Expl Agric. (2011), volume 47 (S1), pp. 153–168 © *Cambridge University Press 2011*
doi:10.1017/S001447971000092X

UNDERSTANDING COMMUNITY PERCEPTIONS OF LAND USE CHANGES IN THE RANGELANDS, ZIMBABWE

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(*Accepted 27 September 2010*)

SUMMARY

The objective of this study was to investigate the user communities' understanding and interpretation of changes in rangeland use and productivity in the communal lands of Zimbabwe. While external knowledge has been instrumental in defining the drivers and effects of ecological changes hitherto, the role of local knowledge is becoming increasingly important in explaining factors that inform user community perceptions and guide their decisions on the use of rangeland resources. Data on community perceptions were collected in four villages, using Participatory Rural Appraisals in each village and household surveys with a total of 104 households. This study showed that user communities in Nkayi district differentiate rangelands among seven categories of livestock feed resources and how these have changed over time. Communities viewed rangelands not as one continuous, designated and specialized land parcel, but differentiated the land by location, productivity, management and uses in different times of the year. Although land use changes affecting these livestock feed resources were considered to be widespread and multi-directional (both negative and positive) they did not cause widespread degradation. Rangelands converted to croplands were not completely lost, but became important dual purpose land parcels fulfilling both household food security needs and dry season livestock feed requirements. The importance of croplands as a feed resource is reflected in the emergence of new institutions governing their use for livestock grazing and to guarantee security of tenure. On the other hand institutions governing the use of common property rangelands decreased or weakened in their application. The study concludes that while this situation presents ecological challenges for the rangelands, it offers opportunities to find innovative ways of utilizing croplands as the new frontier in the provision of dry season feed resources to smallholder farmers in highly variable environments. Implications for livestock water productivity need to be investigated and water saving technologies should be promoted in the land use intensification processes.

INTRODUCTION

Land degradation has been identified as one of the main factors contributing to increasing poverty and vulnerability among mixed crop-livestock systems in sub-Saharan Africa (SSA). More than 15% of Africa's land area (320 million ha) is said to be moderately to severely degraded through human activities with overgrazing contributing 49%, deforestation 27% and poor farming practices 24%. About 5 million ha of Africa's fragile lands are said to be degraded beyond rehabilitation (Dejene, 1997). However, despite these compelling statistics on land degradation, some studies are

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beginning to question the data, arguing that the degradation estimates are overstated. A major reason suggested for the overestimation of degradation levels has been the problem of discriminating between land in a naturally bad state, a temporary bad state and a degraded state (Mazzucato and Niemeijer, 2001). Furthermore, some note that there are methodological difficulties and challenges in measuring land degradation (Breman and de Ridder, 1991) whereas others emphasize the difficulties associated with climatic and natural variability as well as the lack of long-term data necessary for accurate assessments. These challenges have given importance to the role of local knowledge systems not only in assessing degradation, but in interpreting the results of the assessments (Swift, 1981).

Situating this issue in the broader rangeland degradation debate reveals that each view taken culminates in certain recommended management systems. The 'tragedy of the commons' perspective, led by Hardin (1968), indicted user communities as both culprits and victims of degradation, hence management systems focused on protection of rangelands through intensive conservation areas (Little, 2002; McCabe, 1990). Ciracy-Wantrup and Bishop (1975) were among the first to differentiate common property that is managed by defined user groups from non-managed open access, showing that rangelands can be managed in a sustainable manner. Developments in social science and human ecology revealed that through experiential indigenous knowledge systems and communal management sustainable utilization of rangelands is possible (Galaty and Johnson, 1990; Homewood and Rogers, 1987). Behnke and Scoones (1992) demonstrated that rangeland degradation in areas with high climatic variability was not driven by high livestock densities, but rather by the erratic nature of rainfall. This paved the way for the recognition of climatic factors (especially rainfall) as important parts of rangeland degradation processes, and flexibility over large areas as a critical land use strategy and strength of common property systems.

Reed and Dougill (2002) note that while environmental science has played a key role in providing explanations of the problem of rangeland degradation, there is also a need to understand user communities' perceptions of rangeland degradation (causes and impacts) in order to develop sustainable modes of managing common property rangelands. These rangelands are an important support base for the livelihood of most rural communities, who depend on their livestock for food security, income and wealth. Degradation of rangelands often results in negative impacts on the livelihoods of rural communities due to high livestock mortalities related to dry season feed shortages (Homann *et al.*, 2007). The consequences of rangeland degradation on the communities (such as increased poverty and food insecurity, and heavy dependence on food aid) call for better understanding of the dynamics at play.

This paper presents findings of a study that investigated changes in land use and productivity in Zimbabwe's common property rangelands. It focuses on the user communities' understanding and interpretation of the conditions of their rangelands, changes observed, their meanings, causes and impacts, by answering the following questions:

(i) How do user communities define the current condition of their rangelands?

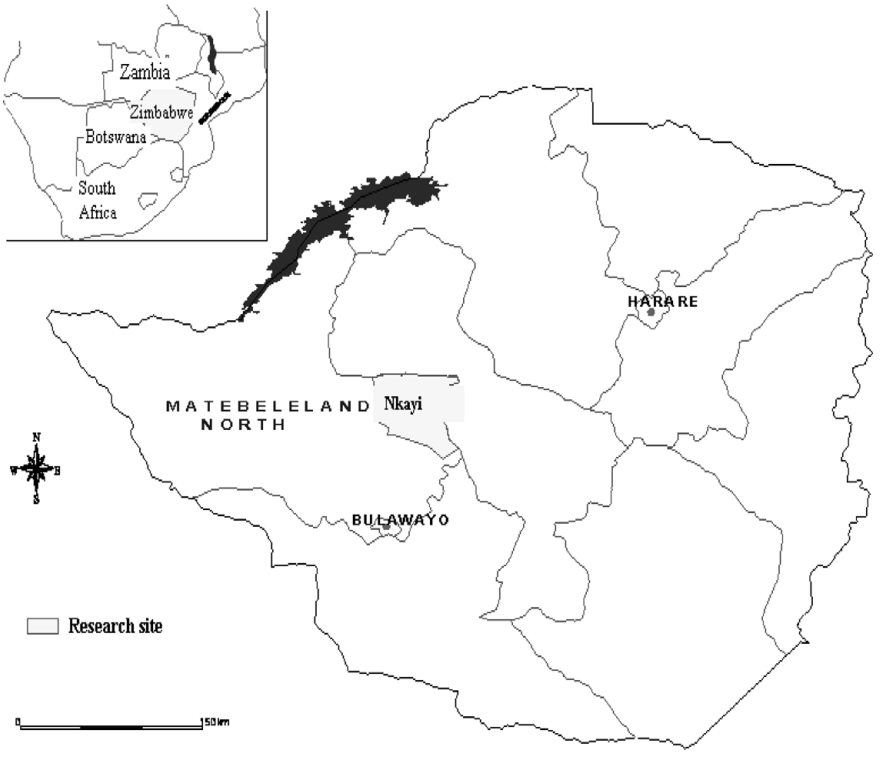

Figure 1. Location of the study district in Zimbabwe.

(ii) How have the rangelands changed over time?
(iii) What are the impacts of the changes on livestock and community livelihoods?

MATERIALS AND METHODS

The study area: Nkayi District

Nkayi is one of the six districts located in Matabeleland North Province in the southwestern part of Zimbabwe (Figure 1). The district lies in agro-ecological region IV, which is a zone of low agricultural potential due to low and erratic rainfall regimes (450–650 mm annual rainfall) while temperatures are relatively high (23–30 °C) and dominated by soils of low inherent fertility. The rainfall characteristics (amount, reliability, distribution and intensity) have an important agro-economic significance as they determine the farming practices in the mostly rainfed smallholder agriculture sector. The erratic rainfall pattern and high inter-annual variability often result in mid-season droughts and cause frequent harvest failures. Soils and vegetation types vary, but range from poor deep Kalahari sands associated with miombo woodlands on the plateau edges to heavier soils associated with mixed acacia and mopane woodlands (Moyo *et al.*, 1991).

Historically, Nkayi District was largely uninhabited and sparsely populated due to its low agricultural potential. It had a small population of the Nyayi and Tonga people who were sedentary agriculturalists, and depended on a wide range of large game present in the area. The land apportionment policy in 1959 brought changes to the land use system in Nkayi through the introduction of the Ndebele, who were traditionally livestock keepers and were moved from their rangelands around Bulawayo and Filabusi areas to make way for white commercial farmers. As a result of this resettlement, the land which was traditionally considered as uninhabitable and largely used for cultivation and hunting was designated as both cultivation and grazing land by the then colonial administration. Although their own detailed scientific assessments showed that the land was fragile and not suitable for high population densities, the colonial administration continued to plan and settle the Ndebele in the area for selfish reasons (Alexander *et al.*, 1998).

Currently, Nkayi is a relatively densely populated district in the semi-arid areas of Zimbabwe with around 40 persons km^{-2} (Central Statistics Office, 1992). This is due to the initial settlement patterns and population growth. In recent years, this pressure has resulted in wide ranging land use changes mostly dominated by the expansion of arable plots into forest and grazing areas.

Study methods

The methodology of this study combined Participatory Rural Appraisal (PRA) techniques with quantitative household questionnaire surveys to measure land use and vegetation cover changes. Quantitative methods were adopted in the measurement of impacts whereas the qualitative approaches were adopted to obtain depth of insight and to ensure precision in meanings of responses to the research questions posed. The combination of methods in the research process helped to establish comparability and complementarity of results from quantitative analyses and those carried out by communities through local knowledge systems and qualitative PRA processes. Through triangulation of methods, the study integrated knowledge from within and between scientific and local bases to establish balance and avoid making conclusions based on unverified local assumptions (Reed *et al.*, 2007).

The purposive sampling strategy was used to select four wards in different areas in Nkayi to capture the local diversity in soils, natural vegetation and human population densities. Two villages (Mhutshapansi and Silindeni) were selected in the sparsely populated northern part of the district with infertile, deep Kalahari sands that support mainly dense miombo woodlands. The other two villages (Menda and Nkunzini) were selected in the more densely populated southern part of the district characterized by red clay and loamy soils.

In each ward, one village was randomly selected. In each village a PRA workshop was conducted with a minimum of 40 participants drawn from community leadership, including traditional leaders, leaders of community institutions such as churches, traditional healers, and leaders of farmer associations and representatives of women's groups. A team of six researchers conducted the PRAs, dividing the responsibilities of

facilitating (two), note taking (two) and observing the discussions. Extension workers participated as observers in focus group discussions. User communities were split into three focus groups for detailed discussions where they used the following participatory tools: rangeland category identification, rangeland resource mapping and use patterns, and seasonality diagramming. Satellite maps from the year 1989 and 2008 were displayed and analysed to discuss land use and productivity change during the previous 19 years. The groups were later brought together into plenary sessions in which selected community members presented results of focused discussions. The results were further questioned, distilled and validated. Data collected through the participatory processes across the research sites was collated, coded and analysed through use of Kenda matrices. The mostly qualitative results of the Kenda matrix were interpreted and compared to the results of household survey and conclusions drawn.

Within each of the villages, 20–30 households were randomly selected among livestock owners for detailed household surveys, giving a total sample of 104 households for the survey. Key questions in the structured household survey questionnaire included farmers' perceptions on rangeland availability and conditions, changes in area size, changes in vegetation composition, biomass quantity and quality, and the impact of changes on livestock and farmers livelihoods. The data was coded, entered in SPSS and analysed through descriptive statistics using the frequencies and cross-tabulation procedures. More profound statistical tests were not applied since the data present farmers' perceptions and were collected as categorical variables.

RESULTS

Nkayi community classification of rangelands

The local Ndebele word for rangelands is *amadlelo*, which traditionally denotes uncultivated lands designated for livestock (mainly cattle) grazing. The word has, however, expanded in its meaning to include all areas where livestock graze throughout the year, including croplands. Following the communities' classification of rangelands, this study uses rangelands as a term for all land use categories that are being used for livestock grazing, and include croplands as a source of crop residue grazing.

These rangelands are common property; the only private land is croplands. Croplands are private until the crops are harvested and local by-laws define the date for opening up the croplands for the communities to let their animals graze on the residues.

Communities do not view rangelands as one continuous, designated and specialized land parcel, but divide the land into distinct categories differentiated by location, productivity and management, and varied in shape and size. Seven categories of land use were identified: grazing lands near homesteads, distant grazing lands, rivers and wetlands, tree and forest lands, grazing reserves, croplands and fallow fields. These land use categories serve as a pool of livestock feed resources during different times of the year. The categories are described and explained as follows.

Grazing lands near homesteads. Grazing areas near current settlements, around and between existing homesteads. Livestock mostly graze in these areas early in the

Table 1. Frequencies of farmers who use rangeland categories during the wet and dry season (%, $n = 104$).

	Wet season	Dry season	χ^2 sign. seasons
Grazing land near homestead	23	40	$p < 0.05$
Distant grazing land	58	17	$p < 0.01$
Rivers and wetland	28	14	$p < 0.05$
Tree and forest land	14	4	$p < 0.05$
Grazing reserves	2	9	*n.s.*
Croplands	2	51	$p < 0.01$
Fallow land	13	30	$p < 0.05$

morning or evening just before penning. Normally, the area is a buffer zone between grazing lands and croplands.

Distant grazing lands. Grazing areas designated by the community at far distance from the settled areas where all households from the village can graze their animals.

Rivers and wetlands. Grazing areas along drainage lines and wetlands that are sometimes protected areas by state conservation laws. These are sometimes defined as key resources because of the high quality and quantity of the biomass produced.

Tree and forest lands. Grazing areas in the Kalahari sands areas dominated by miombo forests and with limited grass growth because of the high tree canopy. These are far away from the settled areas and are home to a wide variety of wildlife including predators such as hyena, leopard and cheetah.

Grazing reserves. Grazing areas at far distance from settled areas and reserved for grazing during times of drought and severe feed shortages.

Croplands. After harvest, croplands are opened for community members to graze their animals. They serve as a great store of feed resources for the dry season due to the availability of crop residues. These exclude small plots next to the homesteads, which are considered as the 'home yard' and remain private land throughout all seasons.

Fallow lands. These are crop fields that are no longer used for cropping purposes but for livestock grazing. They are left fallow for several reasons, including poor soil fertility, inability to utilize the land due to shortage of inputs and speculation.

Rangeland use

Communities utilize a range of different rangeland categories during the wet and the dry season (Table 1). During the wet season most farmers use the distant rangelands (58%), followed by rivers and wetlands (23%) and grazing lands near homesteads (23%). During the dry season croplands become the most frequently used grazing resource for livestock (51%), followed by grazing land near homesteads (40%) and fallow lands (30%). This land use indicates that farmers tend to move their herds to the outer rangelands during the wet season and graze them near to the homestead during the dry season.

The use of rangeland categories was similar across all villages (Table 2), except for the use of grazing areas near rivers and wetlands, which were comparatively more

Table 2. Frequencies of farmers who use rangeland categories during the wet and dry season by villages (%, $n = 104$).

	Wet season					Dry season				
	Menda	Nkunzini	Mhutshapansi	Silindeni	χ^2 sign. villages	Menda	Nkunzini	Mhutshapansi	Silindeni	χ^2 sign. villages
Grazing land near homestead	21	17	35	22	*n.s.*	39	28	60	41	*n.s.*
Distant grazing land	57	59	55	59	*n.s.*	11	14	10	33	*n.s.*
Rivers and wetland	50	10	25	26	$p < 0.05$	21	0	10	22	$p < 0.05$
Tree and forest land	14	10	25	11	*n.s.*	7	0	10	0	*n.s.*
Grazing reserves	4	3	0	0	*n.s.*	18	3	10	4	*n.s.*
Croplands	4	0	0	4	*n.s.*	43	59	55	48	*n.s.*
Fallow land	4	28	0	15	$p < 0.05$	29	35	25	30	*n.s.*

Table 3. Frequencies of farmers' perceptions of the availability of rangeland categories during the wet and dry season.

		Rangeland availability (% of farmers)			
	Number of farmers	Plenty available	Good available	Occasionally short	Chronically short
		Wet season			
Grazing land near homestead	24	8	71	17	4
Distant grazing land	60	22	65	13	0
Rivers and wetland	29	14	48	31	7
Tree and forest land	15	7	80	7	7
Grazing reserves	2	0	50	0	50
Croplands	2	0	0	50	50
Fallow land	13	15	85	0	0
		Dry season			
Grazing land near homestead	42	12	33	48	7
Distant grazing land	18	6	50	44	0
Rivers and wetland	14	0	50	36	14
Tree and forest land	4	0	50	50	0
Grazing reserves	9	11	56	33	0
Croplands	53	17	40	34	9
Fallow land	31	7	55	35	3

common in Menda and Silendeni villages, due to their physical proximity to perennial rivers.

Rangeland availability

Most farmers evaluated the availability of the various rangeland categories as being good (40–85%) or occasionally short (7–50%; Table 3). During the dry season more farmers tended to regard the rangelands as occasionally short, reflecting a seasonal decline in grazing availability, which often leads to feed shortages. Croplands were, however, considered as being more available during the dry season, confirming that crop residues represent a readily available dry season feed resource for livestock grazing after crop harvest, when most other rangeland resources are depleted. Very few households saw the rangelands as chronically short. This evaluation was similar across all four villages (χ^2 not significant for all rangeland categories).

Rangeland condition

Communities used five terms to describe the condition of rangelands in their area: good, medium, moderately degraded, degraded and severely degraded. Good rangeland was considered as rangeland with good basal cover, palatable grasses, limited bare patches, limited gullies from erosion, limited or no bushes, especially of *Acacia karoo*. Rangeland in medium condition was described as rangeland with good basal cover, with few isolated bare patches and limited or no bushes. Moderately degraded rangeland was given as rangeland that had good basal cover, with growing bare patches, increase in annual and woody grass species, bush encroachment from

Table 4. Frequencies of farmers' perceptions of conditions of rangeland categories during the wet and dry season.

		Rangeland conditions (% of farmers)				
	Number of farmers	Good	Medium	Moderate degraded	Degraded	Severely degraded
		Wet season				
Grazing near homestead	24	17	75	8	0	0
Distant grazing land	60	12	60	27	2	0
Rivers and wetland	29	21	48	28	3	0
Tree and forest land	14	14	57	29	0	0
Grazing reserve	2	0	50	50	0	0
Cropland	2	0	50	50	0	0
Fallow land	13	8	62	31	0	0
		Dry season				
Grazing near homestead	42	12	45	38	2	2
Distant grazing land	18	6	56	39	0	0
Rivers and wetland	14	14	57	29	0	0
Tree and forest land	4	0	75	25	0	0
Grazing reserve	9	0	56	33	11	0
Cropland	53	13	59	26	2	0
Fallow land	31	19	39	39	3	0

Acacia karoo and growing gullies from either gully or rill erosion. Degraded rangeland was described as rangeland with limited basal cover, large bare patches, loose top soil, increase in bushes and increase of woody species such as couch grass. The severely degraded areas were given as desert-like areas where the soil is not covered and there is no basal cover even after the rains.

Most farmers viewed the rangeland categories to be in medium condition (39–75%), whereas between 25 and 40% viewed the rangelands as in a moderately degraded state (Table 4). More farmers saw rangelands as moderately degraded during the dry season as compared to the wet season, indicating that they observe a seasonally deteriorating rangeland quality. In particular, the grazing areas near homesteads seem to lose quality, although they are an important dry season feed resource. Among the land in good condition farmers often mentioned fallow land and croplands confirming their important role in compensating for poor rangeland conditions during the dry season. Few farmers considered the rangelands as degraded or severely degraded. This evaluation was also similar across all four villages (χ^2 not significant for all rangeland categories).

Changes observed in the rangelands

In assessing community perceptions of changes in the rangelands and their impacts, the study sought to understand what changes had occurred in their rangelands in the previous 20 years. Communities singled out two critical changes that were observed and recognized, namely changes in the size of the rangelands and changes in vegetation composition.

Table 5. Frequencies of farmers' perceptions of changes in rangeland area size over the previous 20 years.

		Observed changes (% farmers)	
	Number of farmers	Decreased	Increased
Grazing near homestead	19	79	16
Distant grazing land	31	93	7
Rivers and wetland	13	92	8
Tree and forest land	5	100	0
Grazing reserve	4	75	25
Cropland	12	75	25
Fallow land	17	71	29

Changes in rangeland size

Many farmers across all villages (54%) perceived a reduction in rangeland size. Most farmers saw a reduction in the tree and forest lands and distant grazing areas mainly due to ease of access and limited control by authorities. They also observed a decrease of rivers and wetlands, as these are often opened for crop production because of their better water retention and soil fertility (Table 5). The major causes for the reduction of rangelands were explained by most farmers as a result of the expansion of croplands (52%), expansion of residential areas (39%) and the creation of new residential areas (34%). Expansion of croplands occurred as communities responded to food security by cropping in new fields where soils had better fertility and guaranteed better harvests. Although state rules legislated against this, local institutions seemed to accept the opening of new fields.

A number of farmers (13.5%) also viewed rangelands as having increased. This was mainly attributed to a conversion from croplands to fallow lands and back to rangelands, which was further explained as a result of the frequent droughts and harvest failures.

Changes in vegetation composition

A large proportion of farmers (55%) observed changes in the vegetation composition. The major changes recognized were a loss of valuable grasses and an increase in shrublands (Table 6). Most of these changes were seen on the distant grazing lands, as well as those near homesteads, and rivers and wetlands. The majority of households that indicated that there were no substantial changes also indicated that rangelands that were converted to croplands continued to be available for grazing and provided better quality feed (crop residues and other grasses) during the critical dry season period of the year.

Impacts of changes in rangeland production

Communities showed an understanding of the multiple impacts that the changes in rangelands production (that is increase or reduction in biomass quantity and quality) have on their livestock and livelihoods.

Table 6. Frequency of farmers' perception of changes in vegetation composition over the previous 20 years.

		Observed changes (% farmers)							
	Number of farmers	Loss of valuable grasses	Increase woody species	Loss of valuable trees	Increase unpalatable grasses	Decrease basal cover	Increase invaders	Loss of basal cover	Loss of plant diversity
Grazing near homestead	17	35	41	12	6	12	12	0	0
Distant grazing land	26	42	15	27	23	4	4	8	4
Rivers and wetland	15	27	47	27	7	7	7	0	7
Tree and forest land	7	57	29	29	0	0	0	14	0
Grazing reserve	3	0	67	0	33	0	0	0	0
Cropland	9	33	11	11	11	33	11	0	0
Fallow land	15	27	7	27	20	0	27	0	0

Impacts on livestock

Dry season feed shortages. The primary impact of the changes was identified as livestock feed shortages, especially in the dry season. Shortages in dry season feed were viewed as having low to medium impacts on livestock, resulting in increased need for herd management as animals travelled longer distances to graze. The dry season feed shortages also created new expenses for farmers as there was need for supplementary feed resources mainly from crop fields.

Livestock mortality. The major cause for high livestock mortality was given as diseases in combination with the shortage of dry season feed resources. The negative impacts of feed shortages on livestock were seen as aggravated by a combination of factors such as disease outbreaks, as well as shortage of water or drought and failure of livestock services.

Impacts on livelihoods

Although the changes in the rangeland categories had low to medium impacts on livestock, they had high impacts on livelihoods. This is due to the fact that crop production, which is the primary livelihood activity, depends strongly on livestock inputs, particularly draught power. This means that, even though the impacts of degradation were considered to be low on livestock itself, the impact on livelihoods is seen as high due to the fact that weak animals cannot provide draught power. Unavailability of draught power reduces the area under cropping, leading to reduced harvests and eventually food insecurity. A weak livestock system translates into negative impacts on livelihoods at household level.

DISCUSSION

Results showed that farmers perceive rangelands not as one category of land but as various categories of land use and relate them to fodder supply for livestock. This is an important notion for outsiders, e.g. researchers, development or extension who aim at increasing the productivity of rangelands and their sustainable use.

There were widespread land use and production changes in the four sites that were studied in Nkayi District. Conversion of rangelands into croplands and for residential use was found to be widespread, affecting mainly rangelands that were previously managed as common property resources. The study shows that this was widely accepted by local institutions as a moral right to survival as the human population increases. This perception is also embedded in the historical struggle against the colonial state and its domination of the local communities (*uzibuse*). It is viewed as a positive development for household food security, economic survival and income growth, despite scientific views to the contrary (Scoones and Wilson, 1993).

Reduction of rangeland through conversions to cropland was not viewed as degradation although the changes significantly reduced the composition and production of rangelands, and therewith also its ability to provide goods and services (e.g. firewood, honey, thatching grass, wildlife, medicines, etc.). Rangeland was viewed as degraded if it had undergone long-term changes that result in a net loss of benefits

to the users. Rangeland degradation was, therefore, defined in terms of both economic and ecological factors, and economic factors were considered to be more important than ecological criteria alone.

The results also show that rangelands converted to croplands are not a total loss to the livestock farmer, but are available under a different management system and at different times. The land is used more intensively, fulfilling dual purposes at individual household and community levels. At individual household level, the converted rangelands fulfil food security needs through crop cultivation. At community level, the same land fulfils livestock feed needs during the dry season period. According to community views, this offers an advantage as such lands can be better managed than common property rangelands. Owners of rangelands that are converted to croplands have individual access to the land for cropping, and in that way have the right and motivation to invest in soil fertility, fencing and erosion control in order to maximize the benefits of higher crop yields to ensure food security (Cousins, 1987).

During the dry season, when croplands are used for grazing, the individual rights for cropping purposes give way to community rights to access the land for grazing. In other words, the individual cropland reverts to a common property resource where all livestock in the community are allowed to graze. Croplands are thereby managed as a dual property system with individual and community uses.

The results also show that these changes do not necessarily go along with a loss of plant diversity. Ecologically croplands provide pockets of key resources on which livestock depend during the dry season, e.g. contours harvest water during the rainy season that allows for growth of perennial species of high palatability and feed value (such as elephant grass). Due to the enclosure of croplands there is an increase in plant diversity and grasses in croplands can grow to full maturity, thus becoming a critical seed bank. This ecological process would not happen in continuously grazed common property rangelands.

As a result of the growing importance of croplands as dry season feed sources, new local institutions are being formed to govern their use for livestock grazing, whereas those governing the use of common property rangelands are decreasing or weakening in their application. The new institutions governing croplands determine the earliest date when livestock can enter the fields for grazing as a means to protect the crops from being damaged, and they also make sure that after the crops are harvested the croplands become available for dry season grazing of all livestock. Croplands are thus an important feed resource that is effectively controlled by the local institutions. It is further noted that not all rangelands converted to croplands are put under crops during all cropping years, and there is a general increase in the number and size of fallow fields. This offers new opportunities in the process of ensuring the availability of adequate dry season feed resources both in quantity and quality. The fact that the crop fields are controlled by individual households that are willing to invest in their development, as well as available to the community (at certain times of the year) places them in the frontier of new efforts to find lasting solutions to dry season feed shortages in communal areas of Nkayi District. This offers a plausible alternative to the grazing schemes that failed in their efforts to protect common property rangelands (Scoones

and Wilson, 1993). If fallow land can be used to produce fodder, then the communal rangelands can recover through long resting periods from grazing.

The impact of reduction in rangeland size, vegetation composition and production on livestock was generally viewed as low. Where moderate and severe impact is expected, it can be managed through a number of adaptive strategies at both individual household and community level (e.g. through herd movements and alternative feed sources). However, when combined with other factors such as drought, disease outbreaks, poor disease and herd management, the impact was viewed to be negative and beyond the management of communities alone. This means rangeland degradation can affect farmers' livelihoods severely due to the important role that livestock plays in providing inputs into crop production and ultimately food security.

The implications of reduced rangeland availability on water use efficiency need careful site-specific assessments. Changes in land use from grazing, tree and forest land to crop production can result in reduced water use efficiency and affect the water budget of the area negatively due to reduction of evapo-transpiration, increases in evaporation and erosion due to removal of the canopy effect, and run-off. This is especially the case when croplands expand into rangelands, and thus reduce valuable feed resources for livestock, while actual crop production also remains low. Interventions that promote crop production therefore need to enhance farmers' knowledge about water saving technologies, e.g. rain water harvesting, erosion control mechanisms as well as feed and fodder production to ensure sufficient feed quality for livestock. Improving the feed value of crop residues and using them as strategic feed during the dry season is an important strategy to raise the production of croplands, and if livestock mortality is also reduced this would also maintain more water in the system.

One also has to consider that the former Ndebele pastoralists have in few decades changed from a rangeland-based livelihood system towards a sedentary mixed crop-livestock system. This means a cultural change towards more individualistic forms of land use, but eventually greater challenges in collective action across larger areas of land. This makes it more important to improve the productivity and fertility of marginal soils.

CONCLUSIONS AND RECOMMENDATIONS

The major change affecting common property rangelands is the reduction in area through conversion into other land uses such as croplands and settlements. These land use changes are widespread in the study sites. User communities accept the land use changes and justify them as necessary for household food security and a guarantee of survival in times of difficulty. This acceptance has led to the emergence of new supportive informal institutions that are challenged to sustain a controlled use of croplands.

Communities in the study sites are faced with shortage of land, which is a critical production factor in the local economy. Based on experiential knowledge of ecosystem functions and factors affecting livestock production, communities devised creative adaptive management strategies that increase the intensity of land use. As a result of

this, rangelands are not one continuous land, but are divided into distinct parts that serve different purposes as demanded by the local production system. The resultant land use and land cover changes are not all negative. Some are positive as changes are multi-directional. Conditions of rangelands vary, but degradation is not widespread or severe as it only affects certain areas. Rangelands converted to croplands are not totally lost to livestock owners as the croplands continue to provide feed resources under a different management system.

It is recommended to increase common understanding of rangeland conditions, drivers and impacts between the local and policy levels, especially increasing the extent to which the official policy systems understand user community perceptions and farmer logic on which decisions are made.

There is a need to find innovative ways of improving the production of croplands through dual-purpose crops for humans and livestock. Dry season feed provision is a way of compensating for rangelands that are converted to croplands.

More individual land rights on crops combined with community use of the residues, supported and enforced by local institutions is an efficient way to support sustainable intensification of land use. Local institutions need to be informed and supported on how best to guide collective action of the feed utilization.

Acknowledgements. The authors would like to acknowledge the Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (BMZ) for funding this research through the IWMI-led project on 'Improving Water Productivity of Crop-Livestock Systems of Sub-Saharan Africa'.

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