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INTEGRATIVE TECHNOLOGIES FOR ASSESSING THE EXTENT AND CAUSE OF DEGRADATION IN ARID COMMUNITY RANGELANDS IN INDIA

M.H. Friedel [1], S. Kumar [2], G.N. Bastin [1], U.R. Ahuja [2], B.K. Mathur [2], D.K. Saha [2] and P. Narain [2]

[1] CSIRO Centre for Arid Zone Research, PO Box 2111, Alice Springs NT 0871
[2] Central Arid Zone Research Institute, Jodhpur-342 003, India

BACKGROUND

Over 200,000 sq km or 60% of Rajasthan is arid, and forms 62% of the Indian arid zone. Annual rainfall spans 100-350 mm, is largely monsoonal and highly variable, and grazing is the major land use. Meat, wool and milk underpin the economy, while crop production is opportunistic and for subsistence only. The human population is increasing by about 30% every decade and is currently about 20 million, of which 80% are rural dwellers. Livestock numbers are also growing and recent estimates stand at about 11 million Adult Cattle Units (ACU). They are being sustained on a gradually shrinking area as irrigation canals encroach on the grazing lands and degradation increases; the area available per ACU is currently about half what it was 40 years ago. The rural landscape is also being pressured indirectly by expanding urban populations which depend on rural areas for animal products. Presently, there is little quantitative information about the spatial extent and severity of the degradation problem, nor is there capacity to feed back to villagers and district administrators quantitative information about the impacts that land uses are having or the effects that management changes might have. Due to the lack of appropriate tools for land management decision making, effective contingency planning has not evolved.

OUR OBJECTIVES

1. To apply and adapt Australian-developed techniques, using remotely-sensed data, for assessing land degradation, to Indian desert environments.
2. To gather ground-based survey data on socio-economic factors, the natural resource base and animal production for interpreting the results of remotely sensed analyses.
3. To develop means of information exchange with village communities and district administrators in order to explain land degradation.
4. To develop capacity with Indian colleagues for their independent use of all methodologies.

We are integrating knowledge of ground-based field ecology, livestock production and socio-economics in western Rajasthan with remote sensing and GIS skills from central Australia to develop degradation assessment technologies, as a first step towards improving land management.

SUMMARY OF OUTCOMES

Our study is centred on four villages some 80 km west of Jodhpur. Humans are inextricably linked with land condition and this project has an emphasis on understanding how socio-economic factors contribute to land degradation, as determined from satellite and ground-based biophysical data.

Remote sensing and vegetation attributes

Satellite images acquired prior to, and following, three contrasting wet seasons were used to estimate multitemporal vegetation cover. Land degradation was then indicated by the extent of vegetation response to monsoon rains (resilience values, Bastin *et al.* 1996). Results of image analysis were verified with vegetation and soils data collected at field sites.

Livestock and socio-economic data

Livestock, social and economic information was collated from 25 respondents in each of four villages (primary data) and extracted from national census data (secondary data). Some important findings which impact on land use are:

- size of land holdings:– 66% are 1.3-4.8 ha (marginal to small farmers), 29% are 8.6-21.6 ha (medium to large farmers), and holdings are often fragmented;
- numbers of large animals are increasing slowly (7.7% over 5 years) while numbers of sheep and goats, which are hardier, are increasing rapidly (44.3% over the same period);
- average family size is 7.6, but marginal farmers have the largest families (10.6); and
- low literacy levels – men (50%), women (< 10%) – plus early marriage contribute to high population growth.

Data integration with GIS

Remote sensing outputs, digitised maps, ground-based vegetation and soils data, and survey data were combined in a GIS to assist data interpretation (example output shown in Fig. 1).

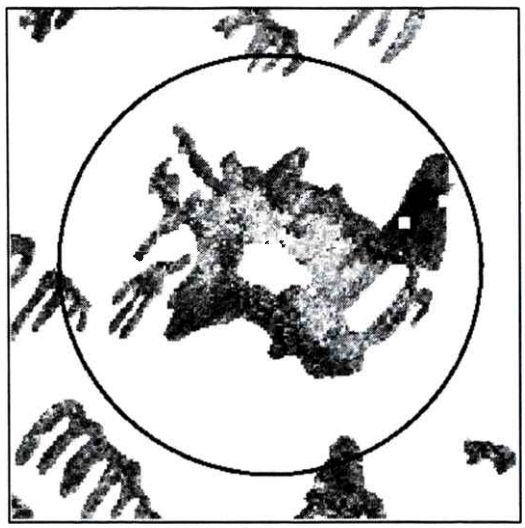

Figure 1a. Degradation status of grazing lands as indicated by resilience values within five km of Shergarh village. Darker areas are more resilient. White squares are locations of field validation sites.

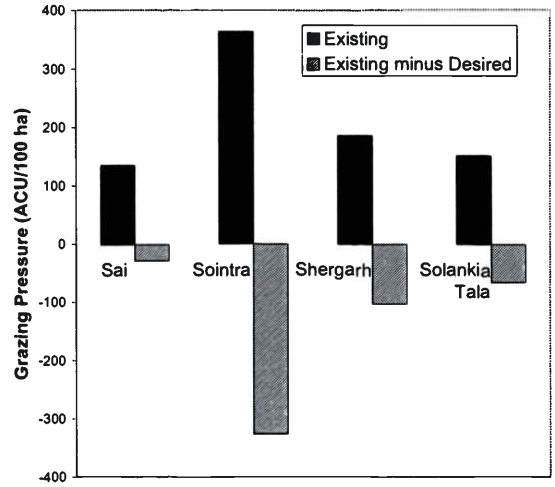

Figure 1b. Disparity between existing and desired grazing pressure at four surveyed villages.

Information exchange

Community entry was achieved through building on previous contacts by CAZRI scientists. Villagers welcomed veterinary advice on diseases and nutrition, veterinary prescriptions and provision of saplings free of cost. Honoraria for informants were unsuccessful because they alienated people who did not receive them. The implementation phase of the project will involve scaling up remote sensing products to assist administrators assess degradation at district or regional scale and target management.

Infrastructure and capacity building

The project has established a remote sensing and GIS laboratory at CAZRI, and acquired equipment, software and imagery. Indian scientists have gained expertise in field methodology, use of equipment, and image processing and interpretation during exchange visits with Australian colleagues. Scientists have also undertaken GIS training to ensure that they can use the project GIS independently.

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