IMPACT ASSESSMENT STUDIES USING MULTITEMPORAL REMOTE SENSING DATA

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Critical land resource parameters like soil, water, flora and fauna are crucial which, influence the basic survival of human beings by supporting food production and providing a congenial living environment. As anthropogenic and natural forces impact the landscape, resource agencies find it increasingly important to monitor and assess these alterations. Changes in vegetation affect wildlife habitat, fire conditions, aesthetic and historical values and ambient air quality. These changes, in turn, influence management and policy decisions.

Concern for environment has become paramount in today's perspective as so much is changing so fast and watershed identification and planning could be one of the prime mover in this direction for judicious environmental planning. The watershed protection Approach could prove to be a strategy for effectively protecting and restoring aquatic ecosystem and protecting human health. This strategy has its premise that many water quality and ecosystem problem are best solved at the watershed level rather than at the individual water body or discharge level. The targeting priority problems, a high level of state holder involvement, integrated solutions that make use of multiple agencies, and measuring success through monitoring and other data gathering integrate into the watershed protection.

The analysis, protection, repair, utilization and maintenance of drainage basin for optimum control and conservation of water with due regard to other resources primarily covers watershed management. Further watershed projects have different objectives depending on the perceived natural resource management problem in a given area, namely in hilly, semi-arid areas, the focus is on water harvesting, or trapping runoff during the rainy season for later use when water is scarce, whereas, in flatter areas with less opportunity for water harvesting, it is more about concentrating soil moisture to raise rainfed agricultural productivity. Watershed management is a landscape-based strategy that aims to implement improved natural resource management systems for improving livelihoods and promoting beneficial conservation, sustainable use, and management of natural resources. Remote sensing and GIS techniques are being widely used for the inventory of natural resources such as hydrogeomorphology, soils, and land use in watersheds and to generate action plans.

The applicability of geospatial technology tool in various facets of environment are necessitated, for environmental impact assessment in the assessment of positive or negative impact of a project may have on the environment, both natural, social and economic aspects. The assessment ensures decision makers consider the ensuing environmental impacts when deciding whether to proceed with a project or make any modifications in the proposals. Geospatial based change detection in watersheds helps in enhancing the capacity of local governments to implement sound environmental management. Change detection is the measure of the distinct data framework and thematic change information that can guide to more tangible insights into underlying process involving land cover and land use changes than the information obtained from continuous change. This involved development of spatial and temporal database and analysis techniques. Integrated use of GIS, Remote Sensing and Image processing technologies enable us to cope with the objectives of change detection. A common observation has been that most of the changes of ecosystems happens on earth is in close proximity of human inhabitations

1.0 INTRODUCTION

Land is the most basic and important of usable resources for human beings, it is where our energy, food, water and raw materials come from and it is also the habitat for wildlife and fauna. Similar to other resources, it is a scare commodity. However, as population increases and the pace of economic development quickens, nowadays the world is being confronted with great threats of land destruction and depletion. Land use is the way in which, and the purposes for which, human beings employ the land and its resources. Land cover describes the physical state of the land surface: as in cropland, mountains, or forests. Land use information is critical for a variety of developmental activities - specially for watershed development, wasteland development, urban planning, highway routing, village transportation network planning, tourism planning and management, facility planning and other developmental activities. Land cover is affected by natural events, including climate variation, flooding, vegetation succession, and fire, all of which can sometimes be affected in character and magnitude by human activities. Both globally and in the India, though, land cover today is altered principally by human use: by agriculture and livestock raising, forest harvesting and management, and construction.

To check these problems in the changes in the land use land cover which is leading to land degradation the watershed programme is being implemented in our country at a large scale. Watershed development is carried out to: rehabilitate the watershed though proper land use and conservation measures in order to minimize erosion; reduce the damage caused by sedimentation to the multipurpose reservoir; develop the watershed's crop, livestock, forestry, fish culture and recreational activities; . Information about change is necessary for updating land cover maps and the management of natural resources. The information may be obtained by visiting sites on the ground and/ or extracting it from remotely sensed data. The remote sensing technology has immense potential to meet the challenges of land resource management which is evident from the improved capabilities of the current satellite sensors and more so from the future missions. It is necessary to periodically evaluate the current status of land use land cover .Change detected from different temporal images usually reflect natural and human activity impact each other. Integrated use of GIS, Remote Sensing and Image processing technologies enable us to cope with the objectives of change detection to study the impact of watershed programmes on the environment.

Objectives: The study is taken up with the following objectives:

- To generate the natural resources thematic layers like LULC To Study the changes in vegetation for Asotra Watershed in Barmer Districts of Rajasthan State
- To Identify the Changes in Density of Vegetation
- To assess the Temporal Changes
- To assess the Impact of the watershed

Study Area

The study area keetnode is one of the villages in Barmer District, Rajasthan State. It is geographically locating in between 72° 17' 30"E to 72° 23'0"E and 25° 40' 30"N to 25° 48'0"N and covers a geographic area of 6550 Hectares.

Methodology

The study was taken up to assess the impact of the watershed projects on the land use land cover. The study was carried out specifically for the years 2002, 2003, 2004, 2005, 2006 and 2007.To reach the objectives of the study the satellite images were procured for every year starting from 2001. These images were corrected for both Geometric and Atmospheric corrections. Using the subsetting options these images were later subsetted as per the study area .These images were later classified using the hybrid classification method by taking approximately 100 classes. Based on the spectral reflectance of the different land use classes the 100 classes were grouped in to ten classes and their aerial extent was calculated. The vegetation indices NDVI was used to identify the changes in the density of vegetation after the implementation of the government restoration efforts. The NDVI helps in identifying the changes in the vegetative cover apart from the normal vegetation. The change matrix technique was used to identify the variations in the land cover over a period of time from one type to another . The field survey was carried out using the DGPS to mark the location of the critical places in the study area and also to check the field accuracy of the land use land cover map prepared from the satellite imagery. After the field visit the accuracy assessment method was used to test the accuracy of the land use land cover results generated from the satellite imagery. For the change detection studies the pre and post satellite data was taken for performing the change detection studies.

5.0 **RESULTS AND DISCUSSION**

Sustainable development is a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for future generations. The study is envisaged to assess the impact of the watershed programme on the improvement of the environmental aspect of the watershed.

Land Use/Land Cover Classification:

Thematic land classes were derived digitally by grouping pixels that have similar spectral signatures from the measurements of individual bands throughout the spectrum. Usually this classification is made with visible, near-infrared, and middle infrared part of the spectrum. Image interpretation was carried out with the help of nine elements of interpretation key.

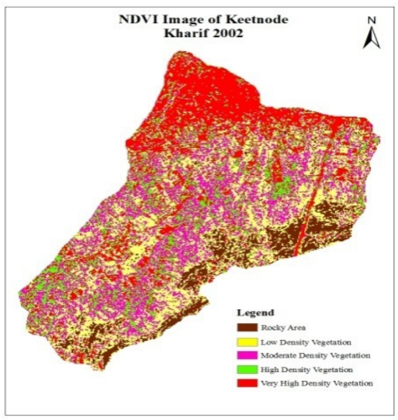
Supervised Classification:

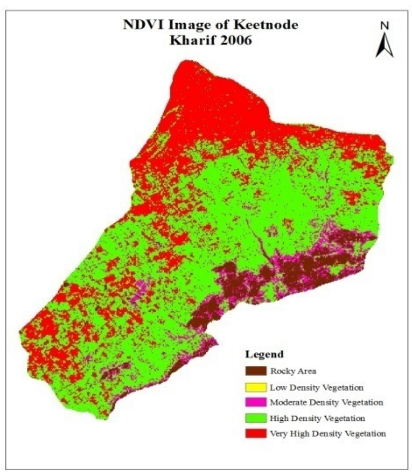
Supervised classification was performed for forming classes that are similar in spectral reflectance. In this approach, pixels are assigned to class (i.e., training classes) verified on the ground in selected areas. The Maximum Likelihood Classifier is used as it is a successful criterion that is based on a priori probabilities. Vegetation density analysis is usually carried out by calculating vegetation indices. A vegetation index is common spectral index that identifies the presence of chlorophyll. The index is composed of reflectance in the red spectral region (620 to 700 nm) and a portion (700 to 1100 nm) of the near –infrared (NIR) spectral region. Spectral satellite measurements in the red and infrared channels were atmospherically corrected for interference from aerosols. Chlorophyll has a relative low reflectance in the red part of the electromagnetic spectrum (strong absorption) and relatively high reflectance in the near- infrared channels have been formulated. The Normalized Difference Vegetation Index (NDVI) is a simple numerical indicator was used to analyze remote sensing measurements and assess whether the target being observed contains live green vegetation or not.

Normalized Difference Vegetation Index (NDVI):

$$NDVI = NIR - Red / NIR + Red$$

NDVI values lies between -1and +1. Vegetation in good condition shows higher NDVI values. This is used to eliminate the seasonal sun angle difference and minimize atmospheric effects. Higher values indicate more density and vigor of the vegetation. NDVI is extensively used to detect seasonal variations among vegetation.



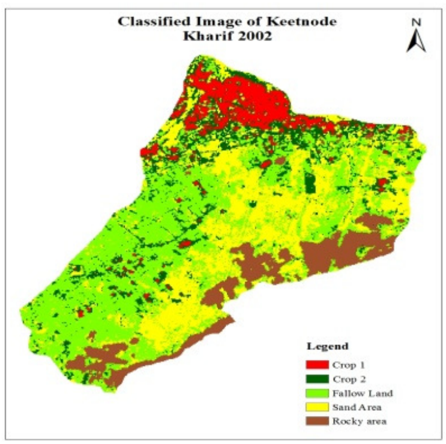


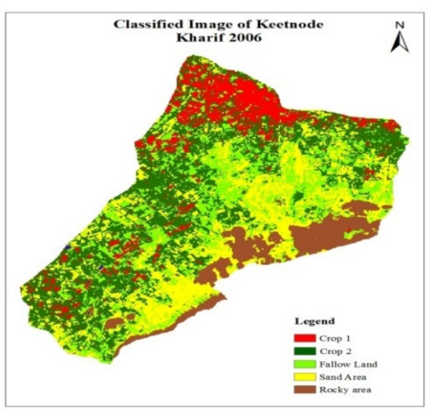
Change Detection

Change detection analysis was carried out with the help of Change Detection Matrix provided with ERDAS imagine. By giving classified image of two different periods as input, the model automatically generates the area where changes are happened. For knowing changes happened in which type of land use classes statistical analysis were also carried out.To get an idea about vegetation, terrain, people and climate, a preliminary field visit was carried out in the early periods of study and necessary literatures and statistical information such as rainfall, temperature, agriculture were collected and incorporated with further studies.

Land Use Land Cover

The knowledge of spatial distribution of land cover/land use of large area is of great importance to regional planners and administrators. Conventional ground methods are time consuming and no uniform classification system was used in the preparation of maps with the advent of remote sensing technology the above problems have been solved to quite some extent. Satellite data can provide information on large areas and the temporal data can be utilized for change detection and updating old data. The land use / land cover categories was obtained from the remotely sensed data include level I classes of land use classification system such as water bodies, forest, grass land, agricultural land, barren land, and scrub land. The Spatial Distribution of the various land use land cover classes found in the study are calculated in GIS environment. The land use land cover maps were generated for the years 2001 to 2007 to study the impact of the watershed programme in the study area.





Change Detection

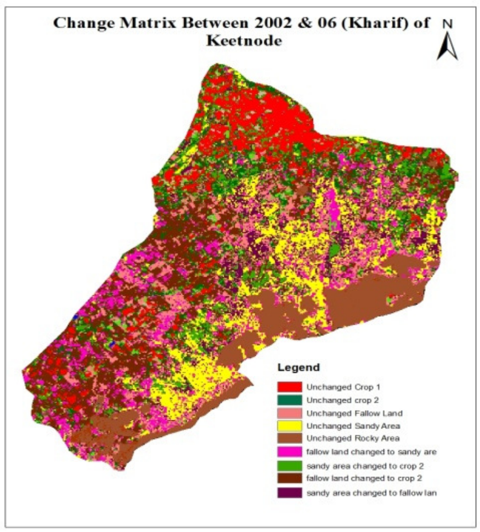
Change detection is used to highlight or identify significant differences in imagery acquired at different times .The Matrix operation from the GIS Analysis menu allows two thematic images or vector files of different years to be compared. By comparing two classified or vector sets of data, we can eliminate false positives due to radiometric differences. The matrix operation in GIS analysis menu is used to find out changes between two seasons. The matrix operation compares all the classes of image with all classes of another image and shows the change from one class to another class.

Classes	Area's are in Hectare
unchanged crop 1	308.2176
Sandy area changed to crop1	38.016
crop 2 changed to crop 1	185.184
fallow land changed to crop 1	91.584
Sandy area changed to crop 2	663.9552
crop 1 changed to crop 2	121.3056
unchanged crop 2	415.4688
fallow changed to crop 2	1132.128
unchanged Sandy area	838.3104
crop 1 changed to Sandy area	4.3776
crop 2 changed to Sandy area	78.4512
fallow land changed to Sandy area	567.2448
crop 1 changed to fallow land	40.896

Sandy area changed to fallow land	**504.5184**
crop 2 changed to fallow land	**139.4496**
unchanged fallow land	**593.7408**

Area extent of Changes in Land use classes

Change Matrix between 2001 and 2006



CONCLUSION

As ecological security is the foundation for sustainable and equitable development, we are committed to strengthening, reviving or restoring, where necessary the process of ecological succession and the conservation of land and water resource in the country. While nature functions as fairly independent system and could perhaps rejuvenate and react in equally good sate in the long run. In conclusion, this study has demonstrated the usefulness of multi-temporal images in detecting land-cover change,in identifying areas for rehabilitation, and in evaluating rehabilitation strategies for management of watersheds. the methods employed in this study can be readily applied for watershed land-cover change monitoring, management and rehabilitation. Change detection techniques using temporal remote sensing data provide detailed information for detecting and assessing land cover and land use dynamics. Different change detection techniques were applied to monitor the changes. The change analysis based on two dates, spanning over a period of seven years using supervised classification, there is an increase in the total area covered by crop land, fallow land, and scrub land has increased from 2001 to 2008. sandy area has considerably decreased from 2001 to 2008.. Watershed development programme has played an active role in the development of the region. And after the implementation of the Watershed development the sandy area has decreased in a great amount in this region. Environment and resource management problems are both spatially distributed and determined by complex process and relationship involving numerous interacting elements with multiple attributes and a dynamic behavior that goes well beyond the analytical capabilities to met commercial GIS software (Fedra, 2006)

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