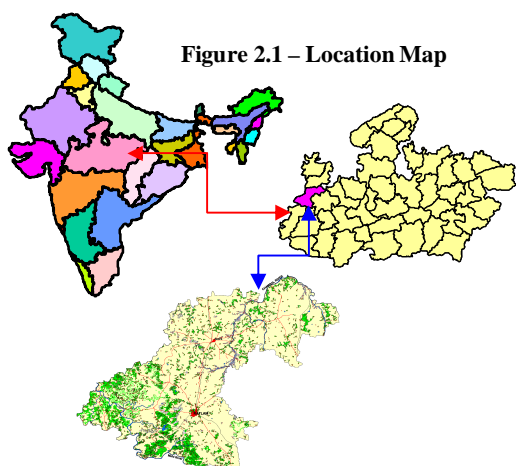


Figure 2.1 – Location Map

### 3. METHODOLOGY

To assess the desertification status landuse/landcover mapping along with the process of degradation and severity of degradation of Ratlam district was done on 1:50,000 scale. False color composites of IRS-1C/1D LISS III satellite images pertaining to Rabi (January and February 2002) and Kharif (October 2001) seasons were used for mapping. Collateral data as well as socio-economic profile of the district were collected from the district headquarter and other concerned organizations. After collecting the relevant and necessary information about the district, the visual interpretation technique was carried out for the preparation of desertification status map.

A reconnaissance survey was conducted in and around the study area to grossly assess the type, extent, cause and possible consequence of the desertification problem with regards to ground conditions. This was helpful in standardizing the image signatures of various land degradation processes and their varying severity. The rail, road, streams, water bodies and land use/land cover map for pockets of degraded lands as per level-1 classification system (table 3.1), were delineated from satellite images. The most important aspect was identification of degradation process (level-2 classification – table 3.2) active in each parcel of land facing desertification based on image signatures and ground truth. Further assessment of severity of degradation (level-3 classification – table 3.3) was done depending upon signatures on image as well as ground truth including soil sample analysis. Finally the digital database was created on 5' \* 5' interval grid using ARC/INFO GIS software. Final desertification status map was prepared by integration of all the layers (figure 3.1, last page). Flow chart of detail methodology for preparation of desertification status map is given below (figure -3.2).

Table 3.1 – Land Use/Land Cover (Level 1)

Agriculture - Unirrigated	(D)
Agriculture – Irrigated	(I)
Forest	(F)*/p
Land with Scrub	(S)**
Barren/Rocky Area	(B/R)#
Water body/Drainage	(W)
Others (Urban, Man-made etc.) Built-up	(T)

\* Rocky areas within forest was annotated as only FV3-r in the map.

\*\* Vegetal degradation in Land with Scrub around periphery of notified forests was delineated as SV.

Encroachment in forest area esp. agricultural practices is FV3.

# Barren and Rocky areas were delineated separately as B or R.

Table 3.2 - Process of Degradation Level 2

Types of morphological processes resulting in degradation:

Vegetation Degradation	(v)
Water Erosion	(w)*
Wind Erosion	(e)
Water Logging	(l)
Man made (Mining/Brick Kiln Industrial Effluents, City Waste, Urban Agg. Etc.)	(m)

\* Gully/ravines was shown as Xw3, where x is the Land use/cover class of surrounding areas.

Table 3.3 - Severity of Degradation (Level 3)

Slight	1
Moderate	2
Severe	3

The details on the severity classes for different desertification process are given below:

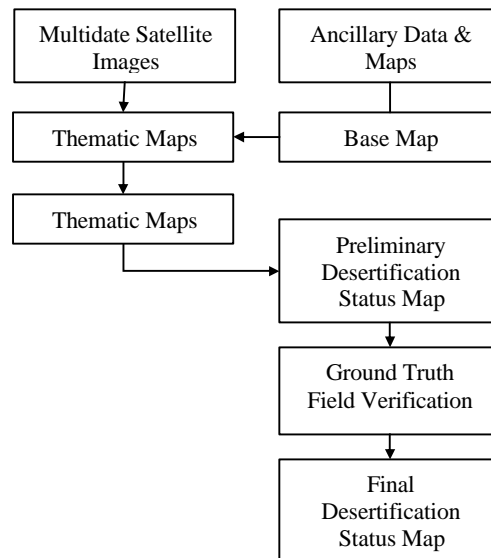
**Vegetative Degradation**

Status criteria	Desertification classes		
	<i>Slight</i>	<i>Moderate</i>	<i>Severe</i>
Plant community	Climax or slightly changed	Long lasting secondary	Ephemeral secondary
Percentage of climax species	> 75	75-25	< 25
Decrease of total plant cover, %	< 25	25-75	> 75
Loss of forage, %	< 25	25-75	> 75
Loss of current increment of wood, %	< 25	25-75	> 75

**Water Erosion**

Status criteria	Desertification classes		
	<i>Slight</i>	<i>Moderate</i>	<i>Severe</i>
<b>Non-Arable land</b>			
Type of erosion (Depth and width is in meters)	Sheet erosion and/or Single rills- (Depth <= 0.5 m and Width = 0.4-0.9 m)	Rill erosion, and/or Formation of gullies – (Depth-0.6-3.0 m and Width- 1.0-3.5 m)	Network or gullies/Ravines – (In Gullies- Depth 3 m-10 m and Width 3.5-20.0 m) In Ravine (Depth > 10 m, width 20-40 m)
Density of channels, linear km per sq.km.	<0.5	0.5-1.5	1.5-3.0
Removal of top soil horizon, %	<25	25-50	>50
<b>Arable land</b>			
Removal of top soil horizon	<25	25-50	>50
Loss of yield of main crop, %	<25	25-50	>50

**Figure 3.2 – Flow Chart of Methodology**



**4. RESULTS AND DISCUSSION**

The major processes of degradation active in Ratlam district were vegetation degradation and water erosion. Analysis of results for Ratlam district revealed that about 50,780 ha. area of land with scrub was affected by degradation process such as vegetation degradation (46,800 ha), water erosion (398 ha). Distribution of areas affected by various degradation processes in barren/rock is shown in table 4.1.

**Table 4.1 – Area wise Details Desertification Classes**

Description of Desertification Class	Area (ha)
Forest – vegetal degradation – Slight	7610
Forest – vegetal degradation – Moderate	9110
Forest – vegetal degradation – Severe	7130
Land with scrub – vegetal degradation – Slight	6730
Land with scrub – vegetal degradation – Moderate	26600
Land with scrub – vegetal degradation – Severe	13470
Land with scrub – water – water erosion – Moderate	3980
Rocky area	1910
Barren area	2180
Barren – water erosion – Moderate	140
Others (Urban, Manmade etc.)	407240
<b>Total</b>	<b>486100</b>

#### 4.1 Desertification of Forest Area

Vast stretches of this category were found in the hilly tracts. These were confined mainly to hill slopes and piedmonts zones. Degradation is mainly due to unauthorized felling of trees to meet the demands of inhabitants for fuel, fodder and timber. The notified Khundiyan Protected Forest and Khafuna Palchuna Protected Forest area are also degraded in patches.

#### 4.2 Desertification of Land with Scrub

It consists of those lands which are presently not used for agriculture. These are generally located relatively higher topographic positions. Thin soil cover exists on top, which mostly support grasses vegetation. Degradation process active in these areas include water erosion and vegetation degradation. This type of wasteland is seen near village Gundanpura, Dhamaniya, Palsari and Rechachu etc.

#### 4.3 Barren/Rocky Area

Barren land represents those areas, which are mostly devoid of vegetation cover. Thickness of soil cover on surface is almost negligible. Rocky areas are rock exposures of different types which occur as massive rocks, boulders etc. Degradation process in barren land is water erosion. It is resulted in formation of hill and ravine depending upon severity level.

### 5. CONCLUSION

Ratlam district is a part of Malwa Plateau and making boundary with Rajasthan State. Part of the area is rugged in nature due to dissection by streams and rivers. Kshipra and Chambal are the two major rivers in the district. It is being affected by the desertification process of nature extending from Rajasthan side, as observed during the last few decades. Mass scale of cattle grazing, lowering of ground water table, non availability of surface water, scanty rainfall, skeletal soil, less of vegetation cover etc. are some of the major problems of the district. Keeping in view the importance and seriousness of the problem, some control measures that are recommended in the area to combat desertification include:

- i. Soil and water conservation measures to control soil erosion and to conserve water resources.
- ii. Land with scrub can be reclaimed by increasing fertility of soil, selective crop rotation and by development of irrigation facilities.
- iii. Reclamation of degraded forest can be done by afforestation programme, regulate forestry, prevention of illegal cutting and excessive grazing by making cattle proof trenches.
- iv. Extension of gullied and ravenous land can be checked by growing permanent vegetation covers and making check dams and bunds at suitable places.
- v. In the district, there are many water bodies/tanks of various sizes some of them are old and some are newly constructed. Due to deposition of silt, these water bodies/tanks require desilting activity in order to increase the volume of surface water storage.

Thus, desilting and deepening of these tanks is suggested wherever required.

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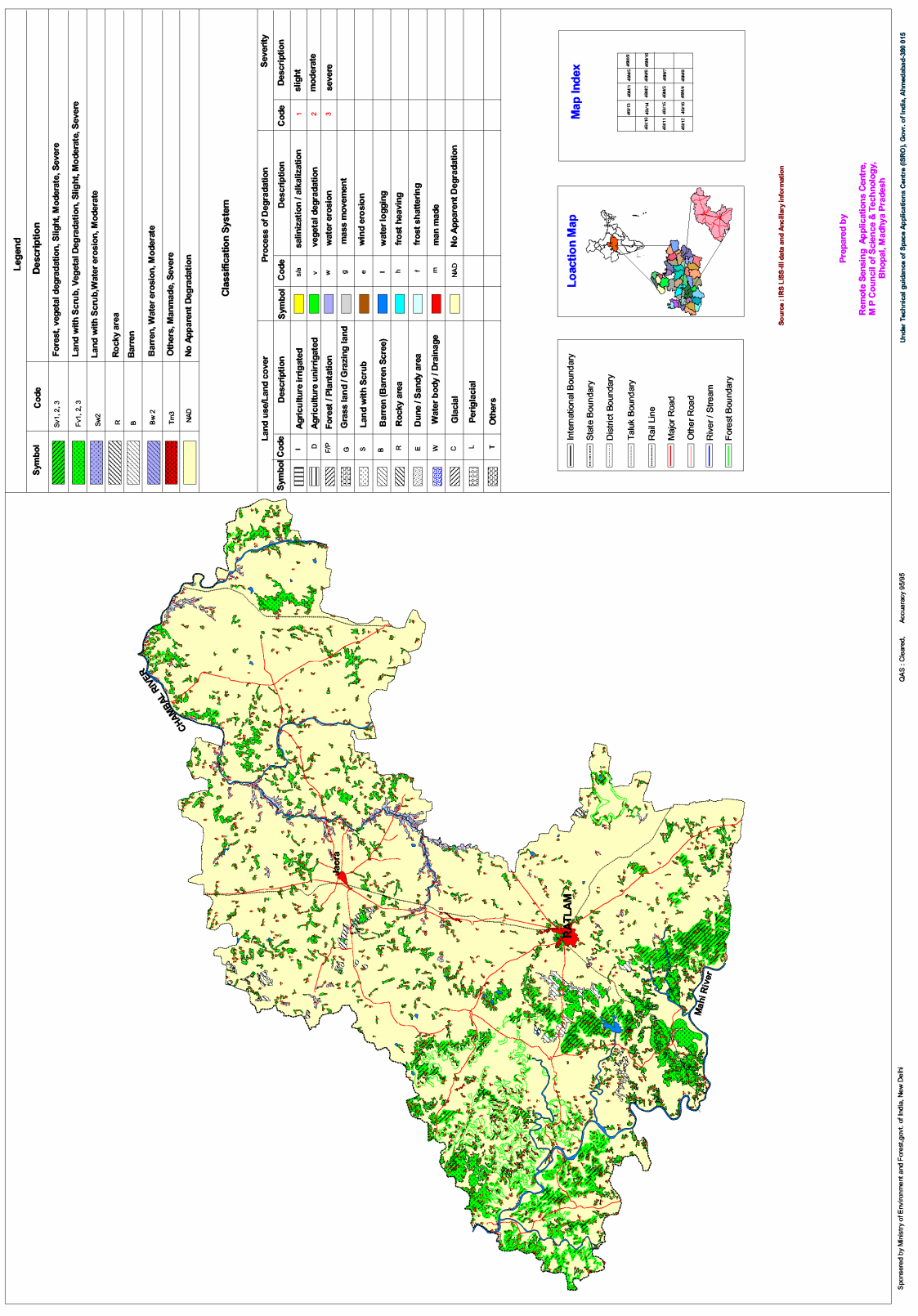
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**DESERTIFICATION STATUS MAP**  
**RATLAM DISTRICT, MADHYA PRADESH**

DESERTIFICATION MONITORING AND ASSESSMENT PROJECT

MAP No. DSM-46 (10 to 15, 46 IM) to 10



**Legend**

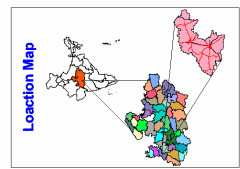
Symbol	Code	Description
	Sr1,2,3	Forest, vegetal degradation, Slight, Moderate, Severe
	Pv1,2,3	Land with Scrub, Vegetal Degradation, Slight, Moderate, Severe
	Sa2	Land with Scrub, Water erosion, Moderate
	R	Rocky area
	B	Barren
	Bw-2	Barren, Water erosion, Moderate
	Tn3	Others, Manmade, Severe
	NAD	No Apparent Degradation

**Classification System**

Land use/Land cover		Process of Degradation		Severity	
Symbol Code	Description	Symbol Code	Description	Code	Description
I	Agriculture irrigated	sls	salinization / alkalinization	1	slight
D	Agriculture unirrigated	v	vegetal degradation	2	moderate
fp	Forest / Plantation	w	water erosion	3	severe
G	Grass land / Grazing land	g	mass movement		
S	Land with Scrub	e	wind erosion		
B	Barren (Barren Scree)	i	water logging		
R	Rocky area	h	frost heaving		
E	Dune / Sandy area	f	frost shattering		
W	Water body / Drainage	m	man made		
C	Glacial	NAD	No Apparent Degradation		
L	Periglacial				
T	Others				

**Map Index**

Symbol	Description
	Sr1,2,3
	Pv1,2,3
	Sa2
	R
	B
	Bw-2
	Tn3
	NAD



Source : IRS LRS-ii data and Ancillary information

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GIS - Cleared, Accuracy 95%

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