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Evaluation of the current situation of sheep production characteristics in Nkasi District, Tanzania

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Abstract. *Kapongo RY, Mbaga SH. 2024. Evaluation of the current situation of sheep production characteristics in Nkasi District, Tanzania. Intl J Trop Drylands 8: 44-57.* This study was conducted in two divisions, Namanyere and Mkwamba of Nkasi District in the Rukwa Region, Tanzania, to assess the sheep production status of smallholder farmers. Eight wards, namely Namanyere, Mtenga, Chala, Swaila, Kipande, Sintali, Kate, and Isale, were surveyed from November 2010 to April 2011. The random sampling technique was adopted to get 20 respondents from each selected ward. Two villages from each ward were chosen randomly, whereby ten respondents were interviewed in each village. A structured questionnaire was used to collect data from smallholder farmers keeping sheep and was complimented by secondary data from the district council offices. The results showed that sheep strains kept mainly by smallholder farmers were variant crosses of local strains and Red Maasai. The strains were deemed tolerant to diseases/parasites, heat, and drought and had better carcasses. Most smallholder farmers adopted an extensive grazing system during both dry and wet seasons. Breeding was uncontrolled; however, rams were selected based on their body sizes, conformation, and performance (e.g., number of lambs per ewe's lifetime, age at first lambing, and lambing intervals). Traits such as disease tolerance, drought, and heat tolerance scored higher for most strains. The average age at first lambing was 6.5 months, the lambing interval was three months, and the average number of lambs per ewe's lifetime was 14. The constraints to sheep production mostly were poor market availability, endemic diseases, and mortality of lambs. On marketing, fewer sheep were sold in the market compared to goats, and the price was 22% lower than that of goats.

Keywords: Farmers, Nkasi, production, Rukwa, sheep

INTRODUCTION

Livestock populations in Tanzania were estimated at 19.2 million cattle, 13.7 million goats, 3.6 million sheep, 1.9 million pigs, and 58 million chickens (MLDF 2010). Sheep and goats are composed of indigenous strains and are widely distributed and adapted to agroecological zones. Smallholder farmers and pastoralists keep them under traditional management systems.

Sheep are more attractive to smallholder farmers because they can multiply and grow faster than cattle at a relatively low cost. They provide a source of income, have two parities per year, are easy to handle, require small grazing areas and little feeds, provide manure, require little initial capital investment, are used in social functions, attain maturity age in a short time, provide meat and have no traditional or religious restrictions compared to pigs (Boutonnet 1999; Mtenga et al. 2003; de Rancourt et al. 2006; Morris 2009). Despite their advantages, sheep production is constrained by the prevalence of diseases, poor nutrition, poor marketing infrastructures, and low genetic potential. In the Rukwa Region, sheep production accounts for 1.6% of the total livestock population. However, in the Nkasi District, sheep production is about 1.9% of the total 296,670 livestock population in the district. The study focused on assessing sheep production status for smallholder farmers because of the socio-economic significance of sheep production in the Nkasi District and Tanzania as a whole.

Sheep are traditionally raised in the Nkasi District, Tanzania, but there are little efforts for improvement despite their socio-economic roles as smallholder farmers. Due to poor sheep husbandry's slow growth, the regular mortality of lambs and adult sheep and low conception rates have been reported (Mtenga et al. 2003). Similarly, delays of ewe on first mating, long lambing intervals, low slaughter weight, and poor mutton marketing are common (Mtenga et al. 2003). Such a situation is caused by many factors, such as poor nutrition, diseases, poor management, low-quality breeds, inbreeding, and inadequate knowledge of sheep production (Mtenga et al. 2003).

In the past, several livestock production improvement programs in the Nkasi District have been implemented by government and development agencies with varying degrees of success. An inadequate knowledge of the need and aspirations of the farmers caused little success in these endeavors. On the other hand, there have been no specific studies on sheep production, and general information on management practices, market availability, production performances, constraints, and their contribution to the livelihoods of smallholder farmers in the district is lacking. Therefore, information is needed to facilitate the design of strategies to improve sheep production in the district. The present study aimed to assess sheep's production status in smallholder production systems of the Nkasi District.

The specific objectives of this study are (i) to describe the desired qualities of sheep kept by smallholder farmers in the Nkasi District, Tanzania; (ii) to determine traditional management practices of sheep kept by smallholder farmers in the Nkasi District; (iii) to assess prices and market availability of sheep inside and outside the district; (iv) to assess production performance and constraints of sheep kept by smallholder farmers.

MATERIALS AND METHODS

Description of the study area

This study was conducted in Nkasi District, Rukwa Region of Tanzania (Figure 1). The district is located to the South-West of Tanzania between latitude 6°58' and 8° 17' South of the equator and between longitude 30°20' and 31°30' East of Greenwich. It borders Mpanda District to the North, Zambia to the South-West, the East, and South-East is boarded by Sumbawanga municipality and the Democratic Republic of Congo to the West. The district has a land area of 13,124 km^{2,} of which 54.4% is arable land, 17% is Katavi game reserve, 28.56% is water bodies, and 4% is others**.** It is a large, sparsely populated district divided into five administrative divisions with 17 wards and 87 registered villages. The study area entails a diversity of farming systems and land use changes. Two divisions, namely Namanyere and Mkwamba, comprising eight wards, were involved in the study from November 2010 to April 2011. Those wards include Mtenga, Chala, Swaila, Kipande, Kate, Sintali, and Isale, dominated by agro-pastoralists and Namanyere, in which agriculture is the dominant economic activity.

According to the 2002 population census, the district has a human population of 207,311, out of which 102,117 were males and 105,194 were females (Nkasi District 2004). The population of Nkasi was estimated to be growing at a growth rate of 4.7% in 2004. 81 % of the population resides in rural areas, and only 19% live in urban areas (URT 2004). About two percent of the population in the district undertook livestock keeping as the main activity, while the majority engaged in crop production. The main types of livestock kept in the district are cattle, goats, sheep, pigs, donkeys, and chickens. Approximately 7.24% of the households have immigrated into the district during the last five years (DALDO 2008). Most of this spectacular growth was due to the immigration of the Sukuma Tribe, who are agro-pastoralists with their cattle, thus reflecting the availability of grazing and agricultural lands. The Nkasi District is largely semi-arid, with bimodal rainfall ranging from 750-1,200 mm and an average altitude of about 1,300 meters above sea level. The short rains are between October and December, whereas the long rains are from February to April. The dominant natural vegetation comprises the plateau woodland occupied by Sukuma agro-pastoralists with a large herd of cattle, goats, and sheep. As a result, soils have natural fertility and are cultivated extensively (DALDO 2008).

Sampling procedure

Purposeful sampling was employed in selecting the study wards based on their accessibility, availability of sheep, prevailing land uses, and socio-economic characteristics. Based on the selected division's sample (n) from each division, it was obtained through the stratification of the population into wards. Five-digit random numbers generated in LIMDEP version 5.1 software matched the name in the ward register that bore the number. The total sample (n=20) was a gross proportionate number of individuals in each stratum from each ward. Four wards were picked in each division, and two villages were selected from every ward.

Smallholder farmers keeping sheep were identified with assistance from extension workers in each ward in the two divisions. For each selected village, ten smallholder farmers keeping sheep were chosen for an interview. At the end of the study, the total number of respondents interviewed in the two divisions was 160 (Table 1).

Data on sheep prices and market availability were collected randomly from sellers and buyers of sheep in the four livestock primary markets using structured questionnaires. Livestock primary markets in the districts are conducted in four wards: Namanyere, Chala, Kipande, and Kate. In each primary livestock market, five buyers and five sheep sellers were interviewed to make up 40 respondents in all primary livestock markets (Table 2).

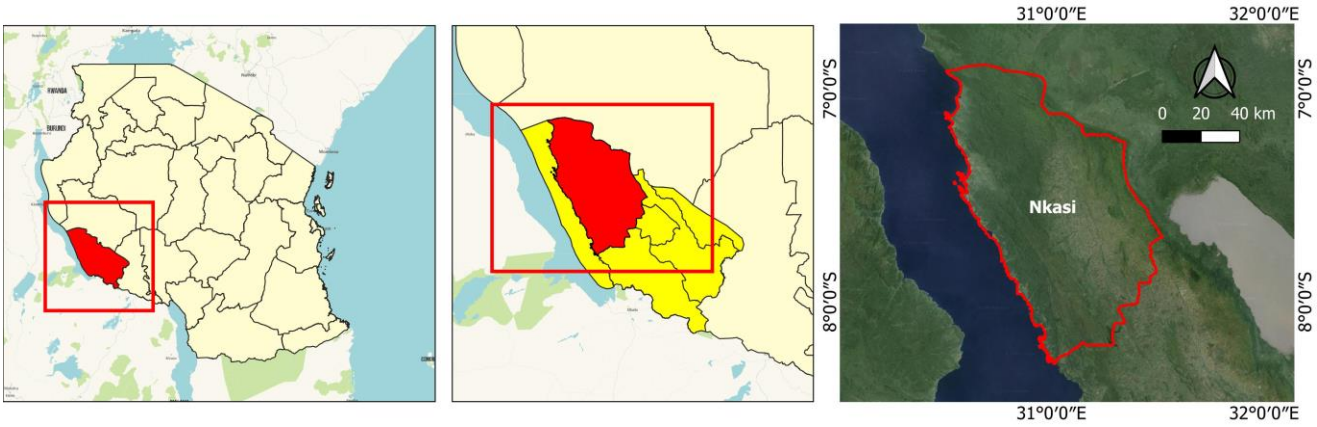

Figure 1. Location of the study area in Nkasi District, Tanzania

Table 1. The sampling frame for smallholder farmers keeping sheep

Division	Ward	Village	Number of respondents
Namanyere	Namanyere	Ipanda, Kakoma	20
	Mtenga	Mashete, Mtenga	20
	Chala	Chala, Kacheche	20
	Isale	Isale, Ntuchi	20
Mkwamba	Swaila	Kasu, Swaila	20
	Kipande	Kantawa, Kipande	20
	Sintali	Nkundi, Sintali	20
	Kate	Ntalamila, Kate	20

Table 2. The sampling frame for the primary livestock market

Division	Primary livestock market (Ward)	Number of respondents
Namanyere	Namanyere	10
	Chala	10
Mkwamba	Kipande	10
	Kate	10

Types and sources of data

Primary data were obtained from rural households in the study area. In addition, a structured questionnaire was administered to a random sample of smallholder farmers in the sample villages. The questionnaire was designed to capture the desired qualities of sheep and information on sheep's traditional management practices, production performances, and constraints faced by smallholder farmers. Furthermore, the study sought information on sheep prices and market availability inside and outside the district. Furthermore, two focus group discussions for each division (8-12 individuals) were used to gather various responses. The conversation taking place during focus group discussions was noted. FGDs were used to identify sheep price and market availability, decision-making on sheep, preferred sheep breeds, and different national policies and programs directed towards the livestock industry in trying to modernize. The interview guide is attached in Appendix 3. In addition, FGD was used to quickly generate more information through interactive learning, knowledge sharing, and assurance of high-level local people's participation in research. That involved relaxed rapport, open dialogue, brainstorming, and mutual sharing of knowledge, skills, and experiences (McCkracken et al. 1988; Chambers 1992). Other techniques used include direct observations. Secondary data were sourced from the district livestock office, unpublished, gray, and published literature from libraries.

Data analysis

Data from questionnaires were coded and analyzed using the Statistical Package for Social Sciences (SPSS 16.0, 2006) computer program. In addition, quantitative data was analyzed, and frequencies, percentages, and means were used to determine the desired qualities of sheep, traditional management practices, prices, market availability, and sheep production performances and constraints. Finally, the recorded information from FGDs was summarised and synthesized according to the checklist used during the discussion.

RESULTS AND DISCUSSION

Overview

The results and discussion of the findings are based on seven sections. The first part of the section provides demographic profiles of the respondents; the second part focuses on sheep strains and preferences kept by smallholder farmers. The third part focused on the traditional management practices of sheep, the fourth part concentrated on sheep's production performances and constraints, and the fifth was based on sheep pricing and market availability. The sixth part explains the preferred animals, prices, and sources in the primary livestock markets. Finally, the last part of the section gives a way forward for improving sheep production.

Demographic profiles of the respondents

The demographic profiles of the respondents examined and presented in this chapter are household profile, source of income, livestock species kept, and household members responsible for sheep activities.

Demographic characteristics of sheep-owning households

Demographic characteristics of sheep-owning households are shown in Table 3. The findings revealed that the leading tribe keeping sheep in the district was the Sukuma (60.6%), while the native comprised Fipa (39.4%). The Sukuma Tribe are agro-pastoralists who emigrated with their herds from different regions of Tanzania to the Nkasi District in search of extensive arable and grazing lands. Also, the study revealed that most of the smallholder families keeping sheep in surveyed wards were male-headed, 81.2%. Under normal situations, in Tanzanian culture, men are the ones who head the family. They are the main speakers considering respondents visited their residential areas during the study.

Furthermore, the results show that 80.6% of the respondents were married, 10.6% single, 6.2% divorced, and 2.5% widowed/widowers. The result showed that 51.9% of the respondents had primary school education, 40% were without school education, and 8.1% attained secondary education. Lack of education was attributed to the long distance to school, and also, in the past, parents were reluctant to send their children to school, and children were considered a source of labor for farm operations. The finding conforms with that reported by Faustine et al. (2002). They observed a low rate of children enrolment in school for the Maasai tribe, partly explained by the fact that pastoralists were less inclined to send their children to school, as they provided an important source of labor in livestock keeping. Education is perceived to be among the factors that influence individuals' perception of innovations before making an adoption decision. It motivates individuals to learn more, attend training, and seek resources or other information regarding livestock production improvement (Fortunate 2009).

It was revealed that the majority (90.6%) of sheep were owned by the household head, followed by the spouse (89.4%), sons (73.1%), and daughters (66.9%) (Table 3). Access to resources such as livestock and land is determined by the patriarchal system in which males dominate women because the inheritance of resources favors men over women. Solomon et al. (2010) reported that in Ethiopia, the access to resources in terms of ownership and decision-making roles varies between husbands, spouses, and children; for example, women and children have property rights over the flocks but are not decision-makers and husbands decide on the income from livestock. In Tanzania, earlier studies by Geoff and Trevor (2009) showed that women and children were usually the managers and not the owners of small ruminants in agro-pastoral communities. The head (father) of the household appropriated all wealth-generated activities, and little to nothing was allocated to women (mother). This type of household power asymmetry constrains women's contribution to poverty alleviation at the household level. However, Pius and Christopher (2010) reported a different finding. They reported that women in the Maasai community in the Simanjiro district in Tanzania owned small ruminants and donkeys while men owned cattle.

Source of income and livestock kept

In terms of respondents' source of income, the results revealed that crops (99.4%) and livestock/livestock products (98.1%) were the primary sources of income for the majority of the households (Table 4). Other sources of income were off-farm business (16.9%), home industries (13.1%), salary/wages (5%), and pension (0.6%). Those indicate that smallholder farmers in the district depend more on crops and livestock than other sources of income. A similar finding was reported by Solomon et al. (2010) in the agro-pastoralist communities in Ethiopia.

The study revealed that most farmers (99.4%) kept goats, sheep (98.8%), and cattle (86.2%) (Table 4). Other livestock species kept were poultry (90.6%), donkey (26.2%), and pigs (12.5%). Cattle were valued for wealth, prestige, dowry, and business, while goats and sheep were kept for household consumption and cash. In addition, sheep were kept for medical purposes, and sheep fat was used in concoctions to treat mothers' medical complications after delivery.

Sheep activities

The study revealed that the activity of purchasing sheep (Table 5) was mainly done by adult males (93.1%) and females (67.5%). Other members of the household who were involved in purchasing sheep were boys (51.2%), girls (26.2%), and hired labor (3.1%). The activity of selling or slaughtering sheep was mainly conducted by adult males (92.5%) and adult females (69.1%). This activity was supported by boys (55.6%), girls (30.6%), and hired labor (5.9%). Finally, herding and feeding sheep was the main activity done by boys (95%) (Figure 2), adult males (68.8%), and girls (68.1%).

That shows that family labor is the primary source of livestock farm labor, and the use of hired labor for flock management is minimal and uncommon. In contrast, Solomon et al. (2010) reported that children and women provide the bulk of labor in sheep and goat management in Ethiopia. This difference in sheep management activities is due to differences in cultural considerations concerning the division of labor. For example, among the Maasai, the young boys *Layoni/Engayoni* not yet circumcised assist their mothers in all female-related works, including grazing sheep, goats, and calves near their *bomas* was shared with girls (Faustine et al. 2002). However, regarding breeding decisions, adult males were responsible (93.1%). Similarly, adult males were responsible for sheep health while other household members assisted.

Table 3. Demographic characteristics of sheep-owning households

Respondents characteristics	Number of respondents (n=160)	Percentage
Tribe name		
Sukuma	97	60.6
Fipa	63	39.4
Total	160	100
Head of household		
Male	130	81.2
Female	30	18.8
Total	160	100
Marital status of the household		
Married	129	80.6
Single	17	10.6
Divorced	10	6.3
Widow/widower	4	2.5
Total	160	100
Highest education level		
No school education	64	40.0
Primary education	83	51.9
Secondary education	13	8.1
Total	160	100
*Members of the household who own sheep**		
Head	145	90.6
Spouse	143	89.4
Sons	117	73.1
Daughter	107	66.9

Note: *Data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Figure 2. Children <15 years of Sukuma Tribe responsible for sheep herding

Sheep strains and preferences

Common name, strain type, and trend within sheep herd

Most sheep strains kept by smallholder farmers (Table 6) were variant crosses of local breeds, Red Maasai, Sukuma, and possibly BHP. Figure 3 shows the mixed strains kept by smallholder farmers in the district. The smallholder farmers kept no pure breeds because no breeding program was in place; instead, uncontrolled breeding was commonly used. The trend of sheep numbers shows that the majority (69.4%) of the respondents said it is increasing, while the minority (11.9%) declared that sheep numbers were decreasing.

Herd structure

The herd structure was consisted of an average of two intact adult males (rams) and nine adult females (Table 7). The intact male lambs were about three, and the intact female lambs were approximately six. The lower proportion of males (intact and castrates) could be attributed to farmers' preference to sell males for slaughter. Smallholder farmers did not prefer to castrate either adult sheep or lambs.

Source and preferred traits of the strain of sheep

The sheep strains' sources were studied to determine where smallholder farmers obtained different types (Table 8). Smallholder farmers purchased their animals from their neighbors (92.5%). Others obtained their initial stock through inheritance (26.2%), purchasing from primary livestock markets (25.6%), and also from the bride price and as a gift after taking care of other people's animals (5.6% each). Smallholder farmers keeping sheep in the district preferred sheep strains that were both tolerant to diseases/parasites (76.9%) and heat (73.1%) because the strains of this type had adaptive capacities enabling them to live and produce under low level of management. A similar finding was reported by Baker et al. (2003) and Owen et al. (2005), as cited by Muigai et al. (2009) that among the traits preferred by farmers keeping indigenous sheep in Kenya include adaptability to the harsh environmental conditions and resistance to gastrointestinal nematodes. Other preferences were better carcass (67.5%) and drought tolerance (63.5%). On the other hand, according to FGDs, the most preferred sheep traits were disease tolerance (84.4%) and easy to market (71.9%). Both farmers and FGD members had a high preference for disease tolerance; however, farmers had other high preferences like heat tolerances, contrary to FGDs, who highly preferred the trait of easy to market.

Also, the preferred traits of sheep strains were achieved by purchasing good sheep breeds from neighbor's sheep flocks (42.5%) and selecting the best animals from the existing stock (26.2%). However, some (40%) of the respondents had no opinion on how the preferred criteria of sheep breed could be achieved.

Table 4. Source of income and livestock kept

Respondents characteristics	Number of respondents (n=160)	Percentage
Source of income		
Salary/wages	8	5
Pension	1	0.6
Off-farm business	27	16.9
Livestock and livestock products	157	98.1
Home industries	21	13.1
Crops	159	99.4
Livestock kept		
Cattle	138	86.2
Goats	159	99.4
Sheep	158	98.8
Pigs	20	12.5
Donkey	42	26.2
Poultry	145	90.6

Note: Data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Figure 3. Variant cross group of local sheep strains kept by smallholder farmers in Nkasi District, Tanzania

Table 5. Members of the household responsible for sheep activities

Activity	Percentage of respondents (N=160)				
	Adult		Boys	Girls	Hired
	Males	Females	(<15 yrs)	(<15 yrs)	labor
Purchasing sheep	149(93.1)	108(67.5)	108(67.5)	42(26.2)	5(3.1)
Selling/slaughtering sheep	148(92.5)	109(68.1)	89(55.6)	49(30.6)	9(5.9)
Selling/slaughtering	110(68.8)	30(18.8)	152(95.0)	109(68.1)	16(10.0)
Breeding decisions	149(93.1)	98(61.2)	110(68.8)	59(36.9)	5(3.1)
Animal health	148(92.5)	111(69.4)	125(78.1)	66(41.2)	11(6.9)

Note: The values in parenthesis are percentages while the ones without parentheses are the number of respondents; data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Perception of sheep quality traits by owners

The excellent quality traits of sheep perceived by smallholder farmers (Table 9) mainly were disease tolerance (64.4%) and drought tolerance (60%). Farmers considered these traits good because the sheep graze in communal land with a high risk of disease infection and low water availability. Sheep kept by smallholder farmers depended on their natural body immunity to tolerate diseases such as FMD and worms since most farmers did not treat or provide vaccination to sheep.

Other traits that scored average quality traits were size (71.9%), conformation/shape (62.5%), and color (Black and white or red) (55%). In addition, FAO (1983) reported that the desirable traits in a crossbreeding system include improving breeding efficiency, growth rate, feed efficiency, market desirability, and adaptability of ewes and lambs to environmental conditions.

Purpose of keeping sheep

Sheep were kept mainly for meat (99.4%), income (84.4%), and manure (68.1%), as shown in Table 10. However, farmers also sold sheep to obtain cash for school fees, clothes, or other household expenditures.

Other purposes were cultural (32.5%), dowry (5%), ceremony (4.4%), and skin (1.2%). The observations in the present study are consistent with the findings of (Andrew 2003; Moradi et al. 2010), who reported that agro-pastoralist communities kept sheep for household consumption and as a source of cash income generation. In most cases, some women from the Sukuma Tribe use ewes for sacrifices. Geoff and Trevor (2009) also reported that sheep in Mexico were kept primarily for wool production, manure, and cultural aspects. Generally, small ruminants contribute to landless, rural farming, peri-urban, and increasingly urban household livelihoods.

Table 6. The common name, type of strain, and trend within sheep herd

Parameter	Number of respondents (N=160)	Percentages
*Common name for the breed/strain**		
Variant cross of BHP and local strains	152	95.0
Variant cross of Red Maasai sheep and local strains	81	50.6
Unknown	23	14.4
Strain type kept		
Pure strain	0	0
Cross-breed/strain	154	96.2
Unknown	6	3.8
Total	160	100
The trend within sheep herd		
Increasing	111	69.4
Decreasing	19	11.9
Stable	29	18.1
Unknown	1	0.6
Total	160	100

Note: *Data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Table 7. Herd structure

Herd structure	Mean
Adult sheep	
Intact male (rams)	2.07±1.7
Castrate	0.01±0.1
Female (ewes)	8.62±7.1
Total	10.41±7.6
Lambs	
Intact male	2.61±1.9
Castrate	0.16±0.9
Female	4.71±4.4
Total	7.02±6.1

Table 8. Source of the breeds/strains, preferred traits of the sheep breeds, and the way the preferred criteria of sheep breeds can be achieved

Parameter	Number of respondents (n=160)	Percentages
Origin/source of the breeds/strains		
Inherited	42	26.2
Market (purchased)	41	25.6
Through paid bride price	9	5.6
Commercial farms	0	0
After taking care of other people's animals	9	5.6
Purchasing from their neighbors	148	92.5
Preferred traits of the sheep breeds(farmers)		
Heat tolerance	117	73.1
Highly fertile	89	55.6
Drought tolerant	102	63.8
Ability to forage	47	29.4
Disease/parasite tolerance	123	76.9
Ability to travel long-distance	95	59.4
Low water requirements	93	58.1
Easy to market	63	39.4
Better carcass	108	67.5
High lamb survival	88	55.0
Preferred criteria of sheep breed achieved?		
Through government by the provision of hybrid sheep to sheep keepers	13	8.1
By purchasing good sheep breeds from neighbors' sheep flocks	68	42.5
By selecting the best animal from the existing sheep flock	42	26.2
No opinion on how the preferred criteria of sheep breed can be achieved	64	40.0
Preferred traits of the sheep breeds (FGDs)		
Disease tolerance	27	84.4
Easy to market	23	71.9
Drought tolerant	21	65.6
Highly fertile	17	53.1

Note: Data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Table 9. Perception of sheep quality traits by owners

Quality traits	Description of the trait (N=160)			
	Poor	Average	Good	No opinion
Size	4(2.5)	115(71.9)	38(23.8)	3(1.9)
Conformation/shape	6(3.8)	100(62.5)	49(30.6)	5(3.1)
Color	4(2.5)	88(55.0)	57(35.6)	11(6.9)
Disease tolerance	6(3.8)	51(31.9)	103(64.4)	0(0)
Drought tolerance	6(3.8)	55(34.4)	96(60.0)	2(1.2)
Heat tolerance	4(2.5)	63(39.4)	90(56.2)	3(1.9)
Meat quality	6(3.8)	62(38.8)	82(51.2)	10(6.2)
Growth rate	2(1.2)	78(48.8)	77(48.1)	3(1.9)
Fertility	4(2.5)	82(51.2)	65(40.6)	9(5.6)

Note: The values in parenthesis are percentages while the ones without parentheses are the number of respondents; data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Table 10. Purpose of keeping sheep

Purpose of keeping sheep	Number of respondents (n=160)	Percentages
Nutrition	159	99.4
Manure	109	68.1
Cultural	52	32.5
Skin	2	1.2
Dowry	8	5.0
Ceremony	7	4.4
Investment	135	84.4

Note: Data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Traditional management practices of sheep

Production, grazing system, feeding, supplementation, and watering

Most (94.4%) smallholder farmers kept sheep under extensive systems through herding continuously during dry and wet seasons (Table 11). That is because a large area in the district is rangeland, where the animals have access to plenty of pasture, although, in some places, they grow crops. On the other hand, few practiced semi-intensive systems (8.1%) and intensive systems (1.2%) by grazing sheep around their homes. Both semi-intensive and intensive systems are mainly practiced in Namanyere town by a few farmers with scarce grazing land. The result aligns with the findings of Mtenga et al. (2003), who reported that sheep-feeding systems practiced in Tanzania are extensive and intensive. However, exercising an intensive system for the large herd is difficult. Most farmers (96.6%) practiced continuous grazing, and only 3.1% rotational grazing. Farmers prefer continuous grazing due to the availability of large grazing land since many farmers live in rural areas.

The most common grazing systems (Table 12) used during the dry season were free grazing (89%) and herded grazing (21.9%). During the wet season, smallholder farmers practiced free grazing (71.2%), herded grazing (23.8%), and tethering (21.9%). Free grazing is preferred because it reduces the costs of feeds. Similarly, Solomon et al. (2010) in Ethiopia reported that extensive grazing in communal lands is practiced, but there were differences depending on agroecologies and geographic regions. For example, farmers in the Nkasi District prefer grazing sheep together with cattle or practicing tethering during the wet season due to the availability of pastures. On the other hand, Sendalo et al. (1993) reported that the Morogoro farmers tethered their sheep to minimize crop damage and avoid using additional labor for herding.

During the dry season, most smallholder farmers relied on crop residues or roughages (49.4%), and most did not supplement their sheep (47.5%). During the dry season, maize straw, sunflower seedcake, maize bran, household food leftovers, sweat, and Irish potatoes were the commonly available supplements. Talle (1995) reported that during the dry season, most smallholder farmers could not supplement animals with concentrates and industrial by-products due to high costs and lack of accessibility. As a result, there were minimal supplementations during the wet season (7.5%). In contrast, Tibbo (2006) reported that the significant supplementary feeds to sheep in Ethiopia were boiled bean, pea, maize, and non-conventional feeds like Atella, Areke, and Borde made with by-products of local beverages. However, FAO (1983) recommended that to improve daily gain and feed efficiency on sheep, the basic concentrate diet containing 16 percent crude protein with a trace element and/or a vitamin mixture (A, D, E) as supplement feed should be used.

Most (97.5%) of the households used communal land for grazing; some had their lands (20.6%), and others had leased lands for grazing (10.6%). Sukuma Tribe, immigrants to the district, often purchase lands from the native Fipa tribe to grow crops or graze their animals after crop harvesting. A similar observation was reported by Solomon et al. (2010) in Ethiopia that the primary feed resources for sheep include grazing on communal natural pasture, crop stubble, fallow grazing, roadside grazing, crop residues, and browses.

In general, smallholder farmers used two methods (Table 13) to provide water to their sheep, *i.e.*, providing water at the household or taking sheep to water sources at a certain distance from their homes. The majority (68.1%) of the smallholder farmers provided water to their sheep during the dry season, while during the wet season, sheep were brought to water sources (75%). A small percentage of the smallholder farmers used both watering methods during the dry and wet seasons. About 73.1% used pond water as a major water source during dry and wet seasons. The distance to the furthest watering point during the dry season was 1-5km (72.5%). Few traveled less than 1km to

reach the furthest watering point (22.5%). During the wet season, water was readily available within a radius of 1km. Similarly, Solomon (2010) reported that sheep were taken to watering points at distances ranging from 2-5km during the dry season in Ethiopia.

The frequency of watering in the dry season for most households was twice a day (60%), while water was available at all times in the wet season. On the contrary, Solomon et al. (2010) reported that during the dry season in Ethiopia, sheep were provided with drinking water every three days; however, the watering frequency varied with season and agroecological zones. Similarly, Acharya (1981) reported that the availability of drenching, poor water quality, and animals had to travel long distances in search of water.

The difference in the frequency of watering animals in the Nkasi District and that reported in Ethiopia could be explained by the fact that in the Nkasi District, the water table is high, and ponds or boreholes provide enough water to livestock during dry seasons. Therefore, the quality of sheep drinking water was generally excellent and clear both during the dry season (79.4%) and wet season (97.5%).

Table 11. Production and grazing systems

Parameter	Number of respondents (N=160)	Percentages
Production systems		
Extension system	151	94.4
Semi-intensive system	13	8.1
Intensive system	2	1.2
Grazing management		
Continuous grazing	155	96.6
Rotational grazing	5	3.1
*Grazing land ownership**		
Own	33	20.6
Communal	156	97.5
Lease	17	10.6

Note: Data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Table 12. Grazing system and supplementation

Grazing systems	N=160	
	Dry season	Wet season
Grazing system		
Free grazing	128(80.0)	114(71.2)
Tethering	17(10.6)	35(21.9)
Paddock	2(1.2)	3(1.9)
Stall-fed	1(0.6)	0(0)
Backyard	0(0)	0(0)
Herded grazing	35(21.9)	38(23.8)
Supplementation regime		
Concentrates or bought-in feed	5(3.1)	8(5.0)
Crop residue or roughage	79(49.4)	9(5.6)
Vitamins and minerals (salts)	5(3.1)	12(7.5)
None	76(47.5)	130(81.2)

Note: The values in parenthesis are percentages while the ones without parentheses are the number of respondents; data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Housing and housing materials

The findings revealed that the majority of the smallholder farmers (Table 14) used simple sheds or stalled housing during the dry season (54.4%), while others used yards and houses (20% each). During the wet season, most (60.6%) used a shed or stalled, while some had a house (24.4%). About 7.5% and 8.1% used kraal during dry and wet seasons. Some farmers in the district reported predation by wild animals such as hyenas. The problem was more pronounced in houses constructed using weak local materials, as shown in Figures 4 and 5. In addition, farmers did not clean their sheep houses, thereby increasing the chance of infection.

Lambs were typically housed together with adults, as reported by the majority (55.6%) of farmers (Table 15). Most of the sheep housing materials used were untreated wood (85%), but few used bricks (16.9%), mud houses (12.5%), and iron sheets (1.2%). The results conform to the ones Geoff and Trevor reported (2009), which stated that most smallholder farmers kept their livestock in buildings and pens made from local materials such as wood or sun-dried bricks thatch from local grasses and bush poles. FAO (1983) reported that the cost of sheep housing must be kept low, with buildings providing only the most essential facilities such as feed storage, feeders, waterers, lambing pens, and creeps, while the roof shape should be of the shed type.

Table 13. Watering

Watering	N=160	
	Dry season	Wet season
Provision of drinking water		
Water is fetched or provided	109(68.1)	17(10.6)
Sheep go to water	50(31.2)	120(75.0)
Both	6(3.8)	29(18.1)
Source of water		
River	18(11.2)	45(28.1)
Spring	23(14.4)	113(70.6)
Dam or pond	117(73.1)	124(75.5)
Borehole	56(35.0)	64(40.0)
Distance to watering point		
1 At household	0(0)	11(6.9)
< 1km	36(22.5)	123(76.9)
1 – 5km	116(72.5)	51(31.9)
6 – 10km	8(5.0)	0(0)
> 10km	0(0)	0(0)
Frequency of watering		
Freely available	12(7.5)	151(94.4)
Once a day	47(29.4)	2(1.2)
Twice a day	96(60.0)	8(5.0)
Once in two days	3(1.9)	0(0)
Once in three days	0(0)	0(0)
Quality of water		
Good and clear	127(79.4)	156(97.5)
Salty (brackish)	22(13.8)	2(1.2)
Muddy	11(6.9)	2(1.2)
Smelly	4(2.5)	2(1.2)

Note: The values in parenthesis are percentages while the ones without parentheses are the number of respondents; data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Disease prevalence and health management

The prevalent diseases in sheep flocks kept by most smallholder farmers were (85%) (Table 16). Diseases occurring in sheep flocks include worms (45%), the flue (20%), FMD (15.6%), and mange mites (4.4%).

These results are similar to Solomon et al. (2010), where mange mites, ticks, lice, and fasciolosis were common. Most (61.2%) of farmers in the district did not vaccinate their sheep, while only a few (38.8%) vaccinated them against diseases. The vaccination or preventive treatments were done when the need arose (85.6%), and only 14.4% were vaccinated routinely. According to the farmers, the reasons that caused them not to vaccinate their sheep include inadequate funds to purchase vaccines and poor knowledge of the importance of vaccination.

Most (71.9%) of smallholder farmers (Table 17) treat their sheep themselves, and some (23.8%) have no access to veterinary services. In addition, some villages have no livestock officers or drug shops where the smallholder farmers can access drugs. In this case, they are forced to travel a long distance to other areas in search of services.

Control of ectoparasites

The majority (80%) of smallholder farmers did not routinely control ectoparasites, and only a few (42%) adhered to routines (Table 18). Spraying (56.2%) was the standard method, while about 16.9% used to dip.

Figure 4. Stall/shed for sheep housing

Figure 5. An open kraal for sheep

Table 14. Housing

Housing	N=160	
	Dry season	Wet season
Sheep housing		
Yard	(32)20.0	(10)6.2
Kraal	(12)7.5	(13)8.1
Shed or stall	(87)54.4	(97)60.6
House	(32)20.0	(39)24.4

Note: The values in parenthesis are percentages while the ones without parentheses are the number of respondents; data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Table 15. Housing materials

Parameter	N=160	
	Frequency	Percentage
Are lambs housed together with adults?		
Yes	89	55.6
No	71	44.4
Total	**160**	**100.0**
*Housing materials used**		
Bricks	27	16.9
Iron sheet	2	1.2
Wire	0	0
Mud	20	12.5
Untreated wood or bush materials	136	85.0

Note: *Data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Table 16. Prevalent sheep diseases

Parameter	N=160	
	Frequency	Percentage
Are prevalent diseases occurring on farms?		
Yes	136	85.0
No	24	15.0
Total	**160**	**100.0**
Is treatment given?		
Yes	77	48.1
No	83	51.9
Total	**160**	**100.0**
*Prevalent diseases occur on farms**		
FMD	25	15.6
Mange mites	7	4.4
Flue	32	20.0
Worms	72	45.0
Are vaccination/preventive treatments given		
Yes	62	38.8
No	98	61.2
Total	**160**	**100.0**
Methods		
Done routinely	23	14.4
Done when the need arises	137	85.6
Total	**160**	**100.0**

Note: *Data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Control of internal parasites

Control of internal parasites (Table 19) was mostly done when the need arose during the dry season (28.1%) and wet season (27.5%). Most respondents did not control internal parasites during dry or wet seasons (36.9% each). However, no traditional method was used to control internal parasites in sheep. The low level of internal parasite control could be explained by either the resistant sheep or farmers lacking knowledge of the internal parasite's economic implications.

Overall sheep flock morbidity rate

Morbidity rates were generally high (>70%) both in adults and lambs (Table 20). The high morbidity of lambs was caused by ignorance of disease management, including control of internal parasites, and poor housing. Given the communal grazing system, re-infection was common even for those practicing routine external and internal parasite controls.

Castration

Most (91.9%) smallholder farmers did not castrate their sheep (Table 21). Only (8.1%) practiced castration to control breeding (6.2%) and improve meat quality (5%). Lambs were castrated when they were about three to six months old. According to FAO (1983), castration should be carried out before lambs reach six weeks of age, although it reduces the gain and feed efficiency rate, and the carcass may contain more fat than intact male lambs.

Entries, disposal, and culling

The major sheep entered the flock through lambs born (Table 22). On average, about six lambs were born within the last 12 months. Farmers depend on lambs born to increase the flock size rather than purchasing from their neighbors. Therefore, entries in the form of donations, purchasing, gifts, and exchanges within the last 12 months were generally low.

Most sheep exits were in the form of death, whereas on average, about one lamb died within the last 12 months (Table 23). Also, sheep exited through slaughtering, exchange, and donations. Death to lambs is caused by improper management soon after lambing, whereby most farmers house the lambs born together with their adults. During land preparation, some farmers usually slaughter an animal as a friendly gesture to individuals who assist in these activities.

Most farmers did not cull their sheep, but few practiced culling (Table 24). The main reasons for culling sheep were small size, poor health, poor performance, and poor conformation (1.9% each). However, culling was rarely practiced owing to the small flock size.

Table 17. Health management

Access to veterinary services	Number of respondents (n=160)	Percentage
Government vet	1	0.6
Private vet	115	71.9
Extension service	31	19.4
Veterinary drug supplier	1	0.6
None	38	23.8

Note: *Data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Table 18. Control of ectoparasites

Control methods	n=160	
	Done routinely	Done when the need arises
None	42(26.2)	128(80.0)
Dip	27 (16.9)	5 (3.1)
Spray	90 (56.2)	27 (16.9)
Hand dressing	1 (0.6)	0 (0)

Note: The values in parenthesis are percentages while the ones without parentheses are the number of respondents; data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Table 20. Overall sheep flock morbidity rate

Sheep classes	Number of respondents (n=160)	Percentage
Suckling lambs	117	73.1
Weaned lambs	115	71.9
Adults	118	73.8

Note: Data on percentages were based on multiple responses

Table 21. Castration

Castration process	N=160	
	Number of respondents	Percentage
Do you castrate?		
Yes	13	8.1
No	147	91.9
Total	160	100
*Reasons for castration**		
Better price	4	2.5
Control breeding	10	6.2
Improving meat quality	8	5.0
*Age of castration**		
< 3 months	1	0.6
3-6 months	4	2.5
6-12 months	3	1.2
> 12 months	2	1.2

Note: *Data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Table 19. Control of internal parasites

Methods	Done routinely		Done when the need arises		If routine, specify how often	
	Dry season	Wet season	Dry season	Wet season	Dry season	Wet season
Drench	45(28.1)	44(27.5)	8 (5.0)	8 (5.0)	Every three month	Every four month
Traditional	0 (0)	0 (0)	0 (0)	0 (0)	Every 0 month	Every 0 month

Note: The values in parenthesis are percentages, while the ones without parentheses are the number of respondents, and data on percentages were based on multiple responses

Breeding

The primary reason for keeping rams was for breeding 100%, though some were kept for socio-cultural purposes (21.2%) (Table 25). Farmers selected rams for breeding based on size (88.8%) and conformation (71.9%). For example, Sukumas select animals with large body sizes and long fat tails. Fats from sheep tails are used for medical purposes, such as treating a person bitten by a snake.

The breeding method used by most smallholder farmers in the district was uncontrolled natural mating (98.8%). In this regard, during grazing time, smallholder farmers allowed their ewes to mate randomly with rams from other herds in the same village or nearby villages. The consequence of rams and ewes running together throughout the year in uncontrolled breeding includes lambing even in unfavorable seasons of low pasture quality. Tibbo (2006) also reported uncontrolled breeding; Solomon et al. (2010).

Production performances and constraints of sheep

The results (Table 26) indicate the production performances of sheep kept by smallholder farmers. The number of rams kept per herd was approximately two, and the average productive life for rams within the herd was about seven years, while that of ewes was approximately eight years. The average number of lambs per ewes' lifetime is about 13, while the average age at first lambing and lambing intervals were six and two months, respectively.

The most common production constraints faced by smallholder farmers keeping sheep were poor market availability (88.1%), endemic diseases (82.5%), and mortality of lambs (50.0%) (Table 27). Moreover, fewer buyers purchase sheep in the primary livestock market because most people in the community do not prefer mutton since it contains more fats and little taste than goat's meat. In addition, endemic diseases such as worms, FMD, and flu are major diseases that farmers face in sheep production and usually cause high lamb mortality.

Table 22. Entries within the last 12 months

Entry	Mean
Lambs born	5.78±5.4
Lambs bought	0.06±0.7
Adult male sheep bought	0.01±0.1
Adult female sheep bought	0.05±0.3
Total lambs and adult sheep	0.08±0.3
Lambs donated or given a gift	0.01±0.1
Adult male donated/given a gift	0.01±0.1
Adult female donated/given a gift	0.04±0.2
Total lambs and adults donated	0.05±0.2
Lambs exchanged or lent	0.01±0.1
Adult males exchanged/lent	0.07±0.4
Adult females exchanged/lent	0.09±0.6
Adult females exchanged/lent gift	0.18±0.8

Table 23. Exits within the last 12 months

Exits	Mean
Lambs died	1.07±1.4
Lambs sold	0.02±0.2
Adult male sheep are sold	0.09±0.4
Adult female sheep are sold	0.11±0.6
Total lambs and adults sold	0.17±0.7
Lambs slaughtered	0.04±0.4
Adult male slaughtered	0.92±1.3
Adult female slaughtered	0.41±0.9
Total lambs and adults slaughtered	1.13±1.5
Lambs donated/given as a gift	0.01±0.2
Adult male donated/given as a gift	0.02±0.2
Adult female donated/given as a gift	0.03±0.2
Total lambs and adults donated/given as a gift	0.04±0.3
Lambs exchanged/lent	0.02±0.2
Adult males exchanged/lent	0.09±0.5
Adult females exchanged/lent	0.12±0.6
Total lambs & adults exchanged/lent	0.19±1.0
Lambs stolen	0.02±0.2
Adult male stolen	0.02±0.2
Adult female stolen	0.06±0.3
Total lambs and adults stolen	0.09±0.3

Table 24. Reasons for culling

Reasons for culling	N=160	
	Males	Females
Small size	(3)1.9	(1)0.6
Health	(3)1.9	(2)1.2
Performance	(3) 1.9	(1)0.6
Temperament	(1)0.6	(0)0
Body condition	(2) 1.2	(0)0
Old age	(1)0.6	(0) 0
Scarcity	(0) 0	(0)0
Overpopulation	(0) 0	(0)0
Drought	(0) 0	(1)0.6
Prevention of inbreeding	(2)1.2	(1)0.6
Conformation	(3)1.9	(2)1.2

Note: The values in parenthesis are percentages, while the ones without parentheses are the number of respondents and data on percentages were based on multiple responses

Table 25. Breeding, choice criteria, and mating system

Parameters	N=160	
	Frequency	Percentage
Primary reason for keeping ram(s)		
Breeding	160	100.0
Socio-cultural	34	21.2
Criteria for choice of ram(s) for breeding		
Conformation	115	71.9
Performance	74	46.2
Size	142	88.8
Mating system		
Controlled natural mating	3	1.9
Uncontrolled natural mating	158	98.8
Group natural mating	6	3.8

Note: *Data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Other constraints were conflicted with crop growers (34.4%), water shortages (16.9%), feed shortages (9.4%), shortage of grazing land (6.2%), theft, and poor mothering ability (3.8% each). Problems related to service giving include the absence of preventive veterinary services such as vaccination and accessible and adequate veterinary clinics, resulting in unethical and inappropriate use of drugs from illegal sources.

The sheep market was mostly available through buying/selling from neighbors, and there were few customers outside the district. The constraints reported by Solomon et al. (2010) in Ethiopia include a lack of adequate supply of appropriate and good-quality animals, poor marketing infrastructure, livestock diseases, lack of adequate sanitary and phytosanitary services to support exports and long market channels (usually three to five stages between producer and the abattoirs).

In Kenya, Kosgey et al. (2008), as cited by Muigai et al. (2009), reported that indigenous sheep face many challenges, including persistent droughts, diseases, conflicts, and poor nutrition. In addition, the low productivity of sheep was caused by inadequate grazing resources, tropical heat, disease problems, and a serious lack of organized effort for genetic improvement (Solomon et al. 2010).

Sheep pricing and market availability

Most (sheep 65% and goats 37%) of customers involved in purchasing/selling sheep came from within the district (Table 28). Many sheep were sold and purchased by farmers without taking them to primary livestock markets. There were more goat sellers (52.5%) than sheep sellers (30%) in the primary livestock markets. There were opinions that over the years, the number of sheep sold decreased (22.5%) while that of goats was constant (22.5%). Moreover, nearly (70%) had no opinion on the trend for the two species.

On average, the number of sheep sold or bought on each primary livestock market was approximately two, while the number of goats sold or bought was about five per day (Table 29), indicating a higher demand for goats than sheep. The mean selling price of rams (mean) was Tshs 39,200 while that of the buck was Tshs 50,800, and ewes were sold at a mean price of Tshs 36,500 while that of does Tshs 47,400.

Preferred animals, prices, and sources in the primary livestock markets

The most sold species in the primary livestock market (Table 30) was cattle (95%), followed by goats (85%) and sheep (65%). The breed/strain of sheep mostly preferred by customers in the market was variant crosses of BHP and local strains (77.5%) and variant crosses of Red Maasai sheep and local strains (67.5%). The determinant of sheep price in the primary livestock market mostly depended on age (92.5%), sex (85%), and season (80%). The source of sheep to the primary livestock market was within the district (100%). The constraints in sheep marketing in the district were low sheep prices on the primary livestock market (62.5%), few customers (57.5%), and little interest in mutton (52.5%).

Way forward for improving sheep production

Smallholder farmers' plans to improve sheep production in the district were to improve the management of the existing sheep flock (63.8%), while 36.2% had no opinion (Table 31). Farmers argued that the government (DC, MLDF) has to provide vaccines for treating diseases (33.8%) and improve sheep market availability (15%).

Table 26. Production performances

Production performance	N	Mean
Number of rams per herd	160	1.91±1.2
Average productive life for rams (years)	160	7.06±2.3
Average productive life for ewes (years)	160	7.79±2.2
Average number of lambs per ewe's lifetime	160	13.97±4.8
Average age at first lambing (months)	160	6.46±1.8
Lambing interval (months)	160	2.82±1.3

Note: N = Total number of respondents interviewed

Table 27. Production constraints of sheep

Constraints	Number of respondents (N=160)	Percentages
Theft	6	3.8
Feed shortages	15	9.4
Endemic diseases	132	82.5
Water shortages	27	16.9
Shortage of grazing land	10	6.2
Conflict with crops growers	55	34.4
Low fertility	0	0
Poor mothering ability	6	3.8
Mortality of lambs	80	50.0
Poor market availability	141	88.1
Cause overgrazing	3	1.9

N = Total number of respondents interviewed

Table 28. Market availability of sheep and goats

Parameters	Percentages	
	Sheep	Goats
*Where do you come from**		
Within the district	65.0	37.0
Outside the district	17.5	25.0
Are you sellers?		
Yes	30.0	52.5
No	70.0	47.5
Total	**100**	**100**
Trend of animals sold as compared to last year		
Increasing	0	7.5
Decreasing	22.5	0
Constant	10.0	22.5
No opinion	67.5	70.0
Total	**100**	**100**
Demand to the market		
High	0	47.5
Medium	25.0	15.0
Low	42.5	0
No demand at all	10.0	5.0
No opinion	22.5	32.5
Total	**100**	**100**

Note: *Data on percentages were based on multiple responses

Table 29. Number and prices of sheep livestock market and goats sold/bought in the primary

Parameter	N	Mean
Number of sheep/goats sold/bought		
Number of sheep sold	12	1.92±0.5
Number of sheep bought	15	1.67±0.7
Number of goats sold	11	4.91±1.6
Number of goats bought	14	4.86±1.7
Price of sheep/goats sold/bought in Tshs		
Price of ram sold	13	39200±2794.2
Price of ram bought	18	41400±3110.2
Price of ewe sold	13	36500±3526.5
Price of ewe bought	18	38500±4003.7
Price of lamb sold	13	13400±1850.2
Price of lamb bought	18	13100±1567.7
Price of buck sold	12	50800±3713.2
Price of buck bought	13	48500±3281.7
Price of doe sold	12	47400±3604.5
Price of doe bought	13	45100±3451.1
Price of kid sold	12	17100±3800.8
Price of kid bought	13	15800±1589.2

Note: N = Total number of respondents interviewed

Table 30. Preference, price, sources, and constraints in the primary livestock market

Parameters	Number of respondents (N=40)	Percentage
Preferred animals in primary livestock market		
Goats	34	85.0
Cattle	38	95.0
Sheep	26	65.0
Preferred sheep breed/strain in primary livestock market		
Variant crosses of BHP and local strains	31	77.5
Variant crosses of Red Maasai sheep and local strains	27	67.5
Long-fat-tailed sheep (non-descript)	11	27.5
The determinant of sheep price in the primary livestock market		
Season	32	80.0
Age	37	92.5
Sex	34	85.0
Levy	8	20.0
Sources of sheep to the primary livestock market		
Within the district	40	100.0
Outside the district	0	0
Constraints in sheep marketing		
Few customers	23	57.5
Little interest in sheep's meat (mutton)	21	52,5
Low sheep price on livestock primary market	25	62.5

Note: *Data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Table 31. Views for improving sheep productivity

Parameters	(N=160)	
	Number of respondents	Percentages
Plans to improve sheep production in the district		
To improve management in the existing sheep flock, kept	102	63.8
No opinion	58	36.2
Total	**160**	**100.0**
Government (DC, MLDF) contribution to improving sheep production in the district		
Improve sheep market availability	24	15.0
Construction of watering points for drinking animals	13	8.1
Provision of vaccines for treating diseases	54	33.8
Training on proper sheep husbandry	20	12.5
Provision of hybrid sheep	22	13.8
No opinion	27	16.9
Total	**160**	**100.0**
General recommendations on what is required to improve sheep production		
Improving sheep market availability	54	33.8
Construction of watering points for drinking animals	4	2.5
Provision of vaccines for treating diseases	17	10.6
Training on proper sheep husbandry	19	11.9
Provision of hybrid sheep	37	23.1
No opinion	29	18.1
Total	**160**	**100.0**
*Plans to improve sheep market availability**		
Introducing hybrid sheep	2	5.0
No opinion	36	90.0
Other reasons	2	5.0
Advice to the government in improving sheep market availability in the district		
Outsourcing sheep customers from outside the district	24	60.0
Provision of hybrid sheep to sheep keepers	7	17.5
Other reasons	12	30.0
*General recommendations on improving sheep market availability**		
The government has to outsource sheep customers from outside the district	17	42.5
The government has to provide hybrid sheep to sheepkeepers	7	17.5

Note: *Data on percentages were based on multiple responses, and N = Total number of respondents interviewed

Most (60%) advised the government (DC or MLDF) to outsource sheep customers outside the district. In comparison, a few (17.5%) requested to be provided with hybrid sheep breeds for crossbreeding with their local breeds to obtain desired preferred quality traits. Some had no opinion on how the government should improve sheep production in the district (16.9%). In comparison, the majority (33.8%) of them recommended that the government improve the sheep market and provide better

breeding stocks (23.1%). Some proposed training on proper sheep husbandry (11.9%). About (18.1%) of the smallholder farmers had no idea about the current situation.

In conclusion, this study found that: (i) Smallholder farmers in the district kept variant crosses of sheep strains of BHP, Red Maasai, and local strains. Most purchased sheep from their neighbors or inherited them from their parents. Farmers prefer sheep that are tolerant to diseases and heat, while the main reason for keeping sheep is for meat and income. (ii) Most farmers kept sheep under an extensive management system. Most farmers kept their sheep in a stall or shed made of untreated bush materials during both dry and wet seasons. (iii) The average herd structure of sheep contained two rams and nine ewes. Ewes had a more productive life span in the herd than rams, and the average first lambing was about 6.5 months. (iv) The most common production constraints faced by farmers were poor market availability, diseases, and mortality of lambs. The sheep market was mainly available within the district rather than outside the district. Also, goats were sold or bought at a higher price than sheep in primary livestock markets, while the price of the animal depended on age, sex, and season. Therefore, there is a need to train smallholder farmers to keep sheep on the proper sheep husbandry to attain high production and improve their socio-economic and national well-being.

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