Goat production and marketing: Baseline information for semi-arid Zimbabwe

International Crops Research Institute for the Semi-Arid Tropics

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Abstract

The role of livestock in rural communities is changing rapidly. Goats are increasingly used to augment cash income and enhance food security, thus serving as an important component in household's livelihood strategies, particularly in drought-prone areas. While much has been done to improve agricultural production in the small-scale sector, little is known and documented about the current state of goat production and marketing in the communal areas of Zimbabwe. This report aims to set a baseline of the current status of goat production and marketing in southwestern Zimbabwe.

The report illustrates the main functions of goats. Basic statistics describe goat ownership patterns with regard to the socioeconomic profiles of goat keepers, and the responsibilities of different household members in day-to-day goat management and marketing. The current productivity of goat flocks and seasonal trends are illustrated, indicating major challenges that farmers face in goat production and marketing. The report then provides a detailed description of the current management practices and existing marketing systems, and illustrates differences between districts, proximity to markets, flock sizes, levels of education and gender.

Goat mortality has been found to be the most important constraint. Farmers with few goats are unable to sustain their flocks, whereas those with larger flocks do not realize the potential benefits from goats due to high mortality rates. Poor access to animal health support, dry season feed shortages and inadequate housing are the most important immediate factors contributing to high mortalities and can generally be ascribed to a lack of information and poor service structures, both resulting from limited support given to the small stock sector by government and NGO support services.

The study also shows that although many farmers attempt to sell goats, markets are underdeveloped, infrastructure is inadequate and market information is not readily available. This results in poor confidence in markets, high transaction costs and low prices for goats. It is hypothesized that improved market access will act as an incentive for farmers to invest more in goat production. Market development is thus singled out as the next important step in further developing the goat industry in Zimbabwe.

Practical options to enhance the contribution of goats to food security and income growth are discussed, and priority interventions are recommended to service providers, development agents and policymakers in Zimbabwe.

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Contents

Foreword

Productivity of the livestock sector in the semi-arid regions of Zimbabwe is low, mirroring the circumstances in most of southern Africa. Poor infrastructure, underdeveloped markets, insufficient information and the lack of adoption of new technologies are among the factors contributing to poor performance. The livestock sector has great potential to generate income and guarantee food security, especially for the rural poor. But despite this potential, scant attention has been paid to understanding and improving it.

This report is the culmination of a one-year study that aimed to establish baseline information on one aspect of the livestock sector in Zimbabwe – goat production and marketing. Based on surveys of 825 farmers in six districts in the southwest region of the country, it captures the state of affairs where the action occurs – in the homesteads, at the farm gate, in the rural market place and the urban shopping center. Links between production, management and marketing are drawn out in detail and form the basis for a series of recommendations for potential interventions.

The information presented in this report is targeted at policymakers and other stakeholders/players seeking to redress the issues surrounding the improvement of the small stock sector. As goats in particular and livestock in general re-enter the development agenda, we hope that this report will contribute to the creation of practical solutions to the problems of enhancing livestock productivity in Zimbabwe and ultimately benefit the individual for whom it matters most – the small-scale livestock keeper.

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1. Introduction

Goats play a vital role in the livelihoods of small-scale farmers in developing countries. They contribute to food security and can alleviate seasonal food variability and availability – directly through milk and meat production and indirectly through cash earned from the sale of their products. In semi-arid areas goats have comparative advantages over cattle. Since they are more resistant to droughts, they utilize a wider diversity of plants and their higher reproductive rate allows populations to recover quickly. As browsers they use different vegetation than cattle and thus allow farmers to make more efficient use of the available natural resources. In addition, goats play an important socio-cultural role. Promoting goat production contributes to risk mitigation, particularly in drought-prone areas, and empowerment of vulnerable groups (women, HIV/AIDS, poor).

The role of livestock – including goats – in developing countries is changing rapidly. Increasingly, livestock and their products are being sold for cash. This is driven by the growing urban demand for livestock products, based on increased urban populations with higher incomes and associated dietary changes. Sub-Saharan Africa in general and southern Africa in particular are currently not benefiting from the so-called 'livestock revolution'. The productivity and offtake in small-scale production systems remain low in most of the region. The greater gap between demand and supply of livestock products has led various countries to import. For the national economies of these countries it is imperative to increase domestic livestock production and thereby reduce their dependency on animal imports. Small-scale livestock keepers in southern Africa could benefit from greater participation in the market economy, achieving higher incomes and improved food security.

Making the leap from subsistence farming to commercially oriented livestock production has been a development objective in the region for a long time, but has had very little success. Emphasis in the public sector was mostly on crop production, as this would ensure household food security, whereas support to the livestock industry was mainly aimed at animal health. Moreover, the support to the livestock sector in itself was biased towards commercial cattle production, with many countries pursuing beef exports to the European market. Small-scale cattle producers could not achieve the high standards required by these markets and were thereby excluded from trade and product development. Goats have been largely neglected on the development agenda, although most small-scale farmers keep them.

While improved livestock production and marketing can assist many rural households to escape the poverty trap, they will need to produce the right product, have access to information and support services, effective markets and the appropriate institutional support. Linking farmers to livestock markets remains a challenge in the current scenario in southern Africa.

The situation in Zimbabwe

The livestock sector previously contributed about 25% of the total value of the agricultural output in 1999, of which the communal areas contributed more than 50% (Agrisystems, 2000). Recent changes in Zimbabwe's land tenure policies have resulted in the dramatic decline of the country's agricultural capacity and low outputs of the livestock sector. With the demise of the commercial sector much of the public and private support services and input supplies are

weakened. Shortages and price escalations of farming inputs have added to the hardships for the small-scale sector.

However, in these challenging times, opportunities do arise. Commercial goat production has become an attractive opportunity in the semi-arid areas of Zimbabwe. The reduction of the commercial cattle herd (–75% from 1996 to 2004) led to higher beef prices and stimulated consumers to substitute it with goat meat (Sibanda, 2005). In the process, the retail prices of goat meat in urban areas have increased to a level comparable to that of beef. Goats offer small-scale farmers possibilities to create value-added products, such as graded meat, milk, skins and manure. Furthermore, small-scale farmers venturing into commercial goat production could benefit from established cattle market infrastructure and large abattoirs that currently function far below capacity.

On the production side, goats are common in most farming households, which own more than 90% of the national goat flock. As can be seen in this report, at least 40% of the households do not own cattle and complement their livestock resources with goats, donkeys, chickens, and, in very few cases, a limited number of sheep. The number of cattle per household, although seen as a highly valued asset, is prognosticated to further decline and farmers' opportunities to enter into commercial cattle production are therefore limited.

Although goats fulfill an important cash function, many farmers often do not realize these benefits. No formal markets for goats exist; infrastructure and access to market information are poorly developed. Farmers often have no other option than to sell their goats at the farm gate at very low prices. Therefore, they have very little incentive to invest in goat management and remain with low goat production. Could improved market access promote this golden opportunity for small-scale farmers to be incorporated into mainstream agriculture?

Need for baseline information

The challenges and opportunities that small-scale farmers face in goat production and marketing are poorly understood. Existing goat markets, market flows and the role of the market players are not documented and it is therefore difficult to develop effective marketing strategies. Little is known about farmers' goat management strategies and access to information and services. Against this background, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), in partnership with Department of Agricultural Research and Extension (AREX), Department of Livestock Production and Development (LPD), Desert Margins Program (DMP), and with support from Netherlands Development Organization (SNV), established baseline information pertaining to the existing goat production and marketing scenarios in six districts of semi-arid Zimbabwe.

The objective of this study is to characterize the socioeconomic situation of small-scale goat keepers, their flock production levels, the diversity of their management strategies (animal health, feeding, breeding, housing, watering), existing goat marketing infrastructure and strategies, and farmers' access to information and services as well as their priorities in development assistance. The study also determined the influence of socioeconomic household characteristics and market access on production and management investment.

The analysis of current production illustrates critical shortcomings in the annual production cycle and indicates opportunities for more focused targeting of development interventions. Future interventions need to be directed within the context of the farmers' socioeconomic profiles and priorities in goat production, as well as their capacity to invest in management and the relative returns on their investment. Determining the various sources of information in goat management and marketing illustrates the most effective channels of communication as well as the value placed on this information. Options for improved information dissemination could be directed by these results.

This study provides baseline information on goat production and marketing in southern Zimbabwe. Forthcoming publications will provide further insights on the determinants of farmers' management strategies and investment patterns, and the effects of improved goat markets. The recommendations are addressed to an audience of practical development agents, private business partners as well as policymakers for the design and implementation of appropriate support schemes. This work also contributes to objectives and partnerships within the Southern African Development Community (SADC) region, such as the ICRISAT/International Livestock Research Institute (ILRI) project on livestock and livelihoods, funded by Implementation and Coordination of Agricultural Research and Training/Competitive Regional Agricultural Research Fund (ICART/CRARF). Benefits from livestock production through improved management and input supply will be further evaluated with market development as the necessary incentive.

2. Research approach

2.1 Research sites

The surveys were implemented in six districts in the provinces of Matabeleland North and South in the semi-arid tropics of Zimbabwe. Three of the districts fall in natural region IV (Matabeleland North) and three are in natural region V (Matabeleland South), both characterized by low rainfall and with crop–livestock production systems as the most common form of land use (Table 1, Figure 1, Table 1 in Appendix).

Table 1. Research districts and their natural conditions.

Province	*District*	*Location*	*Agro-ecological region*	*Rainfall (mm per annum)*
Mat South	Beitbridge	22^0 13' South, 30 ^{0} 00' East	V	0–450
	Gwanda	20^0 56' South, 29^0 00' East		
	Matobo	21^0 3' South, 28^0 27' East		
Mat North	Binga	17^0 37' South, 27^0 20' East	IV	450–650
	Nkayi	19 ^{0} 00' South, 28 ^{0} 54' East		
	Tsholotsho	19 ^{0} 46' South, 27 ^{0}45' East		

Source: Steinfeld (1988)

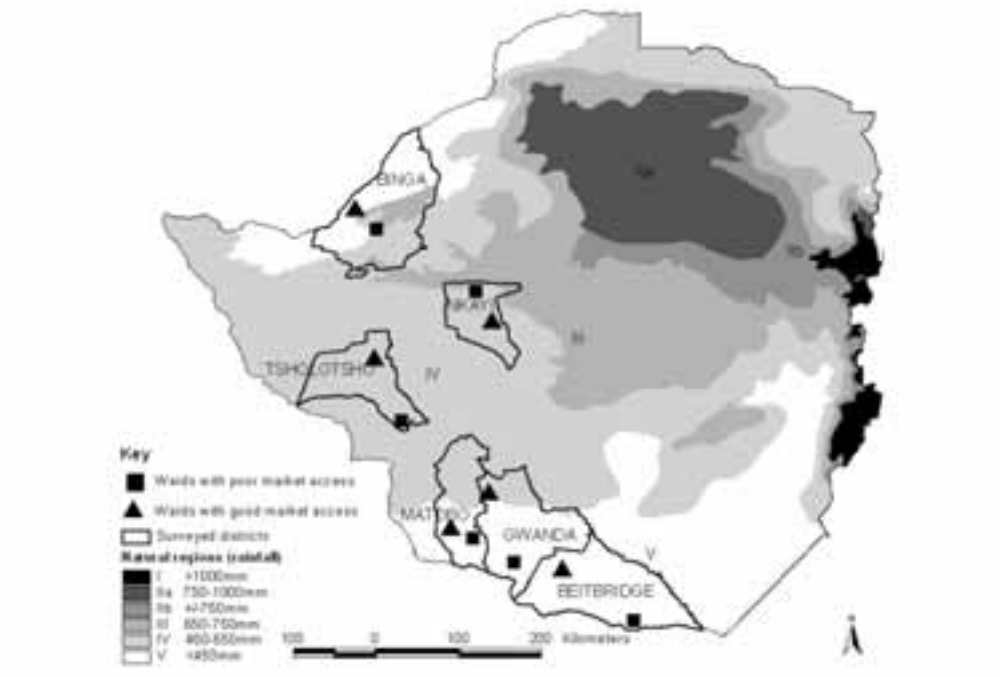

Figure 1. Agro-ecological zones of Zimbabwe and research sites.

Natural Region IV

A semi-extensive farming region with periodic seasonal droughts and severe dry spells during the rainy season. Low and variable rainfall restricts the potential for cropping, but farmers use large proportions of the land for cultivation, mainly maize, sorghum and millet. Livestock production is however most appropriate and can be intensified by growing drought-resistant fodder crops.

Natural Region V

An extensive farming region with very low and erratic rainfall and therefore unsuitable even for drought-resistant grain and fodder crops. Farming depends on the utilization of rangelands. Extensive livestock production is most appropriate; however, farmers still try to grow crops especially maize, sorghum and millet.

Soils, vegetation and water

The most common type of vegetation in the semi-arid areas of southern Zimbabwe is sweet veld, with comparatively high nutritional value of browse and annual grass species (Gambiza and Nyama, 2000). If managed well the rangelands should be able to meet the nutritional requirements of goats and other livestock (Table 2). However, significant proportions of the rangelands are degraded, resulting in low biomass and thus limited feed resources of poor quality particularly during the dry season.

Groundwater resources provide most of the domestic and livestock water supply. There are many boreholes, but they are highly variable in distribution and often of low yields and poorly maintained. Rivers provide a large proportion of surface water, but the flows are seasonally and

Table 2. Selected districts and main types of natural vegetation.

	Woodland types	*Common grass species*
Beitbridge	*Terminalia sericea* and *Burkea Africana*, *Colophospermum mopane*	*Eragrostis* spp., *Digitaria* spp., *Heteropogon contortus*
Gwanda	*Colosphospermum mopane*, *Combretum* spp., *Acacia* spp., *Boscia* and *Grewia* spp.	*Aristida* spp., *Panicum* spp.
Matobo	Miombo woodlands, *Colophospermum mopane*, *Acacia* spp., *Combretum* spp.	*Pogonathria squarrosa*, *Sporobolus stapfianus*, *Heteropogon contortus*, *Andropogon gayanus*, *Digitaria velutina*, *Eragrostis superba*
Binga	*Julbernardia globiflora*, *Brachystegia boehmii*, mixed deciduous woodland, *Combretum* spp., *Colosphospermum mopane*, *Adansonia digitata* (baobab)	*Aristida* spp., *Eragrostis rigidia*, *Heteropogon contortus*, *Ischaemum brachyatherum*, *Dichanthium papilosum*, *Perotis patens*
Nkayi	*Combretum apiculata*, *Pterocarpus* spp., *Sclerocarya caffra*	*Aristida* spp., *Eragrostis rigidia*, *Heteropogon contortus Chloris virgigata*, and *Sporobolus* spp.
Tsholotsho	*Baikiaea* spp. (teak), *Terminalia* spp., *Combretum* spp., *Colophospermum mopane*, *Acacia* spp.	*Aristida* spp., *Enneapogon* spp., *Eragrostis* spp.

Source: Botanical Gardens, Harare, personal communication.

inter-annually variable, depending on rainfall. Constructed dams supplement the water supply in various areas (Chenje *et al.*, 1998).

Livestock production

Livestock production contributes 15–20% of the total value of agricultural output, playing an important role in the economy. More than 50% of the cattle and almost all goats are kept in the communal semi-arid areas, thus contributing directly to the welfare of households in those areas (Agrisystems, 2000).

Populations and densities of cattle and goats differ across districts, according to different agro-ecological suitability (Figure 2, Table 3). Total cattle populations and densities are higher in Matabeleland North, except in Binga where there is high tsetse infestation, than in Matabeleland South. Goat populations are highest in Binga followed by Beitbridge and then Tsholotsho. Goat densities are highest in Binga and Tsholotsho, but low in Nkayi and Beitbridge (DVS, 2005).

In communal areas, cattle are mainly kept as sources of inputs for subsistence crop production (draft power and manure) as well as for milk. Less than 15% of households keep more than 10

Table 3. Goat and cattle population densities in selected districts in Matabeleland, 2005.

Population density (n km^{-2})	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Cattle	53	62	120	77	231	139
Goats	95	117	108	283	65	153

Source: Livestock statistics, DVS, 2005.

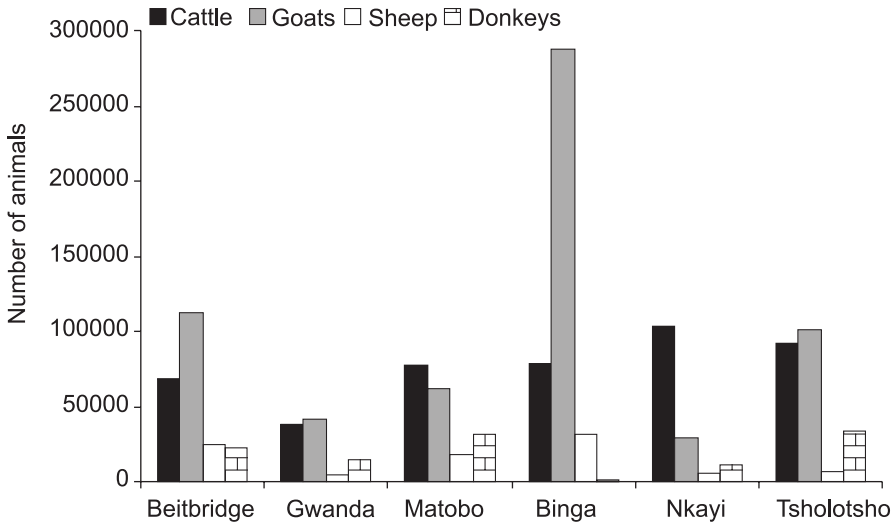

Figure 2. Livestock populations in selected districts in Matabeleland 2005.

Source: Livestock statistics, DVS, 2005.

cattle, which is not enough to commercialize (Hargreaves *et al.*, 2004). Unlike cattle, goats do not contribute to the cropping system and farmers are therefore more willing to dispose of them (Mhlanga *et al.*, 1999).

With many households owning few animals, grazing management is often poorly coordinated, and livestock thereby contributes to rangeland degradation. Recommended stocking rates are 8 ha TLU^{-1} for Natural Region IV and 12 ha TLU^{-1} for Natural Region V, but the current stocking rates are much higher at 3.5 and 4.6 ha TLU^{-1} respectively (LADAC, 2005).

Livestock and market development

Livestock in communal areas has a strong potential to significantly contribute to household income because of an increased demand for livestock products in urban and rural areas (the livestock revolution) (Delgado *et al.*, 1999). In Zimbabwe, beef production, formerly the bulk of livestock industry, has declined substantially and this contributes to a shortage in supply and higher prices (van Rooyen *et al.*, 2007). The fast track land reform caused a reduction of the commercial cattle herd by 75% from 1996 to 2004, while the communal cattle herd increased by 44%, but is of comparatively low productivity. Goat populations in the small-scale farming sector also increased (Sibanda, 2005). Prices for goat meat are now comparable with beef, offering opportunities for small-scale goat farmers to enter commercial markets.

Apart from recurrent droughts and unfavorable economic conditions, the small-scale farming sector is weakened by underdeveloped market infrastructure, extension services and information systems. Formal market facilities, organized and run by local authorities, are better established for cattle, with six to eight cattle sale pens within each district. Local collection points run by individuals and traders provide alternative market opportunities. Most cattle are sold to abattoirs

in Bulawayo and the beef is then sold to urban retailers and butcheries. No formal market facilities exist for goats and most farmers rely on farm gate sales. In a few areas traders use basic holding facilities to buy goats at cattle sale pens or they communicate through local authorities to announce their intention to purchase goats at collection points. Traders either sell the goats to urban butcheries that use the service slaughter facilities of a few abattoirs or directly to consumers at informal peri-urban market places (Figure 3).

Discussion with livestock market participants (traders, abattoirs, butcheries, retailers) revealed major shortcomings along the market chain of both cattle and goats: lack of information on consumer preferences and markets, shortage of slaughtering and processing facilities in urban and rural areas, high transaction costs and difficulties in accessing markets, all of which ultimately contribute to low prices for the farmer.

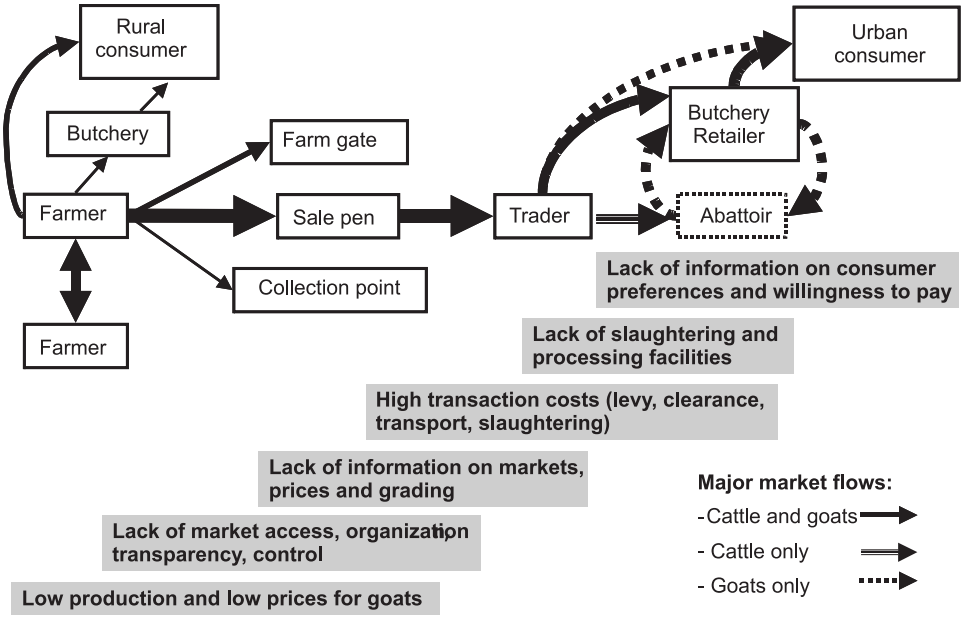

Figure 3. The market chain of cattle and goats in Zimbabwe and most critical constraints.

2.2 Methods

The baseline data collection was done in three phases: a reconnaissance survey (September–October 2005), an in-depth household survey (April–May 2006) and feedback and verification sessions with the communities (May 2007). First a series of informal discussions was held with various key players in goat production and marketing (farmers, traders, processors, AREX, LPD, Department of Veterinary Services (DVS), feed industry). Formal data on goat and cattle sales were collected from the DVS and Rural District Councils (RDC). Based on the information on goat production and market potentials, six districts were selected for the second phase consisting of a household survey.

The household survey, which informs the bulk of this report, was then designed, implemented and analyzed by collaborative efforts of ICRISAT, AREX/MRS, LPD, DMP, and SNV. The basic research tool consisted of a structured household questionnaire with open and closed

questions. Key informant discussions were held with AREX and DVS officers, councilors, dip tank attendants, and village and kraal heads to complement the information gathered from the household survey. Two teams collected the data in three districts each (AREX/MRS, LPD, DMP and SNV in Binga, Gwanda and Matobo and ICRISAT in Beitbridge, Nkayi and Tsholotsho).

Questionnaire development

The development of questions was guided by the underlying hypothesis that farmers would invest more in goat management, and thus achieve higher production and cash income from goats, if goat markets were further developed. A better understanding of farmer profiles, and interactions between goat management diversity and marketing patterns was needed. The questionnaire therefore contained the following modules:

- Socioeconomic household characteristics
- Livestock inventory and flock dynamics
- Goat management and investment strategies (feeding, health, breeding and husbandry, housing, watering)
- Goat marketing (market options and sales)
- Prioritization of development assistance

Enumerator training and pre-testing

A group of eight enumerators experienced in data collection and/or with a livestock production background was employed to implement the field survey. Together with their supervisors they went through a three-day training workshop, facilitated by ICRISAT. The objectives of the training were to explain the purpose of the survey and role of the enumerators, to familiarize the participants with the questionnaire and assess the feasibility of the research tool and procedure. The training therefore involved the following components: (1) background on survey purpose, (2) communication and conduct, (3) explaining the questions, (4) translation of questions into Ndebele, (5) pre-test of the questionnaire, pair-wise and in the field, (6) evaluation of the pre-test and modification of the questionnaire, and (7) evaluation of the training workshop.

District and household sampling procedure

The six districts were selected based on cattle and goat production potential, as evaluated by a preceding reconnaissance survey consisting of informal discussions with abattoirs and traders in Bulawayo as well as farmers and government officials in various districts. Existing working experiences in rural development were also considered (Table 4).

The districts differ in their distance from Bulawayo, the principal regional livestock market, implying different market accessibilities (Table 5). The average human population densities were higher in districts with higher annual rainfall, creating a higher pressure to intensify land use. Binga is an exceptional case, with low human population density despite higher rainfall, and this is mainly because of the remoteness of this district and infestation with tsetse flies.

Table 4. Criteria for district selection.

	Criteria for selection
Beitbridge	High potential and good quality in cattle and goat production. Severe dry season feed shortages require import of feed resources. Smallholder Dry Areas Resource Management Project (SDARMP) worked in this district.
Gwanda	High potential and good quality in cattle and goat production. Dry season feed shortages and limited potential for intensified feed production. ICRISAT is working in this district. Experiences with livestock feeding in farmer field schools (FFS). SDARMP worked in this district.
Matobo	Good potential and quality in cattle and goat production. Dry season feed shortages and limited potential for intensified feed production. ICRISAT and DMP are working in this district. Experiences with livestock feeding in FFS.
Binga	High population of goats that are however of small body size. The area is very remote, with few development interventions. ICRISAT is working in this district.
Nkayi	Good potential in cattle production but low goat production despite abundant feed resources. ICRISAT is working in this district.
Tsholotsho	Good potential in livestock production and more intensive feeding. ICRISAT and DMP are working in this district. Experiences with livestock feeding in FFS.

Table 5. Selected districts, distance from Bulawayo, demographic information and sample size.

	Distance from Bulawayo (km)	*Number of wards*	*Number of villages*	*Human population density (n km^{-2})*	*Number of survey respondents*
Beitbridge	322	18	90	78	135
Gwanda	126	23	120	118	151
Matobo	120	25	na	153	152
Binga	445	21	99	117	123
Nkayi	158	25	150	249	124
Tsholotsho	120	20	120	181	140

Note: na = not available

To account for different market accessibility within districts, wards were classified according to good and poor market access. Government officials were then requested to randomly select one ward from each category.

All villages were listed for each of the selected wards. The average number of villages per ward was six with an average of 200 households each. Three villages were then randomly selected from each ward.

For the selection of households, village heads were requested to compile listings of goat owners within their village. At least 10% of the total number of households was then randomly selected per village. The selected households were identified with the assistance of AREX officers or kraal and village heads.

Questionnaire administration

The teams of enumerators and supervisors first informed local leadership about the survey in preparation for the household samplings. Enumerators then interviewed farmers at their homesteads, and, in the event of community gatherings, at such places. Farmers were encouraged to discuss their responses with family members. Each interview lasted about an hour, and five to six interviews were done per day per enumerator. Supervisors checked the completed questionnaires on the same day, which allowed for immediate correction of errors and deficiencies. A group evaluation of the whole exercise was conducted at the middle and end of data collection in each district.

Data coding, entry and cleaning

All responses in the questionnaires were post coded and variables and value labels for statistical analysis were defined. Two data entry clerks independently entered the data in SPSS DE Dos Version, chosen for its user friendliness. The two sets of data files were merged in Excel. Subtraction of one data set from the other revealed non-zero values as errors. Identified errors were corrected using the original questionnaires. The cleaned raw files were thereby made ready for analysis.

Data analysis and report writing

The data were divided into thematic areas. The responsibility for initial statistical analysis was divided according to the expertise of each partner. SPSS (version 10.0 and 11.0) was used for the statistical analysis and Excel for graphing.

All partners discussed the descriptive results and contributed to the development of a structure for the report. Groups with relevant expertise wrote the respective sections and all authors then revised the entire report.

Feedback to communities

After data analysis and writing of a draft report, one-day feedback workshops were organized at both wards in three of the six selected districts, representing different profiles in goat marketing. In Gwanda goat markets were comparatively better developed, Matobo was transitional and in Tsholotsho goat markets were less developed. The objectives of the feedback workshops were to share major information obtained from the survey with the farmers, discuss the data and implications for development within the local contexts, and thereby validate the research findings.

Government officials, local authorities and farmers were mobilized for the workshops a week in advance. Letters were prepared for AREX, LPD and DVS at district level, as well as for the local authorities (Chief Executive Officers (CEO) and village heads), to inform them about the workshops and ask for their assistance in preparing the workshops. They were requested to recruit five to seven farmers who participated in the survey for each of the three villages involved. Between 13 and 50 participants attended each workshop.

The workshops started with a welcome and introduction of the participants, followed by prayer, brainstorming of participants' expectations and rules for communication. The survey findings were illustrated using Microsoft Powerpoint presentations on key findings, with graphs and percentages on specific facts. The presentations were altered by short discussions about the validity of the respective figures and eventually discrepant perceptions. Final discussions brainstormed farmers' priorities for investments in goat production and marketing.

3. Findings of the study

This section describes the role of goats within the specific socioeconomic and geographic context for different household profiles. Based on this description, key issues in goat production and marketing, as well as location-specific differences are addressed.

3.1 Socioeconomic household characteristics

In this section, farmers' reasons for keeping goats, particularly the cash income function of goats, are presented. Goat distribution and ownership is analyzed for various socioeconomic household profiles. Decision-making and labor investments within households are demonstrated for different goat management components. This provides a better understanding of households' predisposition towards goat production and their potential for increasing offtake rates.

3.1.1 Farmers' reasons for keeping goats

Most farmers (53%) depended on on-farm activities for their main source of cash income, compared to off-farm activities (37%) and non-farm activities (10%).[1] This is a strong indication that farmers need to diversity income generation and cannot make a living from on-farm activities alone. Livestock was the most important source of cash income for the majority of households (Figure 4). Vegetables, remittances, labor sales, field crops, forest products, manufacturing, alcohol brewing, trading and others contributed to a esser extent.

After livestock, the priorities of other sources of cash income differed across districts (Figure 1 in Appendix). Vegetables were second most important in Matobo, Gwanda and Binga. Remittances were second most important source of cash income in Tsholotsho and Beitbridge, probably due to strong links with relatives working in South Africa. In Nkayi, field crops were second most important, probably due to better agro-ecological conditions. Matobo, followed by Beitbridge, had a high proportion of farmers who derived cash income from forest products, such as Mopane worms. In Binga, the contribution of other sources of cash income was substantial (mainly due to fish sales).

Farmers indicated the multiple functions of goats but the majority ranked cash income as the most important (Figure 5). Cash income was followed by meat, milk and manure. The functions of goats however differed across districts. Cash income was considered to be most important in Beitbridge, Binga, Gwanda and Matobo. Meat was more important in Tsholotsho and Nkayi.

1 On-farm cash income is biophysical related income, eg, livestock, field crops, vegetables. Non-farm cash income is non-biophysical related income carried out on the farm by family members, eg, alcohol brewing and manufacturing. Off-farm cash income is from outside the farm gate, eg, remittances, labor, forest products, and trading.

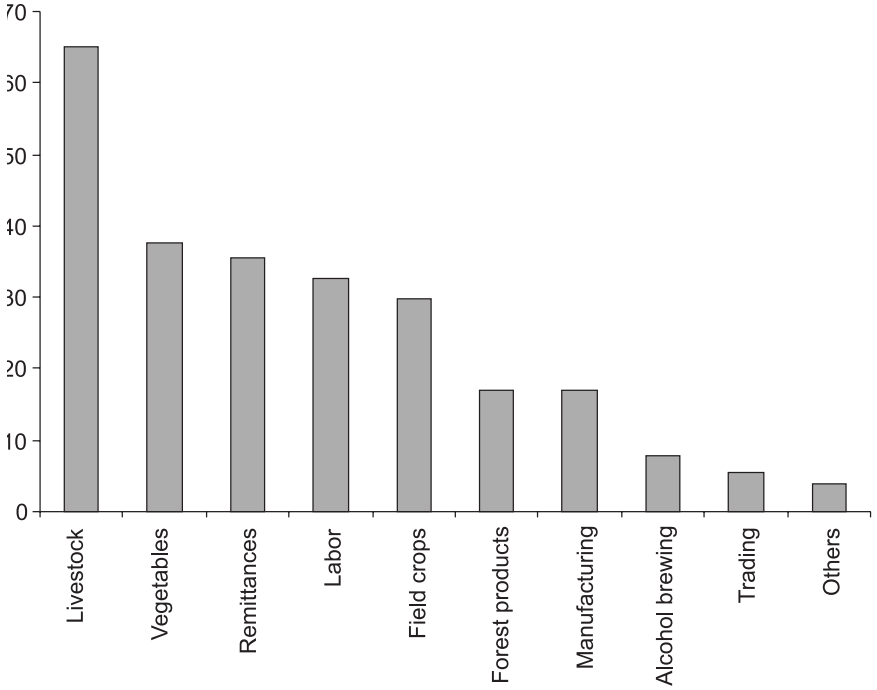

Figure 4. Main sources of cash income for farmers across the selected districts.
Note: Other sources of cash income comprised fish sales, faith healing, gold mining and transport.

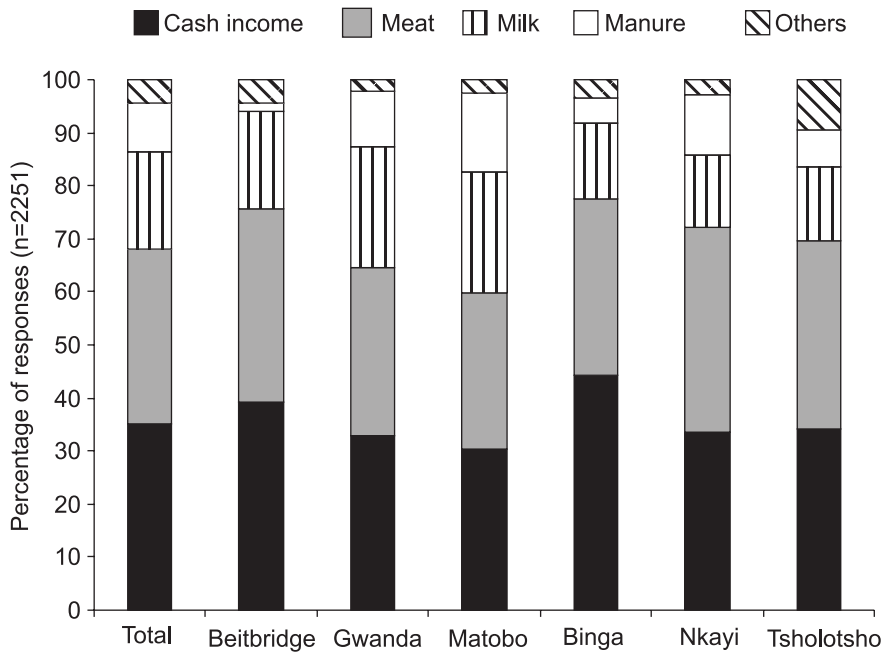

Figure 5. Main functions of goats.
Note: Others encompass ceremonies, prestige, skins and exchange functions.

The next logical question is: what do farmers do with the cash earned from goat sales? Cash from goats was primarily spent on food purchases and payment of school fees, followed by human health fees, farming, drought-coping strategies and clothing-related expenses (Figure 6). Other expenditures included restocking, housing, transport, water, labor, death/funeral, ceremonies, helping others, paying fines and savings. The feedback sessions further explained that better off farmers can sell their goats more voluntarily and have more options to spend their income from goats, whereas poor farmers depend on cash from goats to purchase food items, and sometimes have to sacrifice education for that. Goats thereby contribute directly and indirectly to food security, education and social welfare. The importance of goats particularly for the livelihoods of resource-poor farmers cannot be overemphasized.

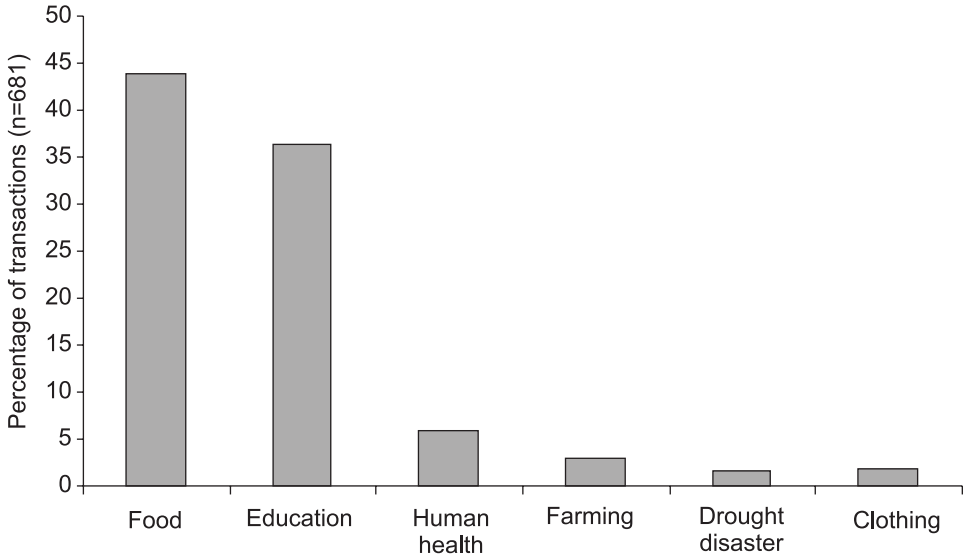

Figure 6. Expenses covered by sales of goats across the selected districts.

A further question would be whether or not farmers plan goat sales in advance as opposed to selling in distress? Most goat sales were to cover expected expenses (80%), whereas only 17% of farmers sold goats to cover unexpected expenditures. Two percent of farmers stated that they used sales as a culling method and less than 1% sold goats because it was their business. Thus, to a certain extent, farmers can plan their expenditures.

Distribution of goats and other livestock assets

Goat flock size categories were created, separating the owners of less than 9 goats (51%) from those with 9 to 19 goats (34%), and those with 20 or more goats (15%) in order to differentiate investment patterns by flock sizes. Figure 7 demonstrates that, although the majority of households fall in the category with few goats, the total volume of goats owned by farmers stems from farmers with large flocks. This implies that the few farmers with large flocks provide the biggest share of goats available for production and sale. The unequal distribution of goats suggests the need for a deeper investigation into goat ownership patterns at the household level.

Goat flock sizes

Goat flocks were generally small in the selected districts, with a high variability between households (Figure 8). Twenty-five percent of the households owned less than 6 goats, 25% owned between 6 and less then 9 goats and 25% owned between 9 and less than 16 goats. The remaining 25% ranged from 16 to 151 goats.

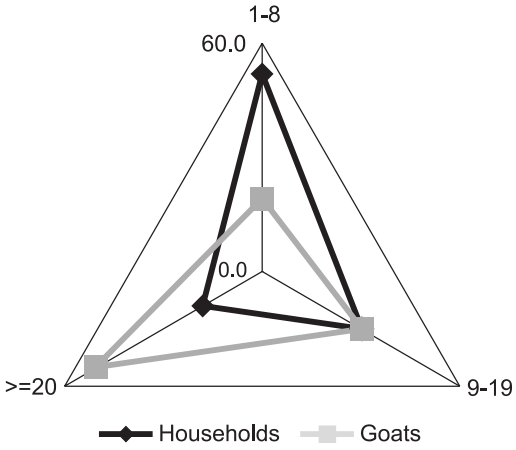

Figure 7. Distribution (%) of households and goats by flock size categories across the selected districts.

The size of goat flocks differed across the selected districts (median test, $p<0.01$; Figure 9). Districts in Matabeleland South had more goats per household than those in Matabeleland North (median test, $p<0.01$). The median flock size[2] was highest in Matobo (15), followed by Beitbridge (10) and Gwanda (8). Gwanda district also had the highest maximum number of goats (151) found during this study (Table 2 in Appendix), whereas median flock sizes were smaller in Nkayi (7), Binga (6) and Tsholotsho (5). Although the median flock size was comparatively low in Binga, the mean (13) and maximum values (105) were high, indicating a greater variation in goat numbers between households.

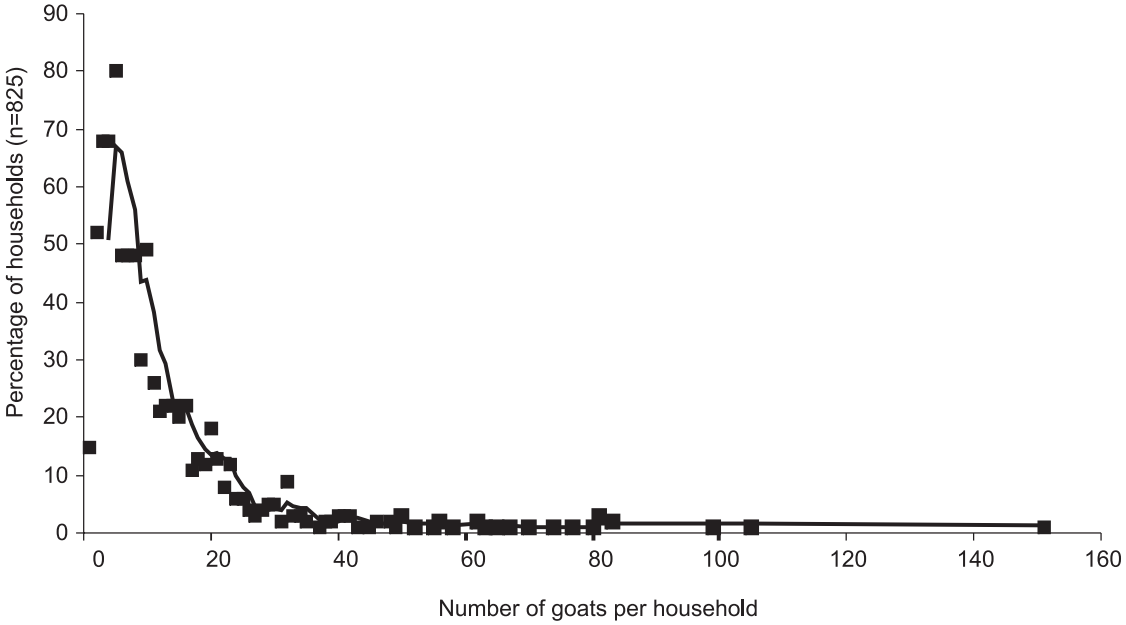

Figure 8. Goat flock size frequencies across the selected districts.

Flock sizes also differed according to market access (median test, $p<0.05$). Generally, more households had flock sizes above the median and thus bigger goat flocks in wards with poor

2 Median represents the more realistic distribution of goat flocks, the influence of outliers is less than when calculating the mean. To illustrate the flock potential, the maximum was included.

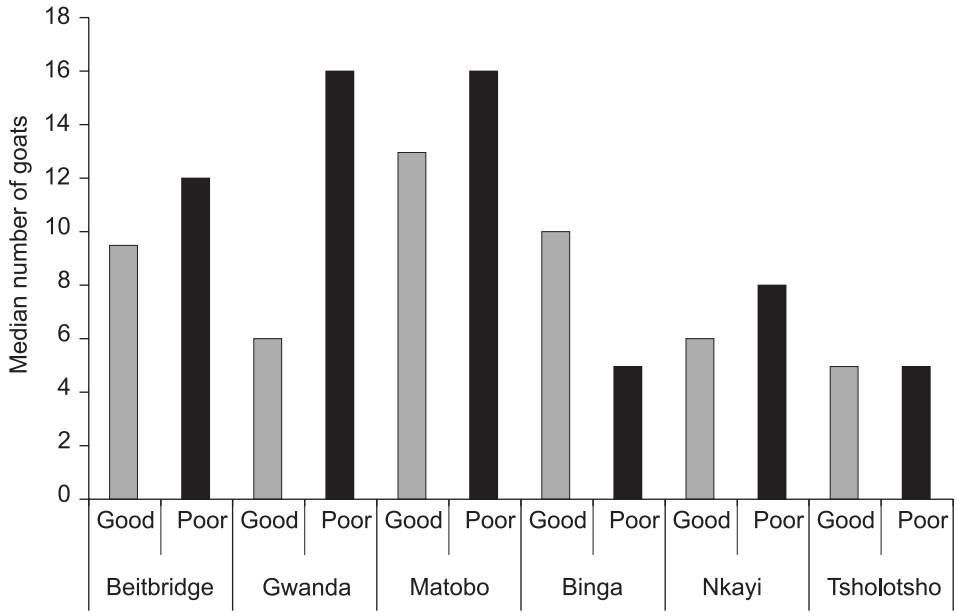

Figure 9. Goat flock sizes by market access.

market access. Yet, at the level of each district, the differences were only significant for Gwanda (median test, $p<0.01$), Binga (median test, $p<0.05$) and Nkayi (median test, $p<0.05$).

Cattle herd sizes

On average 39% of the households did not own cattle (Table 6). This supports the importance of goats as a source of food security and income for small-scale farmers. The frequency of cattle owners differed across districts (χ^2, $p<0.01$) and was lower in the districts in Matabeleland South (χ^2, $p<0.01$).

Table 6. Percentage of households that do not own cattle.

Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
38.9	43.7	49.0	47.4	40.7	19.3	31.5

Cattle herds were also small and variable between households. Among the cattle owners, 25% of the households owned less than 3 head of cattle, 25% owned between 3 and less than 6 head of cattle and 25% of the households owned more than 10 cattle. The remaining 25%, those with a potential for commercialization, ranged from 11 to 51 heads of cattle.

Cattle herd sizes also differed across the selected districts (median test, $p<0.05$, Table 7). More households below the median cattle herd size and a higher variability in herd size was found in Matabeleland South (median test, $p<0.05$).

Table 7. Mean cattle herd sizes.

	Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Mean	8.1	8.9	6.6	7.9	11.1	8.2	6.4
Std. Dev.	8.0	10.7	6.9	9.7	9.1	5.5	4.6

Livestock holding categories

Decisions on resource allocation are usually made based on the number of cattle rather than goats. Therefore, livestock holding categories were created based on cattle ownership.[3] Table 8 shows the distribution of households across these categories. Table 3 in the Appendix shows the comparison between districts. Households with cattle kept on average more goats than those without cattle (median test, $p<0.01$). Furthermore, a significant correlation was found between the number of cattle and goats among cattle owners (Pearson correlation coefficient 0.442, $p<0.01$).

Table 8. Percentage of households and mean goat flock sizes in different livestock holding categories.

	1	*2*	*3*	*4*	*5*
Livestock holding categories	*0 cattle, ≤ 8 goats*	*0 cattle, ≥ 9 goats*	*1–2 cattle*	*3–7 cattle*	*≥ 8 cattle*
Percentage of households	23.9	15.0	12.4	25.5	23.3
Mean number of goats (Std. Dev.)	4.4 (2.0)	19.0 (13.5)	9.4 (7.2)	10.9 (9.5)	20.9 (21.5)

Other livestock species

Farmers keep multiple species of livestock (Table 2 in Appendix). Among the selected goat owners, 88% also kept poultry (median 8). Fifty-five percent of the households kept donkeys (median 2). Only 14% of the households kept sheep.

3.1.2 Determinants of goat ownership

Goat ownership patterns with regard to households' headship, age and educational level of household heads were analyzed (Table 9).[4] In addition, the influence of these socioeconomic characteristics was determined for their effects on livestock holding and goat flock size categories.

3 Households without cattle are usually considered to be the poorest of the poor, yet some of these households keep a considerable number of goats. Therefore, households without cattle and less than eight goats (50 percentile in terms of goat numbers) were separated from those without cattle but more than eight goats. Households with cattle were split according to the 25, 50 and 75 percentiles resulting in thresholds of less than 2, 3–7 and more than 7 cattle respectively.

4 Tables 4–6 in the Appendix show the distribution of household categories in terms of headship, age and educational level across districts.

Table 9. Mean goat flock sizes by socioeconomic household characteristics

	Mean	*Std. Dev.*	*Median*	*n*
Household headship				
Male	14.1	15.8	9	555
De facto female	10.6	12.0	7	80
De jure female	9.5	9.2	7	185
Child	7.3	3.3	6	4
Median test	$p<0.05$			
Age				
40 yrs and below	10.9	11.9	7	184
41−60 yrs	13.5	16.0	8	367
More than 60 yrs	12.8	13.3	8.5	270
Median test	ns			
Education				
Illiterate	10.5	11.5	6	107
Primary education	12.1	13.0	8	430
Secondary education	14.7	16.9	10	246
Advanced/tertiary	13.2	20.4	8	22
Median test	$p<0.05$			

Note: ns = not significant

Household headship

Male-headed households kept larger goat flocks, followed by *de facto*[5] female-headed households. Households with a male component seemed better off in terms of goat ownership than *de jure* female-headed households or child-headed households, the latter thus being more vulnerable. However, flock sizes in male and *de facto* female-headed households were more variable and few big flock sizes caused the high means.

Similar trends were found in the livestock holding categories (χ^2, $p<0.01$). More male-headed households were found among the cattle owners (categories 3 to 5), and the greatest male component was with farmers who have more than eight cattle (category 5). *De jure* female-headed households were most frequent for households without cattle (category 1 and 2). Of all *de jure* female-headed households, 36% were in the relatively poor category 1, indicating a highly vulnerable population. Comparison across goat flock size categories shows that male-headed households were most frequent in the category with big flocks and the proportion of female-headed households significantly lower (χ^2, $p<0.05$).

Age of household heads

There was a trend that younger heads of households kept fewer goats, although the effect of age on flock ownership was not statistically significant. Heads of households within the age group of 40 years and below tended to keep smaller mean flocks. At this age, households built up their goat flocks and were using them for sustaining family needs. Older household heads seemed to

5 *De facto* female-headed households are defined as those who have a male component, though temporarily absent. *De jure* female-headed households do not have any male component (widow, single women).

use their goat flocks as an informal pension facility or maintained the flocks for younger family members. Similar trends were observed for livestock holding categories.

Educational level of household heads

Education had a positive influence on goat ownership. Household heads with a basic level of education (literate) kept more goats, especially those with secondary education. Across goat flock size categories illiteracy was highest for households with small flocks.

The trends for livestock holding categories were similar in that literacy rates were higher for households that owned cattle (χ^2, $p<0.05$). However, the effect of education on livestock holding categories and flock size categories was not significant.

3.1.3 Goat ownership patterns within households

Various members of a given household own goats.[6] Most owners of goats were fathers (41.7%), followed by mothers (35.8%), sons (13.9%), daughters (5.9%), and extended family members (2.7%). Goat ownership has a strong gender component as many women in all districts owned goats. The fact that sons and daughters owned goats underlines the importance of addressing the young generation as custodians of goats for improved management.

Decision making and labor in goat management

All family members contributed to the decision-making process and labor with regard to goat production (Figures 10 and 11). Fathers and mothers made the majority of decisions on goat management and sons were also involved. Fathers were more involved in decisions about health, slaughter and sales; however, mothers also decided in all aspects of goat management. It is

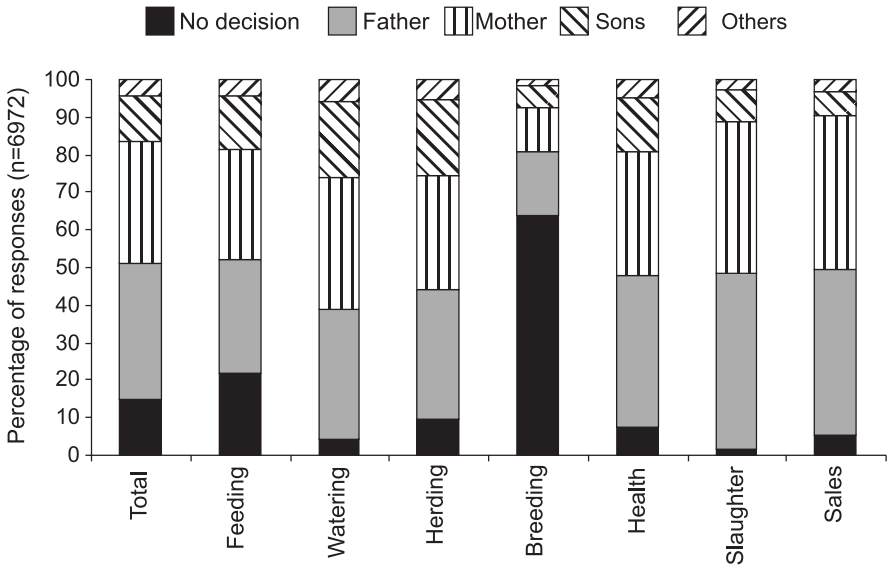

Figure 10. Decision making by management component.

Note: 'Others' encompasses extended family members, daughters and hired labor.

6 Data collection captured family members' involvement in goat ownership, as well as decision making and labor invested in different goat management components.

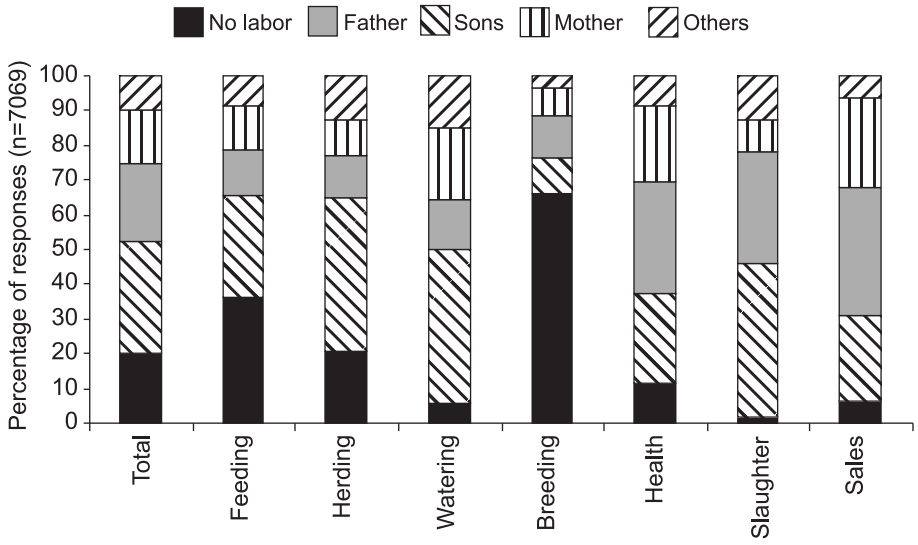

Figure 11. Labor by management component.

Note: 'Others' encompasses extended family members, daughters and hired labor.

important to note the high proportion of mothers were involved in decisions on slaughtering (nutrition) and sale (income). Targeting women in goat production therefore contributes to improved household nutrition and income.

In terms of labor, sons were generally more involved than fathers and mothers. They provided more of the labor for feeding, herding, and watering than other family members. Fathers and mothers provided more labor to animal health and sales and fathers and sons provided most of the labor for slaughter. Extended family members and hired labor were not involved in making decisions but provided labor, particularly for herding, watering, health and slaughter. This shows mutual assistance, despite no ownership.

An important observation is that a significant proportion of farmers did not make any decisions or invest labor in goat management. Farmers exercised little control, particularly with respect to feeding and breeding, but relied on communal resources instead. More than 60% of the farmers did not actively manage breeding and more than 20% were not active in feeding. Addressing these two management aspects could have huge returns by reducing mortality and increasing the productivity of goats.

3.2 Flock productivity

Flock composition and dynamics provide simple information about farmers' existing goat resources and their productivity. Flock composition indicates farmers' priorities in breeding

and the reproductive performance. Flock dynamics indicate the major constraints in production for specific areas for a certain time period.

3.2.1 Flock composition

Goat flocks in the selected districts were comparable to those typically found in semi-arid livestock-based production systems.[7] The flocks consisted mainly of breeding females (63%), followed by kids (26%), castrated males (6%), and bucks (5%). By keeping many breeding

Table 10. Ratios and percentage of goat flock composition by district.

	Breeding females/ intact males		*Births/breeding females*		*Kids/breeding females*		*Castrated males (%)*	
District	*Mean*	*n*	*Mean*	*n*	*Mean*	*n*	*Mean*	*n*
Total	7.3	274	75.5	617	57.7	599	17.5	281
Beitbridge	7.9	49	73.8	103	62.3	84	16.5	57
Gwanda	9.2	46	73.5	114	50.1	121	16.8	54
Matobo	9.8	47	72.9	110	64.1	137	15.8	78
Binga	8.8	32	94.8	92	67.5	83	16.3	18
Nkayi	4.6	67	76.8	117	50.8	102	16.8	32
Tsholotsho	4.1	33	60.5	81	51.6	72	23.9	42
Median test sign	$p<0.01$		$p<0.05$		$p<0.05$		$p<0.05$	

females farmers emphasize reproduction and herd building. The ratio of breeding females per intact buck was low, indicating underexploitation of the male breeding potential, particularly in Nkayi and Tsholotsho (Table 10).

Reproductive performance was also low. Twenty-three percent of households did not experience kidding during the observation period, despite the high proportion of breeding females. Among households with kidding, births per females[8] were on average 76%, below the 100% fecundity rate that is usually found in communal areas. The rate of kids per females was only 58%, indicating significant kid mortality. These ratios differed between districts. The number of births per females was lowest in Tsholotsho and highest in Binga. The number of kids per females was lowest in Gwanda and Nkayi, and again highest in Binga. Thus, the reproductive performance of flocks in Binga is comparatively good, whereas performance is rather poor in Tsholotsho. Gwanda and Nkayi have high kid mortality rates.

Farmers with large flock sizes kept comparatively more breeding females per buck than those with small flocks (Table 11). These farmers can better exploit the male breeding potential of their herds. It is important to note that relatively few farmers with small flocks kept bucks, thus relying on external bucks for mating. The fact that the ratios of births and kids per females were highest for farmers with large flocks indicates that they are more effective in reproductive

7 Otte and Chilonda (2002) report that in traditional semi-arid mixed systems in sub-Saharan Africa the proportion of female goats ranges from 67 to 75%.

8 The proportions were calculated by dividing the number of births during the observation period by the number of breeding females at the beginning of the observation period.

Table 11. Ratios and percentages of goat flock composition by flock size category.

Goat flock size category	*Breeding females/ intact males*		*Birth/breeding females*		*Kid/breeding females*		*Castrated males (%)*	
	Mean	*n*	*Mean*	*n*	*Mean*	*n*	*Mean*	*n*
Total	7.3	274	75.5	617	57.7	599	17.5	281
1–8 goats	2.8	83	78.6	303	59.1	256	26.8	66
9–19 goats	6.0	105	63.0	197	52.1	204	16.3	106
>=20 goats	13.1	86	88.8	117	63.5	139	13.0	109
Median test sign	p<0.01		ns		ns		p<0.01	

Note: ns = not significant

performance, although this was statistically not significant. The proportion of castrated males was highest in small flocks, but only relatively few of those farmers kept castrated males. The proportion of castrated males was significantly higher in Tsholotsho than in all other districts.

3.2.2 Flock dynamics

Seasonal trends

Flock dynamics measure flock inflows and outflows as well as total growth rates for individual flocks. Across districts, inflows were mainly through birth (91%) and to a lesser extent bought and exchanged (8%). Other inflows (1%) were through goats obtained as a payment (0.7%) or on loan (0.3%).[9]

Flock inflows were very seasonal (Figure 12). The major peak in birth was in April/May during the cold wet season (CWS). At this time of the year feed resources are generally good. A minor peak in births also occurs in August at the beginning of the hot dry season (HDS), a time of feed shortages.

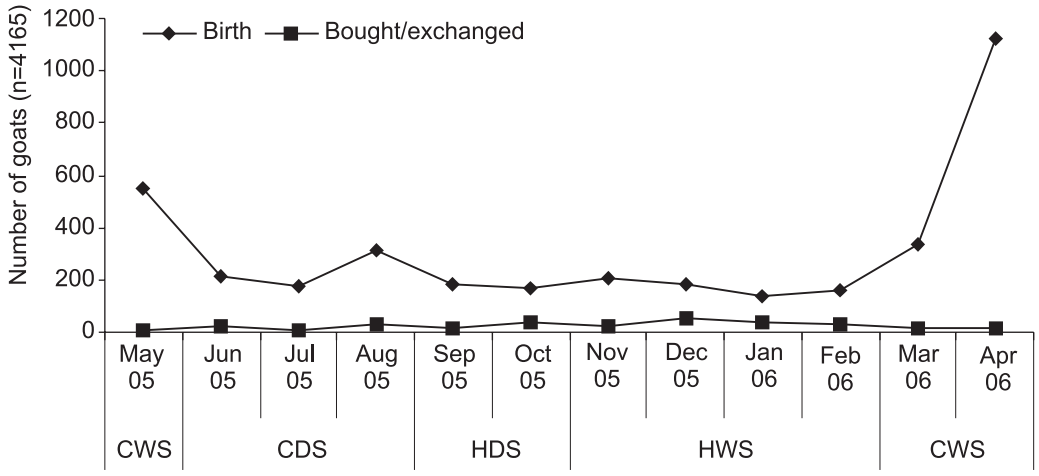

Figure 12. Main flock inflows by months/seasons.

9 On loan (*ukusisa*) – local mode of temporarily 'adopting' livestock into another flock.

Total outflows were mainly through mortality (45%), followed by sales/exchanges (24%), slaughters (14%), losses (9%), predators (8%) and others (1%) such as gifts to farmers and theft. Farmers agreed at the feedback sessions that goat mortalities cause very high losses, especially among kids and lactating females, and that more preventive measures are necessary to preserve goats for use values and sale. Flock outflows also showed seasonal trends (Figure 13). As farmers explained, mortality was high during the cold and hot dry season (CDS, HDS), due to seasonal changes in the quality and availability of feed resources. Peak sales took place in January, during

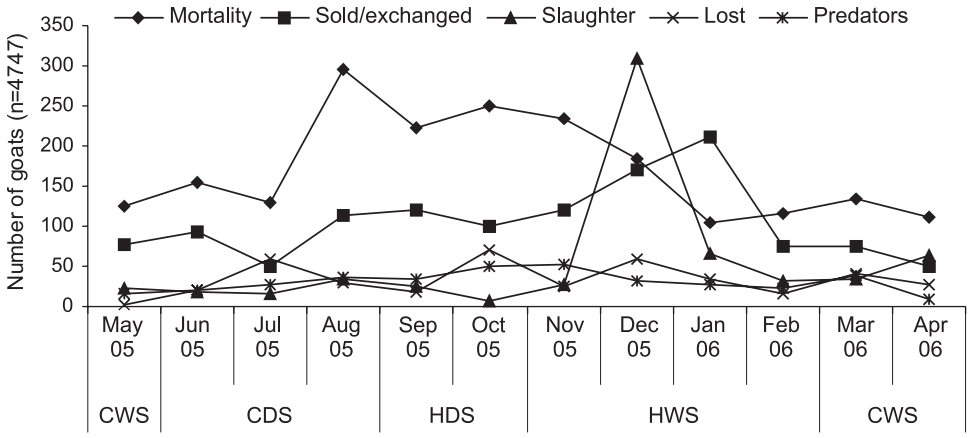

Figure 13. Main flock outflows by months/seasons.

the time of school fees payments and food shortages before harvest. Slaughtering was at the peak in December, during the festive season.

Total volumes of in- and outflows

The total in- and outflows were compared between flock size categories (Figure 14). The few farmers with large flocks made up the highest volume of in- and outflows. For them the total number of births surpassed the outflows, resulting in net flock growth.

The highest proportion of goats lost to mortality originated in those households with small flocks. Farmers argued that resource-poor farmers are worse off in access to information and inputs and thus less capable of preventing goat mortalities. This is a very strong argument to support interventions to reduce goat mortality, as this would increase

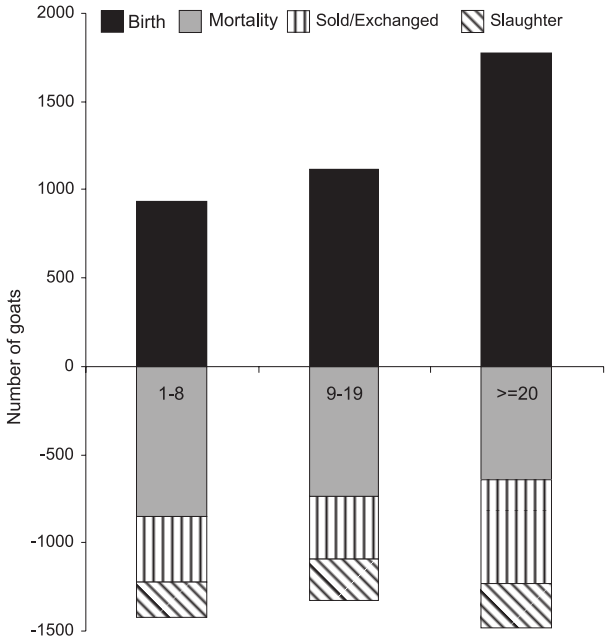

Figure 14. Total goat in- and outflows by flock size categories.

the number of animals available for sale and use for those farmers who depend greatly on the economic potential of goats.

The proportion of goats for sale/exchange and slaughter was highest in the household category with big flocks, the category that represented the lowest proportion among the sampled households. Households with large flocks thus present a significant source of goats for the market. The high proportion of births from this group confirms that they have a potential to increase offtake, a strong argument for investments in goat market development.

The fact that almost one third of the goats for sale originates from farmers with small flocks shows that although they have limited resources these farmers make a significant contribution to the market. Interventions that aim at increasing the supply of goats to the market therefore need to target resource-poor farmers. Furthermore, facilitating market access to resource-poor farmers increases prices for their goats and thereby contributes to food security and income growth.

In- and outflows at household level

Comparing the in- and outflows at the household level showed strong variations between districts (Table 12). Goat flocks increased in number in Matobo and Nkayi but declined in Gwanda and Tsholotsho.[10] High birth rates contributed to the flock growths in Matobo and Nkayi, despite the high mortality rates. Flock dynamics in Gwanda resulted in the most negative trend because of the lowest birth rates despite moderate mortality rates. Tsholotsho resulted in negative trends because of comparatively low birth rates and above average mortality rates. The potential to increase goat production or sales thus differs between districts because of different local environments.

Table 12. Mean in- and outflow rates (%) by district, May 2005–April 2006.

	Inflow	*Outflow*			
District	*Birth*	*Mortality*	*Sold/exchanged*	*Slaughter*	*Total*
Total	39.8	25.7	10.8	7.1	–1.7
Beitbridge	40.5	28.4	10.4	7.5	–7.5
Gwanda	23.5	18.6	14.3	3.4	–25.8
Matobo	53.8	24.3	6.5	6.9	22.7
Binga	37.6	24.8	18.7	5.0	2.5
Nkayi	51.0	31.7	7.8	11.6	8.0
Tsholotsho	31.5	28.0	8.4	8.1	–11.0
Median test sign	$p<0.05$	$p<0.01$	$p<0.01$	$p<0.01$	$p<0.05$

Farmers with small goat flocks showed relatively higher in- and outflow rates compared to those with big flocks (Table 13). They thus produced more goats and slaughtered and sold more goats in relation to their flock size. But they also faced relatively high mortality rates. This confirms that high mortality rates severely restrict farmers with small flocks from deriving higher benefits

10 Changes in flock size were calculated by the households' total inflows/total outflows during the observation period in relation to their flock size at the beginning of the year.

Table 13. Mean in- and outflow rates (%) by flock size category, May 2005–April 2006.

Goat flock size category	*Inflow*	*Outflow*			
	Birth	*Mortality*	*Sold/exchanged*	*Slaughter*	*Total*
Total	38.9	25.7	10.8	7.1	–1.7
1–8 goats	44.6	35.4	13.2	8.5	–4.4
9–19 goats	40.3	19.5	8.5	7.2	5.8
>=20 goats	25.8	10.1	8.3	3.3	–6.5
Median test sign	ns	p<0.01	p<0.01	p<0.01	p<0.01

Note: ns = not significant

from goats. Being in a continuous need of cash to solve immediate problems these farmers cannot build up their flocks to a sustainable size and therefore remain with low goat production.

In order to better target interventions that prevent mortality, the age and sex of goats lost to mortality were identified. Within these categories, more adult females (10%) and kids (10%) died compared to adult males (4%).[11] Adult females made up the highest proportion in the goat flocks and are thus the category most affected by mortality. Mortalities of adult female goats peaked during the dry season, which can be attributed to weak conditions during times of feed shortages (Figure 2 in Appendix). Supplementary feeding for pregnant and lactating females during the dry season is therefore critical. No seasonality was found in the mortality of kids and males. Narrative information suggests that goat kids mainly die due to poor housing and related diseases, rather than feed shortages.

3.3 Goat production and management

This section reports challenges in goat production and management as perceived by the farmers. Farmers' investments in improved goat management were tested across districts, goat flock categories and socioeconomic household characteristics in order to better understand the different farmer profiles.

During the survey farmers prioritized their need for support services in goat production (Figure 15). Animal health problems were ranked as the most important, followed by marketing and feeding constraints. Farmers' priorities reflect their concern about major causes of goat mortalities and unexploited market opportunities. Farmers linked goats' susceptibility to diseases and feed shortages with the high mortality rates observed during the dry season. From the farmers' viewpoint, diseases (68%), followed by feed shortages (19%) caused the high goat mortalities. They observed that weak animals were more susceptible to diseases when they were faced with feed shortages. The fact that farmers ranked the need for market support as equally important as feeding underlines the need for market analysis and development, as reported in Section 3.4.

11 The households' goat mortalities according to age and sex were calculated using the number of dead goats in each category during the observation period in relation to the total flock size at the beginning of the year.

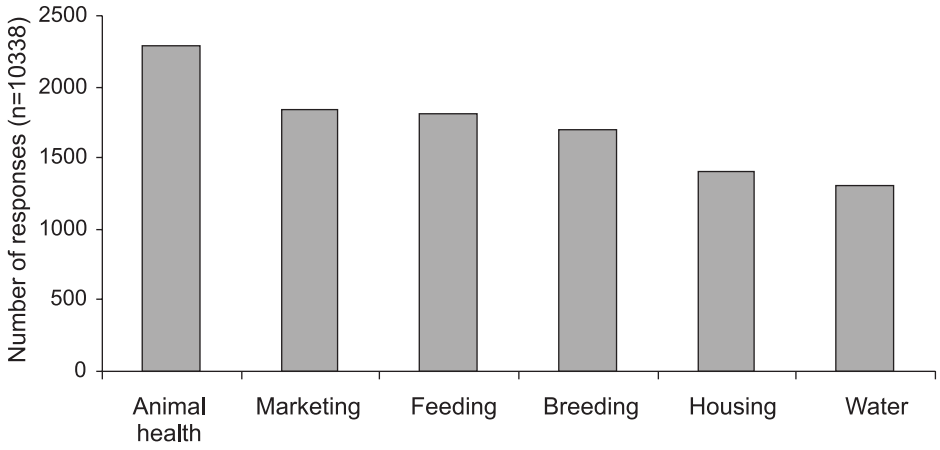

Figure 15. Farmers' priorities for support services.

3.3.1 Animal health

Effective management of animal health can reduce the mortality rates of goats, which are highest during the dry season. The range of diseases was site and season specific and hence requires diligent and timely attention.

Most common seasonal diseases

Dry season

A little more than three quarters of the farmers (76%) reported goat disease problems during the dry season. The most common disease mentioned was pulpy kidney (enterotoxaemia), followed by helminthosis (internal parasites), tick-borne diseases, mange (external parasites), and eye problems (Table 14). To a lesser extent, goats suffered from pustular dermatitis (orf) and foot

Table 14. Most common diseases in the dry season by district (n = 2134).

	Beitbridge	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Pulpy kidney	++	+++	++	o	+++	+++
Helminthosis	+	+	++	o	o	+
Tick-borne	+	+	+	o	+	o
Mange	o	o	o	+++	o	o
Eye problem	o	o	+	o	o	o
Orf	o	o	o	o	o	o
Foot rot	o	o	o	o	o	o
Other	o	o	o	o	o	o

Note: o = 0–22; + = 23–44; ++ = 43–66 and +++ = 67–88; calculated by dividing the total frequencies by the number of districts and number of categories.

rot. Other diseases included foot and mouth disease, anthrax, sudden mortality and gid (*Taenia multiceps*/*Coenurus cerebralis*).

Pulpy kidney, the most frequent disease, is caused by a sudden change in the diet. However, when it occurs in the dry season, it is mainly due to nutritional stress. The high frequency of internal and external parasites (helminthosis, tick-borne diseases and mange) suggests a need for strategic parasite control. The high prevalence of diseases during the dry season is related to poor body condition due to feed shortages that render the animals more susceptible to infection.

Disease prevalence differed across districts (χ^2, $p<0.01$). Nkayi and Tsholotsho were more affected by pulpy kidney than the other districts because they are comparatively wetter and changes in vegetation between seasons are therefore more pronounced. Helminthosis was frequent in Matobo, Tsholotsho, Gwanda and Beitbridge. Tick-borne diseases were frequent in Nkayi, Beitbridge, Gwanda and Matobo. Binga was an exceptional case, with a predominance of mange and few cases of pulpy kidney. Binga is located in the Zambezi valley where environmental conditions favor proliferation of these parasites. The district-specific disease profiles give direction to animal health management programs that include feeding as a preventive measure.

Rainy season

Fifty-six percent of the farmers reported disease as a problem during the rainy season. However, the trials posed by disease seemed lower during the rainy season than during the dry season (76%). This could be due to better nutrition and body condition in the rainy season.

The most common disease during the rainy season was foot rot, followed by tick-borne diseases, helminthosis and pulpy kidney (Table 15). Eye problems, orf and mange (caused by blood-sucking lice) were less common. This was in contrast to the dry season where pulpy kidney was most prevalent disease. Other diseases included foot and mouth disease, anthrax, sudden mortality and gid.

The high frequency of foot rot is caused by wet conditions during the rainy season, worsened by poor housing conditions. These conditions are more conducive for the parasites to breed. Pulpy kidney was still a problem because of the change in diet from poor to higher quality feed, particularly higher protein diets.

Table 15. Most common diseases in the rainy season by district (n = 1620).

	Beitbridge	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Foot rot	+	++	++	++	+	o
Tick-borne	++	+	+	o	++	++
Helminthoses	o	+	+	++	o	+
Pulpy kidney	o	+	++	o	+	o
Eye problem	o	o	o	o	o	o
Orf	o	o	o	o	o	o
Mange	o	o	o	o	o	o
Other	+	o	o	o	o	o

Note: o = 0–23; + = 24–46; ++ = 47–69 and +++ = 70–92; calculated by dividing the total frequencies by the number of districts and number of categories.

Disease prevalence differed across districts (χ^2, $p<0.01$; Table 15). Foot rot was most common in Binga, Gwanda, Beitbridge and Matobo. Tick-borne diseases were mostly in Tsholotsho, Nkayi and Beitbridge. Helminthosis was more common in Binga, Tsholotsho, Gwanda and Matobo. Pulpy kidney was frequent in Matobo, Gwanda and Tsholotsho. During the rainy season farmers therefore require tailor-made animal health and feed management programs.

Disease control

Disease prevention and treatment are two main strategies by which farmers can reduce goats' susceptibility to diseases and control infection and outbreaks. More than 40% of the surveyed farmers attempted to prevent diseases and more than 50% attempted to treat diseases, indicating a general awareness of the importance of disease control (Table 16). At first glance the feedback participants evaluated these figures as too high, as farmers would be reluctant to invest in disease control for goats. The figures were however justified when considering a high frequency of traditional control methods, and the fact that many cattle owners used residual cattle inputs on their goats.

Table 16. Percentage of farmers preventing and treating diseases (n = 825).

	Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Prevention	42.4	34.8	47.7	42.1	36.6	39.3	54.0
Treatment	56.7	50.4	64.2	55.3	47.2	57.1	65.3

Across districts more farmers in Tsholotsho prevented diseases, but fewer did so in Beitbridge and Binga (χ^2, $p<0.05$). In general, however, fewer farmers invested in disease prevention than treatment, particularly in Tsholotsho and Gwanda (χ^2, $p<0.05$), indicating a need to strengthen preventive measures.

Goat flock size had no influence on farmers' decisions in prevention and treatment, or on purchases of veterinary inputs. Among the socioeconomic characteristics, only education influenced farmers decision to prevent diseases, with more educated households involved in preventing diseases (χ^2, $p<0.05$).

Among the survey households, traditional modes of disease prevention (medical plants, releasing blood, external oil application) were most common, followed by vaccination,[12] for both the dry and rainy season (Table 17). Dosing, dipping, improved housing, feeding and use of oil were less frequent. More farmers used non-traditional prevention in Nkayi, Tsholotsho and Beitbridge (χ^2, $p<0.01$). Binga relied on traditional prevention only.

In terms of disease treatment, traditional (medicinal plants, soot, salty soil), conventional (dipping, spraying, dosing, vaccination), and non-conventional (salt solution, used motor engine oil, potash, washing powder) methods were applied (Table 18). The most common method in both seasons was the use of traditional medicine. Use of non-conventional methods increased in the rainy season.

12 The term for vaccination and injection is the same in the local language. Therefore, interpretation needs to be considered with caution.

Table 17. Modes of disease prevention during dry and rainy season by district.

		Beitbridge	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Dry season (n = 532)	Traditional	+++	+++	+++	+++	+++	+++
	Vaccination	+	+	+	o	+++	++
	Dosing	o	o	+	o	+	+
	Dipping	o	o	o	o	o	o
	Housing	o	o	o	o	o	o
	Feeding	o	o	o	o	o	o
Rainy season (n = 515)	Traditional	++	+++	+++	++	++	++
	Vaccination	++	o	+	o	+++	+
	Housing	o	++	+	o	+	o
	Dosing	o	o	+	o	o	o
	Dipping	o	o	o	o	o	o
	Feeding	o	o	o	o	o	o

Note: o = 0–11; + = 12–22; ++ = 23–33 and +++ = 34–44; calculated by dividing total frequencies by the number of districts and categories.

Table 18. Modes of disease treatment during dry and rainy season by district.

		Beitbridge	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Dry season (n = 786)	Traditional	++	+++	+++	+++	+++	+++
	Conventional	++	+	++	+	+++	+++
	Non-conventional	o	o	o	o	o	o
Rainy season (n = 753)	Traditional	+++	+++	+++	++	+++	++
	Conventional	+++	+	++	o	+++	++
	Non-conventional	+	+	+	+	+	+

Note: o = 0–16; + = 17–32; ++ = 33–48 and +++ = 49–64; calculated by dividing the total frequencies by the number of districts and categories.

According to farmers' information, the knowledge on traditional disease control methods was often not shared. Traditional methods were therefore often not effectively applied. Thus, even if farmers were aware of the need for disease control, they did not apply it because the necessary knowledge and technologies were not available to them. Farmers indicated a potential for widespread use of traditional knowledge and practices, if made available to them.

Across districts, more utilization of non-traditional methods was reported in Nkayi, Tsholotsho and Beitbridge (χ^2, $p<0.01$). The differences in prevention and treatment across districts indicate that farmers develop animal health strategies according to local disease prevalence. The effectiveness of prevention and treatment methods however needs to be further evaluated.

Although on average 40% of the farmers across districts bought medicines/drugs for their goats,

Table 19. Percentage of farmers purchasing veterinary supplies (n = 825).

Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
40.0	43.7	35.8	35.5	15.4	47.9	51.6

in areas such as Binga only 15% did (Table 19). This implies a very wide variation in the use of conventional medicines for disease control in goats across districts (χ^2, $p<0.01$). Modern medicine was appreciated for being more effective than traditional methods, but not accessible to most farmers, especially those without cattle.

Furthermore, farmers who bought medicines/drugs tended to be those with higher levels of education (χ^2, $p<0.01$), male-headed households (χ^2, $p<0.05$), and in the active age group (χ^2, $p<0.05$).

The most common sources of medicines/drugs were the DVS (district office), urban shops and private veterinarians (Table 20). The fact that the DVS faces limited resources in service provision and farmers have to rely on urban shops clearly demonstrates the lack of locally available medicines/drugs. Accessibility to medicines and drugs differed between districts, with greater reliance on urban shops in Matabeleland South (χ^2, $p<0.01$).

Table 20. Sources of veterinary medicines (n = 356).

	Beitbridge	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
DVS	++	+++	+	+	+++	+++
Urban shop	+++	++	+++	o	+	+++
Private veterinary	o	+	++	o	o	o
Local shop	o	o	o	o	++	o
Other farmer	o	o	o	o	o	+
Extension officer	o	o	o	o	o	o

Note: o = 0–7; + = 8–14; ++ = 15–21 and +++ = 22–28; calculated by dividing the total frequencies by the number of districts and categories.

External parasite control

The majority of farmers controlled external parasites with variations between districts (χ^2, $p<0.01$, Table 21). The exception was Binga where mange was the predominant parasitic disease during the dry season. It was also found that households with older heads conducted more parasite control (χ^2, $p<0.05$).

Farmers used a diversity of parasite control methods across districts (χ^2, $p<0.01$, Table 22). Manual removal of ticks was the most common, although this does not treat the infection. Commercial products comprising tick grease, plunge, spray and pour-on dips were ranked second, and were more common in Beitbridge and Nkayi and least frequently used in Binga. Motor engine oil was a common mode of external parasite control in Matobo. Traditional parasite control methods were used in Binga and Matobo.

Table 21. Percentage of farmers controlling external parasites (n = 825).

Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
90.1	96.3	82.9	90.2	43.9	97.6	89.0

Table 22. Methods of external parasite control (n = 939).

	Beitbridge	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Manual removal	+++	+++	+++	+	++	++
Commercial	+++	++	++	o	+++	++
Motor oil	o	+	++	o	o	+
Traditional	o	o	+	+	o	o
Culling affected goats	o	o	o	o	o	o

Note: o = 0–20; + = 21–40; ++ = 41–60 and +++ = 61–80; calculated by dividing the total frequencies by the number of districts and number of categories.

There was however no regular external parasite control regime, as is the case in commercial production systems. About 90% of the farmers controlled external parasites only when the need arose in both the dry and rainy season. Few farmers (7%) controlled parasites regularly in the dry season (most of them were in Tsholotsho, Beitbridge and Binga). The frequency increased slightly in the rainy season (12%). The lack of a control regime could be due to the absence of plunge dip tanks for goats, which is the most effective means of external parasite control.

About 49% of the farmers purchased acaricides occasionally, and this was higher than the use of medicines/drugs (Table 23). The use of acaricides also varied across districts (χ^2, $p<0.01$), with lowest use of acaricides in Binga. The low use of acaricides in Binga might have contributed to the high prevalence of mange. Similar to purchase of medicines/drugs, more educated households bought acaricides (χ^2, $p<0.01$). Cattle owners were better off in terms of parasite control, because they could use the residual cattle inputs on their goats.

The most commonly used sources of acaricides were urban shops, followed by the DVS, local shops and other farmers (Table 24). The fact that most farmers travel to urban shops for acaricides reconfirms that acaricides like other medicines/drugs are not locally available. This supports the need to decentralize veterinary input supply systems, building on existing facilities and district-specific needs. Districts such as Nkayi and Matobo had more sources of acaricides, compared to Binga where only few sources were available (χ^2, $p<0.01$).

Table 23. Percentage of farmers purchasing acaricides (n = 825).

Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
49.0	51.1	44.4	48.0	22.0	68.6	58.1

Table 24. Sources of acaricides (n = 464).

	Beitbridge	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Urban shop	++	++	+++	o	+++	+++
DVS	+	+	+	o	++	++
Local shop	o	+	++	o	++	o
Other farmer	+	o	+	o	+	+
Private veterinary	o	o	o	o	o	o
Extension officer	o	o	o	o	o	o

Note: o = 0–10; + = 11–20; ++ = 21–30 and +++ = 31–40; calculated by dividing the total frequencies by the number of districts and categories.

3.3.2 Feeding

Goat production in communal production systems is highly dependent on rangeland resources. However, these resources vary spatially and temporally, resulting in nutritional bottlenecks during the dry season. Effective management requires clear identification of periods of feed shortages.

Feed shortages

The majority of farmers (93%) stated that they face shortages in the supply of sufficient feed for optimal goat production. This contradicts the common assumption that goats can subsist solely on natural rangelands. In all studied districts feed shortages began in July, reaching a peak in September/October and phasing out in December/January (Figure 16). From July onwards rangeland resources became depleted, both in quantity and quality. Although rainfall starts in November, vegetation takes at least a month to re-grow, explaining the availability of feed in December/January.

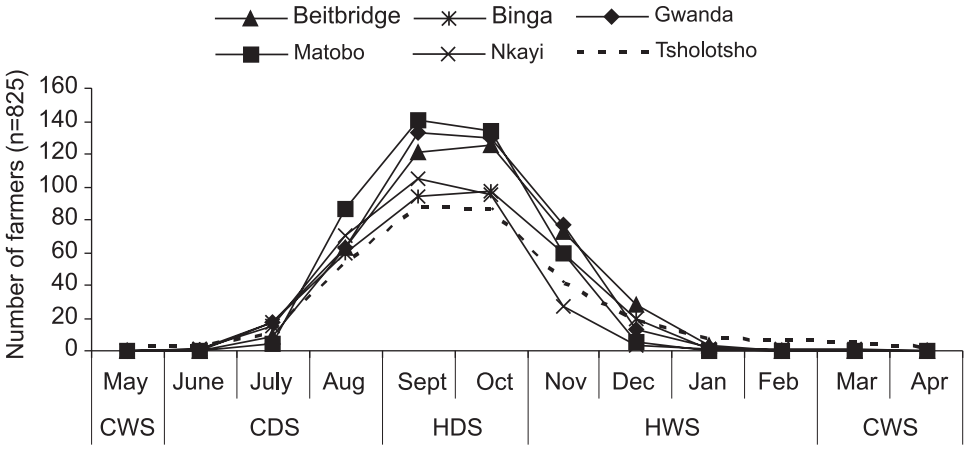

Figure 16. Feed shortages by months/seasons.

Note: CWS = Cold Wet Season, CDS = Cold Dry Season, HDS = Hot Dry Season, HWS = hot wet season.

Based on the information obtained from the survey, feeding interventions should start in June/July, before the goats' body conditions begin to deteriorate. They should continue until December/January when the rangelands are able to support the nutritional requirements of goats. Although the trends were similar across all districts, the magnitude of feed shortages might be area specific and therefore require the development of localized feeding strategies.

Feed calendars

Feed calendars indicate the various feed resources that farmers use in the different seasons of the year. The feed calendar covering all districts shows a strong seasonality, with a higher diversity of

feed resources when rangelands are depleted during the dry season, from August to November (Figure 17 and Figures 3–8 in Appendix). Farmers supplemented rangeland grazing with mainly legume crop residues (eg, groundnuts, bambara nuts, cowpeas), and to a lesser extent with cereal crop residues (eg, sorghum, millet, and maize), and they increased the use of key resources (nearby crop fields, river banks, wetlands). At the late stage of the dry season various other supplements, such as cut and carry (*Acacia* branches, pods), home mixes (milling residues with salty water), commercial stock feeds, planted forages (dual purpose cereals, legumes, grass) and grazing along roadsides, also became important. The diversity of feed resources shrank when rangeland conditions provided biomass from December to May.

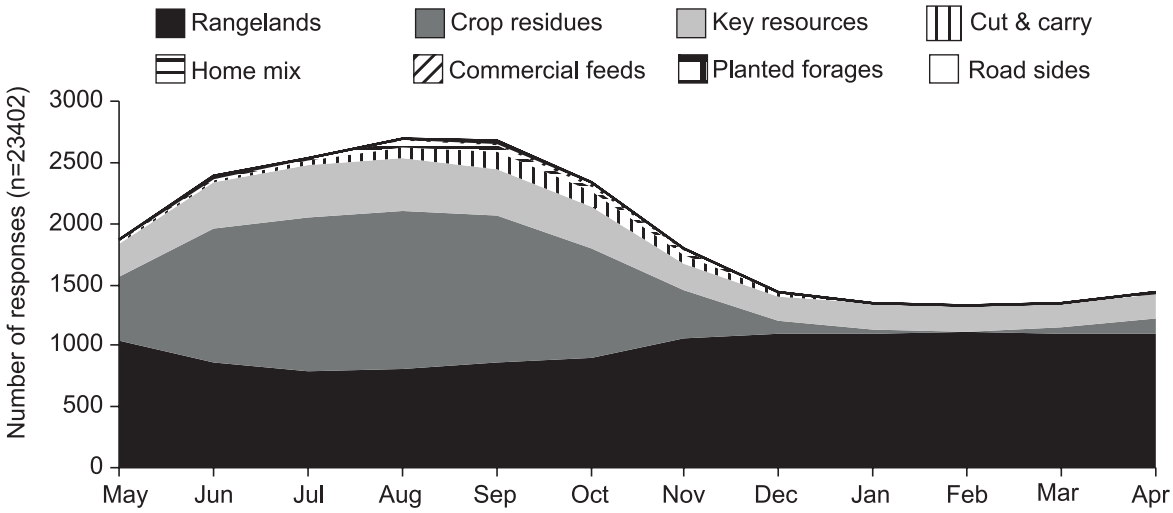

Figure 17. Seasonal feed resources across the selected districts.

Feed utilization

The magnitude of using a variety of feed resources does not necessarily translate into an adequate supply of nutrients. Although rangelands were the most extensively used feed resources for goats, they are high in fiber but low in protein, particularly during the dry season. Therefore, only few farmers (6%) relied exclusively on communal rangelands, except in Tsholotsho where a significant share of farmers (12%) depended on rangelands throughout the year (χ^2, $p<0.05$; Table 25).

Most farmers used alternative feed resources to supplement rangeland resources (Table 26). Table 7 in the Appendix shows the classification of the various feed resources into feed resource

Table 25. Percentage of farmers using only rangelands.

Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
5.5	5.2	4.0	2.6	7.3	2.9	12.1

Table 26. Percentage of farmers using alternative feed resources (n = 825).

	Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*	χ^2 *sign*
Crop residues	82.9	87.4	84.8	73.7	74.0	95.7	81.5	p<0.01
Cereals	71.0	80.0	76.2	48.0	74.0	86.4	62.9	p<0.01
Legumes	48.8	39.3	47.0	65.8	15.4	65.7	54.8	p<0.01
Key resources	54.9	44.4	66.9	85.5	52.0	40.0	33.9	p<0.01
Cut & carry	19.4	23.0	32.5	27.6	0.8	10.7	17.7	p<0.01
Legumes	17.0	20.7	31.8	27.0	0.0	7.1	10.5	p<0.01
Grass	2.7	3.0	2.6	2.0	0.8	0.7	7.3	p<0.05
Home mix	8.1	11.1	0.7	0.7	0.0	18.6	19.4	p<0.01
Roadsides	4.0	4.4	2.0	7.9	1.6	2.9	4.8	ns
Commercial feeds	3.0	8.9	4.6	2.0	1.6	0.0	0.8	p<0.01
Planted forages	1.3	0.0	2.0	0.7	0.8	1.4	3.2	ns

Note: ns = not significant

categories. Differences across districts indicated locally specific predispositions for farmers to improve feed availability and quality. Most farmers used crop residues (83%), legume residues more for goats and cereals more for cattle. Crop residues, being more common than legumes and eventually stored for cattle, were often left for goat grazing in the fields. Yet, more farmers stored legume residues for their goats and preserved their nutritional quality. It was reported that some farmers kept two storage places, one with cereal residues for their cattle and one with legume residues for their goats. This shows that farmers' have started investment in the nutritional quality of crop residues, but it requires further treatment for improved digestibility and protein supplementation.

Key resources found in more humid areas and thereby sustaining survival of flocks in dry periods, were second in frequency (55%). More farmers used key resources in Matobo and Gwanda, improving the feed supply of their animals by locally available resources. Key resource areas are small in size and patchy, and therefore cannot sustain a large number of animals. Yet, they have the potential to provide high-quality feed when the rangelands are either depleted or poor in quality.

To a lesser extent farmers used cut and carry practices (19%), and used more tree legumes and pods than grass. Cut and carry for tree legumes and pods were also more frequent in Matobo and Gwanda, exploiting the local protein sources and improving feed quality. However, the practice of collecting legume pods was not accepted in some wards, where community by-laws did not allow this for environmental management purposes.

Eight percent of the farmers used home mixes for supplementary feeding, blending milling residues with salty water. This simple technology was applied by a number of farmers in Nkayi and Tsholotsho, using locally available feed resources and improving feed digestibility.

Four percent of farmers grazed their goats along roadsides when the rangelands were depleted. This option was more used in Matobo. Other forms of reserved grazing or community managed were not found.

Those few farmers (3%) who could afford to use commercial stock feeds have a comparative advantage over those who rely solely on rangelands. Stock feeds were used more in Beitbridge

and Gwanda. Farmers indicated a reduction in the use of commercial feeds due to reduced access to commercial feeds and the high costs. According to their explanation, the commercial stock feed companies had closed their depots in rural areas. At the feedback meetings farmers explained that considering the highly unreliable rainfalls and shortages of water, they would prefer purchasing stock feeds than planting forages.

Planted forages (1%) were not a common occurrence in the survey areas. They were mainly found in Tsholotsho and Gwanda, where projects had introduced bana grass through farmer field schools. Farmers reported a lack of knowledge and technologies especially in forage production, although few farmers had planting material available.

Feed utilization categories were created to compare farmers' intensity in using feed resources (Table 27). The comparison confirms differences in feed utilization between districts (χ^2, $p<0.01$). Fifteen percent of farmers relied on natural grazing only (category 1), whereas the majority of farmers (57%) had a low intensity combination by using crop residues in addition to rangeland grazing (category 2), more so in Binga and Nkayi. A more diverse combination including cut and carry (23%, category 3) followed this and was common in all districts, except Binga. Options of higher investments such as stock feeds or planting forages (category 4) were comparatively few, and found in Beitbridge and Gwanda.

Flock size categories influenced farmers' decision to intensify feed utilization (χ^2, $p<0.05$; Table 28). Farmers with larger flocks more often used natural grazing (category 1) or invested in higher intensity feeding (category 4); thus, they either kept their goats extensively or supplemented them effectively through financial means. Those farmers with smaller herds invested more in improving the locally available feed resources using crop residues (category 2) or cut and carry (category 3).

Table 27. Percentage of farmers using different feed resource categories by districts (n = 825).

	Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
1	15.4	9.6	14.6	23.7	25.2	4.3	15.3
2	57.2	54.1	50.3	48.0	72.4	70.0	50.8
3	22.9	27.4	28.5	25.7	0.0	23.6	29.8
4	4.5	8.0	6.6	2.6	2.4	2.1	4.0

Note: 1 = communal rangelands + key resources + roadsides; 2 = 1 + crop residues; 3 = 1 + 2 + cut & carry; 4 = 1 + 2 + 3 + stock feeds + planted forages.

Table 28. Percentage of farmers using different feed resource categories by flock size categories (n = 825).

	Total	*1–8 goats*	*9–19 goats*	*>=20 goats*
1	15.3	13.8	15.7	18.8
2	57.3	58.8	58.5	51.0
3	22.9	24.1	22.2	20.8
4	4.5	3.3	3.6	9.4

Note: 1 = communal rangelands + key resources + roadsides; 2 = 1+crop residues; 3 = 1 + 2 + cut & carry; 4 = 1 + 2 + 3 + stock feeds + planted forages.

Farmers' investments in improving feed quality

Although farmers' feed utilization reflects relatively low investments in feed quality, more than 50% of the farmers stated that they have tried to improve feed quality (Table 29), more so in Gwanda and Binga (χ^2, $p<0.01$). Farmers seemed to be aware of the need to improve the nutritional quality for their goats, but knowledge and technologies were not accessible, and implementation therefore insufficient.

Table 29. Percentage of farmers investing in feed quality (n = 825).

Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
54.5	45.2	79.5	43.4	67.5	43.6	47.6

Feed supplementation mainly involved grazing crop residues in fields, making use of available low-quality feeds, but not adding value to the nutritional quality (Figure 18). A significant number of farmers have started to collect and use cereal crop residues and/or to feed residues treated with salty water, which preserves the quality of crop residues and enhances digestibility. The high number of farmers feeding residues to goats indicates the severity of dry season feed shortages, as otherwise they would utilize them for cattle. Cutting and carrying indigenous pods was a common practice to enhance protein content in the diet. Fewer households purchased feed inputs or fed home mixes. Very few farmers planted forages. Farmers thus make efforts to improve goat feed resources using the simplest means and locally available materials.

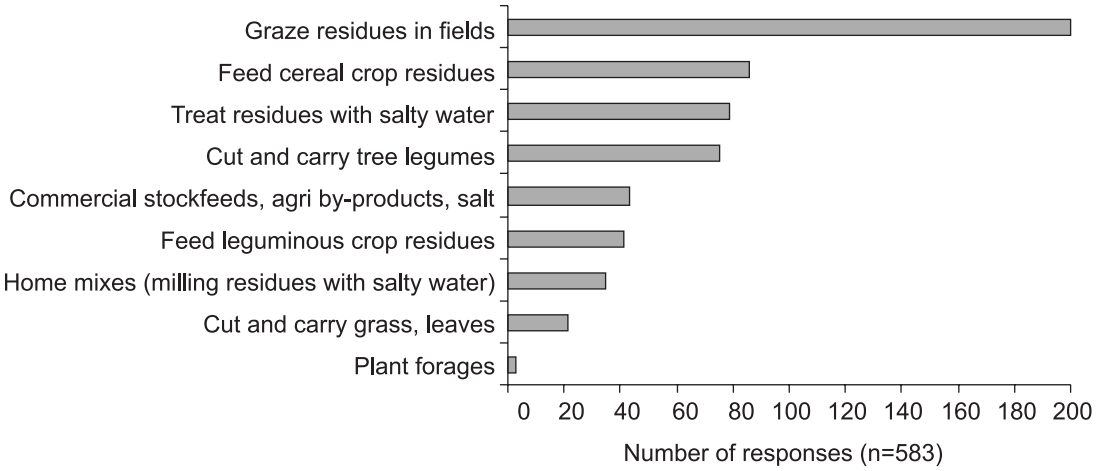

Figure 18. Farmers' investments in feed technology across the selected districts.

Goat nutrition information

About 50% of the farmers did not have access to information on goat nutrition and similar figures were found for information on veterinary, breeding and housing. Those who had access to information mainly received it from other farmers (Figure 19). AREX, DVS, NGOs and local authorities provided information to a lesser extent. The type and reliability of information received was not determined in this study.

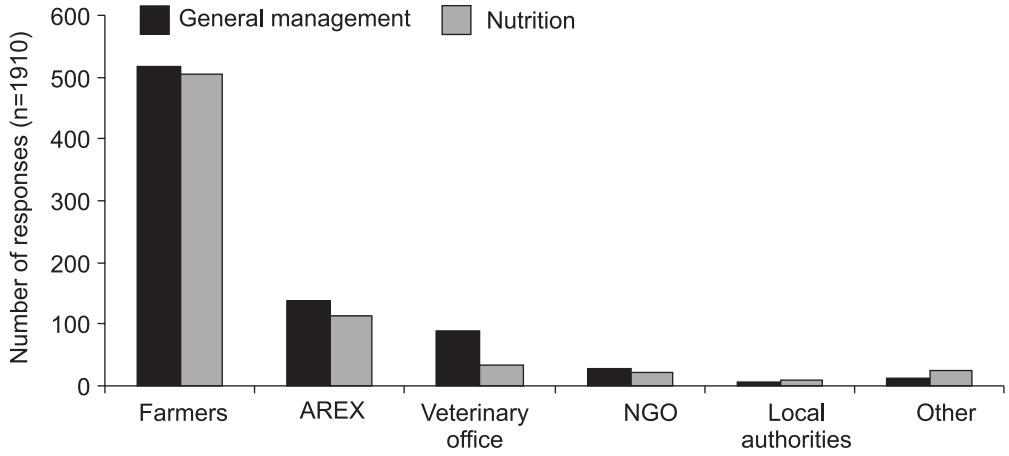

Figure 19. Sources of information on general goat management and nutrition across the selected districts.
Note: 'Other' encompasses newspapers, radio, own observations, LPD, input sellers and Forestry Commission.

3.3.3 Breeding and husbandry

Breeding management is critical to improve goat production and subsequent marketing. The feedback discussions however clarified that although farmers see the importance of improved breeding and husbandry, communal grazing makes the necessary investments difficult. This section presents information on mating control, investment in good-quality bucks, castration and culling.

Mating

In most cases, farmers kept their goats under communal grazing systems and therefore mating was not controlled and occurred all year round (Table 30). Controlled mating differed across districts and was more prevalent in Gwanda and Tsholotsho, simply by keeping males and females separate (χ^2, $p<0.01$). Where controlled mating was practiced, kidding could coincide with periods of high nutrition or planned supplementary feeding. This has further implications on market planning and ensuring a consistent supply of high-quality goats. Flock size categories and socioeconomic characteristics did not have an influence on controlled mating.

In addition to the above, only 33% of farmers maintained their own breeding buck. Among those households who kept a buck, the buck to female ratio was 1:7. This figure is above the recommended ratio of 1:25 for controlled goat production systems. This indicates that the overall number of bucks per females in the community was sufficient to ensure a high level of kidding, but as stated before, the male breeding potential is underutilized.

Table 30. Percentage of farmers who controlled mating (n = 825).

Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
5.7	2.2	11.3	3.3	1.6	2.9	12.9

Investment in good-quality bucks

Investment in good-quality bucks was not common and differed across districts (χ^2, $p<0.01$, Table 31). Farmers in Gwanda, Binga and Matobo seemed to realize the need for good-quality bucks. Flock size categories did not influence farmers' investment in quality bucks, except in Beitbridge, where more farmers with bigger flocks invested in quality bucks (χ^2, $p<0.05$). There was a trend that younger households invested more in quality bucks (χ^2, $p<0.05$). The impact of high-quality bucks on goat production might, however, be low, due to uncontrolled mating.

Table 31. Percentage of farmers investing in good-quality bucks (n = 825).

Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
11.6	9.6	20.5	13.8	14.6	4.3	4.8

Castration

More than 90% of the farmers in all the districts castrated their goats (Table 32). A higher rate of castrated bucks was found in Matobo, followed by Gwanda and Beitbridge, but was lower in Binga (χ^2, $p<0.01$). More farmers with larger flock sizes castrated their bucks (χ^2, $p<0.01$). But younger households, aged below 40, as well as *de facto* female-headed households tended to castrate less (χ^2, $p<0.05$).

Table 32. Percentage of farmers castrating bucks (n = 825).

Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
91.1	96.3	96.6	98.0	75.4	90.7	86.1

The reasons for castration were mainly to improve the quality of meat by reducing smell, prevent straying and, to a lesser extent, selection of better breeding bucks (Table 33). The fact that farmers castrated bucks to improve meat quality is a strong indication that they know castration affects meat quality. Districts showed different priorities for castrating bucks, with most emphasis on improved meat quality in Binga and on selection of breeding bucks in Matobo (χ^2, $p<0.05$).

Table 33. Reasons for castration by district (n = 1133).

	Beitbridge	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Improved meat quality	+++	+++	+++	+++	+++	++
Control straying	+++	+++	++	++	+++	++
Selection of breeding bucks	o	+	++	o	o	o
Bigger size	o	o	o	o	o	o

Note: o = 0–24; + = 25–48; ++ = 49–72 and +++ = >72, calculated by dividing total frequencies by the number of districts and categories.

Culling

Most farmers practiced culling, which indicates a basic knowledge of goat husbandry (Table 34). The use of culling differed across districts and was most common in Gwanda and Matobo (χ^2, $p<0.01$).

The main reasons for culling were old age, followed by poor body condition and low kidding rate (Table 35). Culling for old age does not however improve breeding quality, but only removes old animals from the flock. Culling as a means to improve breeding quality (poor body condition, low kidding rate) differed across districts (χ^2, $p<0.05$), and was more common in households with bigger flocks (χ^2, $p<0.05$).

Table 34. Percentage of farmers culling goats (n=825).

Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
71.5	66.7	81.5	78.9	63.4	65.0	66.1

Table 35. Reasons for culling (n = 893).

	Beitbridge	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Old age	++	+++	+++	++	++	++
Poor body condition	+	+	+	o	+	+
Low kidding rate	+	++	++	+	+	o

Note: o = 0–25; + = 26–50; ++ = 51–75 and +++>75, calculated by dividing total frequencies by the number of districts and categories.

3.3.4 Housing

Appropriate housing reduces mortality and facilitates effective animal health management. Farmers explained that although they realized the importance of roofed kraals, the construction material was often not sufficiently available and this prevented many farmers from using this technology.

Farmers let their goats range free during the day and more than 90% of the farmers penned them every night, either in an open or roofed kraal depending on the season and with differences across districts (Table 36).

In the rainy season more farmers housed their goats under a roof than compared to the dry season. The period of investment in improved housing coincided with increased disease risk (foot rot, pneumonia) indicating farmers' awareness of the effect of the rainy season on animal health.

Table 36. Percentage of farmers using open and roofed kraals during the dry and rainy season (n = 825).

		Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Dry season	Kraal with roof	18.4	1.5	16.6	4.6	31.7	35.7	23.4
	Open kraal	81.5	98.5	82.8	95.4	67.5	65.0	76.6
Rainy season	Kraal with roof	39.6	23.7	37.7	19.7	51.2	62.1	46.8
	Open kraal	59.4	75.6	60.3	78.9	48.0	37.1	53.2

The use of roofed kraals was more common in Matabeleland North, during both the dry and rainy season (χ^2, $p<0.01$). More farmers with smaller flocks invested in roofed kraals than those with big flocks (χ^2, $p<0.01$), thus better protecting their goats against weather and disease risk. In addition, more households with a male component (χ^2, $p<0.05$), as well as those with higher levels of education (χ^2, $p<0.05$) invested in roofed kraals during the rainy season.

3.3.5 Watering

Most common sources of water

Consistent watering improves feed intake and reduces time and energy invested in walking to and waiting at water points. Watering is therefore an important management component, which is often not addressed.

During the dry season, the most important sources of water were boreholes, followed by perennial rivers, dams and wells (Table 37). In Beitbridge, reliance on boreholes was highest, probably due to the absence of naturally occurring water sources. In such districts as Binga, Gwanda and Nkayi, farmers could also use perennial rivers (Zambezi, Sebungwe, Tuli, Gwayi), dams and wells.

Table 37. Water sources by season and district.

		Beitbridge	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Dry season (n = 1031)	Borehole	+++	+++	+++	+++	+++	+++
	River	+	+++	++	+++	+++	++
	Dam	+	+++	+++	+++	+	+
	Well	o	++	o	+	+	+
	Pans	o	o	o	+	o	o
	Rainwater harvesting	o	o	o	o	o	o
Rainy season (n = 1166)	River	++	+++	+++	+++	+	o
	Pans	+	+	++	++	+++	++
	Dam	+	++	++	+	+	++
	Borehole	+	+	+	o	+	o
	Well	o	o	o	o	o	o
	Rainwater harvesting	o	o	o	o	o	o

Note: o = 0–28; + = 29–56; ++ = 57–84 and +++ = >85, calculated by dividing the total frequencies by the number of districts and categories.

During the rainy season, rivers, pans, dams as well as boreholes were major sources of water. Compared to the dry season, reliance on boreholes declined. The importance of water sources varied from one district to another, during both seasons (χ^2, $p<0.01$). Yet, the potential to make use of rainwater harvesting seemed underutilized across all districts.

Investments in improved access to water

More than 50% of the farmers improved access to water, except in Binga, where the villages surveyed were closer to perennial rivers and hence investment in water was low (χ^2, $p<0.01$; Table 38). Farmers with small and medium goat flocks (χ^2, $p<0.05$) and those aged above 40 years (χ^2, $p<0.05$) more often improved access to water.

Table 38. Percentage of farmers who improved access to water by district (n = 825).

Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
54.3	51.9	65.6	50.7	18.7	68.6	66.9

In most cases, those farmers who improved access to water invested labor and time by fetching water from sources and carrying it home for their goats (Table 39). Watering goats at community water pumps was also common and farmers dug wells near to riverbeds. Only in a few cases financial resources were invested in drilling boreholes.

Table 39. Modes of investment in improved access to water by district (n = 434).

	Beitbridge	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Fetch water	+++	+++	+++	++	+++	+++
Pump water	+	++	o	o	o	o
Dig wells	o	+	o	o	+	o
Drill borehole	o	o	o	o	o	o
Rainwater harvesting	o	o	o	o	o	o

Note: o = 0–7; + = 8–14; ++ = 15–21 and +++ = >21, calculated by dividing the total frequencies by the number of districts and categories. Fetching water = transporting water from source to homestead; pump water = hand pumping at borehole; dig wells = creating shallow wells in riverbeds for goats to drink on site.

3.3.6 Determinants of goat management strategies

Table 40 gives an overview of the impact of district, flock size category and socioeconomic household characteristics on selected management strategies. The results show that districts affect most of the management strategies, reconfirming the need for area-specific technology development. The effects of flock size categories and socioeconomic household characteristics differed and need further investigation at the district level.

3.4 Goat marketing

This section sets the scene for options for improved goat marketing. Existing market options are characterized for the selected districts. Farmer and buyer profiles as well as challenges in goat marketing from the farmers' perspective were also documented.

Table 40. Summary of interactions between district, flock size category and socioeconomic characteristics on goat management strategies (χ^2 test and median test).

	District	*Flock size category*	*Household headship*	*Age*	*Education*
Disease prevention	p<0.05	ns	ns	ns	p<0.05
Disease treatment	p<0.05	ns	ns	ns	ns
Purchase of medicines/drugs	p<0.01	ns	p<0.05	p<0.05	p<0.01
External parasite control	p<0.01	ns	ns	p<0.05	ns
Purchase of acaricides	p<0.01	ns	ns	ns	p<0.01
Feed utilization	p<0.01	ns	ns	ns	ns
Improved feed quality	p<0.01	ns	ns	ns	ns
Controlled mating	p<0.01	ns	ns		ns
Purchase of breeding bucks	p<0.01	ns	ns	p<0.05	ns
Castration	p<0.01	p<0.01	p<0.05	p<0.05	ns
Culling for higher performance	p<0.01	p<0.05	ns	ns	ns
Roofed housing in dry season	p<0.01	p<0.01	ns	ns	ns
Roofed housing in rainy season	p<0.01	p<0.01	p<0.05	ns	p<0.05
Improved water access	ns	ns	ns	ns	ns

Note: ns = not significant

3.4.1 Main goat markets

Goat markets are generally underdeveloped. Farmers rely on informal market channels with the main buyers being traders and neighboring farmers. The main market option for goats were farm gate sales, and, to a lesser extent, sales linked to cattle sale pens organized by RDC, local collection points and business centers (Figure 20). Most farmers characterized only two options, confirming the lack of market alternatives.

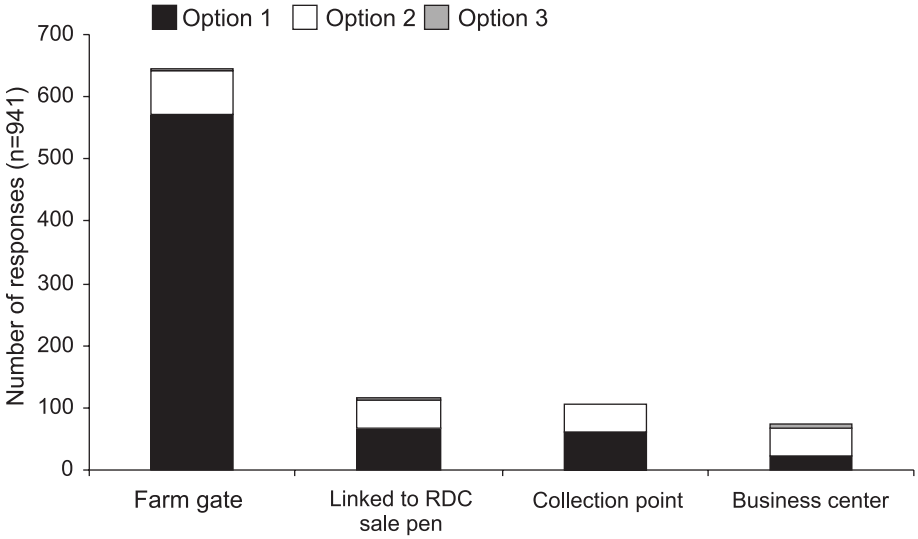

Figure 20. Main market options for goats.

Note: Options 1, 2 and 3 were derived from farmer rankings of the most common market options in their area.

Farmers' rely on farm gate sales because no other market options are available to them. The fact that only few farmers mentioned a third market option reconfirms the lack of alternative goat markets.

RDC cattle sale pen infrastructure is not designed for goats, but farmers take the opportunity to sell goats parallel to the cattle sales, thus, creating a regular goat marketing option.

Local collection points are not regular. Local authorities (councilors), who act as intermediaries between traders (bulk buyers) and farmers, mainly organize the collection points for goats upon the traders/buyers demand.

Local business centers have potential demand for goats through several butcheries and various consumers buying goats spontaneously. Their advantage is that they are accessible for most farmers and farmers can reinvest their cash from goat sales nearby.

The availability of alternative market options differs across districts (Figure 21). Farmers in Beitbridge, Gwanda and Binga cited RDC sale pens, collection points and the business center as alternative options to different extents. Fewer options and thus more reliance on farm gate sales were found in Matobo, Nkayi and Tsholotsho.

Access to alternative market options also differed within districts. In the districts with alternative market options, farmers made more use of them in wards with good market access. Beitbridge demonstrated an effective use of the existing RDC cattle sale pens in the ward with good market access. In Gwanda the ward with poor market access turned out to have a very strong local market, explaining the high level of sales at local collection points and links to the RDC sale pens. Farmers in Binga made use of the business centers and local collection points at

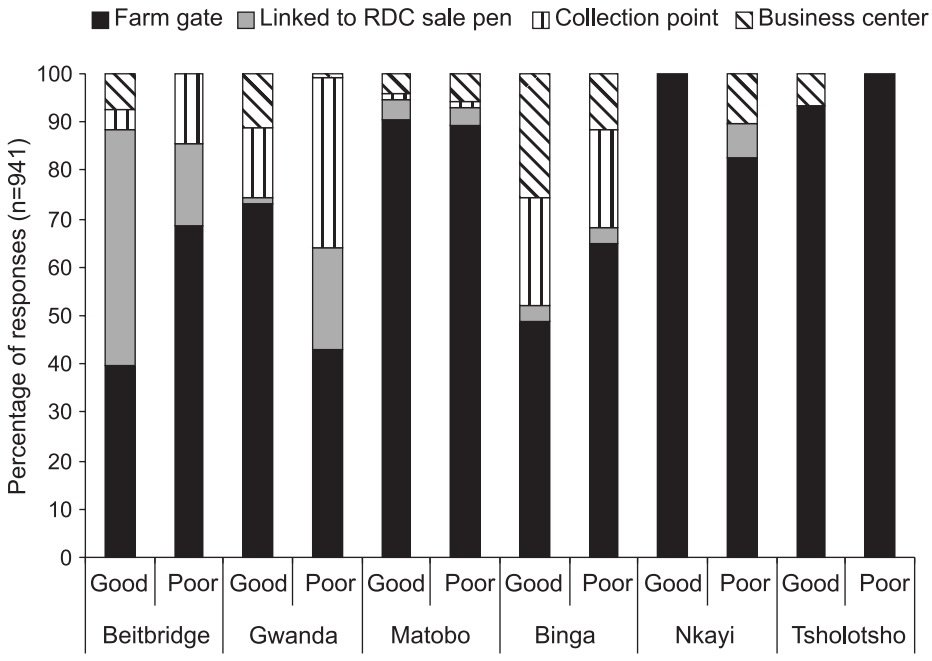

Figure 21. Main goat market options by ward (good versus poor market access).

both wards. Local differences in evolving market options need to be considered in goat market development.

Farmers' perceptions of goat markets

From the farmers' point of view, a good market should have certain advantages (Figure 22). Most important are low transport costs, followed by price-related advantages (higher prices, confidence in pricing, payment for good quality, farmer determined prices) and market-related advantages (availability of buyers, regular market operations). To a lesser extent, farmers cited opportunities to collaborate in production and marketing activities.

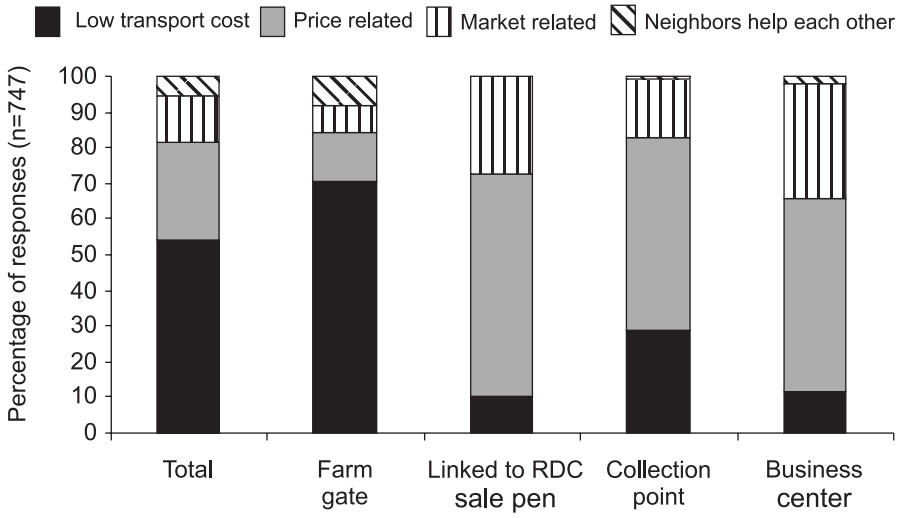

Figure 22. Advantages of main goat market options.

The most frequently stated disadvantages of goat markets and thus challenges for improvements were low prices, long distances from the markets and inconsistent operations (Figure 23). Both advantages and disadvantages characterized the different market options to varying extents.

3.4.2 Farmer profiles

The number of farmers participating in goat marketing was generally low (Table 41). On average only 44% of the farmers sold at least one goat during the observation period, but this differed across districts (χ^2, $p<0.01$). In Gwanda and Beitbridge, where better market facilities were established, more farmers sold goats.

Also, farmers' participation in goat marketing differed within districts (χ^2, $p<0.01$). In Beitbridge, more farmers sold goats in the ward with good market access and established sale facilities at RDC cattle sales. More farmers in Binga sold goats in the ward with good market access. In Gwanda and Matobo, however, more farmers sold goats in the wards with poor market access. In both districts, strong local markets far from the main market were discovered during the data collection. Nkayi also had a higher market participation in the ward with poor market access that

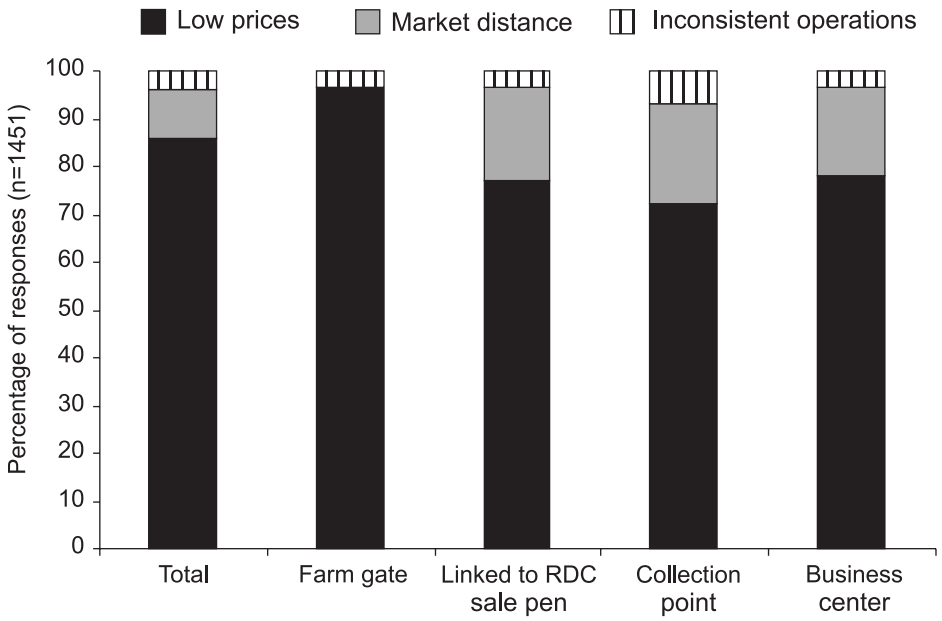

Figure 23. Disadvantages of main goat market options.

Table 41. Percentage of households participating in goat marketing from May 2005 to April 2006 by district and ward.

	Between districts	*Within district*		
		Good market access	*Poor market access*	χ^2 *sign at*
Total	44.0	41.7	46.3	ns
Beitbridge	50.4	63.9	34.9	$p<0.05$
Gwanda	61.6	46.7	76.3	$p<0.01$
Matobo	40.1	23.1	58.1	$p<0.01$
Binga	43.9	63.3	25.4	$p<0.01$
Nkayi	36.4	20.3	52.1	$p<0.01$
Tsholotsho	29.0	36.1	22.2	ns

Note: ns = not significant

had a better natural potential for goat production. It was concluded that the market accessibility and local demand for goats has a positive impact on households' decision on whether or not to sell goats.

Among farmers who sold goats during the observation period, the mean number of goats sold/exchanged ranged from two to seven, with significant differences across districts (median test, $p<0.01$, Table 42). Binga had the highest mean and a high standard deviation in goats sold/exchanged implying that a few households sold many goats. There was also the exceptional situation where most goats were bartered for basic food items (mealie meal). The high number of sales/exchanges might be caused by the drought spell that coincided with the observation period. In Gwanda, not only were many households involved in goat marketing, but also the mean sales/exchanges of goats were comparatively high. In Tsholotsho and Nkayi, where goat

Table 42. Mean number of goats sold/exchanged per household from May 2005 to April 2006 by district and ward.

	Between districts			*Within district*						
				Good market access			*Poor market access*			
	n	*Mean*	*Std. Dev.*	*n*	*Mean*	*Std. Dev.*	*n*	*Mean*	*Std. Dev.*	*Median test*
Total	363	3.6	4.9	173	3.8	5.6	190	3.5	4.2	ns
Beitbridge	68	3.0	2.4	46	3.4	2.6	22	2.3	1.6	$p<0.05$
Gwanda	93	4.6	5.4	35	2.3	1.6	58	6.0	6.4	$p<0.01$
Matobo	61	2.8	2.3	18	2.8	3.2	43	2.8	1.9	$p<0.01$
Binga	54	6.5	9.0	38	7.9	10.3	16	3.2	3.4	$p<0.01$
Nkayi	51	2.0	1.5	37	2.2	1.6	14	1.4	1.2	$p<0.01$
Tsholotsho	36	1.9	1.1	22	2.1	1.2	14	1.6	0.9	ns

Note: ns = not significant

sale facilities were not developed, fewer households were involved in selling goats and they also sold fewer goats per household.

Within districts, the number of goats sold per household differed according to good and poor market access.[13] In Binga, and to a lesser extent in Beitbridge, the number of goats sold at areas with good market access was almost twice that sold at areas with poor market access. In Gwanda the high number of goats sold where market access was poor resulted from local market opportunities. These results show that better access to markets influences farmers' decision to sell more goats.

Among those who sold goats, there was a trend that the total number of goats sold/exchanged increased with the households' flock size (Pearsons' correlation coefficient 0.531, $p<0.01$). Differences between the flock size categories confirmed that relatively more farmers with large flocks sold goats than those with small flocks (χ^2, $p<0.01$, Table 43). The total number of goats sold during the observation period was also higher among those with big flocks (median test, $p<0.01$). However, the sale rates were higher for farmers with small flocks, who proportionally

Table 43. Proportion of households participating in goat marketing, households' number and rate of goats sold/exchanged from May 2005 to April 2006 by goat flock size category.

	Proportion of households sold/ exchanged (%)	*Number of goats sold/ exchanged*		*Sale/exchange rate (%)*	
		Mean	*Std. Dev.*	*Mean*	*Std. Dev.*
Total	44.1	3.6	4.9	23.8	0.6
1–8	34.2	2.5	2.5	36.3	0.3
9–19	49.6	2.9	2.5	17.1	0.2
>=20	63.1	6.3	8.1	13.2	1.1

13 Note that the total number of goats sold at good or poor market access was not significantly different and was probably caused by the effect of locations.

sell more goats (median test, $p<0.01$). Farmers with large flocks are in a better position to increase goat sales, whereas those with few goats need to conserve their animals for solving urgent needs. Those with few goats exploit their flocks more, and therefore need more effort to maintain a sustainable flock size.

Comparing the sales of goats among households of varying livestock holding categories showed similar trends. Farmers with no cattle and few goats were less inclined to enter goat sales (χ^2, $p<0.05$; Table 44). Although differences in the total number of goats sold between livestock holding groups were not statistically significant, farmers with no cattle and few goats sold comparatively fewer goats and those with highest number of cattle and goats sold more goats. The sale rates of goats were however highest for households with few goats and no cattle, implying that these farmers sell more goats in relation to their small flock size (median test, $p<0.01$).

Table 44. Proportion of households participating in goat marketing, number and rate of goats sold/ exchanged from May 2005 to April 2006 by livestock holding categories.[1]

	Proportion of households sold/ exchanged (%)	*Number of goats sold/exchanged*		*Sale/exchange rate (%)*	
		Mean	*Std. Dev.*	*Mean*	*Std. Dev.*
Total	44.0	3.6	4.9	23.8	60.6
1	35.5	2.2	1.4	38.8	26.9
2	54.8	3.6	4.4	17.3	11.8
3	43.1	3.2	2.8	22.7	27.0
4	44.3	3.3	3.0	27.5	99.6
5	45.8	5.4	8.1	13.6	58.1

1 Livestock holding groups were categorized as follows: 1 = 0 cattle, < 8 goats; 2 = 0 cattle, > 9 goats; 3 = 1–2 cattle; 4 = 3–7 cattle; 5 = > 8 cattle.

The selected socioeconomic household characteristics did not influence the proportion of households that sold goats, or the households' sale/exchange rate. Yet, among those households who sold/exchanged goats, the total number of goats sold/exchanged differed by households' headship (Table 45). Male-headed households tended to sell more goats compared to female-headed households. Although statistically not significant, heads of households in the productive age group and literate households tended to sell more goats.

Influence of goat sales on management strategies

An important departure point is whether farmers who sell more goats also invest more in goat management, indicating a disposition to commercialize. Therefore, farmers' goat sales during the observation period were tested on investments in different management components (Table 46). A clear pattern between higher sales and management investments could not be found. Farmers who sold more goats castrated their bucks more often and culled for higher performance, but they were less involved in disease prevention. Those farmers who sold fewer goats were more involved in disease treatment and more often had a roofed kraal, but bought quality bucks less often. In addition, the above variability in sales and management investments across districts

Table 45. Mean number of goats sold/exchanged from May 2005 to April 2006 by household headship, age and education of head of households.

		n	*Mean*	*Std. Dev.*	*Median test*
Household headship	Male	259	4.0	5.6	p<0.05
	De jure female	69	2.7	2.6	
	De facto female	35	2.4	2	
	Total	363	3.6	4.9	
Age	> 40 yrs	80	3.3	3.4	ns
	41–60 yrs	175	4.2	6.4	
	< 60 yrs	107	2.9	2.4	
	Total	363	3.6	4.9	
Education	Illiterate	45	2.9	2.5	ns
	Primary education	191	3.2	3.9	
	Secondary education	109	4.6	7.1	
	Advanced	9	3.2	2.2	
	Total	363	3.6	4.9	

Note: ns = not significant

confirms the need to further test the effects of sales on management investment for each district. These results indicate that a mindset for commercializing goats is not yet developed.

Table 46. Summary of interactions between goat sales and selected management strategies (χ^2 test and median test).

	Goat sales	*Number of goats sold*
Disease prevention	ns	p<0.01
Disease treatment	ns	p<0.05
Purchase medicine/drugs	ns	ns
External parasite control	ns	ns
Purchase of acaricides	ns	ns
Feed utilization	ns	ns
Improved feed quality	ns	ns
Controlled mating	ns	ns
Purchase of breeding bucks	ns	p<0.05
Castration	p<0.05	p<0.05
Culling for higher performance	p<0.05	p<0.05
Roofed housing in dry season	ns	p<0.05
Roofed housing in rainy season	ns	ns
Improved water access	ns	ns

Note: ns = not significant

3.4.3 Buyer profiles

Traders (43%) and farmers (40%) acquired most of the goats (Table 47). The high proportion of traders in relation to farm gate sales as the most common market option, leads to the conclusion that traders collect a significant number of goats at the farm gate.

Traders were the main buyers of goats in Binga, Gwanda and Beitbridge (Figure 24). Other farmers were the main buyers in Matobo, Nkayi and Tsholotsho. Traders thus tend to operate in areas where there are relatively better market facilities and higher goat populations.

In Beitbridge and Binga, districts with alternative market options in the ward where market access was good, higher sales and exchanges were done with traders rather than with other

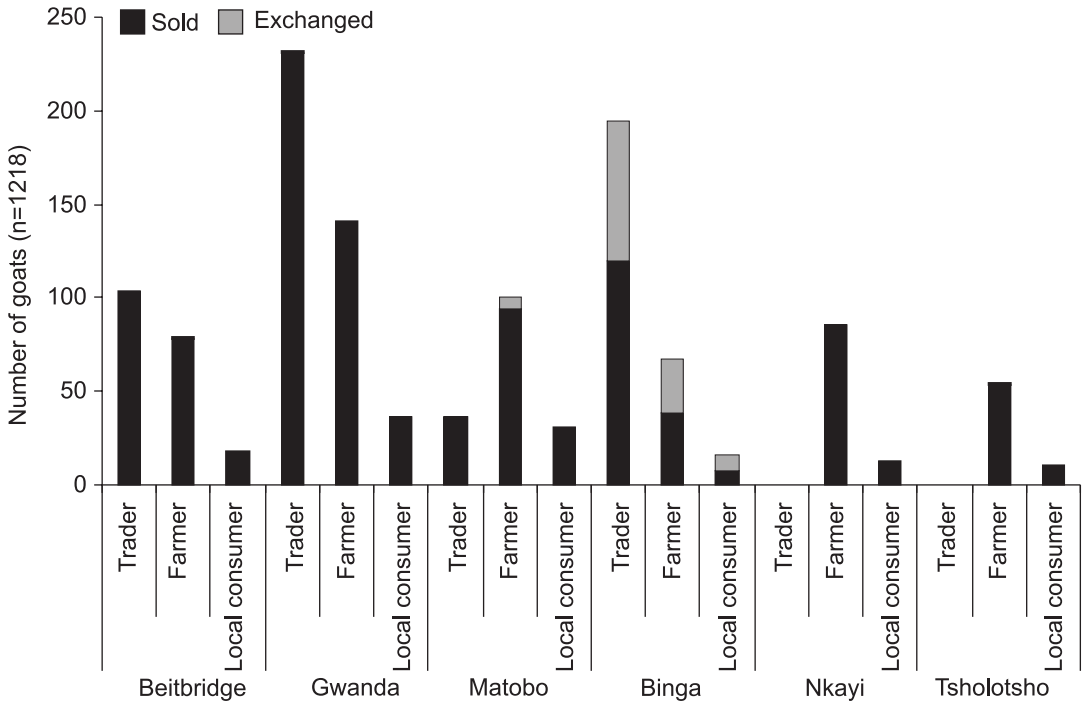

Figure 24. Goats sold and exchanged by type of buyer and district.

farmers (Figure 9 in Appendix). Gwanda showed highest sales of goats to traders in the ward with poor market access, with a strong local demand. These results clearly show that where goat market opportunities are available market players such as traders respond.

Table 47. Total number of goats sold and exchanged by type of buyer.

	Trader	*Farmer*	*Business center*	*NGO*
Sold	491	491	72	43
Exchanged	75	37	9	0

3.4.4 Farmers' challenges in goat marketing

In order to effectively respond to farmers' needs and priorities, it is critical to understand their perceptions on goat marketing. Most farmers cited market-related constraints (difficulties to contact buyers, lack of price and grade information, high transport cost, and tedious legal procedures; Table 48). Low market prices for goats were also frequently cited across all districts. Production-related constraints (insufficient number of goats, low goat productivity and quality) were more common in Gwanda, Matobo and Tsholotsho and least in Nkayi.

Table 48. Main constraints in goat marketing by district (n = 1020).

	Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Market constraints	+++	+++	+++	+++	+++	+++	+++
Low prices	+++	+++	+++	+++	++	+	++
Production constraints	++	+	+++	+++	++	o	+++

Note: o = 0–28; + = 29–56; ++ = 57–84 and +++ = >84; calculated by dividing the total frequencies by the number of districts and number of categories.

Pricing

Farmers determined prices for goats mainly by goat sizes, across all market options (Table 49). Animal condition also played a role at the RDC sale pens and collection points, indicating a concept of quality requirements at alternative market options. Age and sex played a minor role. Other criteria for price determination were comparing prices with other farmers, the breed type and whether or not males were castrated. Only a few farmers determined the price according to the problems that they faced, thereby displaying a basic understanding of price determination and market requirements.

Table 49. Farmers' criteria for price determination by market option (n = 1892).

	Total	*Farm gate*	*Linked to RDC sale pen*	*Collection point*	*Business center*
Size	++	+++	+++	++	+
Condition	+	+++	+	+	o
Age	o	++	o	o	o
Sex	o	++	o	o	o
By problem	o	o	o	o	o
Other	o	o	o	o	o

Note: o = 0–47; + = 48–94; ++ = 95–141; +++ = >141, calculated by dividing the total frequencies by the number of districts and number of categories.

According to farmers, buyers generally did not pay for better goat quality, especially at the farm gate (Table 50). At other market options, buyers were more likely to pay for quality goats.

Farmers tended to be in a better position to set prices at the farm gate where buyers incur most of the transaction costs (Table 51), unlike the other marketing options that limit the bargaining power of the farmers. Yet, one has to consider other factors that determine goat prices, such as lack of alternative market options, lack of competition among buyers, distress selling and general price levels for goats and substitutes.

Table 50. Percentage of farmers acknowledging that buyers pay for quality.

Total	*Farm gate*	*Linked to RDC sale pen*	*Collection point*	*Business center*
39.8	33.4	51.4	52.8	55.8

Table 51. Farmers' criteria for price determination, by market option (n = 845).

	Total	*Farm gate*	*Linked to RDC sale pen*	*Collection point*	*Business center*
Farmer/seller	++	+++	+	+	+
Buyer/auctioneer	+	++	+	++	o
Negotiation	o	+	o	o	o
Councilor	o	+	o	o	o

Note: o = 0–26; + = 27–52; ++ = 53–78; +++ = >78, calculated by dividing total frequencies by the number of districts and number of categories.

Market information

Access to information on goat markets was identified as a critical factor affecting marketing decisions. Thirty-one percent of the farmers had no access to information on goat marketing. Those who had access to information mainly relied on other farmers, livestock traders, local gatherings, local authorities, schools and AREX (Figure 25). Governmental and non-governmental organizations were ranked low as sources of information.

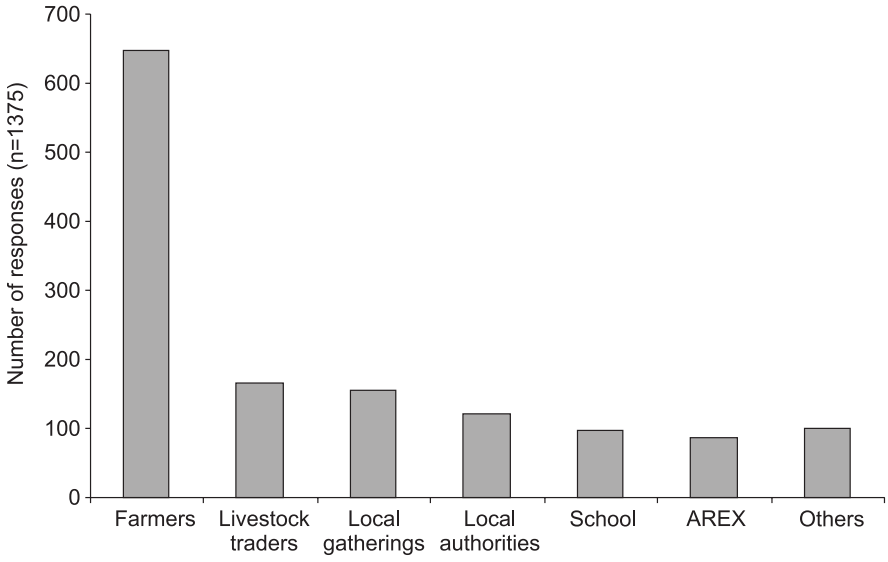

Figure 25. Sources of information on goat marketing

Note: Other sources of information include the DVS, posters at local shops, NGOs, livestock markets, dip tanks, public media, local butcheries and Zimbabwe Farmers Union (ZFU).

The most important sources of information differed across districts (χ^2, $p<0.01$). Livestock traders were cited as important sources of information in Matobo (24%) and Beitbridge (11%), and local gatherings (23%) and authorities (23%), particularly in Gwanda. However, the quality and consistency of supply of information was not confirmed in this study.

Modes of transport

Walking was the most common mode of transporting goats to the market, followed by use of scotch cart (Table 52). Other modes of transport were trucks, public transport, boats or renting a truck. Districts differed in their most common modes of transport (χ^2, $p<0.01$). In Beitbridge, Gwanda and Binga districts, where a variety of alternative market options existed, farmers were

Table 52. Modes of transporting goats to the market, by district (n = 915).

	Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Buyer collect	+++	+++	+++	+++	+	+++	+++
Walk individually	+	+	++	+	++	o	o
Own scotch cart	o	+	+	o	o	o	o
Walk in a pool	o	o	o	o	o	o	o
Rent scotch cart	o	o	o	o	o	o	o
Others	o	o	o	o	o	o	o

Note: o = ≤25; + = 25–50; ++ = 51–75; +++ = >75, calculated by dividing the total number of responses by the number of districts and categories.

more inclined to organize themselves to get their goats to the market. In these three districts farmers rented scotch carts and also pooled to walk goats to the market. Currently, buyers and traders bear the bulk of the transport cost, but transfer the cost to the farmer by offering low prices.

4. Discussion: Implications for development interventions

The results of this study revealed that there is great potential in goat production, but this is currently not exploited in Zimbabwe. Goats are a critical source of cash income for small-scale farmers, and income from goats is of utmost importance to sustain human nutrition and education, particularly in the semi-arid areas where few alternative cash income options exist. Goats also contribute directly to food security, providing high-quality protein (meat and milk), especially for the many resource-poor households that do not own cattle. However, most farmers have neither the capacity nor the incentive to invest in goat management and therefore remain with low goat productivity. Farmers with small flocks in particular face highest goat mortalities, although they depend most on the benefits from goats. To achieve greater benefits from goats, development interventions must combine capacity building in goat management, sustaining committed farmers in flock building and improving market opportunities that will stimulate farmers with sufficiently large flocks to increase offtake.

Figure 26 provides a framework on the environment, management components and interactions, which need to be considered by support systems that aim at improving farmers' capacity in goat production and marketing (Campbell *et al.,* 2005). Strategies for improved goat management and marketing need to be generated in local contexts, and facilitated by appropriate networks and feedback systems to achieve the expected benefits (Conroy, 2005). Realization of the expected benefits in the form of higher goat production and higher income from goat sales is considered an incentive for farmers to invest more in goat production technologies and enhances sustainability in developing the goat sector

This chapter discusses challenges in goat production and marketing in their natural and socioeconomic contexts. Based on this, priorities in goat management and the role of developing markets are investigated. A better understanding of local goat production systems can contribute to better-targeted and thus more effective development interventions for small-scale farmers in Zimbabwe's semi-arid areas.

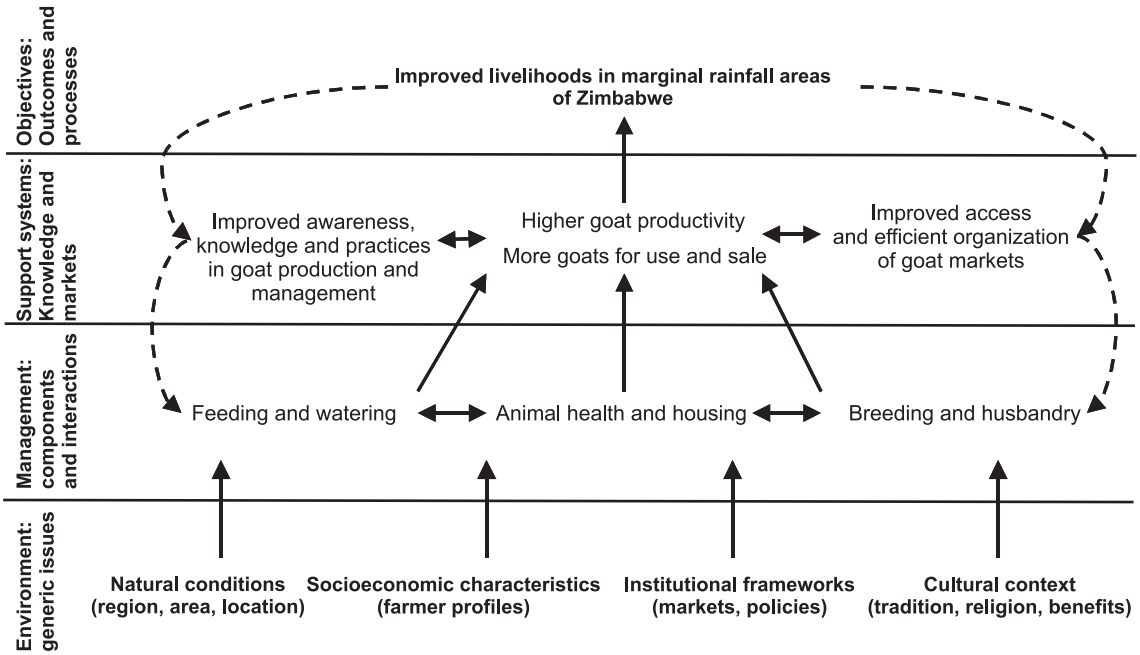

Figure 26. Framework for improved goat production and marketing.

4.1 Key challenge: Reducing mortality and enhancing fecundity

Overall goat flock dynamics – as a simple indicator for goat productivity – showed negative trends, although farmers emphasized reproduction and consequently flock building. Among the in- and outflows, low birth rates waged against high mortality rates. The study postulates that reducing the high mortality rates is the most effective and quickest means to sustain farmers in production, increase goat productivity and provide more goats for the market. Forty-five percent of goats died before they could be utilized for human consumption or sale. Reducing the number of goats lost would immediately impact the farmers' asset base, as these goats would remain available for reproduction and other use values. Securing available goat assets preserves farmers' livelihoods, and is therefore a good starting point for development interventions aimed at improved goat production.

Highest goat mortality rates occurred in the dry season (from August to December), indicating a requirement for time-specific interventions. Since mortalities peak in does in the dry season, interventions should specifically address feed shortages for pregnant and lactating does. Protecting does will also facilitate quicker flock regeneration after droughts. On the other hand, kid mortality depends more on average annual rainfall and rates can also be high for kids born in the CWS (from March to May). According to local experience, kids are highly susceptible to the cold and often die of weather-related diseases. For kids, special emphasis should therefore be on proper housing; this technology has already been developed and proved (Sikosana, personal communication).

The fact that mortality was highest for farmers with small flocks, which also form the largest group of households, indicates the need to improve goat management skills particularly for

resource-poor farmers. For example, farmers with small flocks might be using their does more intensively through higher milk extraction, but not sufficiently investing in their feed requirements, resulting in the high mortality rates. On the other hand, farmers with large goat flocks who are more engaged in goat marketing have more resources to control mortalities.

The other way of sustaining and increasing goat flocks is to improve goat reproduction rates. Reproductive performance found in this study was generally low (fecundity rate 76%). Otte and Chilonda (2002) reported an average fecundity rate of 130% for semi-arid mixed farming systems in sub-Saharan Africa. The low reproduction rates in this study could have been influenced by the poor rainy season of 2004/2005 and merits further investigation.

Higher reproduction can be achieved by increasing fecundity. Most flushing and mating happens in October/November when the rangelands start to replenish. Interventions that improve the body condition of does before this period, for example through supplementary feeding, could achieve higher conception and kidding rates, thus leading to higher reproduction rates.

Local variations in flock dynamics indicate area-specific constraints in production. Districts in Matabeleland South had on average larger goat flocks and therefore higher potential for goat production. More households did not have cattle or had a few cattle, rendering goats more important. Interventions in those districts with high goat mortality and low birth rates (eg, Gwanda) should focus on sustaining flock growth. Interventions in other districts with low goat mortality and high birth rates (eg, Matobo) should place more emphasis on enhancing offtake. In Matabeleland North, goat flocks were generally smaller, despite a higher feed production potential. Farmers in Matabeleland North have more cattle and could therefore place less emphasis on goat production.

4.2 Priorities in goat management

To improve goat productivity, it is critically important to develop practical measures that improve management. However, most farmers are reluctant to make the necessary investments, possibly due to the fact that they do not realize the returns on their investments and do not see the commercial potential for goats. Furthermore, the effects of flock sizes and goat sales on the measured investments in improved management were inconsistent. Farmers who kept or sold more goats did not necessarily invest more in improved goat management, suggesting a lack of information across all goat keepers.

Improved management strategies should integrate different management components, namely animal health and housing, feeding and watering, mating and breeding together with goat marketing. Interactions between the components and their impact on goat production need to be considered. District-specific differences reflected in the variability of management investments should be taken into account.

Animal health and housing

For effective health management, farmers should be able to diagnose, prevent and treat the most common animal diseases. However, it was observed that farmers were often unable to identify diseases and causes as well as to determine appropriate treatment. This shows a critical

knowledge gap and need for improved access to basic information on the most common diseases and their seasonal prevalence.

The high frequency of using traditional medicines for disease prevention and treatment proves farmers' need to improve animal health. Predominance of traditional methods could imply that farmers either possess sufficient indigenous knowledge in health management, but it could also signal that farmers do not always have the financial resources and/or access to commercial control measures, or both. Therefore, the effectiveness and dosing rates of these remedies must be evaluated. If validated, indigenous knowledge in animal health (ethno-veterinary practices) will need to be documented. Its distribution remains a challenge as it is often tacit and enshrined in cultural practices and restrictions and thus difficult to access. Sustaining farmers' ethno-veterinary practices enhances their experimentation skills, rather than encouraging a reliance on externally supplied products. Applied ethno-veterinary practices require preservation of natural resources and integration with modern medicine.

Apart from the lack of knowledge and information for disease prevention and treatment, access to veterinary medicine/drugs was limited. The current constraints within government services result in reliance upon the initiative of farmers and private suppliers. Farmers' capacity to source animal health inputs and pool their resources needs to be strengthened in order to reduce the costs involved and achieve greater responsibility and ownership in animal health programs. Concerted vaccination programs are important to avoid uncontrolled spread of diseases and reduce the costs involved in treatment. More emphasis needs to be placed on the development of cost-effective distribution systems of veterinary supplies, especially to the remote rural areas.

In terms of external parasite control, preventative measures were inadequate. Access to acaricides for goats was also limited and not provided by government support services. In addition, dipping facilities specifically for goats were non-existent. Therefore, dipping of goats depended on cattle dip tanks, which were often not functional, especially in Binga. In cases where goats were dipped, they were left to make use of what remained after dipping cattle. This gives precedence to cattle owners because they would have paid dipping fees. As a result, most farmers practiced manual removal of ticks whenever there was a need and only few farmers purchased acaricides from private suppliers. This confirms the need for improved veterinary input supply systems.

Appropriate housing is a precondition to prevent weather-related diseases, especially for kids, thus reducing mortality. According to work at Matopos Research Station, improved housing reduced kid mortality rates by at least 10% (Sikosana, personal communication).

Education had a strong influence on various animal health aspects. Literate farmers invested more in disease prevention, including improved housing. They also bought more medicine/drugs and acaricides. Yet, flock sizes had no influence on investment in animal health. This implies that training in animal health management, regardless of flock size, would have a strong impact on improving disease control. Illiterate households need special support in animal health.

Animal health interventions would be more effective for goats in good body condition, emphasizing the need for appropriate nutrition and feeding. Better exploitation of health and nutrition interactions also strengthens reproduction, growth and the ability to withstand drought.

Feeding and watering

Feed shortages were a concern for most farmers and 83% of farmers utilized alternative feed resources in addition to rangelands. This is a very strong argument that farmers are prepared to invest in improved goat nutrition. The fact that most investments were in locally available low-quality crop residues substantiates the need for higher quality feed and fodder resources for goats. Improved feed and fodder production would reduce the pressure on the rangelands, particularly during the dry season, when herbage quantity and quality is low. Establishment of local feed production and markets is essential as opposed to introducing commercial stock feeds that are most often not available and unaffordable, particularly for the many farmers with small flocks.

Improved rangeland management is critically important in order to preserve and increase the productivity of natural grazing as well as to restore degraded grazing areas. Community-based grazing management was evaluated as generally poor (Scoones *et al.*, 1996). To govern seasonal land use on a large scale, institutional development, integrating traditional leadership and formal administration, is necessary. Initiatives in rangeland protection, such as social fences found in Nkayi or local by-laws in Matobo, are appropriate to control extensive rangeland utilization. Such initiatives could have a positive impact on both livestock and the rangelands.

Supplementary feeding provides alternative feed resources during periods of nutritional bottlenecks and reduces pressure on the rangelands, thereby allowing the rangelands to recover (Holness, 1999). Crop residues (legumes more than cereals) are very important in ensuring the survival of goats. They were extensively utilized, as they are available at low cost to most farmers. However, the process of harvesting, collecting and storing crop residues needs to be improved to avoid leaf disintegration and damage by rain and sun. There is also need for value addition by improving protein content and digestibility, for example through urea treatment or making silage.

Characterization and conservation of key resource areas (nearby crop fields, river banks, wetlands) could be a strategic approach to enhancing herbage production in highly productive areas. Reinforcement of these sites with legumes would improve the nutritional value (protein and digestibility) of the goat diet. To effectively utilize these resources during the dry season, they need to be well managed and protected throughout the year. Such interventions require strong community consensus and support from the traditional leadership and formal administration.

Cut and carry practices (*Acacia* branches, pods and grass) provide quality nutrition for goats, and also depend on communal resources. Apart from identification and documentation of high value plant species, rules and regulations for their utilization need to be developed.

Commercial stock feed utilization, the highest quality feed option, is financially prohibitive for most farmers and further restricted by inaccessibility. Accessibility can be improved through involvement of local dealers and formation of farmer purchase cooperatives or syndicates, optimizing on economies of scale. Farmers who invest in commercial stock feeds have a greater potential to take up other feeding technologies such as crop residue treatment and forage production. Alternatively, they can create a local market for feed resources.

Planting forages in individual cropping fields could be another way to reduce the impacts of seasonality of feed supply and provide higher quality feed than the rangelands can supply (Mhere *et al.*, 2002). A few farmers in Gwanda and Matobo have implemented this successfully (as a result of farmer field schools). Access to information and technologies, and the availability of labor and land might however restrict broader adoption. Value addition in individual crop fields and along contours and homestead boundaries might be a cost-effective option. The benefits from planting forages must be clearly demonstrated and compared with farmers' expenditures on commercial stock feeds.

Improving the local availability and quality of feed resources needs to be combined with developing a reliable distribution of supplementary/emergency feeds during droughts. This would sustain the survival of key goat categories, primarily does, and is a cost-effective intervention to keep farmers in production. Provided at strategic places, for example near markets, such feeding programs would also support market flows and achieve reasonable prices for farmers. It should result in better quality goats that are ready for consumption and sale (December and January), and thus form an important strategy for farmers interested in commercialization. Sources of emergency feeds need to be identified, such as fodder banks, residues from irrigation schemes or agro-industrial by-products. To sustain feed distribution, traders could be involved in selling emergency feed in remote areas at times of need.

Feed interventions need to be linked with rangeland protection and water management for optimal use of the natural resource base. To prevent rangeland degradation as well as underutilization, the local distribution of water points needs to be considered. Lack of naturally occurring water sources in the rainy season reduces the ability of goats to make full use of rangeland feed resources and this also limits their recovery from the dry season. In the dry season, a high reliance on boreholes creates competition with the human population, reducing water and feed intake for goats. Degradation around those water points is a common phenomenon. Integrated land-use planning should ensure appropriate allocation of water resources, paying particular attention to vulnerable groups and marginal areas (FAO and UNEP, 1999).

To complement the measures recommended above, farmers need reliable information on goats' nutritional requirements and available feed options. Literate farmers invested in a more diverse combination of feed resources. However, formal sources of information on goat nutrition were limited and poorly accessible to farmers. Thus, there is a high need for expanding training and extension services in goat nutrition. The curricula should address basic goat nutrition principles as well as agronomy of forage production, processing and conservation. This should be complementary to a package of rangeland conservation techniques.

Improving feed and fodder production would open up new cash income opportunities for farmers without livestock as well. The potential depends on natural availability, as well as infrastructure such as irrigation schemes, market facilities and access to information. Using and processing locally available feed resources for sale during the dry season is not yet exploited.

Breeding

Within flock selection, conservation and utilization of local breeds, rather than introducing exotic breeds, can be done as a starting point in long-term breed improvement strategies (Mhlanga,

1999). Selection for locally adapted breed types enhances flock productivity at low investment cost. Local breeds are known to be better at coping with heat, walking long distances and surviving feed shortages in the dry season. Breeding programs should therefore ensure the *in situ* conservation of indigenous well-adapted animal genetic resources to be sustained by good feeding, health and housing strategies.

Seasonal breeding should synchronize the demand of goats to the naturally available resources. Through controlled mating (October/November) farmers can ensure optimal nutrition for does and kids during the reproduction cycle and lactating period. Matopos Research Station has shown that kidding during wet season (February/March) when there is good herbage, together with improved housing to avoid exposure and external parasite control, reduces goat mortality. Furthermore, when goat production is considered as a commercial enterprise, controlled mating, as part of a well-planned breeding program, is necessary to meet market demands at specific times of the year. Individual mating control should not be too difficult to apply in communal grazing systems as most males are castrated. Revitalizing the traditional use of aprons is a simple and affordable technical option. Its broader application needs to be accompanied by institutional arrangements and involvement of the traditional leadership.

Improved breeding in a communal setup would be most effective through selection for high-quality bucks. The most common husbandry practice was castration, although this was done for meat quality rather than breeding purposes, especially by farmers with larger flock sizes. Young farmers as well as *de facto* female-headed households castrated less, suggesting that they keep their bucks for reproduction. Castration, as a way of selecting good-quality bucks, needs to be promoted and can be an entry point for training in goat production and marketing.

Under communal farming conditions, where most farmers are not in a position to purchase quality bucks, a breeding program that supports preservation of few high-quality bucks and regular exchange with external breeding material is required. This would require a community-based management approach, with shared responsibility of a few high-quality bucks. Decentralized breeding centers could support such initiatives for nearby training and effective breed development.

Selection of does for improved flock performance can be achieved through culling. However, mainly households who already have sufficient goats to cover their basic needs could adopt this practice. Preserving goat lines proven for high reproduction and longevity, and sustained by improved management, can substantially contribute to upgrading flock performance. Progeny history, recording the performance of does and their offspring, is recommended as an effective method for farmers to monitor flock productivity.

These recommended husbandry practices are simple and accessible to all groups of farmers at minimum cost and without external material. Above all, they strengthen local knowledge generation and effective use of available resources for all goat farmers. The consistent influence of districts on management investments confirms the need for local approaches in identification and support.

4.3 Driver: Market development

We argue that market development will provide the necessary incentive for farmers to invest in goat management, and thereby achieve higher goat production. This would benefit farmers with few goats to build their flocks in a more sustainable manner and it would stimulate those farmers with sufficiently large flocks for increased offtake. More farmers would thereby start selling goats and the market flow of goats would increase. Goat market development is thus conceived as a driver for farmers to increase technology uptake, and requires investigating farmers' current predisposition for higher goat sales as well as the existing market infrastructure and input delivery systems.

The approach of integrating goat market development with improved management technology builds on previous experience such as that with the Cold Storage Commission, where farmers were offered high prices for goats. However, lack of appropriate goat management technologies and capacity building programs reduced the success of the intervention. Goat productivity and quality remained low, resulting in failure to supply sufficient goats to the market.

Farmers provided historical evidence on the impact of market development on cattle production. According their information, cattle owners did not invest in cattle management until independence, because cattle markets were inaccessible and offered poor prices.

Sustainable goat market development is based on sound gross margin calculations that identify biggest volumes and most efficient market chains. It requires cost-effective investments in goat production (flock building and quality improvement) and market systems (infrastructure, security, transparency, information and services).

Farmers' predisposition to sell goats

Farmers showed a higher inclination to sell goats (than cattle) and also sold more goats in districts with better market facilities, and in wards with nearby markets. Farmers thus respond positively to market development by increasing market participation. This confirms markets as entry points for higher cash incomes from goats.

Farmers with smaller flock sizes were less involved in goat sales, indicating that insufficient numbers of goats restrict sales. They often had no cattle, and were thus highly dependent on goats and are even reluctant to sell them in despair. As Rohrbach *et al*. (2004) explain, farmers with few goats would reduce their recuperative potential if they sold (creating a poverty trap). The risks for small-scale farmers to participate in markets are greater than those for farmers with larger flocks. Therefore, this group of farmers will require extra support when designing interventions and recommendations that reduces the necessity to sell, thus protecting their flocks. Improved management is critically important for this group to ensure survival and flock growth until they have enough goats to participate in goat marketing.

On the other hand, those farmers with large flocks ($\geq$ 20 goats) who currently supply most goats to the market could be a target group for commercialization. Farmers with large flocks in most cases also have cattle and are therefore less dependent on goats. They are more flexible in disposing them irrespective of immediate cash needs. They can also better plan their

expenditures and readily apply timely management and marketing strategies. Identification of such commercializing farmers and building on their experience for technology development is recommended.

Yet, a number of farmers with large flocks did not sell but maintained their flocks. For these farmers the purpose, especially the insurance function and cultural values, of keeping goats needs to be further differentiated. One explanation could be that these farmers kept their goats instead of selling them to have a source of capital that can be liquidated for immediate cash needs.

Support services for marketing strategies thus have to respond to farmers' different objectives when selling goats. Farmers who mainly sell in distress need support programs to protect their small flocks from sale (eg, community-based loan schemes and/or trusts). Farmers who sell for immediate cash needs need strengthening in planning skills and facilitation of options for reinvestment (eg, linking input and output markets, facilitate goat markets in times of school enrollment). Those farmers with sufficiently large flocks and in a position to sell for commercial purposes need to be addressed for the development of more effective marketing strategies.

Although better market access influenced farmers to sell more goats, this was not translated into higher investments in goat management. This suggests that a commercial mindset has not yet developed, even among those farmers with sufficient goats. For effective participation in goat markets, farmers need to improve productivity and thus invest more in management. Farmers would only make the necessary investments if they were convinced that they would benefit. They would increase offtake rates if other use values from goats were covered (consumption, cultural). Market interventions therefore need to consider the issue of incentives. This does not necessarily mean direct price interventions, but also reducing transaction costs such as transport, access to information and contacting buyers.

Access to goat markets

Improved market access is expected to facilitate a more commercial orientation in goat production (KIT *et al.*, 2006). This study has proven that districts with alternative market options – such as sales linked to RDC auctions or local collection points – had higher goat sales and more goats were sold to traders. Having alternative options to sell their goats means that farmers can benefit from being in a better position to negotiate prices. Better market access can also improve the contact between farmers and traders, and thereby enhance the transfer of knowledge and information, especially about prices and quality standards. Traders can benefit from regular and better quality goat supplies at defined markets, important criteria to sustain their operations. Good market access can thereby stimulate farmers' investment in goat management and expose them to technical information effectively.

For cost-effective operations goat market facilities need to be improved. The study also identified high transport costs as a major constraint that traders incur and subsequently transfer to farmers. More effective transport modes are therefore necessary to enhance the flow of goats from rural to urban areas with resulting benefits for both farmers and traders. Improved market facilities also require better handling facilities (including feeding, watering and veterinary care) to reduce weight losses due to starvation during the market process, which also negatively affect goat

prices. In order to build farmers' trust in goat markets and for more transparency in price setting, a functional grading system with simple indicators for determining quality standards and prices, such as body weight and body condition scoring combined with age and sex, need to be established and distributed. Reducing the high transaction costs in goat marketing can significantly increase farmers' returns on investments.

Special attention should be paid to providing reliable market information on the timing of goat sales, quality standards and prices. Farmers currently lack market information and thereby have a reduced ability to respond to the market requirements and catch up with improved technology. In order to sustain effective market information dissemination, interventions need to facilitate the links between farmers, traders and local authorities, who were identified as the major sources of information. Traders in particular are carriers of up-to-date market information as they interact with the urban abattoirs, butcheries and consumers. Local authorities act as intermediates in the organization of goat markets. More effective coordination and transparency can lead to synergies for the market participants and increase farmers' benefits from goat markets.

Market development needs to take into account area-specific conditions that influence farmers' decisions about sales. In districts with better-developed market facilities and more goat sales (Beitbridge, Gwanda, Binga), traders were the main goat buyers and could become important partners in linking farmers to markets. Binga reflected a peculiar situation in which farmers bartered goats at very low exchange value and traders took advantage of less-developed markets. In other districts (Nkayi, Tsholotsho and Matobo), where farmers were main goat buyers, interventions should focus more on assessment of and awareness creation on market potential and establishment of basic market facilities.

Linkages also need to be established between consumers, traders and farmers. Currently, there is almost no exchange of information about consumer preferences, their willingness to pay for higher quality products and the margin for increasing domestic trade in goats. Prices for quality goat meat are significantly higher in urban centers, creating a limited niche for high-quality products. Increasing beef prices raise the demand for goat meat, particularly in poor households. Goats are thus an important source of animal protein at low cost in both urban and rural areas. Common grading standards and pricing categories need to be defined for this purpose.

It is important to note that all farmers sold live animals and no value-adding activities were reported. This is due to limited facilities in urban and rural areas and a general lack of awareness and knowledge about value addition. For instance, farmers do not obtain any value from such by-products as hides and offal. In addition to that, processing goat products in times of droughts and dry seasons could be an important emergency intervention for poor households, who are reluctant to sell goats and risk high mortality losses.

4.4 Goat farmer types

Differentiating household types in terms of goat marketing and management investment facilitates the development of targeted interventions (Heffernan *et al.*, 2004). This is based on the assumption that local contexts as well as socioeconomic household characteristics determine different predispositions in goat production and marketing. It implies that support strategies might differ for households with similar investment patterns in a poorly compared to a better-developed goat production and marketing context.

The fact that most management and marketing variables differed across districts confirms that interventions need to be developed at the local level, capturing local conditions (natural, socioeconomic, institutional). Farmer profiles might differ within districts, even though no difference was shown across districts.

Flock size determined goat sales and certain management variables. Farmers with larger flocks sold more goats and were also more involved in castration and culling, and thus had enough goats to sustain the flocks. Farmers with small flocks sold fewer animals and invested mainly in improved housing, but incurred highest mortalities during the dry season. This implies that different approaches need to be developed, addressing the needs of farmers with different flock sizes. Approaches for farmers with large flocks who sell already would focus on improved marketing and quality production, whereas those who do not sell would require more emphasis on awareness creation. Those farmers with few goats need support to maintain flocks and reduce the risk of mortality.

Among socioeconomic variables, household headship affected flock size and sale, with male-headed households in a better position to commercialize. This implies that special support is required to strengthen female-headed households in goat production and marketing. Yet, within households, the distribution of goat ownership, decision-making and labor investments showed that all family members are involved in goat production. Therefore, addressing gender relations in goat production and marketing has a strong empowerment component and dealing with these power balances is expected to have an impact on technology uptake.

For instance, sons provided most of the labor and are thereby in closest observation of the goats. They are a prime target group for interventions if management is going to be improved. Rangeland issues should target sons, as they mainly look after the goats and feed and water them. Daughters need to be trained, because they will own goats after marriage when they become mothers. Integrating the younger generation ensures continuity and contributes to the sustainable development of the sector.

The results further showed that younger households sold more goats, although their flocks were smaller. Young households seem to utilize more goats to cover daily expenses, establishing their own families. They are more likely to take up new technologies, as they are considered to be more receptive compared to the more risk-averse elders. For better communication and higher adoption of improved technologies, interventions should stratify households according to age (old/young) and target both age groups separately.

The high literacy level in the study districts offers a potential for improving goat production. Literate heads of households tended to keep and sell more goats. They might be more prone to taking risks and thus more inclined to commercialize and take up new technology. Illiterate goat owners require specialized information dissemination systems.

Drought, as a cause of high goat mortality rates, can change farmers' tendencies to invest in goat management. After a drought, more households might have below-average flock sizes and need to rebuild their flocks. Short reproductive cycles of goats – if well managed – allow for quick rehabilitation from drought, to rebuild flocks and continue commercialization. Development interventions need to be flexible enough to account for the impact of drought. They need

to integrate temporary emergency support, in order to get farmers back into production and marketing.

Further investigations are necessary to find out whether external sources of cash income have an influence on the number of goats offered for sale, and furthermore whether external income leads farmers to reinvest more in goat production, to secure their flocks or as an evolving goat business enterprise.

4.5 Feedback to communities: Lessons learned

Providing communities with feedback on research results and the discussion on appropriate development interventions proved highly useful for validation of research results and conclusions as well as for developing a working relationship with goat keepers. Furthermore, it led to a better understanding of the broader picture in goat production and technology dissemination pathways. It also stimulated a joint learning process between farmers and research and development support staff on crucial issues in goat production and marketing. Several farmers who already act as innovators and could become partners in the further testing and demonstrating of technologies were identified.

From this positive experience it was concluded that a follow up is necessary, but should involve all stakeholders along the goat value chain to discuss these results and their implications for goat development projects. This should lead partners to revise existing projects and agree on an action plan on how to best link producers to the market, so that it is beneficial for households with few goats as well as for those that are able to commercialize. However, to operationalize such a forum of discussion and re-evaluation needs further investment in conceptual thinking and budgets.

5. Conclusions and recommendations

This set of recommendations is based on a comprehensive analysis of current goat production and marketing and key constraints in six districts of southern Zimbabwe. These recommendations do not necessarily comprise the entire evolutionary process in goat development, but present the 'first steps' of development towards improved goat production and marketing. These options therefore need to be revised within the respective local contexts and implemented in a holistic approach, engaging different interest groups, and taking into account farmers' interests/objectives, limitations and existing initiatives. Most of the recommendations apply to both types of farmers, those with few goats who focus on building and maintaining flocks, as well as those with larger flocks who can successfully commercialize. The farmers with fewer goats will however need extra support and perhaps also a different approach to implementing the recommendations.

The key findings of this report indicate that resource-poor farmers have the potential to improve goat production and increase offtake levels, making use of locally adapted resources (genetic and natural). However, high goat mortality is the most limiting factor. This is due to a number of causal factors that include inadequate disease control, dry season feed shortages and poor nutrition, inappropriate housing and little efforts in improving the local breeds.

Therefore, the key entry point in improving goat production and offtake levels needs to be on strategies that reduce goat mortalities and ensure higher reproductive rates among existing

flocks. This can be achieved through developing farmers' awareness and their capacity to effectively use and improve technologies for animal health care, dry season feeding, nutrition, housing and breeding. In implementing these interventions farmer support and facilitating organizations (NGOs and government support services) need to demonstrate the benefits of proactive goat management. Technology dissemination pathways need to emphasize farmer learning and practice through initiatives such as farmer field schools. In order to train farmers in conducting and evaluating their own experiments in goat production, simple record keeping is recommended (progeny history, flock dynamics, goat body condition scoring). In our view, this learning approach will contribute to sustainable impacts on goat production and marketing.

The recommendations are presented in a tabular form that displays information and technical gaps identified in the various management components along with messages about how policy makers and government support services can provide support towards solving these challenges (Table 53). Practical options for livestock development agencies that implement interventions aimed at improved goat production and marketing are also presented.

Building on the hypothesis that market development would stimulate farmers' investment in improved goat production and management, we strongly recommend the development of improved markets (facilities, information and transport) that would facilitate higher production and increased offtake.

Table 53. Recommendations for strengthening goat management and marketing.

Animal health	
Information/technical gap	**Enabling framework by policymakers and government support services**
Farmers need information and knowledge with regards to disease management, including prevention, diagnosis and treatment of common diseases. Farmers require access to vaccines and other prophylactics and dipping infrastructure and services.	Develop conducive policies for improved goat production, marketing and trade Build the capacity of Department of Veterinary Services (DVS), the Department of Livestock Production and Development (LPD), Department of Agriculture and Extension (AREX) to provide the necessary animal health services and infrastructure specifically for goats
Practical options for livestock development agencies to consider - Create awareness and provide information and knowledge on animal health - Strengthen the capacity of farmers and community organizations to take control of their animal health care needs - Strengthen animal health and management centers (AHMCS) for day-to-day health care needs and link them with the community based animal health care officers/paravets - Engage farmer groups and/or community-based animal health care officers/paravets in sourcing inputs and information to increase their responsibility and ownership in animal health programs - Provide the necessary information and train farmer groups and/or community-based animal health care officers/paravets on all aspects of disease management for goats - Develop and distribute user-friendly extension material, simple prevention, diagnosis and treatment guides (using illustrations and written in the vernacular) - Evaluate, document and disseminate disease-specific ethno-veterinary knowledge on prevention, diagnosis and treatment - Propagate simple record keeping for farmers' own cost-benefit analysis, especially with regard to reduced mortality rates	

- Prevention
  - Vaccination and dosing
    - ♦ Identify important preventable diseases of livestock species and most vulnerable livestock categories, especially small stock and develop preventative programs
    - ♦ Lobby for national vaccination and dosing programs in high-risk zones
    - ♦ Facilitate monitoring and evaluation of these programs at local (household) and regional level to illustrate its value or otherwise
- Dipping
  - Develop appropriate dipping facilities for small stock: infrastructure, water provisioning, chemical supply including low-cost dipping technologies such as half drums particularly for poor households
  - Strengthen community ownership and management of dipping facilities
  - Monitor use and effectiveness of dip tank operations
- Diagnosis and treatment
  - Support farmers with basic skills and information to diagnose most common area- and season-specific diseases (information leaflets and posters at local shops/offices/schools, livestock markets, dip tanks, radio programs)
  - Engage private veterinaries, drug dealers, local shops and livestock traders in the distribution of small packages of medical care, especially in remote areas

Animal housing

Information/technical gap	**Enabling framework by policymakers and government support services**
There is a general lack of awareness that many goat diseases, and therefore mortalities of especially goat kids, can be prevented by providing adequate shelter for goats	Support the capacity of LPD to create awareness and inform goat keepers about housing technologies

Practical options for livestock development agencies to consider

- Create an awareness of the role of improved housing (eg, roofed and dry pens) on especially the survival of goat kids and sick and weak animals during cold and wet spells
- Provide goat keepers with appropriate technologies and skills for the construction of improved housing
- Illustrate the use of locally available materials to construct low-cost roofed and well drained housing and generally create better housing conditions
- Demonstrate the benefit of improved housing by simple record keeping, compare mortalities with sites where adequate housing is not available

Animal nutrition

Information/technical gap	**Enabling framework by policymakers and government support services**
Most farmers experience severe dry season feed shortages as well as drought emergency; this results in high mortality rates and low productivity	Government support services (LPD, AREX) should facilitate the sustainable utilization of rangelands. Promote alternative feed systems including dry season feed and fodder technologies.

Practical options for livestock development agencies to consider

- Improved rangeland management and increased rangeland productivity
  - Strengthen local institutions/community based organizations (CBO) to manage rangelands, eg, establish resting periods from grazing for regeneration (paddocking, social fences)
  - Collectively define institutional responsibilities for effective regulation and utilization of communal resources

- Develop local capacity and commitment to restore productivity of overgrazed rangelands (eg, bush clearing, re-plant locally adapted grass and browse species)
- Reinforce the productivity of key resource areas, high potential grazing sites within communal rangelands
- Establish grazing reserves for emergency grazing during droughts (eg, forage banks with legume fodder trees)
- Identify, manage and protect survival of high-quality herbs, wild fruits and legume trees for cut and carry systems within rangelands and/or pocket areas, and promote collection, processing and storage technologies, and develop community regulations for the extraction of these communal resources

- Crop residue utilization
  - Invest in drought-tolerant, dual-purpose crops (groundnuts, cowpeas, bambara nuts, millet, sorghum)
  - Promote technologies that improve the nutritional value and digestibility of these crops by appropriate storage and treatment (eg, silage or urea treatment)
  - Explore the potential of irrigation schemes as source of crop residues for feed resources
- Forage production
  - Provide access to drought-tolerant and locally adapted forage (forage sorghum, napier grass, bana grass) and dual-purpose legume varieties (cowpea, Dolichos bean)
  - Provide necessary information, training and backstopping to farmers to effectively utilize these crops (production, processing storage, value addition and feeding)
- Commercial stock feeds
  - Facilitate the decentralization of stock feed supply to rural areas particularly during the dry season and droughts
  - Facilitate relations between farmers and feed/input suppliers (goat traders as strategic input suppliers, stock feed depots at rural livestock markets)
- Feeding strategies
  - Develop feed calendars showing local and seasonal availability of feed resources and goat nutritional requirements (protein, energy) and use these to illustrate the need for proper fodder flow (feed supply) management
  - Facilitate the implementation of strategic dry season feeding, early enough to prevent losses in body condition and long enough to allow rangeland regeneration and improved animal condition for increased conception rates
  - Develop recommendations for the use of a feeding strategy for goat categories with special demands such as young, weak, late pregnancy and lactating goats
  - Assess options for more intensive feed systems through goat finishing on small-scale feed lots
  - Demonstrate the benefits of improved feeding by comparison with goat body condition and mortalities where feeding was not improved
- Emergency feeding
  - Identify and provide access to supplementary high-quality feeds of low-cost (agro-industrial by-products such as cotton husks, sunflower cake, oil products, molasses)
  - Improve farmers' access to high-quality feed products during droughts through improved transport and feed distribution schemes at strategic places
  - Link feed/input supply to de- and restocking programs
  - Record the impact of emergency feeding during droughts on goat reduced mortalities
- Feed marketing
  - Explore the potential of local and regional feed and fodder markets between areas better endowed with feed resources and those without
  - Stimulate feed and fodder production and marketing as cash income source, regardless of livestock ownership
  - Create regulations for marketing communally owned feed resources

<table>
<tr><td colspan="2">Water supply</td></tr>
<tr><td>Information/technical gap</td><td>Enabling framework by policymakers and government support services</td></tr>
<tr><td>Water is a major limiting factor. Farmers often lack access to good quality water for home use and for livestock, competition between water users are high. Infrastructure is poorly maintained and capacity to manage water sources is weak.</td><td>National and local governments should strengthen appropriate water related policies that would facilitate the provision of water for human and animal consumption on equitable basis while also contributing to maintenance and management.</td></tr>
<tr><td colspan="2">Practical options for livestock development agencies to consider
- Request continued national investments in construction and maintenance of adequate water supply infrastructure, particularly to vulnerable groups in remote areas
- Develop and strengthen rainwater harvesting technologies at household level
- Facilitate the planning/development of emergency water supply strategies during droughts
- Evaluate the distribution of functional water points in relation to rangeland condition, adjust water and land management practices accordingly
- Facilitate the integration of community-based water-point management committees into other natural resource-use strategies, land-use planning and management
- Rehabilitate existing water points, including the provisioning of livestock watering facilities
- Evaluate optimal placement of new water sources in relation to human and livestock densities</td></tr>
<tr><td colspan="2">Animal breeding</td></tr>
<tr><td>Information/technical gap</td><td>Enabling framework by policymakers and government support services</td></tr>
<tr><td>Two important issues were identified in this study: 1. Births take place throughout the year and no controlled mating takes place, resulting in poor animal performance and high mortalities as many kids are born during inappropriate times; 2. Although the indigenous goat breeds are well adapted to local conditions, within flock selection can significantly improve the quality of goat flocks. Farmers lack the know-how to select for better quality goats.</td><td>Government support services (LPD, AREX) should promote correct breeding seasons and select indigenous breed types and establish local breeding centers that would support the conservation and utilization of the valuable genetic resources.</td></tr>
<tr><td colspan="2">Practical options for livestock development agencies to consider
- Mating time
• Controlled 12 month mating cycles to ensure high kid survival rates
• Plan mating according to natural feed availability (October/November), eg, by dressing bucks with aprons to prevent unplanned mating
• Prevent immature does from mating
- Selecting for breed improvement
• Select within flocks of indigenous breeds to improved production (fecundity, growth rates and survival) and disease resistance
• Identify and preserve robust and reproductive doe lines and cull non-productive does
• Select high-quality bucks for breeding and castrate non-productive ones
• Create buck selection and management systems at community level for open mating systems
• Restrict importing goats from other agro-ecological areas (restocking) as this increases the risk of importing diseases and reduces vitality</td></tr>
</table>

Marketing	
Information/technical gap	**Enabling framework by policymakers and government support services**
Goat markets and necessary infrastructure are not developed despite a strong demand for goat products in urban centers. There is a gap in the demand and supply for goat products, and prices for goats therefore remain low.	National government and support services (LPD, DVS, AREX) need to create favorable conditions, regulatory frameworks and establish efficient goat market infrastructure for the development of competitive markets for goats.

Practical options for livestock development agencies to consider

Infrastructure development

- Production and marketing potential
  - Assess area-specific marketing potential in relation to goat productivity, goat ownership patterns and population dynamics
- Sale facilities
  - Evaluate functional and non-functional sale facilities and revitalize and increase the number of sale facilities – integrate with other commodity markets
  - Establish appropriate equipment for weighing and develop a functional grading system
- Transport and handling
  - Invest in higher volume transport capacity for cost-effective transportation of goats while also ensuring animals are humanely treated and maintained in good condition (eg, well ventilated three-tier trucks)
  - Invest in better handling facilities to maintain animal body condition and prevent spread of infectious disease (feeding, watering, veterinary care, theft protection)

Institutional development

- Sale cooperatives
  - Facilitate the establishment of sale associations/clubs and increased communicating with local authorities and market intermediaries (traders, auctioneers, graders, processors etc.) for more effective transfer of information and transport pooling, better farmer position in price negotiations, more reliable goat supply to traders
- Drought mitigation
  - Facilitate markets as part of drought contingency planning and de- and restocking campaigns to avoid goat mortality; link goat markets to processing facilities for value addition (eg, canned goat meat, biltong)

Information

- Timing
  - Establish marketing calendars with regular sale options, including higher frequency of sales at times of high demand for goats and emergency sales
- Pricing
  - Establish transparent price setting mechanisms and indicators (based on transparent grading system) as an incentive for farmers to produce higher quality products
  - Indicate price levels beforehand so farmers can plan ahead
  - Promote simple sources and materials of information (field days, market days, agricultural shows, printed materials at agricultural service offices, rural shops, schools)
- Grading
  - Establish grading standards and a common grading system in order to sustain quality supply (body condition, hides and skins, health) and adequate payments
  - Evaluate consumer preferences and classify goat product demand for domestic low-income households versus high-income households and export opportunities
  - Support showcasing goats at established markets to raise awareness about the commercial value of quality goats, stimulate farmers' investments in goat business and attract buyers of goats

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Appendix

Table 1. Information on selected districts and wards.

Districts	*Market access/Number of wards (distance from main market, km)*	*Name of villages*
Beitbridge	Good: 11 (233 km from Bulawayo, 89 km from Beitbridge town)	Msane, Tshamnangana, Malusungane
	Poor: 2 (390 km from Bulawayo, 68 km from Beitbridge town)	Dite, Chapongwe, Rukange
Gwanda	Good: Wenlock, 6 (186 km from Bulawayo, 60 km from Gwanda town)	Khozi, Gwakwe, Mtshabezi
	Poor: Manama, 19 (231 km from Bulawayo, 125 km from Gwanda town)	Halisupi, Mlambapele, Msendane
Matobo	Good: Malaba (160 km from Bulawayo, 40 km from Maphisa growth point)	Malaba, Mfila, Mazwi
	Poor: Dzembe (180 km from Bulawayo, 60 km from Maphisa growth point)	Mhlonhlweni, Sikhamaswe, Sigaba
Binga	Good: Manjolo (475 km from Bulawayo, 30 km from Binga business center)	Manjolo, Dumbwe, Bulawayo kraal
	Poor: Kariangwe (565 km from Bulawayo, 120 km from Binga business center)	Keba, Mbelele, Dandanda
Nkayi	Good: 19 (158 km from Bulawayo, 15km radius around Nkayi business center))	Mantoni-Makhohliso, Mphinda-Zhende, Mantsholoozane
	Poor: 3 (216 km from Bulawayo, 58 km from Nkayi business center)	Mazembe, Duha, Majuta
Tsholotsho	Good: 6 (146 km from Bulawayo, 26 km from Tsholotsho business center)	Mpucuko, Siyaphambili, Siyazama
	Poor: 19 (169 km from Bulawayo, 49 km from Tsholotsho business center)	Chepfunye East, Jibbie, Dikili East

Table 2. Households' average number of livestock by districts.

District		*Cattle*	*Goats*	*Sheep*	*Donkey*	*Poultry*
Beitbridge	Mean	5.0	14.2	1.2	3.3	12.0
	Median	2	10	0	3	9
	Std. Dev.	9.2	15.0	4.3	3.3	12.1
	Maximum	47	83	38	14	103
Gwanda	Mean	3.4	14.3	1.1	2.3	8.3
	Median	1	8	0	2	6
	Std. Dev.	6.0	17.9	3.0	2.6	11.7
	Maximum	45	151	18	11	120
Matobo	Mean	4.2	18.5	2.0	4.2	12.6
	Median	1	15	0	4	10
	Std. Dev.	8.1	13.7	5.2	3.7	9.9
	Maximum	51	81	40	18	72
Binga	Mean	6.6	12.6	1.2	0.1	7.5
	Median	3	6	0	0	2
	Std. Dev.	8.9	16.7	3.5	0.4	14.0
	Maximum	42	105	24	4	111
Nkayi	Mean	6.6	8.8	0.3	2.1	14.1
	Median	5	7	0	1	11
	Std. Dev.	5.9	9.5	1.4	2.6	10.5
	Maximum	25	99	13	11	58
Tsholotsho	Mean	4.4	6.8	0.1	2.2	8.5
	Median	3	5	0	1	7
	Std. Dev.	4.8	5.7	1.0	2.6	6.0
	Maximum	23	34	11	12	26
Total	Mean	5.0	12.7	1.0	2.4	10.6
	Median	2	8	0	2	8
	Std. Dev.	7.4	14.3	3.5	3.0	11.2
	Maximum	51	151	40	18	120

Table 3. Percentage of livestock holding categories by district.

Livestock holding category	*Total*	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
0 cattle,≤8 goats	23.9	24.4	29.1	14.5	33.3	17.1	26.6
0 cattle,≥9 goats	15.0	19.3	19.9	32.9	7.3	2.1	4.8
1–2 cattle	12.4	17.0	14.6	14.5	4.9	8.6	13.7
3–7 cattle	25.5	19.3	21.9	21.7	22.0	35.7	33.1
≥ 8 cattle	23.3	20.0	14.6	16.4	32.5	36.4	21.8

Table 4. Percentage of household headship by district.

Household headship	*Total*	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Male	67.4	62.2	72.2	69.1	73.2	67.1	59.7
De facto female	9.7	12.6	4.0	10.5	9.8	5.0	17.7
De jure female	22.4	25.2	23.2	20.4	15.4	27.1	22.6

Note: The proportion of male-headed households is comparatively high (67.4%). This is probably due to the fact that sampling was based on livestock owners.

Table 5. Percentage of age categories of household heads by district.

	Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
40 yrs and below	22.4	25.4	20.0	15.9	48.0	13.6	14.5
41–60 yrs	44.6	47.8	40.7	49.0	35.8	43.6	50.8
More than 60 yrs	33.0	26.9	39.3	35.1	16.3	42.9	34.7

Table 6. Percentage of education level of household heads by district.

	Total	*Beitbridge*	*Gwanda*	*Matobo*	*Binga*	*Nkayi*	*Tsholotsho*
Illiterate	13.3	32.1	6.1	6.1	19.0	10.0	8.3
Primary education	53.5	53.0	49.3	51.7	50.9	52.1	65.3
Secondary education	30.5	13.4	41.2	40.8	28.4	33.6	22.3
Advanced/tertiary	2.7	1.5	3.4	1.4	1.7	4.3	4.1

Table 7. Classification of feed resources into feed resource categories.

Feed resources	*Feed resource categories*
Communal rangelands, trees, forests	Rangelands
Maize, millet, sorghum, watermelons, vegetable waste	Crop residues: cereals
Bambara nuts, ground nuts, cowpeas, soya beans	Crop residues: legumes
Nearby crop fields, river sides, wetlands	Key resources
Legume tree leaves, pods	Cut & carry: legumes
Grass and herbs	Cut & carry: grass
Salt, maize bran	Home mix
Bought in feeds	Commercial feeds
Dual purpose cereals and legumes	Planted forages
Communal grazing along roads	Roadsides
Melons (*majodo*)	Others

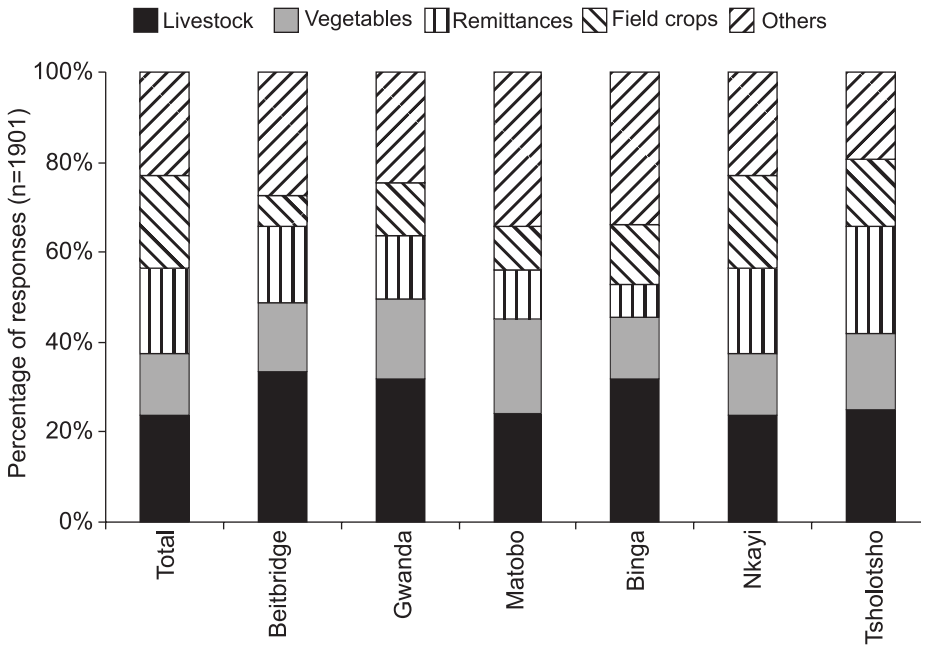

Figure 1. Main sources of income by district.

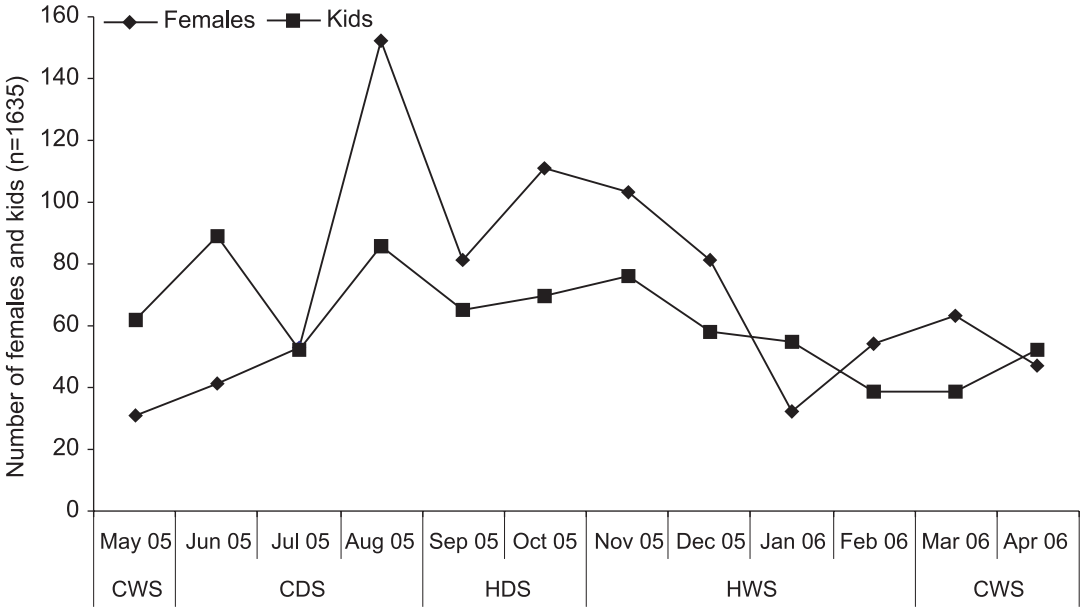

Figure 2. Mortality of female goats and kids by month/season.

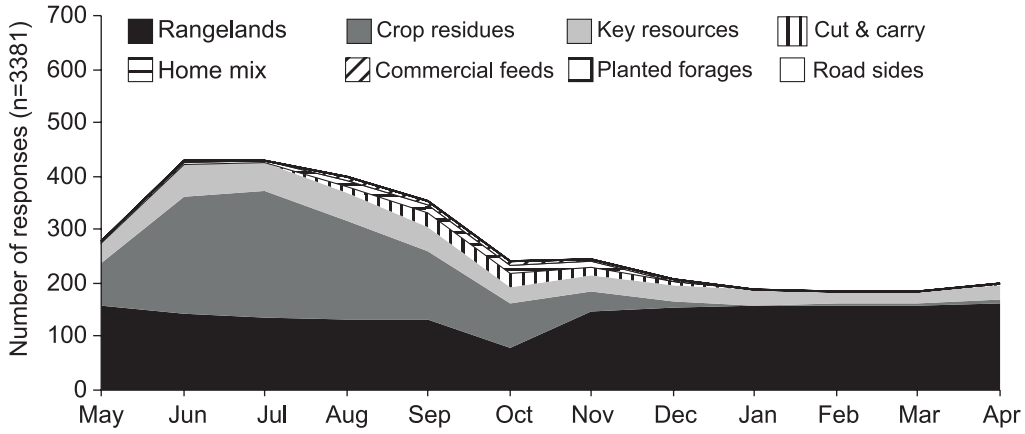

Figure 3. Seasonal use of feed resources in Beitbridge.

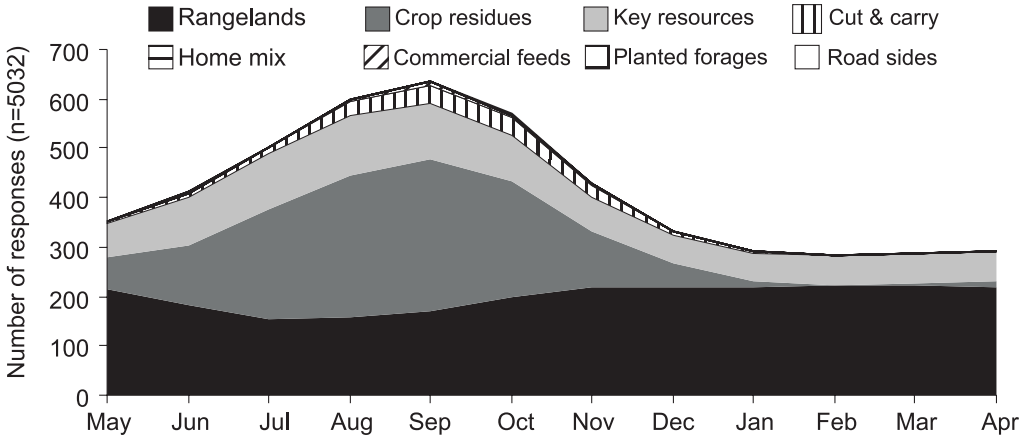

Figure 4. Seasonal use of feed resources in Gwanda.

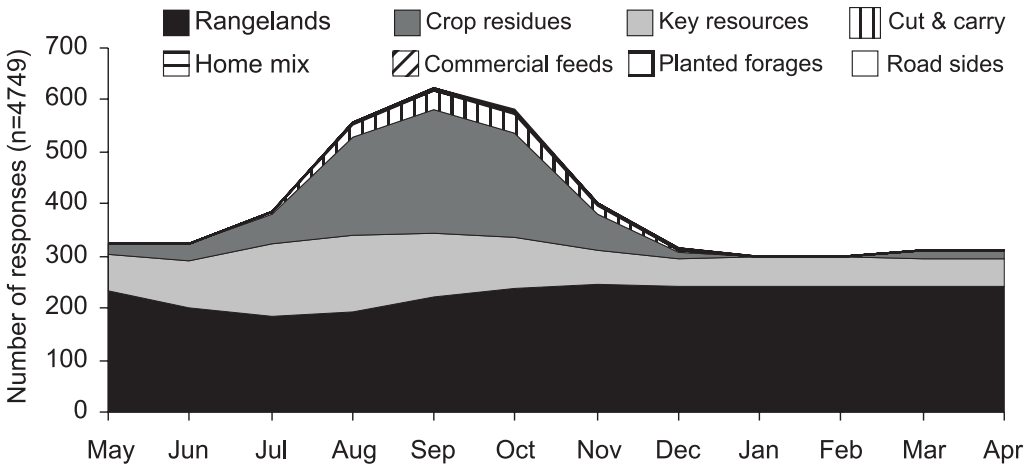

Figure 5. Seasonal use of feed resources in Matobo.

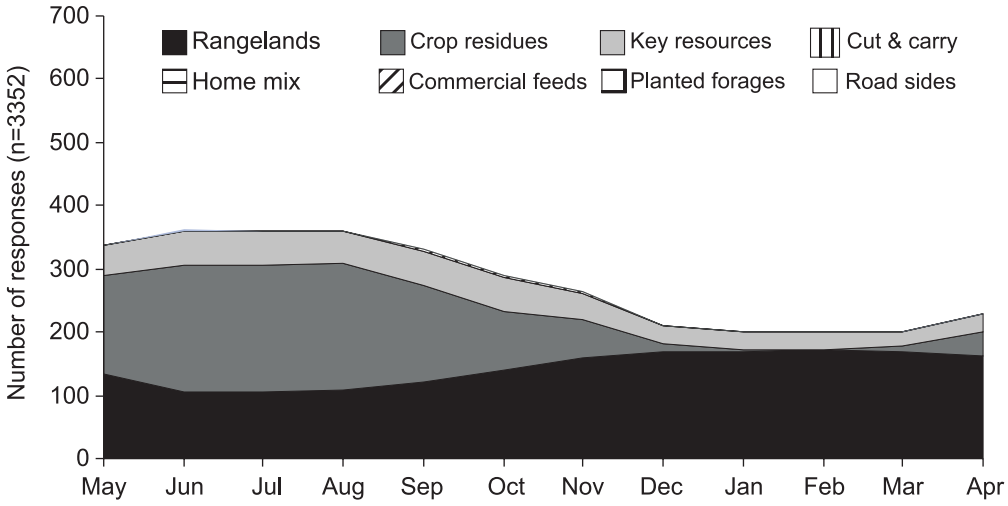

Figure 6. Seasonal use of feed resources in Binga.

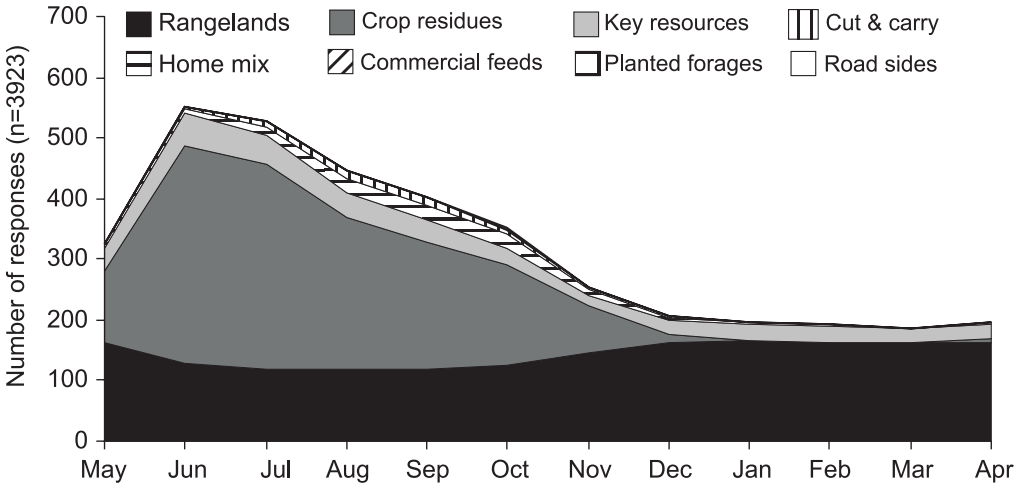

Figure 7. Seasonal use of feed resources in Nkayi.

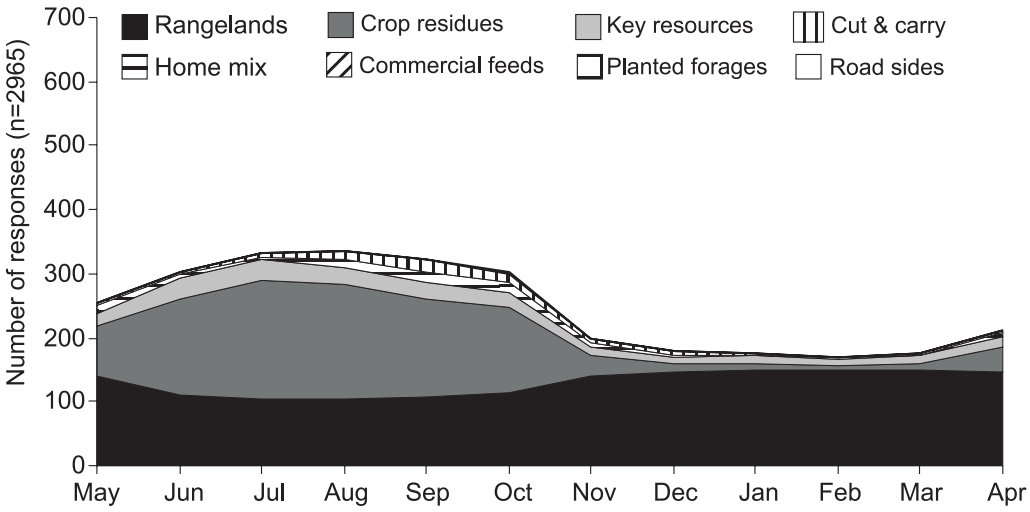

Figure 8. Seasonal use of feed resources in Tsholotsho.

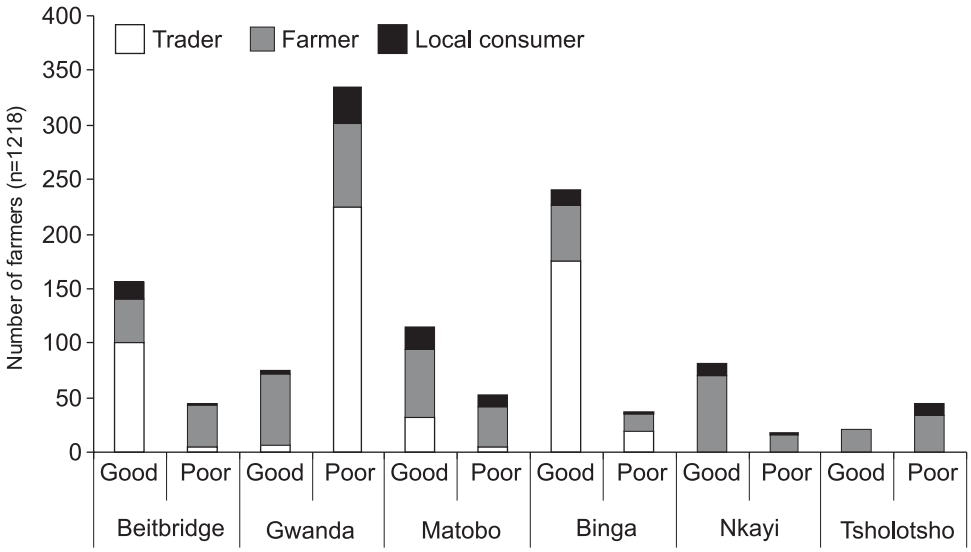

Figure 9. Number of goats sold/exchanged by type of buyer and ward.

About ICRISAT

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 600 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Centers of the Consultative Group on International Agricultural Research (CGIAR).

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