Mapping of Thar Desert Grasslands Using High Resolution Carto-Data (A Case Study of Jodhpur District)

Mahesh Kumar Gaur
Central Arid Zone Research Institute, India

Pratap Chandra Moharana
Central Arid Zone Research Institute, India

C. B. Pandey
Central Arid Zone Research Institute, India

R. K. Bhatt
Central Arid Zone Research Institute, India

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Mahesh Kumar Gaur*, P. C. Mohrana, C. B. Pandey, R. K. Bhatt
ICAR - Central Arid Zone Research Institute, Jodhpur, India
*Corresponding author e-mail : maheshjeegaur@yahoo.com

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Introduction

The spatio-temporal condition and trend of grasslands in India at village-level is still not known completely. Historical and contemporary monitoring and assessment protocols are primarily based on the wisdom, knowledge and experience of village-level revenue officer (*patwari*) which is *just* significant from the statistical point of view. Contrastingly, such grassland areas are considered to be of high priority by government authorities for the long-term conservation of biodiversity. Protection, development and sustainable use of grasslands are very important for the rural economy and livestock. The major grasslands now survive west of isohyets 200 to 250 mm rainfall where livestock population is more than human beings. Animal husbandry plays such an important role in the lifestyle and economics of the inhabitants, scientific management of the grasslands, on which the animals depend for nourishment, is totally neglected. Pastoralism has coexisted within dry lands for decades. The constant pressure from an increasing human population and anthropogenic activities, particularly mining, has caused considerable damage to this unique desert grassland ecosystem. Several important grasslands have been converted to agricultural fields and the pressure to convert more grassland into such uses is mounting. Area under grasslands in the Jodhpur district has declined very sharply. It was 6.4% in 1976 (Sen, 1978) but has been reduced to <1.5% of the district area. Grasslands are one of the important classes of land use mapping exercise. The aim of the present project was to identify and map all grasslands and grazing areas in the Jodhpur district using spectral signatures of 2012-13 high resolution satellite data of Cartosat LISS-IV plus PAN merged and compare with 1976-77 and 2005-06 data. There is a need to sustain and conserve grasslands at grassroots level because these are the important life-supporting mechanism of the dry region. There is an immediate scope for the spatial and temporal scale dependence of assessment tools for grassland monitoring and undertaking research at village- to district-scales to incorporate geographic information systems and satellite remote sensing data, as well as new ecological concepts from landscape ecology and complex systems science

Materials and Methods

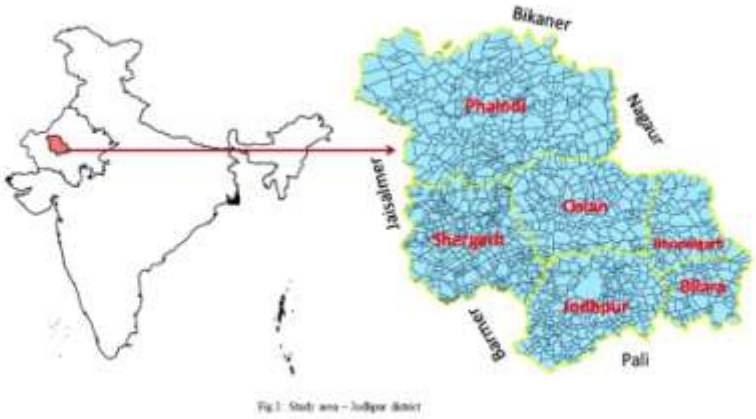
Study Area: The district of Jodhpur 26^0 00' and 27^0 37' north latitude and between 72^0 55' and 73^0 52'east longitude. It was founded in the 15th century by Rao Jodha, and served as the capital of the kingdom of Marwar under the Rathore Rajput dynasty until after Indian Independence in 1947. The district covers an area of 22,844 sq. km with 1363 villages (Fig.1).

According to the 2011 census Jodhpur district has a population of 3,685,681. The district has a population density of 161 inhabitants/kilometre^2. Its population growth rate over the decade 2001-2011 was 27.69%. As per the NSSO report, 18.8 per cent persons and 11.2 per cent households are below poverty line. Livestock population comprises of sheep, goats, camels, cows, buffaloes and donkeys. As per the quinquennial livestock census of 2012, the district has more than 3.59 million livestock which is about 11.9 per cent of the total livestock population of the Thar Desert of Rajasthan state.

Material and methods

The study was made utilizing high resolution Cartosat-1 (PAN) and Resourcesat-1 (LISS-IV Mx) data on 1:10K scale. The PAN sensor and the LISS-IV Mx has spatial resolution of 2.5m and 5.8m respectively. The satellite data was onscreen visually interpreted using ArcGIS software on 1:10,000 scale. The following layers were generated viz.,(i) Land use/Land cover, (ii) Drainage, (iii) Infrastructure (Roads & Rails), (iv) Settlement. Maps of 1976-77 and 2005-06 were prepared on 1:50K scale, using available Landsat and DES data as well as toposheets of 1960s.

Grazing lands possess irregular shapes with contiguous or non-contiguous appearance and are associated with agricultural lands; riverbeds and forested areas. All the doubtful areas and sample points were checked through proper planning and careful selection for field verification. Legacy data have formed an important source of input information and greatly increased the accuracy of current mapping.



Results and Discussion

Detailed maps on grassland / grazing land cover were prepared as part of land use and land cover mapping exercise. Area under grasslands and grazing lands in 1976 was 1442.74 sq. km. which reduced to 984 sq. km. in 2005-06 and about 341.15 sq. km. in 2012-13. So, there is a decline of about 425% area under grass and grazing lands during a span of 35-40 years. It also indicates that there is a threat to the village support system due to human intervention which is an alarm for the desert ecosystem of western arid Rajasthan. The GIS database of the district now holds all information as points, line & polygons in an integrated manner and can be analyzed in various ways. Following factors has been understood through this mapping exercise:

(i) Mining of various minerals, particularly the building material, in the district has become a full-fledged industry. Leasees are granted in the areas adjoining to grass and grazing lands, thus, leading to severe encroachments.

(ii) Expansion of agricultural activities by the farmers having land close to grass and grazing lands has made encroachment, thus, reducing its size in most of the villages.

(iii) Ground truthing of these grazing-grass lands were carried out and it was found that most of them have thicket of *Prosopis juliflora* (Fig. 2). Other species were found in very few numbers or in exceptional cases.

(iv) Attitude of villagers towards grass and grazing lands is very deplorable. These have become free for use as *gram panchayats* are not able to contain people. As a result, overgrazing on these lands has given space to invasive species like *P. juliflora* which grows very fast.

This exercise would enable the local people and planning officials for grass root planning. The village-wise wastelands, which have been identified, should be earmarked for agriculture and plantation purposes. Water bodies have also been identified. Gullied and ravenous lands could be now taken for soil conservation measures. Thus the local people and planners could now display and analyse various information on computer screen. The site suitability, correlation studies and future projections could now be under taken. It also became possible to site and link various poverty alleviation programs of the Government. Since, large parts of the Jodhpur district are suited for livestock rearing. Considering the soil, vegetation, and water resources, 30-40 percent of lands is suitable for conservation purposes, and is suitable only for pasture and range development. But, in recent times, attempts have been made by farmers and state agencies to increase the intensity of their use, especially for crop production. The problem in those lands is not only to increase farm production but to conserve available natural resources. With a view to increasing cereal and oilseed production, more and more of sandy areas, which are unsuited for the purpose due to low fertility, have been put under cultivation. This has further assisted the forces causing land degradation. Despite the increased area put under cultivation for common crops, this district has shown a decline, within 3-4 years of cultivation, in the total yield of most of the cereal and oilseed crops. Hence, this shows that the utilisation of land for crop production and cultivation purpose is resulting in a decrease of natural resources, which are already scanty. Statistics for block-wise grasslands-grazing lands were generated (Table1).

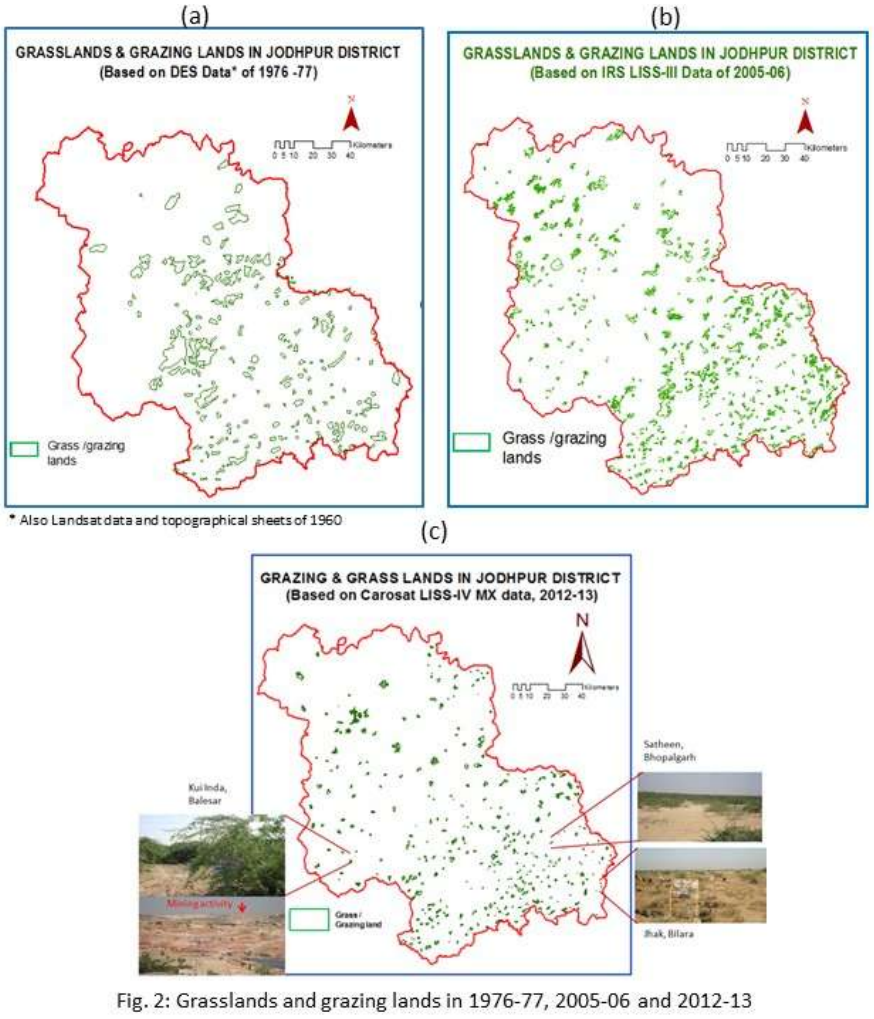


Fig. 2: Grasslands and grazing lands in 1976-77, 2005-06 and 2012-13

Table1. Statistics for block-wise grasslands-grazing lands were generated

Name of block	Area (sq. km)	Name of block	Area (sq. km)	Name of block	Area (sq. km)
Shergarh	43.65	Phalodi	104.02	Osian	53.35
Jodhpur	83.68	Bilara	24.52	Bhopalgarh	31.52

The major problems of grazing and grasslands of the district can be attributed to various factors. Because of the aridity of the climate and over-stocking of the grass range, carrying capacity of these grazing-grass lands is poor, and fertility is also low due to neglect. As most of the natural waterbodies and grasslands dries up in early summer, there is a high risk towards range ovr-grazing due to the traditional annulment of livestock during this period.

Conclusion

This study has demonstrated that remote sensing and GIS technology could generate low cost, up-to date, integrated information required for monitoring of grass lands and grazing lands in the Thar Desert of Rajasthan which has seen a steep decline due to increase in human and livestock population, mining activities and encroachment for agricultural activities. This facilitates in achieving better results with respect to area, perimeter, centroid calculation, *etc*. Such exercises provide real-time data for the planning officials and local people where both could work together in planning, monitoring, management of all aspects of locality in quantitative, time bound and transparent manner.

References

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