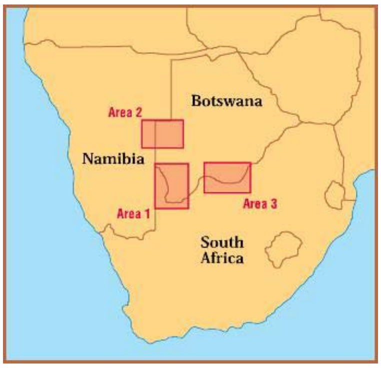
Using Remote Sensing to Monitor Rangelands

Key points

- Remote Sensing techniques are important tools for monitoring long-term change in rangeland conditions
- Ongoing long-term modelling of time-series data such as ATSR-2 potentially allows the identification of vegetation change due to management practises



Research areas:

1 Arid southwest:
  a) Mier, South Africa
  b) SW Kgalagadi, Botswana

2. Semiarid northwest:
  a) Ghanzi Dist, Botswana
  b) Omaheke, Namibia

3. Dry sub-humid southeast:
  a) NW Province South Africa
  b) Barolongs, Botswana

No. 1D

PANRUSA Briefing Notes

PANRUSA, Poverty Policy and Natural Resource Use in Southern Africa. A DFID funded research project at the University of Sheffield UK.

This briefing discusses the use of remote sensing as a tool in the PANRUSA project to examine cross-border variability in rangelands. Remote sensing involves the remote collection of data from the air, in this case from the ATSR-2 satellite sensor, which has been used to estimate vegetation properties based on solar reflectance values.

Methodology

Satellite remotely sensed images for study areas 1 and 2, taken approximately every 3 days, were acquired for the period May 1995 to February 1999 from the ATSR2 (Along-Track Scanning Radiometer). Light reflected from the Earth was measured by ATSR2 in three wave bands (red, near infra-red and Top of Atmosphere) and analysed to estimate spatial variability in vegetation growth during the period using the Normalised Difference Vegetation Index (NDVI). The NDVI provides an indication of various biophysical properties of vegetation. High NDVI values are associated with vegetation growth and good rangeland conditions.

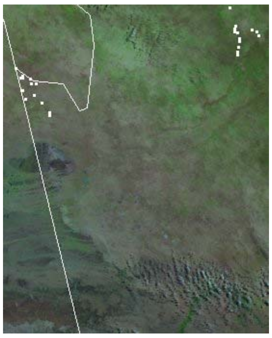


Fig. 1(a) 1(b)

Figure 1. Location of 82 sites distributed (a) from the Mier region, RSA (Study Area 1) to (b) North-east of Ghanzi, Botswana (Study Area 2).

The interpretation and analysis of the satellite imagery was made possible by field measurements from 82 transect sites in study areas 1 and 2 to estimate the fractional cover of perennial grass, annual grass, litter and bush (Figure 1). The location of the centre of each transect was determined using a Global Positioning System so that each study area could be identified on the satellite imagery.

On the basis of these measurements, and interviews with local farmers and scientific experts to assess long term trends, each site was analysed with respect to climate and management practice. For example, the Mier region in study area 1 contained sites in three categories of rangeland condition: D: Degraded; M: Moderate; and G: Good. Degraded sites in study area 1 were generally characterised by a mixture of dridoring (*Rhigozum trichotomum*) and an annual 'sour' grass (*Schmidtia kalaharensis*) in the interdunes with no vegetation on the dunes. Good sites had a mix of perennial and annual grasses often with some other palatable species and occasional *Rhigozum* bushes. Moderate sites showed reduced perennial grass cover resulting in a higher proportion of bare ground which is subsequently invaded by *Rhigozum* and *Schmidtia*.

Remote sensing: the potential to monitor changes in rangeland

Although the modelling of remotely sensed data (NDVI) provides a good measure of vegetation response to rainfall change, the challenge has been to separate out the influence of management effects on rangeland variability.

Rainfall exhibits an increase from SW to NE but in the individual study areas varies from year to year and exhibits marked local variability. The outcome of rain is rapid growth of grasses causing a sharp rise in the NDVI while the grass is actively green. Over time the spatial occurrence of variability becomes more randomly distributed potentially enabling vegetation responses to management practises to be identified. Figure 2 shows vegetation health measured by cumulative NDVI for nine neighbouring sites (3 Degraded, 3 Moderate and 3 Good) in the Mier region, RSA (Study Area 1).

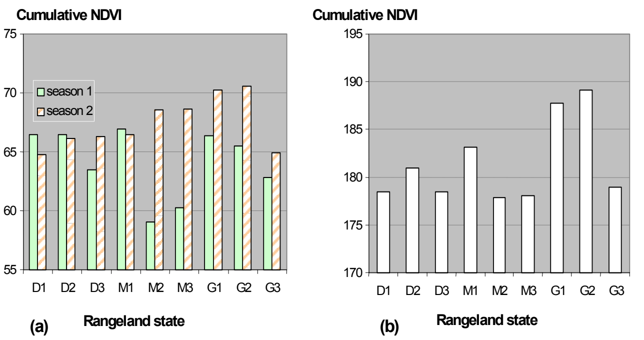


Figure 2. The cumulative NDVI calculated (a) for two 12 months periods from 15 Sept'96 to 15 Sept'97 and 15 Sept'97 to 15 Sept' 98 and (b) for a 35 month period from 15 Sept'96 to 15 June'99 for nine selected sites in the Mier region ranked as good, moderate and degraded rangeland

Figure 3a reveals little difference in NDVI response according to level of degradation over the two 12 .

month periods. For example the cumulative NDVI for two of the 'Moderate' sites was less than the 'Degraded' sites over the first season which may reflect rainfall variability. Cumulative NDVI calculated for 35 months, the total period for which ATSR2 data is available, begins to show some evidence of increasing vegetation health with improved rangeland condition although the time period is unlikely to be sufficient to rule out the effects of localised rainfall variability completely. A high degree of variability in cover components and soil colour within the rangeland categories is likely to have produced low values for site G2 and high values for site D2. Active management over the period (manual removal of *Rhigozum trichotomum)* was conducted on the degraded sites which would appear to have improved vegetation response.

Outcomes

- **This preliminary assessment suggests that long-term monitoring of rangeland using remote sensing techniques provides the potential to decouple the effects of local climate variability from the effect of rangeland state due to management**
- **Satellite imagery and remote sensing models are cost-effective methods for identifying localities in which local populations are vulnerable to changes in natural resource**
- **Limited field assessments of vegetation allows the better interpretation of satellite imagery**

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