ASSESSING DEGRADED LANDS FOR ALTERNATE AGRICULTURAL LAND USE THROUGH REMOTE SENSING AND GIS

ABSTRACT

In recent years, the use of remotely sensed data and GIS applications have been found increasing in a wide range of resources inventory, mapping, analysis and environmental management. Remote sensing data provides an opportunity for better observation and systematic analysis of terrain conditions following the synoptic and multispectral and multidate coverage. The present study deals with identification, categorisation and mapping of degraded lands in Kheragarh *tehsil* of Agra, Uttar Pradesh, India using remotely sensed data (IRS-P6 LISS III) of three dates viz., February, May and October, 2009. The objectives were (i) to assess different types of degraded lands in the study area using remote sensing techniques, (ii) to evaluate land suitability for various agricultural land use options and (iii) to suggest plausible management plan for mitigation land degradation to enhance land productivity. Along with remote sensing data, three remote sensing derived indices have been used namely Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI) and Soil Brightness Index (SBI) for identifying vegetation, waterlogged area and salt affected land respectively. Decision Tree Classifier (DTC) has incorporated these derived indices for delineating and mapping different types of degradation. Results revealed that about 41.24% of area is non agricultural land in which four categories of degradation could be identified i.e. degraded hill (4.05%), degraded forest (3.46%), wetland (6.26%) and ravinous land (3.26%). The remaining (58.76%) is agricultural land out of which 75.08% is normal land and (24.92%) suffers from two types of degradation *viz*., chemical (salinity) and physical deterioration (waterlogged). An attempt was made to ensure the efficiency of DTC by comparing it with supervised classification approach .The values of the Kappa statistics were used to compare the performance of the classifiers and it was found to be higher (0.95) for the DTC than supervised classification (0.75). The *Z* statistics was computed for comparing Kappa coefficients obtained from the error matrices of two above mentioned classifications. Z value was found to be 21.08 which implied that there was a significant difference between Kappa coefficients in both approaches.

Land evaluation procedure given by FAO (1976) for soil site suitability for various land utilization types has been used to assess the land suitability for different crops and for generating cropping pattern for *kharif* (summer) and *rabi* (winter) seasons. The database on soil, land use/land cover was generated from data derived from IRS -P6 remote sensing satellite and soil survey to perform an integrated analysis in the geographic information system environment. Agricultural and non-agricultural lands were delineated using DTC and non-agricultural areas were masked for removal from future analysis. Different soil chemical parameters and physical parameters were

evaluated for different crops. Subsequently all of them were integrated using a multi criteria decision making and GIS to generate the land suitability maps for various crops. *Kharif* and *rabi* season cropping patterns maps were developed by integrating crop suitability maps for the winter and summer seasons separately. Results of land suitability evaluation indicated that about 55 % is highly suitable (S1) for sugarcane and 60%, 54% and 48 % of the area are moderately suitable (S2) for cultivation pearl millet, mustard and rice respectively. Fifty percent of the area is found to be marginally suitable (S3) for growing maize. It was also found that better land use options could be implemented in different land units as the conventional land evaluation methods suffer from limitation of spatial analysis for the suitability of various crops.

Further, investigations were carried out to characterize and classify the soils of the study area. Nine representative pedons were chosen. All pedons were moderate to deep in depth, well to poor drained, slightly to strongly alkaline in soil reaction (7.73-9.75), slightly to highly saline (0.8- 11.0 dS m^{-1}), low to medium in organic matter (0.05-0.67%), CEC medium to high (17.91-30-35 cmol (p+) kg^{-1}), Calcium Carbonates ranged from (0-2.5%) in all samples of the soils except in the ravinous land where the content was very high (11-20%). Regarding nutrients, the soils were low to medium in available N (37.0-364.00 kg ha^{-1}), low to high in available P (0.1-86.20 kg ha^{-1}), medium to high in available K (134.0-459.0 kg ha^{-1}). Further, the soils were adequate in available Fe and Mn but low to high available Zn and Cu. All soils belong to Inceptisol order and Aquept, Ustept suborder. Six soil families were identified in the selected profiles. The actual productivity class of P6 was excellent and the remaining profiles were good except in P4, it was average. There is a scope to improve the productivity of all pedons as indicated by their respective coefficient of improvement (CI) values and in all cases the productivity classes are elevated to excellent except P4 to good. The potential productivity of P4 offers a little change due to limited scope for improvement.

Keywords: Land degradation; Remote Sensing; GIS; DTC; NDVI; NDWI; SBI; MCDM; Land suitability; Soil classification; Soil productivity.