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PATCH USE BY CATTLE IN DRYLAND ZIMBABWE: FARMER KNOWLEDGE AND ECOLOGICAL THEORY

by

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Introduction

The call for using farmer knowledge in designing appropriate research, development and extension strategies has become common in recent years (eg Richards, 1985). However, in practice involving farmers in research is generally limited to them participating in questionnaire surveys and providing lists of 'indigenous technical knowledge'.

This paper argues that this approach misses much of the deeper understanding developed by farmers as managers of their farming system and local environment. Understanding farmers' strategies allows a framework for posing technical, scientific questions in research. It also provides the basis for evolving development strategies that are not imposed as alien 'packages' that contradict with existing practices.

I illustrate this theme with an example from research carried out in Zvishavane District, southern Zimbabwe. It illustrates how an understanding of farmers' livestock management strategies, their environmental classification and their understanding of ecological processes led first to the questions of a scientific study being posed and secondly to the answers and their development implications being understood.

The questions relate to how livestock utilise different habitat patches in a dryland environment. This includes the use of two different ecological zones and, within these zones, the use of 'key resource' patches for providing fodder. This study leads logically to recommendations for grazing land and livestock development that, in certain respects, conflict with standard recommendations emanating from a process of research and development divorced from local social and ecological context.

Figure 1 RAINFALL: 1986 - 87
Manhivi Station, Mototi Ward, Mazvihwa

HABITAT TYPES: a classification

Clay veld:

Topland: Acacia and Mopane woodland; Key resources: riverine and drainage lines (dry season only); Arable grazing: contour ridges, fields

Sand veld:

Topland: Miombo woodland; Key resources; vleis; Arable grazing: contour ridges and fields

1 Study area and research methods

This study was carried out between 1986 and 1988 while based in Mazvihwa Communal Area (CA) in Zvishavane District. The study area was centred on Mototi Ward which straddles two distinct ecological zones. In one part nutrient poor sandy soils support a dry miombo woodland dominated by *Julbernardia globiflora* and *Brachystegia* spp.. The landscape is broken with granite kopjes with vleis in the valleys. In the other part, heavy clay soils derived from doleritic intrusions support a woodland dominated by *Colophospermum mopane*, *Combretum apiculatum* and *Acacia* spp.. This is found on a relatively flat plain criss-crossed with drainage lines and streams feeding the Gwen'ombe and Runde rivers. Zvishavane town receives an average (1923 - 1984) of 571 mm of rainfall per annum, but this is very variable between years. The coefficient of variation for rainfall between 1923 and 1984 is 38.7%. The rainfall for the period of study for a station in Mototi Ward is shown in Fig 1. The methods used for the study reported here have combined anthropological/social science interview work with natural scientific methods.

* Interviews were carried out with many 'key informants' in Mazvihwa and in comparability studies carried out in Runde, Chivi, Mberengwa and Mwenezi Communal Areas. These have combined with group discussions in these areas. These have been open-ended and unstructured explorations focussing on historical patterns or specific ecological questions dependent on the interest and knowledge of the group or informant.

* Research into the ecological characteristics of the two zones represented in the study area was carried out using methods of plant ecology (eg Walker, 1970; Rutherford, 1980). Quadrant (50 cm x 50 cm) sampling was carried out along 100m transects randomly located within different vegetation associations identified by farmers' classifications and sited using aerial photographs. 20 quadrants along each transect

were used to estimate standing crop of herbaceous biomass at three times: February 1987, August 1987 and March 1988. At the same sites an indicator of the available biomass of browse below 2.5m by species was also estimated along belt transects. The canopy volume, assuming cylindrical canopies, was used as the indicator.

* The feeding behaviour of cattle was studied by following known cattle (4-5 per herd) in four herds located along the gradient between clay veld savanna and sand veld savanna. Cattle were observed for the full day on a monthly basis for a year (November 1986 - November 1987). The location and activity of each animal was noted at half hour intervals. Cattle are herded from the start of the cropping season (around November) to the harvest (around April). The use of grazing resources is therefore influenced by herding decisions for this period. At other times of year cattle move freely and are only herded when being taken to distant water resources or to the dip tank. Cattle were kraaled daily for the period until August 1987, when night time feeding was allowed. This paper reports the results for two of these herds; one from the clay veld area, the other from the sand veld zone. The full results will be discussed in future publications.

* The availability of the different habitat types in the two zones was assessed on aerial photographs (1985). The area of each habitat patch identified by farmers was assessed within a 2km radius of the kraals where the herds whose foraging behaviour was studied.

2 Farmer Knowledge: Setting the questions for research

Two themes emerged from the interviews and discussion workshops. One is derived from an understanding of the historical dynamics of the relationship of farmer strategies to ecological processes. The other relates to how farmers use an ecological classification to understand ecological processes and make livestock management decisions. I will illustrate these two themes using some quotes from transcripts of discussions carried out in Mazvinhwa and Runde CAs.

Historical dynamics

Farmers note the importance of drought movements of livestock from the clay veld savanna to the sand veld areas. This they relate to the relative stability of production in the sand veld areas. This is not only grass production but also grain production. In the past, when food crops failed in the clay veld areas people with insufficient stored food would move to the sand veld areas. Cattle, which fare well on the nutritious grass of the clay veld in good years, would then be exchanged for grain with the entrepreneurial farmers, the hurudza of the sand veld. Farmers also noted the past practice of moving cattle to clay veld areas for fattening in wetter years.

> Some people from Chibi and Mapanzure drove their cattle to this place long back, perhaps in the 1920s: they loaned them to relatives and left them here to fatten them up (Interview, Mototi, Mazvihwa; 3.7.87)

> We remember the drought yeKenya (1947). We went to Chikai with cattle to exchange with grain ... I saw the zhara yomukondombera (probably 1922) and we went to Mberengwa to buy grain in sacks made from cattle skins. (Group interview in Mazvihwa, 5.8.87)

Archival records support the stories recounted by older farmers. The DC of Chibi in his report of 1912 reports a continual stream of people heading north to exchange cattle for grain. Similarly, the DC in Shabani (Zvishavane) reports in 1947 that natives from Chibi, Belingwe, Insiza and even some from Nuanetsi come here (Runde) to buy food, swamping local supplies.

Environmental classification

The distinction between these two zones is, not surprisingly, central to any environmental classification. Farmers distinguish between the two areas by referring to the makomo (hills) and deve (forested plain); the difference is not one based on altitude more of soils and past patterns of settlement. Farmers note the importance of the difference in soils musheche (sand) vs chiwomvo and gan'a (heavy soils) as well as vegetation.

Within these zones various distinct habitats/vegetation associations are identified. In particular, farmers identify patches of land that are critical for livestock forage.

The following are excerpts from a discussion held at Mototi focussing on drought related movements of livestock:

> The cattle from the deve have always gone to the makomo. Even if the grass is sparse there the cattle will always stay alive.
>
> The major difference is centred on the fact that the loose musheche soils of the makomo allow germination of grass, even if the rainfall is slight. Also there is alot of falling leaves there which helps the grass. The deve soil is heavier and so requires very much rainfall. Most of the rivers start in the hills - these and the vleis provide alot of grass for livestock.
>
> In the hills loose soils encourage grasses like nhandira (Digitaria sp) which is not good for cattle. In the deve, ha'achi (Urochloa mossambicensis) grows which is really excellent fodder. The big problem with the deve is that there are no vleis. That is why we are forced to drive our cattle to the makomo.

On the basis of discussion with farmers it is possible to derive a classification of habitats centred on the fundamental distinction between clay and sand veld savannas. The habitats identified can then be used as the basis for land-use studies.

Deve (clay veld savanna): Mupani (C. mopane) woodland;

Muvunga (Acacia spp.) woodland; Makwatara (drainage line woodland); Makandiwa (contour ridge grassland); Makawa (drainage pans); Mugwizi (riverine areas).

Makomo (sand veld savanna): Mutondo (J. globiflora) woodland; Makuvi (vlei grasslands); Makwatara; Makandiwa.

These can be further subdivided into topland grazing, 'key resource' grazing and arable block grazing. This is used in the analysis below.

Not only do farmer discussions provide useful classifications, but also they give insight into key ecological processes. Interestingly, the comments made in the excerpts included above relate directly to current concerns in scientific studies of savanna ecology.

3 Farmer Understanding and Ecological Theory

The importance of soil type to savanna dynamics has been pointed out by Bell (1982) and East (1984). These authors show that the structure of large herbivore communities in Africa can be explained according to the distinction between nutrient poor, high infiltration rate soils and nutrient rich soils where plant growth is often water limited. This distinction serves the basis for savanna ecologists' classification of savannas into dystrophic and eutrophic types (Frost et al, 1986); the same classifications as used by rural farmers in Zimbabwe.

Dye and Spear (1982) have demonstrated with 15 - 19 years of data from grassland studies at the Matopos, Nyamandhlovu and Tuli research stations, southern Zimbabwe why farmers' distinction between the interannual stability of sand veld grass production and the variable, but high quality, production of the clay veld savanna is significant.
They conclude:

> Thornveld, which is associated with soils of a high clay content, shows a relatively high correlation of yearly grass yield with annual rainfall, large year-to-year variation in these yields and marked changes in species composition over time. By contrast, on the two sandveld sites on coarse-textured soils, there is a poor correlation between yearly grass yields and annual rainfall, less year-to-year variation in these yields and less obvious changes in species composition over time. (Dye and Spear, 1982: 113)

Farmers' explanations go further than this though, as they point to the importance of vleis (and other patchy resources such as drainage lines and river banks) in sustaining livestock. It is not only the relative stability of sand veld grass production that is critical in drought periods, but the existence of small patches of productive grassland that provide fodder at critical periods. This is equally true of the clay veld areas. Browse, also, is regarded as an important resource.

Farmers emphasise the importance of vleis and the dry season flush of miombo woodland in the sand veld savanna:

> Cattle like to come and graze in the vleis in the dry season. They get greener in August or so when the water starts to rise up. They really rely on the vleis for feeding. At this time the trees begin to shoot, so they survive very well. (Mapanzure vlei seminar, 12.5.87)
>
> At this time (July) cattle survive completely on the vleis. The cattle will remain in the vleis until ploughing. They will find plenty of bulk food, but not enough good quality feed to keep them strong. They will be alive though. (Mutonga vlei seminar, 25.7.87)

While in the clay veld zone browse is particularly emphasised:

> These heavy soil plains support a wonderful woodland: <u>mubhondo</u> (<u>Combretum</u> <u>apiculatum</u>), <u>mutehwa</u> (<u>Grewia</u> spp.) and <u>muunga</u> (<u>Acacia</u> <u>tortilis</u>, for example. These trees produce their leaves very early nice and low down for stock. The trees on sandy soils are not as good for browse. (Mototi trees seminar, 15.3.87 [Wilson, 1987: Appendix 1]).

In the same workshop the group go on to recommend the planting of a whole range of trees for browse. For instance, Combretum hereroense, Lonchocarpus capassa and Grewia spp. were all proposed, along with drought reserves of Opuntia ficus-indica.

Other studies of foraging livestock in pastoral areas have noted the phenomenon of the use of 'key resources'. Coppock et al (1986) note the importance of drainage lines in Turkana, while Homewood (1987) has investigated the significance of the Baringo swamp in Kenya for sustaining livestock. The importance of the patchy use of a heterogeneous environment has been emphasised by ecologists studying wildlife systems (eg McNaughton, 1985, for the Serengeti) and temperate herbivore grazing systems (eg Pratt et al, 1986). Browse use by livestock in southern Africa is discussed by Walker (1980).

In Zimbabwe, the importance of vlei grazing has been recognised for a long time. The McIlwaine report on natural resources (1939) comments on the importance of vlei grazing (p 39) and the DC's in their annual reports continually emphasised the importance of 'key resources' in sustaining livestock in the 'reserves'. During the drought of 1933, the DC of Selukwe (Shurugwi) comments:

> There is evidently abundant sustenance along the banks of perennial streams in the Native Reserve as cattle kept in remarkably fine condition throughout the year.

The DC of Chibi (Chivi) comments on the importance of browse during the same year.

> Inspite of the shortage of grazing and water, cattle kept in remarkable condition and very few deaths occurred from poverty. This I attribute to the leafage on bush and trees coming out well during the latter months of the year and the cattle browsing off these.

4 Vegetation Ecology: a comparison of the two zones

The results of standing crop studies are presented in Tables 1 and 2 below. A distinction is made between topland and key resources. Key resources are those identified by farmers as being particularly valuable to livestock grazing: vleis, drainage lines, river banks and contour ridges. Topland grazing is the C. mopane, Acacia spp. and J. globiflora woodland areas.

Tables 1 and 3 compare standing crop in a good year (1987/8; c 600mm to April) and a bad year (1986/7; c 245mm to April). It compares all the transects studied in terms of the ratio of standing crop between the years. On clay veld topland in the wet year grass standing crop is about four times that in the drier year. On sand veld grass standing crop is only two times higher with a doubling of rainfall. However, in the drier year the standing crop of topland grass is higher on the sand veld than on the clay veld. This is what the Matopos study has shown (Dye and Spear, 1982). The data also illustrates the importance of 'key resources' in stabilising interannual variability. With the exception of the riverine area, which was heavily used in the rainy season of the dry year (Fig 2), the key resources where measurements were made in consecutive years (drainage line and vlei) show relatively stable levels of standing crop between years.

Tables 1 and 3 also show seasonal variation of standing crop in the different environments investigated. This was in a drought year, so the differences are quite dramatic; this is especially so in the clay veld sites. The sand veld sites show much more stable levels of standing biomass between seasons. The 'key resource' areas are heavily used in the dry season and so standing crop is accordingly reduced. However, the amount of biomass available per unit area is still relatively high in sand veld areas, although the quality of the fodder is quite low.

tables 1 and 2

table 3

table 4

table 5

Table 5 lists the major grass species found in each of the sites. Sand veld sites are characterised by species low in digestible crude protein, while clay veld areas are typified by high quality fodder grasses (cf Plowes, 1957; Elliot and Fokemma, 1961). This is exactly as farmers point out.

Table 3 aggregates the data shown in Table 1 into topland and key resources. The ratio of standing crop between areas shows the importance of key resources as patches of high resource availability, especially in the dry season or in dry years. Key resource areas are small in terms of the overall grazing land (Table 2). Vleis represent 4.8% of total available dry season grazing in the sand veld area, and drainage lines and riverine strips represent 6.3% and 6.2% respectively in the clay veld area studied. Contour ridge grazing (taken as 10% of total field area) constitutes 2.8% of dry season grazing area in the clay veld and 0.14% in the sand veld area.

When the standing crop results are weighted by area of key resource v topland in the two zones, they still represent c 45% of available biomass in sand veld areas and c 15% in clay veld areas during the wet season and c 70% during the dry season. This illustrates why farmers regard these patches as so important.

The ecological studies have also looked at the availability of browse in the two zones. The sand veld woodland is more diverse than the clay veld (Wilson, 1987), but there is less available browse. Table 6 shows the different browse availability in the two areas. Differing browse availability is related both to the density of trees and their structure. A farmer ranking exercise scored all the trees identified in the area for browse use by cattle (Scoones and Madyakuseni, 1988). The top browse trees in the sand veld area were not represented prominently in the potential browse availability estimations. This is because these trees (eg <u>J. globiflora</u> and <u>Brachystegia</u> spp) have a tall growth form and soon become unavailable to cattle (Lawton, 1980). These are the trees that are important for lopping in the late dry season, as the leaves of the miombo vegetation shoot before the onset of the rains (Jeffers and boaler, 1966). The C. mopane, Grewia spp and C. apiculatum of the clay veld are all readily accessible for browsing stock and heavily utilised, even as dry fallen litter in the dry season.

The plant ecological studies have demonstrated the differing availability of fodder resources both between years and seasons. However, until herbaceous production data is collected the relative productivity of each of the habitat types under different rainfall conditions cannot be assessed. The quantitative studies, contextualised by the results of other longer term studies, have substantiated the claims made by farmers on the pattern of resource availability and the contrasting ecological dynamics between the two zones. The next stage is to examine how this patterning of resources influences the use of them by foraging livestock.

5 Livestock Foraging Behaviour: Responding to a patchy and variable environment

The seasonal use of different patches of the environment has been studied in the livestock foraging behaviour studies. These were carried out during 1986/7. This was a drought year, so the patterns of use represent those prompted by forage scarcity. Other studies under different levels of rainfall need to be done to complement these results. However, this study is important as it is resource availability at the close of the dry season in a drought year that ultimately determines the lower limit of ’ecological carrying capacity’. Any planning for livestock development must take these extreme situations into account.

Figure 2 CLAY VELD SAVANNA: CROPPING SEASON (%)

Figure 3 CLAY VELD SAVANNA: EARLY DRY SEASON (%)

Figure 4 CLAY VELD SAVANNA: LATE DRY SEASON (%)

Figure 5 SAND VELD SAVANNA: CROPPING SEASON (%)

Figure 6 SAND VELD SAVANNA: EARLY DRY SEASON (%)

Figure 7 SAND VELD SAVANNA: LATE DRY SEASON (%)

Figure 8 UTILISATION OF THE BROWSE RESOURCE
Two ecological zones, Mazvihwa CA

Sand veld savanna
Clay veld savanna

The availability of different habitat patches to the cattle under study at the two kraals on a seasonal basis is shown in Table 2. This is based on the analysis of aerial photographs for the area.

Figs 2 to 7 combine the results from each of the cattle of two herds: one from the clay veld, the other from the sand veld. The use of the resource patches in terms of percentage day time feeding spent at a particular site is illustrated according to three seasons. These are the cropping season (November to March), the early dry season (April to June) and the late dry season (July to October/November). The amount of rain recorded in Mazvihwa for these periods (1986-7) was 175.2, 0 and 31.9 mm respectively.

In the sand veld area vlei and topland grazing are important in the cropping and late dry season. In the early dry season grazing stover from the fields dominates. Contour ridge grazing is also important at this time and this persists into the late dry season.

In the clay veld area the topland is only used to any significant degree in the cropping season, and then only a quarter of the time. Cropping season grazing is sustained by the use of accessible drainage lines and riverine areas. The same applies in the late dry season. In the early dry season, stover is grazed as well as contours. The use of grass on contour ridges continues until the following cropping season.

In general, the pattern between the two zones is similar. Key resources dominate feeding time in the cropping and late dry season, while grazing stover and contour grass is important in the interim period. The only important difference is that the grass production in the sand veld area did not collapse as dramatically due to the season’s low rainfall (see above) as it did on the clay veld. This collapse forced cattle to rely on the clay veld key resources very heavily during the cropping season. As already mentioned the riverine strip got heavily utilised in this period. In a wetter year we would expect the pattern to be reversed. High grass biomass production levels on clay veld and adequate, but low quality, grass on the sand veld toplands would result in more topland grazing in clay veld areas and more key resource grazing in sand veld.

The results for a cattle herd located on the boundary between the two zones have yet to be analysed. We can expect that livestock behaviour and herding practices will exploit the benefits of both environments with switching between the zones.

The seasonal preferences of foraging cattle for different habitat patches can be assessed. An index of preference is used in Table 4. The preference index is:

$$PI = \frac{\text{\% feeding time spent in habitat patch x in season y}}{\text{\% of total area available as habitat patch x in season y}}$$

The data is derived from the results shown in Figs 2 - 7 and Table 2. The higher the index, the greater the preference. The results show the high positive preferences for 'key resources' at all times of year. As discussed above the pattern of use of 'key resources' changes through the year. Topland is consistently avoided.

The feeding activity of all cattle was recorded as well as location in relation to habitat patch. This revealed the seasonal pattern of browsing behaviour in the two zones. Fig 8 illustrates the results graphically. It shows how a greater proportion of feeding time is spent browsing in the dry season in both zones. In the sand veld the dry season flush of leaves prompts an increase in browsing around September.

table 6, 7, 8

In the clay veld much late dry season browsing is of fallen leaf litter (see Table 7). Browsing represents a greater proportion of feeding time at other times of the year in the clay veld where grass availability was low. The species browsed are those that farmers have identified for planting as part of their community management project (see Table 8), and are those recognised as important browse species in these environments (Walker, 1980).

6 Discussion

A number of conclusions can be drawn from this research that are of relevance to the general issue of livestock development policy in the communal areas of Zimbabwe. These include conclusions relating to methodology in livestock production research and to technical questions surrounding interventions proposed for the communal areas.

* The role of farmer knowledge is vital in setting the questions and the framework for applied scientific study. In this instance, farmers highlighted the implications of the critical differences in ecological dynamics between sand and clay veld savanna. They pointed to the importance of key resources and provided local classifications of habitat patches. These local insights were able to articulate with a scientific study of vegetation dynamics and foraging behaviour. Because of a local understanding of system functioning, the results can be interpreted. Farmer knowledge is not a remote and removed set of natural historical facts, it can be critical, scientific and with important theoretical content. Savanna ecologists only started publishing on the subject of contrasting dystrophic and eutrophic ecological zones in the past decade or so. Farmers have probably understood and been using this distinction for generations. The involvement of farmers in applied agricultural research should not be regarded as a quirky anthropological sideline, but should enter the mainstream of formal research. How this

can be fully achieved, both in terms of practical field approaches and institutional set-ups, has yet to be worked out.

* The analysis presented here offers a different way of thinking about 'carrying capacity' of rangeland. Conventional approaches regard the range as a uniform area of grassland and indicators are used to assess the appropriate stocking rate (eg Ivy, 1969 for the method used in Zimbabwe). Topland grazing is used to derive the assessment and it is assumed that the availability of grazing here determines the 'carrying capacity' level. In the communal areas this is not so. This study suggests that it is small 'key resource' patches that determine the ability of livestock sustain themselves through the dry season and during the cropping season in a drought year. There are also significant differences between clay and sand veld savanna areas.

If 'carrying capacity' is determined by these patches (plus browse) any assessment of its level must take them into account. A disaggregated approach is needed that focuses on 'key resources'. The loss of these patches to arable or through degradation should be a matter for concern. A more strategic view of range conservation and management could then emerge for the communal area situation.

Putman (1986: 189) comments on the conclusions of a long-term detailed study of herbivore use by cattle, ponies and deer in the New Forest, southern England. Despite the dissimilar environment, there are important parallels with the communal area situation.

> Overgrazing is an emotive but rather nebulous concept. Do we mean that grazing pressure on the Forest is so high that animals are no longer able to maintain condition, or that from a vegetational point of view grazing is such that productivity is suppressed? Or do we mean that grazing pressure is causing a decline in the 'ecological value' of the area through reduction in diversity of species composition and structure, or that it is

> preventing woodland regeneration? According to which criterion we adopt, we may feel that certain areas of the Forest may or may not be considered overgrazed ... Equally importantly, different community types may differ in the degree of 'overgrazing' experienced. We have stressed already that grazing animals do not use all habitats equally and that some sustain much higher impact than others. Further, different patches of the same community type suffer different grazing pressures dependent on their juxtaposition with other communities or geographical position within the Forest.

With an understanding of the patchy use and primary productivity of different communities the study goes on to offer an alternative method for assessing grazing capacity. While acknowledging that herbivore populations are not solely limited by forage availability (other factors such as shelter and water sources are important), food limitation is commonly significant (cf Sinclair, 1977) and can serve as a reasonable indicator for grazing capacity. Putman (1986: 190) explains the method used:

> The fact that 'not all vegetation types are alike' to the animals may be accounted for in that seasonal productivity is calculated separately within each vegetation type and may thus be related directly to figures for required offtake also derived for that particular vegetation type. With carrying capacity thus derived in any season in terms of that vegetation type offering minimum supply in relation to demand, full account is taken of the specific requirements of cattle and ponies from their different forage types in areas of mixed vegetation.

We do not have sufficient information to do a similar rough calculation for any communal area. The data collected in the study reported here goes some way towards this, but true primary productivity measures (rather than standing crop) would have to be made, along with estimates of forage requirements for subsistence by communal area cattle. The comparative foraging requirements and habitat use patterns of donkeys and goats would also have to be examined for a complete picture. Similarly, the implications of changing land-use patterns (eg arable expansion, grazing enclosure etc) in different regions of Zimbabwe needs to be assessed in terms of the impact on 'key resource' patches.

* Some researchers have asked in the context of Zimbabwe's communal area livestock populations: 'how and why do the herds keep growing?' (Jarvis and Erickson, 1986). The existence of a pattern of opportunistic, adaptive resource use of a heterogenous environment may be part of the answer. If this opportunity is removed there could be serious consequences for livestock production in the communal lands. The patchiness of the environment and the patterns of livestock use need to be explicitly acknowledged in land-use planning exercises. This is not necessarily done in the planning of grazing schemes. These are designed on the basis of the subdivision of the topland into fenced paddocks for a short duration rotation. In land unit classification vleis, river banks and drainage lines are not formally designated grazing land. They may not be considered on the aerial photographic mapping of the scheme boundaries and paddock layout. These are the resources that are the focus of boundary disputes between schemes (eg Abel and Blaikie, 1988: 109). They should be the central focus for planning and design of any scheme.

If the arable production of the CAs is to be sustained, there is an urgent need for cattle populations to remain high (Scoones and Wilson, 1988). Maintaining high populations of large herbivores is often dependent on the availability of reserve forage patches. Walker et al (1987:381) comment on the situation for southern African wildlife populations during the 1982-4 drought:

> Culling is ecologically unnecessary where sufficient spatial heterogeneity exists to provide reserve forage. Some drought related mortality is natural and probably beneficial to both animal and plant populations.

Maintaining spatial heterogeneity needs to be central to grazing management strategies. In other areas of semi-arid Africa 'key resources' are the basis of grazing management systems. For instance, Acres et al (1985) describe how in Tanzania vleis are the focus for a grazing scheme. In Zimbabwe there is an urgent need for grazing scheme planning and management to acknowledge the legitimacy of farmer strategies for grazing management and the ecological rationale for such practices. A greater understanding of farmer strategies for grazing management and the ecological rationale for such practices. A greater understanding of local ecology can be gained by more applied ecological studies in the communal area and, particularly, involving farmers in the research and planning process.

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