DESERTIFICATION CHANGE ANALYSIS IN SIWALIK HILLS OF HARYANA USING GEO-INFORMATICS

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ABSTRACT:
Desertification constitutes one of the international environment problems whose global importance has been recognized by the international community. Desertification is a problem that affects a number of regions of the world in the developed and developing countries. Desertification is even more closely associated with the development process insofar as it impacts on peoples livelihoods much more directly than other environmental problem. One of the central challenges of environment management in the coming years, the loss of productive land is of major concern in a world where hundreds millions of individuals already go hungry today. Availability of remote sensing data from earth observation satellite and GIS techniques has made it convenient to map and monitor land use /land cover of desertification areas. In the present study Desertification Change analysis in Panchkula district Haryana was carried out by using LISS-III satellite data of 2002 and 2011. The main objective of the study was to monitor the changes in degraded lands in the district. Onscreen digitization technique was followed to interpret the satellite data. The two dates maps were overlaid and changes in area under various degraded lands were calculated. It was observed that Total geographical area of under investigation is 1021.86 sq. km.

1. INTRODUCTION:

Desertification is a process of land degradation. It often arises from the demands of increased population that settle on land in order to grow crops and graze animals. Policies that can lead to an unsustainable use of resources and lack of infrastructures. Change in frequency and amount of rainfall, reduction in vegetal cover, wrong agricultural management practices, cultivation on marginal lands are major contributor to land degradation.

Desertification as defined by UNEP in 1992 and adopted by United Nations Convention to combat Desertification (UNCCD), is 'Land degradation in arid, semi-arid and dry sub humid areas resulting from various factors' including climatic variations and human activities.

Remote sensing data and Geographical Information System (GIS) techniques have capability to provide reliable information for spatial modeling. The synoptic large area repetitive coverage provided by satellite sensors can provide appropriate data base for desertification mapping.

The present study aims at land use/land cover mapping of the study area to monitor the change status of desertification during the period 2002-2011 in Siwalik hills of Haryana, using Satellite data of LISS-III sensor for the year's 2002 and 2011.

2. STUDY AREA:

The study area comprises of Panchkula district, Haryana, India located between $30^0$21'N to $30^0$58'N latitudes and $76^0$48'E to $76^0$10'E longitudes as shown in figure-1. The total area is 1021.86 sq.km.

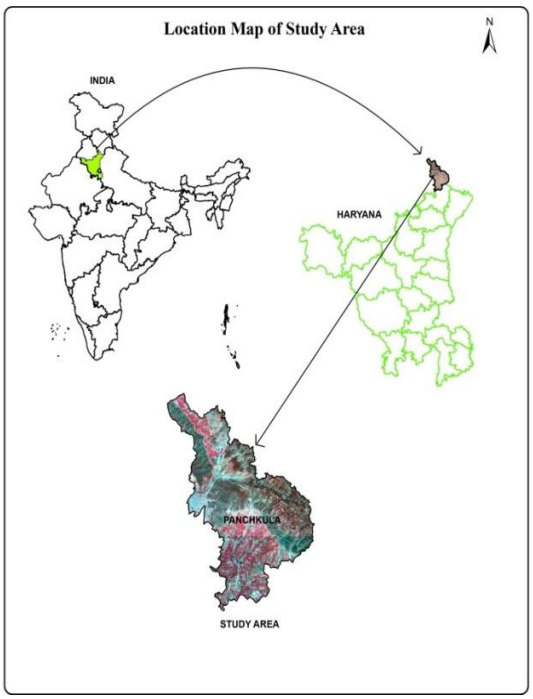

Figure-1: Study area map

The climatic conditions in the study area are dry sub-humid. The summer months are very hot, whereas winter season is fairly cool and dry. Occasionally, frost also occurs in the winter. There is a rapid increase in temperature after February up to June Maximum

temperature reaches up to 40^0C. The monthly average annual rainfall of the district is 987 mm. The variation of annual rainfall is very large. About 82% of annual rainfall is received during the months of June to September. The study area can be divided into two distinct Physiographical units viz. foothill rolling plain and alluvial Plains. The foothill rolling plain is a long belt of undulating, fairly sloping plain with elevation between 300- 400 meter, adjoining the Shiwalik range. Alluvial fans have been formed by the deposit of material brought down by the seasonal streams from Shiwalik range. Tropical dry deciduous forests and subtropical and sub tropical forests are found here. Shisham (*Dalbergia sissoo*) Kikar (*Acacia nilotica*) and Mango (*Mangifera indica*) are the important tree species grown in the area.

3. DATA AND MATERIAL USED:

The Indian Remote Sensing Satellite data (IRS-P6) LISS-III was used for the study area. Satellite sensor and acquisition dates of the data used for the analysis are given in Table-1.

Table-1: Satellite Data Used

S. No.	Satellite	Sensor	Date of acquisition
1.	IRS-P6	LISS-III	March, 2002
2.	IRS-P6	LISS-III	March, 2011

3.1 Survey of India Topographical Sheets:

Study area is covered by SOI toposheet no.53B/13, 54 F/01, 53B/14, 53F/02, 53B/15, 53F/03 on 1:50,000 scale.

3.2 Software used:

ERDAS IMAGINE 9.3 and ARC/MAP 9.3.

4. METHODOLOGY:

In the present study land use /land cover maps were prepared on 1:10,000 scales to monitor the desertification changes during the year 2002 to 2011. Remote Sensing Satellite data (IRS-P6) LISS-III acquired during 2002 and 2011 were used. Ground truth data was collected and used in preparation of Desertification status maps (DSM).

The national classification system for DSM as evolved and standardized through a pilot project and adopted for the present work is given Table-2 & 3. Level-1 comprises land use categories; level-2 describes the process of degradation and level-3 deals with the severity of degradation. Codification of classification system is given as Table-3.

Table- 2: Classification scheme

Level 1:Land use/Land Cover	
Code	Description
I	Agriculture Irrigated
D	Agriculture Unirrigated
F/P	Forest/Plantation
G	Grassland/ Grazing Land
S	Land with Scrub
B	Barren(Barren Scree)
R	Rocky Area
E	Dune/ Sandy Area
W	Water body/Drainage
C	Glacial
L	Periglacial
T	Others

Level 2:Process of Degradation	
Code	Description
s/a	Stalinization /alkalization
v	vegetal degradation
w	water erosion
g	mass movement
e	wind erosion
i	water logging
h	Frost heaving
f	Frost shattering
m	Man made
NAD	No Apparent Degradation

Level 3: Severity	
Code	Description
1	slight
2	moderate
3	severe

Table-3. Codification of Classification System

Legend	
Code	Description
Fv1,2,3	Forest, Vegetation Degradation, Slight, Moderate, Severe
Fw1,2	Forest ,Water Erosion, Slight, Moderate
Fg1,2,3	Forest, Mass Movement, Slight , Moderate ,Severe
Iw1,2	Agriculture Irrigated, Water Erosion , Slight, Moderate
Dw1,2,3	Agriculture Unirrigated, Water Erosion , Slight, Moderate , Severe

Sw1,2,3	Land with Scrub , Water Erosion, Slight, Moderate, Severe
Tm1,2,3	Others , Man Made, Slight, Moderate, Severe
NAD	No Apparent Degradation

Details of methodology are described in the flow diagram (figure-2). Base maps prepared using the Survey of India topographical maps on 1:50,000 scale and satellite images were used while analyzing satellite data. Base features like road, rail, habitation and drainage were taken from Topographical maps for preparing base maps. Ground truth data collected from various places were used to finalize the maps.

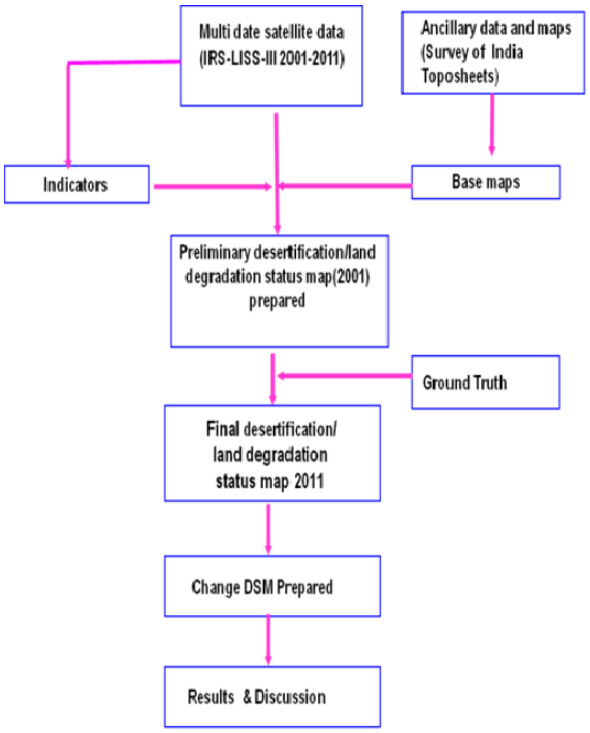

Figure-2: Methodology Flow Chart

5. RESULTS AND DISCUSSION:

Desertification change status maps were prepared on 1:50,000 scale for the years 2002 and 2011. Image interpretation and ground truth is done for the area under investigation according to the legend suggested for the *National classification system*[4]. Total geographical area is 1021 .86 sq.km. Various processes of land desertification appears distinctly on satellite imagery as an example the satellite image showing desertification process such as water erosion, vegetation degradation, land with scrub, water logging and water erosion In 2001 in the No Apparent Degradation (NAD) category total area is 521 sq. km. in 2011 it is 547.46 sq.km. due to management of agricultural activities and forest area leads to a positive change of 26.46 sq.km. in the district. As shown in table no. 4. The second largest category is Land with Scrub Water Erosion and Slight (Sw1) in 2001 the area under this category is 68.09 now it decreased 8.82 sq. km. in Forest Vegetation. The area of Categories as Barren (B), Forest Mass Movement Slight (Fg1), Forest Vegetation Degradation, Slight (Fv1), Forest Water Erosion Slight (Fw1), Land with Scrub Water Erosion Severe (Sw3) is increased as 0.31,1.95,7.32,1.12 and 2.06 sq.km during studying time and the area under categories as Agriculture unirrigated, Water Erosion Moderate (Dw2), Agriculture unirrigated, Water Erosion Severe (Dw3), Forest Mass Movement Moderate (Fg2), Forest Vegetation Degradation Moderate (Fv2), Agriculture Irrigated Water Erosion Slight (Iw1) is decreased as 6.94,2.97,0.06 and 1.13 sq.km. Agriculture unirrigated Water Erosion Slight (Dw1) decreased as 8.99 it changed into the category Agriculture Irrigated Water Erosion Moderate (Iw2) 0.31 sq.km and No Apparent Degradation (NAD) 8.68 sq.km the area under this category is 40.95 sq.km. in 2002 whereas it 31.96 sq.km in 2011. The category Forest Mass Movement Severe (Fg3), Forest Vegetation Degradation Severe (Fv3), Forest Water Erosion Moderate found no change as shown in Table no 4. Desertification change status also given in map (Figure-3).

Table-4: Change of desertification during 2002 to 2011

Categories	Area in 2002(sq.km.)	Area in 2011(sq.km.)	Change
B	17.98	18.29	+0.31
Dw1	40.95	31.96	-8.99
Dw2	52.26	45.32	-6.94
Dw3	35.93	32.96	-2.97
Total	**147.12**	**128.53**	**-18.59**
Fg1	00.29	02.24	+1.95
Fg2	03.02	02.96	-0.06
Fg3	00.18	00.18	0.00
Total	**03.49**	**05.38**	**+1.89**
Fv1	36.07	43.39	+7.32
Fv2	37.59	36.46	-1.13
Fv3	04.55	04.55	0.00
Total	**78.21**	**84.40**	**+6.19**
Fw1	01.15	02.27	+1.12
Fw2	00.45	00.45	+0.00
Total	**01.60**	**02.72**	**+1.12**
Iw1	16.04	12.24	-3.80
Iw2	18.91	16.26	-2.65
Total	**34.95**	**28.50**	**-6.45**
Sw1	68.09	59.27	-8.82
Sw2	44.47	41.13	-3.34
Sw3	20.28	22.34	+2.06
Total	**132.84**	**122.74**	**-10.10**
Tm1	14.49	14.83	+0.34
Tm2	05.40	04.82	-0.58
Tm3	27.21	27.18	-0.03
Total	**47.10**	**46.83**	**-0.95**
W	0.80	0.80	0.00
R	54.75	54.50	-0.25
NAD	521.00	547.46	+26.46
Grand Total	1021.86	1021.86	

6. CONCLUSIONS:

- It was observed that satellite data proved to be very useful for mapping of desertification and land degradation areas. It is easy to differentiate different degradation processes active in study area by satellite image interpretation.
- By using modern agriculture technique and by controlling the water erosion and maximizing the vegetation cover, land can be improved from desertification.
- Desertification Status Map can be helpful for the control of desertification in the district.

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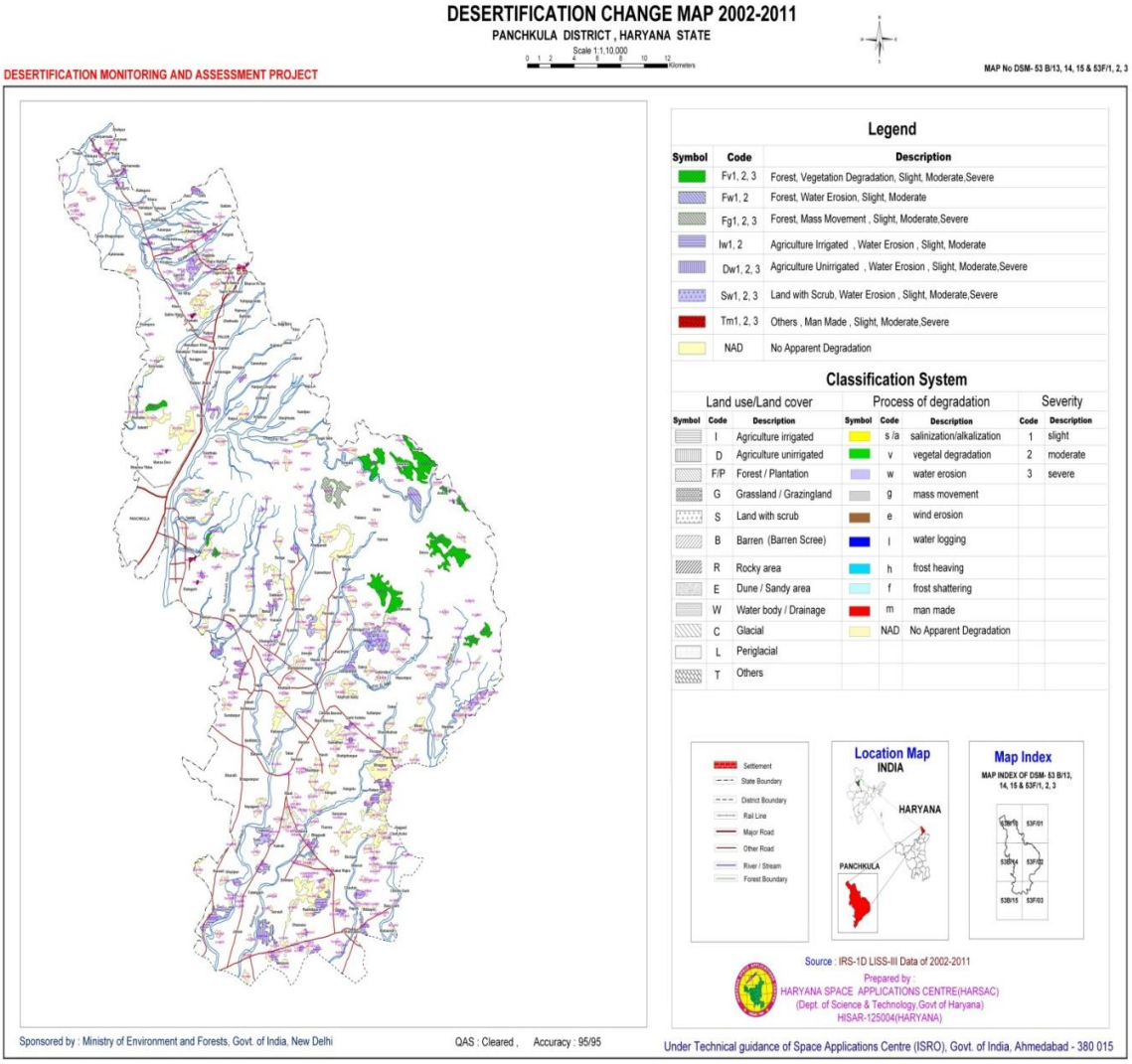

Figure-3: Map Showing the Desertification status and change analysis