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Mapping of Wasteland and Change Detection using Geospatial data - A case study from Annavasal block of Pudukkottai District, Tamilnadu, India

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Absract

In India, excessive demand of land for both agricultural and non-agricultural uses has resulted in the development of vast stretches of different kinds of wastelands. This has necessitated adoption of scientific measures for increasing land productivity and bringing more areas under cultivation/forests. In this context, the present study map the wasteland categories for 1975 and 2015 through image processing techniques of Landsat TM and IRS P6 images and the changes in wasteland categories could be detected with the help of GIS. It has been observed that an area of 112.49 sq.km wastelands has been identified in 1975 and then it decreased to 19.46 sq km in 2015.These studies may be helpful for the planners and stack holders in the process of overall sustainable development of the study area.

1 Introduction

Wasteland is a degraded land which can be brought under vegetative cover, with reasonable effort, and which is currently underutilized and the land which is deteriorating for lack of appropriate water and soil management or on account of natural causes. The wastelands statistics indicated that about 63.85 million hectares of land, which account for 20.17% of the total geographical area (328.72 million hectares) exist as wastelands in India (Manual NRSA, 2007). According to Indian Wasteland Atlas (2010) the wasteland area is now increased to 24% of the total geographical area. If these wastelands could be brought under cultivation or other uses like afforestation and horticulture, it can help in the socio-economic development of the people and accelerate the overall economic growth of the country. According to the NRSC report, there are 2.42 million hectares (17%) of wasteland in Tamil Nadu. The percentage of wastelands to the total geographical area at district level is 30-40 percent in Ooty, Tiruvarur and Nagapattinam districts, 20-30 percent in Erode, Salem, Dharmapuri, Tiruvannamalai, Tiruchirapalli and Pudukottai, 10-20 percent in Kanyakumari, Ramanathapuram, Sivagangai, Virudhunagar, Madurai, Dindigul, Coimbatore and Namakkal and less than 10 percent in the remaining districts. The government has initiated projects to improve the productive capacity of wastelands by raising plantations on government-owned lands and by redistributing wastelands to farmers. The study area is economically backward and it is a notified drought prone district and hence possesses multiple problems in various resources. Lack of irrigation water is the major problem in the study area. The area is experienced by chronic droughts and severe shortfall of rainfall. Due to the resource scarcity, lack of technological and scientific knowledge as well as lack of information dissemination, farmers of this region are unable to make use of the dry land tract with alternate land use options.

Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times (**Singh**, 1989). Change detection is an important process in monitoring and managing natural resources and urban development because it provides quantitative analysis of the spatial distribution of the population of interest. These studies may be helpful for the planners and stack holders in the process of overall sustainable development of the study area. **Gupta et al** (1998) have attempted for identification, categorization, and mapping of degraded lands of Palamu district of Jharkhand (erstwhile Bihar) using remotely sensed data. **Mahalingam et al** (2000) have attempted to map the wasteland in part of Kayathar block in Tuticorin using remote sensing techniques. **Nathawat et al** (2010) have used the multi-temporal satellite images of IRS P6 LISS-III data to map wastelands dynamics over different seasons. Based on the image characteristics and a prior knowledge of the study area delineated the wasteland classes. **Sastry et al** (2011) have quantified the wastelands Nellore District in 2006 and 2009 and identified the changes during the same period. For detection of temporal changes in the wastelands, two period data sets i.e., IRS LISS III 2005-06 and 2008-09 are used. **Kumaraswami et al** (2011) have delineated and mapped the wastelands in Devarkonda block, using high resolution satellite data - IRS P6 LISS IV Rabi-2006 (Feb) images. The geo-database generated using Arc GIS and on screen digitization techniques, shows the type, extent and spatial distribution of different wasteland categories present in the area. **Unnamalai** and **Namasivayam** (2012), have estimated the changes that are taking place on wastelands in proportion to total geographical area in between the periods of 1985 and 2000 for the selected 10 districts in Tamil Nadu based on NRSA classification of waste lands.

Basavarajappa and Manjunatha (2014) have identified the wastelands of Chitradurga district through hi-tech tools of geoinformatics. In their study, mapping and record of the wastelands are mapped using topographical data and IRS 1D PAN+LISS III satellite data and Google Earth software with limited ground truth check (GTC) and final wasteland layer is generated. The database provides spatial baseline information in distribution, extent and temporal behaviour of wastelands in planning and implementation of development strategies in wastelands reclamation of the country. **Suraj Kumar Singh et al** (2014) have assessed the factors responsible for contrasting signature of wasteland development in northern and southern Ganga Plains in Bihar based on satellite data. **Arya et al** (2015) have monitored the wasteland changes in Jhajjar District of Haryana by using Geo Informatics.

There is a drastic change in the wasteland area in the study area between these years. So it is necessary to analyze the mapping of wastelands and changes in the catogories and detection have to be made.

2.About the study area

Annavasal block is a revenue block of Pudukkottai district and lies between 10 ^{0} 20 ’41” and 10^0 20 ' 58 ’’of the North latitude and between 78^0 38’20" and 78^0 38’ 36” of the East longitude and shown in Fig 1. The study area have a total of 43 panchayat villages, climate is mainly tropical in nature with a cooler period from December to February. Maximum average temperature is 24°C- 43°C. Rainfall is variable both annually and seasonally. The annual rainfall ranges from 779.1 mm to 1485.2 mm in the last 10 years period. Generally the weather is Hot and dry with moderate moisture availability of Cauvery delta. The major rivers flowing in this region are Pambar and Vellar.

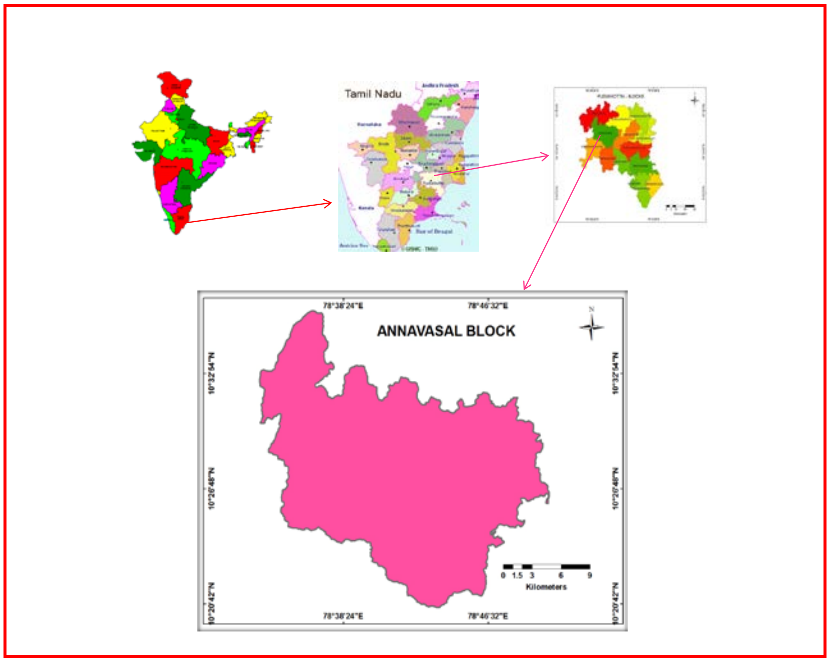

Figure 1 Study area location

3 Objectives of the study

The main objectives of the study are

- Mapping of wasteland categories between 1975 and 2015 using Landsat and IRS P6 respectively
- To detect the changes in waste land categories for those periods using GIS

4 Methodology

The 1975 Landsat raw digital data were processed and image processing techniques has been carried out, then supervised classification has been adopted for interpreting waste land based on NRSC classification. From the supervised classification, the wasteland categories were digitized and prepared for 1975 wasteland map. Same procedure has been adopted for IRS P6 digital data for mapping of 2015 waste lands. Then, the changes in the wasteland categories area detected using GIS analysis. First the year 1975 wasteland data and 2015 wasteland data overlaid and changes in each category of wastelands are calculated

5 Spatial distribution of wastelands in 1975 and 2015

The wastelands data for 1975 and 2015 has been prepared based on the supervised classification of image processing techniques and the spatial distribution of th ewaste land categories are prepared as GIS raster image and shown in Fig 2 and 3. It has been observed that the barren rocky / stony waste, gullied and ravenous, scrublands, Salt affected land, Degraded forest land, Sandy Area and Mining / industrial wastelands categories. The area under each category of wastelands has been calculated and changes are worked out and are discussed below.

5.1 Barren Rocky/Stony waste

The rock exposures of varying lithology often barren and devoid of soil & vegetation cover appear as isolated hill exposures in the study area, those areas mapped under these categories. This type of wasteland found 7.48 sq.km of area in 1975 and 2.09 sq.km in 2015.

5.2 Gullied and ravenous land

Gullies developed from rills which are tiny water channels with a few centimeters deep, formed as a resultant impact of heavy rainfall and wearing action of run-off generated. Those areas were mapped this categories and found in the north west part of the study area and it occupies 0.4 sq.km areas in 1975 and 0.29 sq.km in 2015. It is about 0.93% of total wasteland area.

5.3 Scrublands

Scrub lands may be having a thin cover of grass or other weeds or bushes over their surface. Soil fertility and land texture depends on the parent rock from which these have originated and the extent of their weathering. This type of wasteland occupies major composition of wastelands in the study area. These are found as open scrub, fairly dense scrub and dense scrub in various part of the study area. This type of wasteland occupies major composition of wastelands and occupied 80.02 sq.km in 1975 and 2.44 sq.km in 2015.

5.4 Salt affected land

Salt affected lands have the layer or encrustation of different salts, the depth of layer may vary with the quantity of the salts which have deposited over a period. Due to deposition of salts on the upper crust, their color varies which may be from white to grayish white. The factors contributing to the development of these soils are generally arid and semi- arid climate, hard impervious pan in the subsoil region, basin-shaped topography, high water table, impeded drainage, salt-bearing substrate, excessive canal irrigation, use of saline and brackish water for irrigation. Such type of area has been identified and mapped in 1975 an area of 42.43 sq.km and 5.19 sq.km in 2015.

5.5 Degraded forest land

The area under forest, but due to removal of fuel and firewood by the nearby villagers and nomads, the tree canopy has been reduced and the trees almost look like bushes or merely skeletons and they are not able to grow further. Such lands are usually classified as degraded forest lands. Their occurrence can be anywhere near the forest areas. In the study area it has found in the central part and it occupies an area of 6.9 sq.km in 1975 and 6.54 sq.km in 2015.

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5.6 Sandy Area

Sand deposits may be found in a layer of 10 to 15 cm on the surface of the soil so they are unfit for cultivation. This type of wasteland has been observed in an area of 12.26 sq.km in 1975 and 2.23 sq.km in 2015.

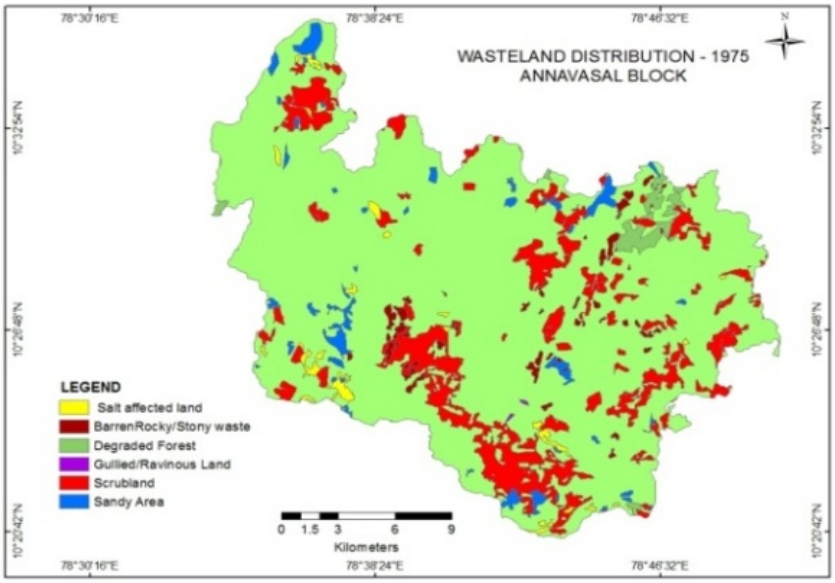

Figure 2 Wastelands in 1975

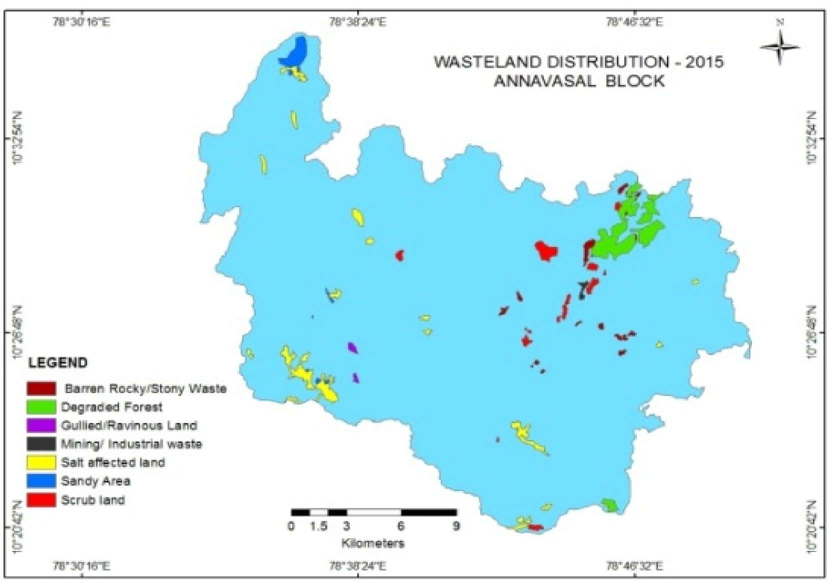

Figure 3 Wastelands in 2015

5.7 Mining / industrial wastelands

The land is made barren to large extent by mining excavations, old surface of the rock has been removed and the refuse or remainder of the excavated material gets deposited in the foot-hills and that after the rains goes down to the plains. In plains, the mining material is different like metallic ones, brick making, building material etc. The throw outs of wastes those are unwanted for the soil and lead to the increase in the area of wastelands. These lands are of little agricultural value due to lack of their settlement and lack of fertility. Such type of land observed in 2015 only and it occupies an area of 0.28 sq.km

6 Change detection of Wastelands

Change detection is an important process in monitoring and managing natural resources and urban development because it provides quantitative analysis of the spatial distribution of the population of interest. The 1975 waste land data and 2015 data has been overlaid using GIS and changes were made shown in Fig.5. The category wise wasteland distribution and changes are worked out and are shown in Table 1.

From the study it has been observed that barren rocky waste areas has been decreased from 7.48 sq.km in 1975 to 2.09 sq.km in 2015 and the decreases are worked out an area of 5.39 sq.km. The scrub land has been decreased from 80.02 sq.km in 1975 to 2.44 sq.km in 2015. The sandy area shows decreased from 12.26 sq.km in 1975 to 2.23 sq.km in 2015. The degraded forest area and salt affected area remains almost same throughout the period of study. The gullied/ ravenous land shows an increasing trend from 0.14sq.km in 1975 to 0.29 sq.km in 2015. Mining/ industrial wastes are newly formed here and occupies an area of 0.27sq.km.

Table1 Changes in wasteland categories of Annavasal block

Wasteland category	**Area in sq.km 1975**	**Area in sq.km 2015**	**Changes in sq.km**
Barren rocky/Stony waste	7.48	2.09	-5.39
Gullied/Ravenous land	0.14	0.29	0.15
Scrubland	80.02	2.44	-77.58
Degraded forest	6.9	6.54	-0.36
Salt affected land	5.69	5.59	-0.10
Sandy area	12.26	2.23	-10.03
Mining/ Industrial waste	0	0.28	0.28
Total	**112.49**	**19.46**	**- 93.03**

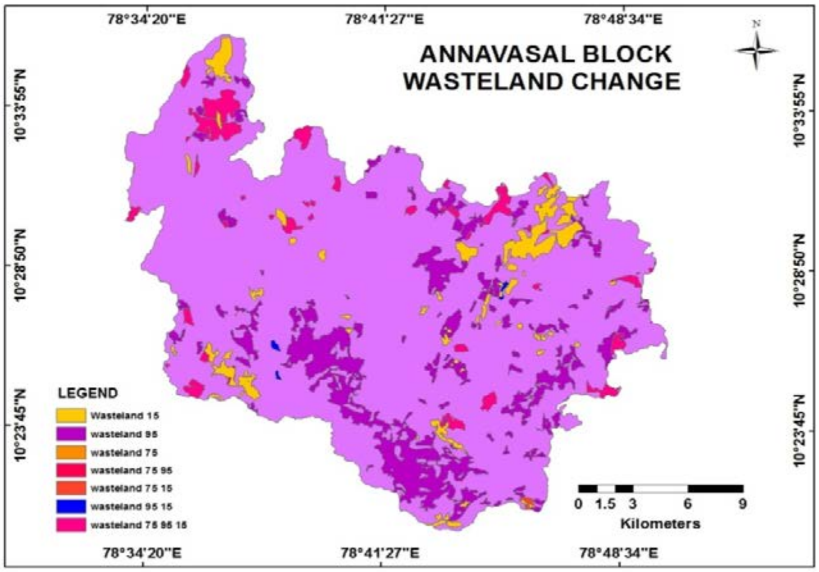

Figure 5 Wasteland change detection

7 Conclusion

The study concluded that a maximum of 77.58 sq.km in the scrublands, 5.39 sq.km of area of barren rocky/stony waste and 10.03 sq.km.of sandy area have been decreased between 1975 and 2015. The degraded forest area and salt affected land has also been decreased about 0.36 sq.km and 0.10 sq.km respectively during these periods. At the same time the gullied/ ravenous land has been increased from 0.14 sq.km to 0.29sq.km between these years and the change is about 0.15 sq.km of the area. About 0.28 sq.km of mining / industrial waste were identified in 2015 in the study area.

References

[1] V.S Arya Sandeep Kumar., Anil Kumar., Hardev Singh., Sandeep Arya and R. S. Hooda, (2014), Wasteland Change Analysis in of Northern Haryana's six Districts Using Multi-Temporal Satellite Data in GIS Environment, International journal of advanced scientific and technical research, Issue 4, Vol. 2.

[2] H.T Basavarajappa, M.C Manjunatha.,(2014),Geoinformatic techniques on mapping and reclamation of wastelands in Chitradurga District, Karnataka, India, International Journal Of Computer Engineering & Technology (IJCET), Volume 5, Issue 7, pp. 99-110

[3] K Gupta (1998) Inventory of Degraded Lands of Palamau District, Bihar - A Remote Sensing Approach, Journal of The Indian Society of Remote Sensing, Vol.26, No.4, pp 161-168

[4] K Mahalingam., Dhakshinamoorthy M., Mohamed Haroon A R.,(2000), Wasteland mapping of part of Kayathar block of Tuticorin district in Tamil Nadu using remote sensing techniques, Madras Agricultural Journal, Vol. 87, No. 4/6, pp. 335-337.

[5] M.S Nathawat., V.S, Rathore., A.C.Pandey, Suraj Kumar Singh, G.Ravi Shankar, (2010), Monitoring & analysis of wastelands and its dynamics using multi- resolution and temporal satellite data in part of Indian state of Bihar, International Journal of Geomatics and Geosciences Volume 1, No 3, ISSN - 0976 – 4380

[6] V J Sastry., C H Babu., G Mehar., Baba And A Mruthyunjaya Reddy.,(2011), Change Detection in Wastelands using Remote Sensing and GIS Techniques for SPS Nellore District, Andhra Pradesh, International Journal of Earth Sciences and Engineering ISSN 0974-5904, Vol. 04, No 08 - Spl issue, December 2011, pp. 82-88, Cafet-Innova Technical Society.

[7] G Kumaraswami., K Mruthyunjaya Reddy., and G Mehar Baba., (2011), Large Scale Wasteland Mapping using IRS P6 LISS IV Data for Integrated Wasteland Development Programmes-A Case Study of Devarkonda Block, Nalgonda District, Andhra Pradesh, International Journal of Earth Sciences and Engineering ISSN 0974-5904, Vol. 04, No 08 - Spl issue, pp. 89-93.

[8] A Shweta., M.S Ardak., .S Nagaraju., Jagdish Prasad., Rajeev Srivastava And A. K Barthwal.,(2010), Characterization and evaluation of land resources in Khapri village of Nagpur district, Maharashtra using high resolution satellite data and GIS, Agropedology, Vol. 20 (J), pp.07-18.

[9] G.S Tagore, G.D Bairagi, N.K Sharma., R Sharma., S Bhelawe. And. P.K Verma, (2012), Mapping of Degraded Lands Using Remote Sensing and GIS Techniques, Journal of Agricultural Physics, Vol. 12, No. 1, pp. 29-36

[10] R Unnamalai, D Namasivayam., (2012) Common property resources and land degradation in Tamil Nadu, India, Land degradation in Tamil Nadu, Indian Journal of Innovations Development, Vol. 1, No. 2,

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