Map and Identify Desurfaced Soils in Rohtak and Jhajjar District in Last Five Years using RS

Priyanka Singh, Rani Devi, R. S. Hooda, M. S. Grewal

Abstract: ***In the past century, industrialisation and urbanization have created many environmental problems like air, water and soil pollution. As the result of soil desurfacing by brick kilns the soil fertility is affected. Increasing population and human interventions are responsible factors for environmental degradation. In the National capital region construction activity is on the peak and for this requirement for the bricks has increased many times. The focus of this study is to map and identify the desurfaced soils due to brick kilns in Jhajjar and Rohtak districts which lies in the NCR in the years 2007 and 2012. The desurfaced area of 2007 and 2012 is digitized and map is developed.***

Index Terms—Cartosat-I, Worldview-II, Brick kiln, GIS, RS

I. INTRODUCTION

Soil is the basis for crop production because about 99% of food is produced from the soil. The soil is the life supporting system upon which human beings have been dependent from the very beginning of the civilization. An intensification of agricultural production on a global scale is necessary in order to secure the food supply for increasing world population [17]. One of the most serious threats to food security is the increasing degradation of agricultural land from natural or human induced changes due to the physical, chemical and biological processes. The word 'degradations' from its Latin derivation, means reduction to a lower rank [9]. This degradation is mainly because of earth desurfacing. When the land becomes degraded its productivity declines, unless steps are taken to restore productivity and check further losses [14]. Increasing population and human interventions are responsible factors for environmental degradations via fast urbanization and industrialization. Desurfacing is a process where earthy material is loosened and removed mechanically or manually from soil surface for some other purposes, such as making bricks, foundations for buildings, rails and roads, and land fill etc., leaving infertile

Sub soil exposed to surface that are poorly suited for growing crops. Desurfacing affects both on-site damage for soil and crops and off-site damage in the form of accelerated soil and water loss. However, the degree of damage is determined by the soil profile constrains, nature of the soil and its position in the landscape[11] Other environmental costs of the brick kilns are reduction in soil fertility, reduced visibility, drying the ground water source. Bricks are decorative facade of buildings to show social prestige. Usually sun-dried and raw bricks were used when there was no technology to fire the bricks.

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Brick industry falls under small/cottage industry group, and it is a seasonal industry, with a seasonal employment opportunity. Along with the urbanization, these industries are rapidly growing and migration of people into the city area forcing to create more brick kilns[16] The removal of topsoil for urban uses mainly for brick-making is growing rapidly due to the tremendous growth in urbanization and industrialization in many developing countries. Unfortunately, brick kilns are mostly situated on fertile agricultural land, as brick manufacturers need silty clay loam to silty clay soils with good drainage conditions. Often, many farmers are forced to sell soil for brick-making because their neighbours have sold soil which leaves a 4-6' deep gap in the surface levels between those who have sold soil and those who have not [15]. Another important dimension to the problem is the excessive depth over which the soil is removed above the agreed depth of soil extraction, which renders land unsuitable for agriculture. Geographic Information System (GIS) are used so widespread in the soil erosion researches. [18] Soil degradation affects composition of fertile top-soil and changes soil properties which are inter-linked. Average fertile top soil composition by volume is: mineral-45 % plus organic matter-5 % makes solid portion; and air-25 % plus water- 25 % constitute pore space [10]. There are many brick kilns in the study area The land degraded because of brick kilns over the decade has increased. The total number of brick Kilns in Haryana state is 2500.

II. OBJECTIVES

1. To identify and map desurfaced soils in distt. Rohtak and Jhajjar with the aid of multispectral and multi temporal satellite data of last 5 years.
2. To develop the graph to depict the change in brick kiln area in the 5 years in the two Districts.

III. STUDY AREA

The study area includes two districts of Rohtak and Jhajjar of Haryana state. The Rohtak district lies in 28^0 23" to 29^0 6" N latitude and 76^0 13" to 76^0 58" East longitudes. The Jhajjar district lies in 29^0 21'30" to 29^0 51'30"N latitudes,76^0 16'30" to 76^0 58' 45" East longitudes. The study area falls in the survey of India topographical sheet Nos.53C/8, 53C/12, 53C/4, 53D/01, 53D/5, 53D/6, 53D/7, 53D/9, 53D/10, 53D/11, 53D/13, 53D/14, 53D/1

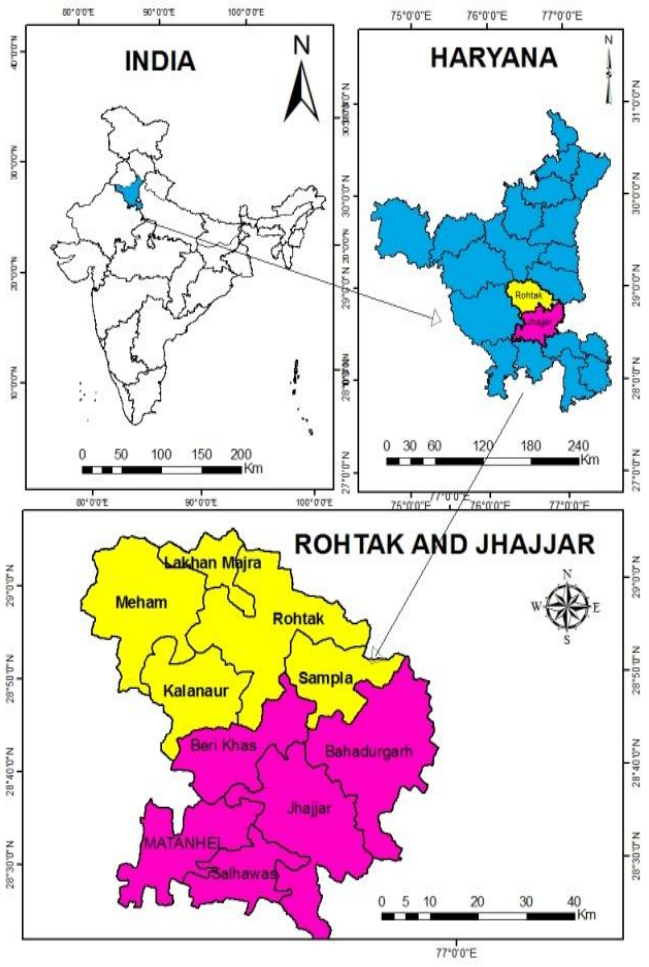

Fig.1 Study Area

Satellite data

1. Cartosat-1 or IRS-P5 is a stereoscopic Earth observation satellite in a sun-synchronous orbit, and the first one of the Cartosat series of satellites. The satellite was built, launched and maintained by the Indian Space Research Organisation. Cartosat-1 carries two state-of-the-art panchromatic (PAN) cameras that take black and white stereoscopic pictures of the earth in the visible region of the electromagnetic spectrum. The swath covered by these high resolution PAN cameras is 30 km and their spatial resolution is 2.5metres.It is a satellite launched in 2005. The data of 2007 is a cartosat data of two districts Rohtak and Jhajjar.

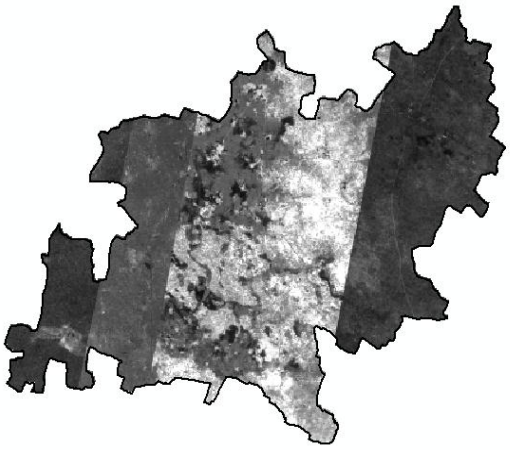

Fig. 2 Cartosat Image of Jhajjar Distt. Of 2007

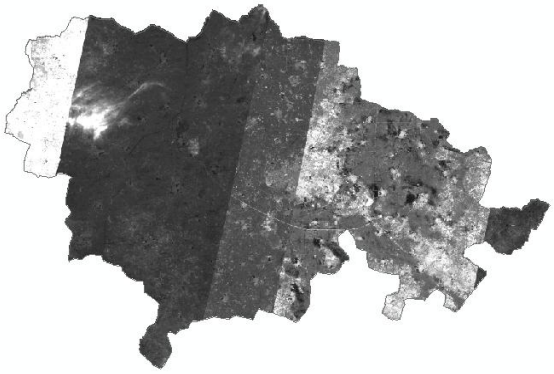

Fig. 3 Cartosat Image of Rohtak Distt. Of 2007

2. WorldView-2 is a commercial Earth observation satellite owned by Digital Globe. WorldView-2 provides commercially available panchromatic imagery of .46 m resolution, and eight-band multispectral imagery with 1.84 m (6 ft 0 in) resolution[1]. It was launched October 8, 2009 to become Digital Globe's third satellite in orbit, joining WorldView-1 which was launched in 2007.

Fig. 4 Worldview Image of Jhajjar Distt. Of 2012.

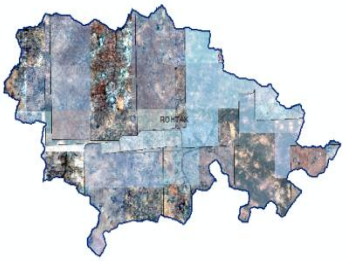

Fig. 5 Worldview Image of Rohtak Distt. Of 2012

3. Survey of India toposheets Survey of India (SOI) topographical sheets of the said district on 1:50,000 scales were utilised for registration of satellite data, selection of ground control points and to identify and authenticate the various cultural features on the satellite image.

IV. METHODOLOGY

The general methodology adopted for delineation / mapping of various desurfaced soils are given step wise. Two multi temporal and multi spatial satellite images i.e.cartosat-1and worldview-2 have been studied to accomplish the task of monitoring of Desurfaced soils in Rohtak and Jhajjar districts.

AOI has been extracted from the available images.

1. Base Map preparation

Base map has been prepared with the general information like road, canal, railway line and settlements using Survey of India topographic sheets and satellite data on 1:50,000 scale.

V. DIGITAL DATA ANALYSIS

The hybrid techniques of on screen image interpretation and digitization of the satellite data has been carried out using the standard interpretation keys viz. tone, texture, shape, size, pattern, texture for preparation of Desurfaced soils Status map by using Arc Map software. The general steps involved in the data preparation, on screen digitization and map generation were as follows:

1. Mosaicing
2. Extraction of AOI
3. Creation of Personal Geo Database
4. Creation of Shape files
5. On screen digitization
6. Ground Truth Survey
7. Area Calculations
8. Map composition

2.1 Mosaicing Mosaicing offers the capability to stitch images together so one large, cohesive image of an area to be created. The necessary condition for mosaicing process of images is uniform datum and projection system, but they need not to be having the same cell size. In addition, the input images have the same number of layers. Satellite images were mosaiced, and the process is done using the 'MOSAIC IMAGES' module of the ERDAS Imagine Professional (Ver. 9.1).

2.2 Extraction of AOI

The boundary of Rohtak and Jhajjar Districts were superimposed on mosaiced satellite data, so as to extract the study area from the original satellite data.

2.6 Providing Projection to the Shape File

Projections were imported to the new shape file from an already Geo-Referenced shape file or map or image. Otherwise, select option in the spatial reference properties dialog box was clicked. Then, suitable projection to shape file was provided, generally, it is UTM projection. Then Arc Map was opened, data added in the standard tool bar. Some specifications related to the projection are given below:

- Projection used: Universal Transverse Mercator (UTM)
- Datum: WGS 1984
- Zone: 43 North
- After feature dataset was created, its icon was right clicked and import feature class option was selected. Shape file created earlier was selected and output location and name of feature class were given.
- selected and output location and name of feature class were given.

2.7 Adding Data to Arc Map

In this step satellite data and shape files were added in Arc Map.

2.8 Digitization

After adding the shape file to the data, brick kilns of the two districts on the FCC image using the standard interpretation keys viz. tone, texture, shape, pattern were identified and digitized.

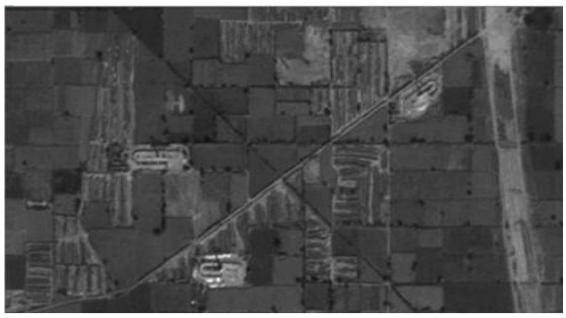

Fig.6 BRICK KLIN IN CARTOSAT IMAGE

This is the view of the Brick kilns in the Cartosat image of the year 2007

Fig.7 BRICK KILNS IN WORLD VIEW IMAGE

This is the View of the brick kiln in the Worldview-2 image.

2.9 Ground Truth Survey

Ground truth / field verification was conducted to ascertain the accuracy of the interpreted details. Latitude and longitude values obtained from GPS were converted into degree decimals and excel table was prepared. Table shows the latitude / longitude values of GPS points taken during the ground survey of study area. This is the ground truth map of the two districts Rohtak and Jhajjar. This depicts the Brick kiln area and points where the verification has been done. This shows that identified desurfaced soils are correct.

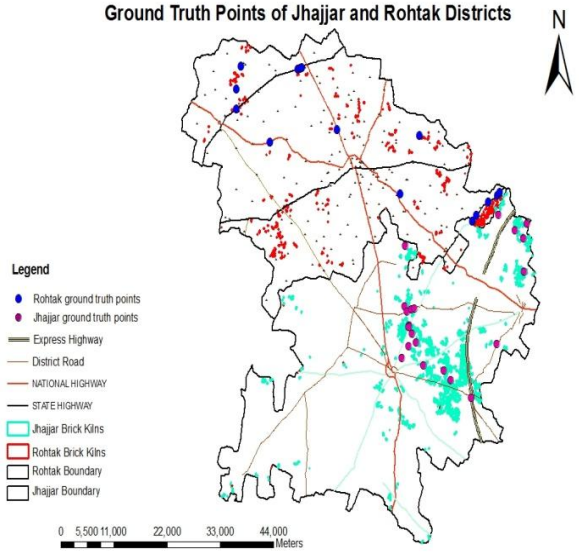

FIG.8 Map of Ground truth points in Jhajjar and Rohtak Districts

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Table no.1 Ground Truth points of Jhajjar District

Sr. no.	Latitude	Longitude	Block name
1	28 40.237N	76 41.516E	Jhajjar
2	28 40.237N	76 41.434E	Jhajjar
3	28 39 525N	76 41.850E	Jhajjar
4	28 38.729N	76 42.354E	Jhajjar
5	28 38.421N	76 41.361E	Jhajjar
6	28 37.405N	76 40.495E	Jhajjar
7	28 36.760N	76 43.255E	Jhajjar
8	28 41.856N	76 40.927E	Jhajjar
9	28 47.085N	76 41.066E	BeriKhas
10	28 41.446N	76 41.233E	Bhadurgarh
11	28 41.677N	76 42.161E	Bhadurgarh
12	28 36.294N	76 45.868E	Bhadurgarh
13	28 35.411N	76 46.709E	Bhadurgarh
14	28 33.850N	76 49.246E	Bhadurgarh
15	28 38.459N	76 52.569E	Bhadurgarh
16	28 44.656N	76 56.187E	Bhadurgarh
17	28 47.555N	76 56.145E	Bhadurgarh
18	28 48.783N	76 56.601E	Bhadurgarh
19	28 48.254N	76 55.096E	Bhadurgarh
20	28 49.628N	76 53.024E	Bhadurgarh

Table no.2 Ground Truth points of Rohtak District

VI. AREA CALCULATION

Attribute table of the shape file opened and then new field was added to the table, name and type were provided for the same. Area of polygons was calculated in square meters. The total area in the two districts is then calculated by exporting the data to excel. This is given in the two tables.

3.1 Map composition

The final Desurfaced soils maps on 1:26,00 scales were composed for Cartosat 2007 image and on 1:15,00 scales for worldview 2012 image in Arc Map 9.3 software to display brick kiln layer in an effective manner. Legend, title, north arrow, scale were added to the maps. These maps were then exported to JPEG / PDF format. The four maps have been composed shown in different figures.

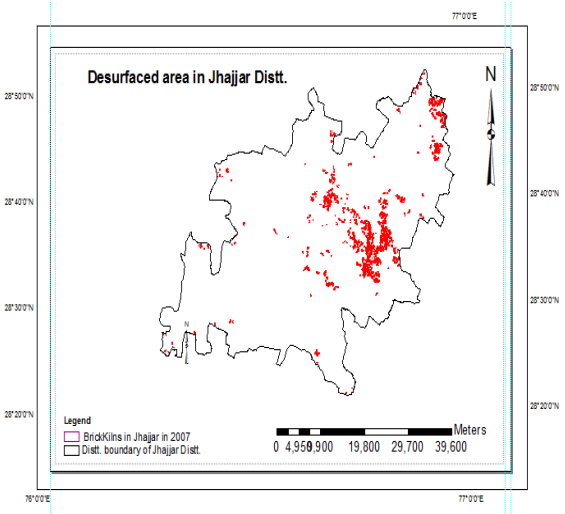

Fig.9 Map of Jhajjar Distt. Showing Desurfaced Area In 2007

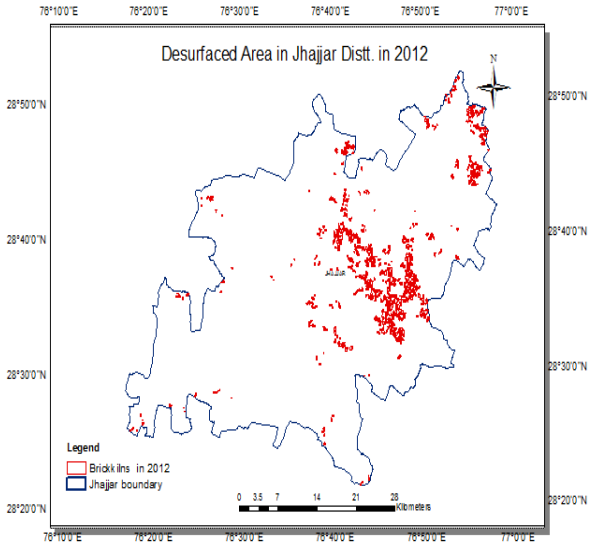

Fig.10 Map of Jhajjar Distt. Showing Desurfaced Area in 2012

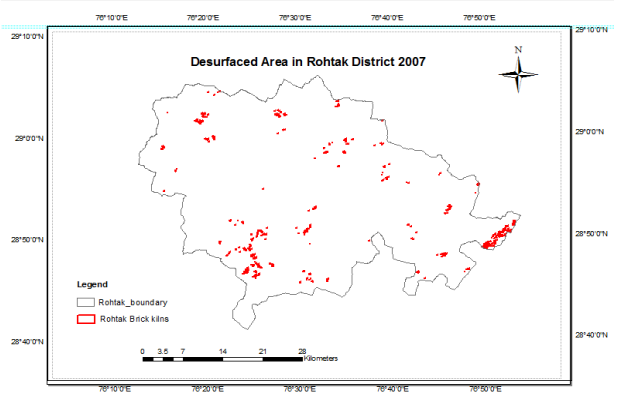

Fig.11 Map of Rohtak Distt. Showing Desurfaced Area in 2007

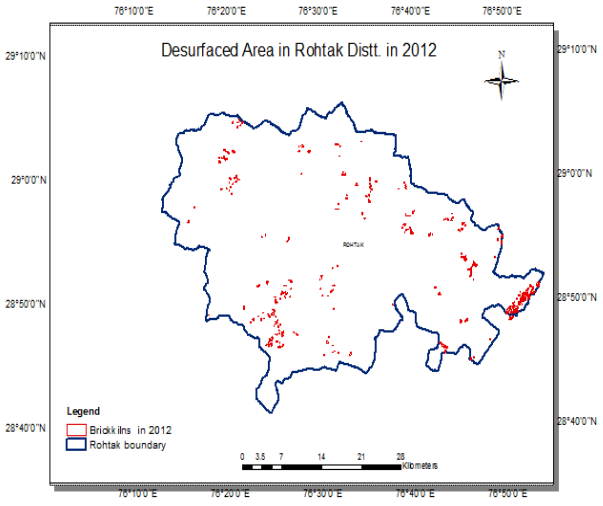

Fig.12 Map of Rohtak Distt. Showing Desurfaced Area in 2012

Table 1 Jhajjar District

Sr. no.	years	Brick kiln Area (sq.mts.)
1.	2007	28844566
2.	2012	40869446

Table 2. Rohtak District

Sr. no.	years	Brick kiln Area (sq.mts.)
1.	2007	6292921
2.	2012	8888051

This table gives the brick kiln area in Jhajjar District in years 2007 and 2012.The area was 28844566 sq.mts in 2007 and area has increased to 40869446 sq.mts in the year 2012.This increase has been clearly shown with the help of a graph in fig.13

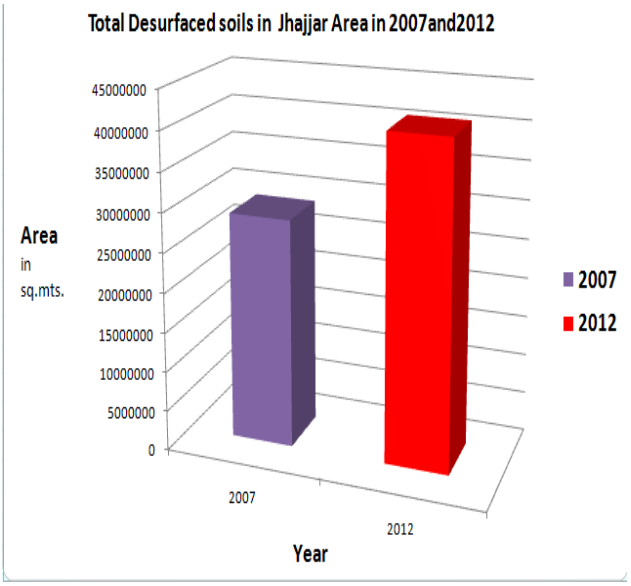

Fig.13 Total desurfaced soil in Jhajjar in 2007 and 2012

This table gives the brick kiln area in Rohtak District in years 2007 and 2012.The area was 6292921 sq.mts in 2007 and area has increased to 8888051 sq.mts in the year 2012.This increase has been clearly shown with the help of a graph in fig.14

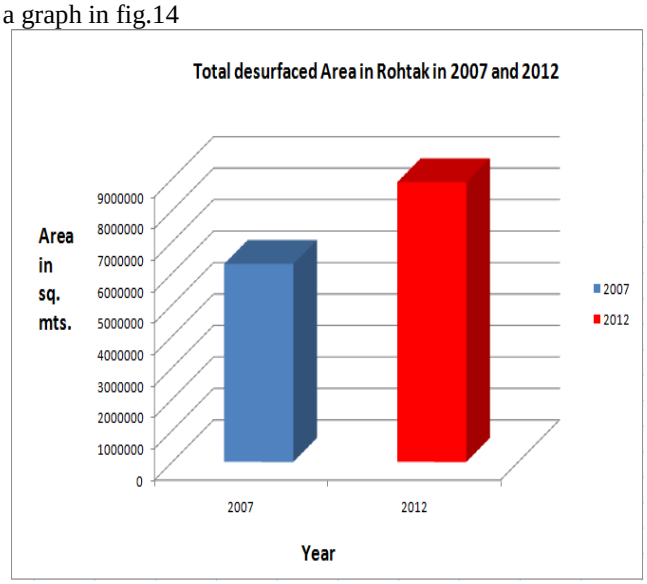

Fig. 14 Total desurfaced soil in rohtak in 2007 and 2012

The graphical representation clearly shows that there is a considerable increase in the brick kiln area in the 5 years i.e. from 2007 to 2012 in the two districts. This increase is mainly because of the increased requirement of the bricks in the two Districts due to more construction in the National Capital Regions. This increase will affect the crop production in Haryana as the fertility of the soil will be affected by desurfacing of the soil due to brick kilns.

VII. CONCLUSION

From the above results we conclude that the desurfaced soils have increased over the 5 years i.e. it is increasing with time. This increase is mainly because of increasing construction in the NCR due to more development in the Rohtak and Jhajjar Districts. If we compare the increase in two Districts we find that the brick kiln area is much more in Jhajjar than Rohtak. This shows that construction work is more in or near the Jhajjar District as it lies near to Gurgoan due to rapid economic growth and the continued expansion of urban areas. In addition, removal of surface soil for brick resulted in substantial areas of low quality land. The land is incapable of productive use without some form of remediation.

REFERENCES

1. Prasad, C. R. S. and others: Use of landsat imagery for mapping soil and land resources for development plaC\nning in parts of northern Karnataka, India. Int. Jr. Remote Sensing, 11(10): 1889-1900 (1990).
2. Raina, P.: Assessment of soil degradation hazards in Jalor and Ahor tehsil of Jalor District (Western Rajasthan) by remote sensing. J. Indian Soc. Remote Sensing, 22(3): 169-181 (1994).
3. Rao, U. R.: Remote sensing for sustainable development, J. Indian Soc. Remote Sensing, 19(4): 217-235 (1991).
4. Yadav, S. K.: Management of Degraded Soil for Sustainable development Using Remote Sensing and GIS Techniques in South Delhi Region (India). PhD Thesis Jawaharlal Nehru University, New Delhi (1997).
5. Malik,R.P., Shanwal,A.V. and Iyer,H.S.(1984). Identification and delineation of saline soils using aerial photographs in Yamuna alluvial plain of Haryana. Journal Ind.soc. Photo int. And Remote sensing 12: 59-64
6. Moharana,P.C. and Singh, Nepal.(2000). Characterization of degraded landforms in Balotra –Pachpadra area of Arid Western Rajasthan usingRemote sensing Techniques. J. Indian Soc. Of Soil Science ,vol.,49,no.1,pp.154-163.
7. Pradip Sharma,Dhanjit DEKA AND RAJAN SAIKIA. An analysis of changing land use pattern and its effect on Umtrew basin Northeast India. Hungarian Geographical bulletin 60(1) (2011) pp.67-78.
8. Alba Yadira Corral Avitia and Antonio DeLa Mora Cavarrubias.Environmental Assessment of Brick kilns in ChichuahuaState,Mexico,usingDigitalCartography.(2011
9. R.B. Singh, " Brick Kiln Industry as Drivers of Land-Use Change and Related Land Degradation in Rural-Urban Fringe of Delhi, - Sustainable urban development, 2006
10. Remote Sensing Based Management of Degraded Soil Due to Brick Industry for Sustainable Development–A Case Study S.K. Yadav - J. Hum. Ecol, 2003. Brick kiln industry prevailing in SSW of Jawaharlal Nehru University (JNU), New Campus, New Delhi.
11. M.S.Grewal and M.S.Kuhad Soil Desurfacing–Impact on Productivity and Its Management Department of Soil Science, Haryana Agricultural University Hisar-125 004, India .12th ISCO Conference Beijing 2002
12. Kachhwala T S. (1985). Temporal monitoring of forest land for change detection and forest cover mapping through satellite remote sensing. In: Proceedings of the 6th Asian Conf. On Remote Sensing. Hyderabad, pp 77–83.

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13. Chilar J. (2000). Land cover mapping of large areas from satellites: status and research priorities. International Journal of Remote Sensing, 21(67): 1093–1114
14. Blaike and Brook field(1987) soil resources information for natural resources census, AP
15. Kathuria(2007) Environmental cost of using top-soil for brick making – A case study from India.(Plate 2 in Appendix 1) EAERE (2008)
16. Suman Kumar Pariyar, Tapash Das, Tanima Ferdous (May2013) Environment And Health Impact For Brick Kilns In Kathmandu Valley international journal of scientific & technology research volume 2, issue 5, May 2013 ISSN 2277-8616.
17. Bruno Glaser · Johannes Lehmann · Wolfgang Zech Ameliorating physical and chemical properties of highly weathered soils in the tropics with charcoal – a review Received: 24 April 2001 / Accepted: 5 March 2002 / Published online: 18 April 2002
18. King et al, 2005; Bou Kheir et al, 2006 and Miller et al, 2007) 8th International Soil Science Congress on Land Degradation and Challenges in Sustainable Soil Management