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ASSESSMENT OF SHEEP PRODUCTION SYSTEM IN BURIE DISTRICT, NORTH WESTERN ETHIOPIA

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ABSTRACT: *The study was conducted in Burie District to assess the sheep production system and to identify and prioritize the sheep production constraints. Informal and formal surveys were conducted in four selected kebeles of Burie District, namely, Woheni Durebetie, Woyenema Ambaye, Denbun and Boko Tabo. The farmers interviewed in the informal survey were selected purposively and for the formal survey, by systematic random sampling method. Farmers rear sheep for two main purposes, for cash income and home slaughter on festivals. On average, one household had 3.7±2.46 heads of sheep (n = 127). Washera and Horro sheep breeds were found in the area. There were more Washera sheep (98%) in Woheni Durebetie Kebele and more Horro sheep (92%) in Boko Tabo Kebele. The main feed resources for sheep were natural pasture and stubble grazing. Most farmers supplement common salt and Atella (a local beer (Tela) residue) to their sheep. Feed shortage occurs both during the dry and rainy seasons in the highland kebeles. There was a deficit of 0.7 ton DM feed per household per year in the highland kebeles. The sheep production system is subsistence-oriented. Sheep diseases, lack of adequate veterinary service and feed and nutrient shortage were the main sheep production constraints in the area in that order of importance. To improve sheep production in Burie District, these constraints should be given more emphasis in research and development activities that are going to be undertaken in the study area.*

KEYWORDS: Sheep, Production System, Production Constraints, Ethiopia

INTRODUCTION

In Ethiopia, more than 80% of the human population depends on agriculture for their livelihoods (Azage, 2005) and usually keep livestock as pastoralists or in mixed crop livestock systems. The livestock population of Ethiopia is currently estimated at 43.1 million cattle, 23.6 million sheep, 18.6 million goats, 1.7 million horses, 0.3 million mules and 4.5 million donkeys excluding nomadic areas (CSA, 2008) and is diverse genetically. The current contribution of the livestock subsector in Ethiopia is below its potential (Berhanu *et al*., 2007). Cash income from livestock production is especially important for the poor and landless Ethiopian households. Small ruminant population of Ethiopia is one of the largest in Africa (IBC, 2007). Most of the small ruminant population of the country is kept by smallholder farmers and small ruminant production in the country is traditional (EARO, 2001a). According to Moti *et al*. (2009) citing Pingali (1997), subsistence agriculture may not be a viable activity to ensure sustainable household food security and welfare. Commercialization of smallholder agriculture is an indispensable pathway towards economic

growth and development for developing countries relying on the agricultural sector. In Ethiopia, the small ruminant production system in different agro-ecological zones is not studied fully and farmers' needs and production constraints have not been identified (EARO, 2001a). Improvement in small ruminant productivity which is low in Ethiopia (EARO, 2001a) can be achieved through identification of production constraints and introduction of new technologies or by refining existing practices in the system.

Assessment of the sheep production system and identification and prioritization of the constraints of production are prerequisites to bring improvement in sheep productivity. Prioritization of the production system constraints helps to use the scarce resources efficiently. Understanding the production system helps to design appropriate technologies which are compatible with the system. In Burie District, the sheep production system is not studied adequately and sheep production constraints are not identified and prioritized. Hence, assessment of the sheep production system in the district is necessary in order to achieve improvements in sheep productivity. Therefore, this study was conducted to assess the sheep production system and to identify and prioritize the sheep production constraints in Burie District.

MATERIALS AND METHODS

Description of the study area

Burie District is located between 10˚15′N and 10˚42′29″N and between 36˚52′1″E and 37˚7′9″E in Amhara National Regional State (ANRS), Ethiopia. It has altitude range of 713 – 2604 masl (BOFED, 2008; IPMS, 2007). The rainy season in Burie is from May to September with a monomodal pattern and a mean annual rainfall of 1386 – 1757 mm (IPMS, 2007). The long term mean annual temperature of Burie ranges from 14 ºC to 24 ºC. As the district has different agro-climatic settings, it is suitable for different crops and livestock species production. The total area of the district is 72,739 ha. The land use pattern in the district consisted of about 47% cultivated land, 16% wasteland, 15% shrub, 8% natural forest, 7% construction (roads and houses), 6% natural pasture and 1% perennial crops (OoARD, 2007). The livelihood of most of the district population is dependent on agriculture. According to OoARD (2007), average cultivated landholding in Burie District is about 1.6 ha per household. There are 22 rural kebeles and 2 towns in the district. The main cereal crops grown in the district include maize, wheat, *tef (Eragrostis tef)*, finger millet and barley. The district is one of the surplus grain producer districts in the region. It has higher road density (68.5 km/ 1000 km^2) compared with the region. This is an advantage to transport agricultural inputs and products from the kebeles and market places in the district (IPMS, 20007). The farmers in the study kebeles rear different types of livestock. Cattle, sheep, goat, equine and chicken rearing is common in the area. Farmers also keep bee colonies.

Informal survey

Before beginning the informal survey, secondary data were collected from various sources. Based on the secondary data and participation of district livestock experts, four representative rural kebeles were purposively selected for the study. The criteria used for selection of the study kebeles were sheep population and density, accessibility by vehicle and non-adjacent

kebeles to one another. The selected kebeles were Woheni Durebetie, Woyenema Ambaye, Denbun and Boko Tabo.

For the informal survey, checklist was prepared and used for the study. Farmers to be interviewed in the informal survey were selected purposively from the selected kebeles. Three types of interviews were conducted: individual, key informant and group interviews. For individual interviews, farmers who were involved in sheep production and from various economic status (poor, medium and rich (based on resident farmers' evaluation)) were selected. For key informant interviews, kebele administrators and religious leaders were selected and interviewed. During key and individual interviewee selection, those farmers who lived in the area for several years were selected and interviewed. For the group interview, farmers from different age, economic status and gender were included. Sheep production constraint prioritization was set using pair-wise ranking method for each kebele and single list ordinal ranking method for the district (ARARI, 2005).

To assess the sheep breed composition in the sheep flocks, data were collected from each kebele during the informal survey field work. Sheep flocks in each kebele were selected purposively in the grazing fields and each animal in the flock was caught, identified and data were recorded.

Formal survey

Based on the informal survey result, questionnaire was prepared and pretested. The formal survey was conducted on the same kebeles that were used for the informal survey. Respondents were selected from each kebele residents' list by systematic random sampling method. Enumerators (elementary school teachers, kebele managers and development agents) from each kebele were selected and trained on data collection. The sheep production constraints for the formal survey result were prioritized using single list weighted category based ranking method (ARARI, 2005). To calculate the feed balance in the study area the mean number of livestock species owned by a HH was converted into TLU (ILCA, 1990) and one TLU is the equivalent of one bovine animal of 250 kg body weight.

Statistical analysis

The data were analyzed using SPSS (2003) statistical software. Data were summarized using descriptive statistics. Mean comparison was done using ANOVA.

Results

Households and farm characteristics in the study area

The study area is characterized by mixed crop-livestock system. On average, land holding per household in the area was 1.3 ha (n = 126, SD = 1.05). This figure is lower than the figure reported by IPMS (2007) for Burie District. About 57% of the household heads interviewed are uneducated. Farmers in the lowland kebele (Boko Tabo) had more ($P<0.05$) land per household than those farmers found in the highland kebeles (Woheni Durebetie, Woyenema Ambaye and Denbun).

Sheep production purpose and sheep breeds in the study area

The sheep production in the study area is extensive. Farmers in the area rear sheep for two main purposes: to get cash income and for home slaughter on festivals. Farmers on average had 3.7 heads of sheep (n = 127, SD = 2.46) per household. Easter, New Year and Christmas are the main occasions on which farmers slaughter sheep in that order of imprortance. On average, one household slaughtered 1.6 heads of sheep (n = 127, SD = 0.74) per year. Based on the informal survey result, male sheep at young age (from 3 to 12 months of age) were mostly slaughtered for home consumption.

There are two sheep breeds in the study kebeles of the district. These are Horro and Washera. In addition, there is a sheep type which is a crossbred between Horro and Washera. Washera breed has short fat tail, large body size, short hair, predominantly brown colour, both males and females are polled. This breed is found in Amhara National Regional State, Ethiopia (Solomon *et al*., 2011). According to the same source, Horro breed has long fat tail extending below the hock, either straight (51.4%) or coiled/ twisted (48.6%) at the tapering end; prominent fat tail in males; large, leggy and prolific, dominant colours are brown and fawn, belly is lighter especially in adult ewes, less frequent are black, white, brown with white patches; both sexes are polled. This breed is mostly found in Oromia National Regional State, Ethiopia. There are more Washera sheep (98.0%) in Woheni Durebetie and more Horro sheep (91.6%) in Boko Tabo kebele (Table 1). The sheep breeds in the Woina Dega kebeles (Woyenema Ambaye and Denbun) were Horro, Washera and crossbreds of the two breeds. Originally, based on respondents' opinion in the area, there was Washera breed in Woheni Durebetie and Woyenema Ambaye kebeles; and Horro breed in Boko Tabo kebele. Currently, Horro breed is being introduced to the highland kebeles and Washera breed to the lowland kebele. According to the respondents, Horro breed is more disease resistant than Washera breed. But farmers in the highland kebeles prefer Washera breed from Horro breed for home consumption.

Table 1. Proportion of Washera and Horro sheep breeds and their crossbred in the study kebeles of Burie District

Name of kebele		Breed of sheep			Total
		Washera	Horro	Crossbred	
Woheni Durebetie	Count	297	1	5	303
	Expected count	123.8	106.3	72.9	303.0
	% within the kebele	98.0%	0.3%	1.7%	100.0%
Woyenema Ambaye	Count	107	100	91	298
	Expected count	121.8	104.5	71.7	298.0
	% within the kebele	35.9%	33.6%	30.5%	100.0%
Denbun	Count	90	41	169	300
	Expected count	122.6	105.2	72.2	300.0
	% within the kebele	30.0%	13.7%	56.3%	100.6%
Boko Tabo	Count	0	282	26	308
	Expected count	125.8	108.0	74.1	308.0
	% within the kebele	0.0%	91.6%	8.4%	100.0%
Total	Count	494	424	291	1209
	Expected count	494.0	424.0	291.0	1209.0
	% in all the kebeles	40.9%	35.1%	24.1%	100.0%

Feed resources

The main feed resources for sheep production in the study area are natural pasture and crop stubble grazing (Table 2). The main feed resources in the dry and rainy seasons for sheep were different. Natural pasture was the main feed resource during the rainy season; natural pasture and stubble grazing, in the dry season. In the lowland kebele, the grazing lands have more browse species and sheep utilize these feed resources. In the lowland kebele, there was more land that was available for grazing and hence feed shortage was not the main problem when it is compared with the highland kebeles. Farmers usually supplement local beer residue (*Atella*), maize grain, food leftover and salt to their sheep (Table 3). Supplementation of agro-industrial by-products and improved forages for sheep was rare in the study area. Noug seed cake supplementation was commonly practiced for sheep fattening.

Table 2. Major feed resources for sheep during different seasons in the study kebeles of Burie District

Major feed resource	Sept. – Nov. N = 127		Dec. – Feb. N = 127		March – May N = 127		June – August N = 127	
	N	%	N	%	N	%	N	%
NPO	114	90	52	41	65	51	98	77
SO	6	5	46	36	50	39	4	3
NPAS	6	5	29	23	12	10	25	20
NR	1	1	0	0	0	0	0	0

N = Number of respondents; NPO = Natural pasture only; NPAS = Natural pasture and stubble;
SO = Stubble only; NR = No response

Table 3. Feed supplements for sheep during different seasons in the study kebeles of Burie District

Feed supplement type	Sept. – Nov. N = 127		Dec. – Feb. N = 127		March – May N = 127		June – August N = 127	
	N	%	N	%	N	%	N	%
MGO	27	21	12	9	14	11	7	6
AO	51	40	65	51	59	47	55	43
FLO	8	6	5	4	9	7	19	15
MGA	14	11	15	12	12	9	5	4
MGAFL	2	2	11	9	8	6	5	4
AFL	6	5	3	2	4	3	1	1
other	16	13	15	12	18	14	14	11
NR	3	2	1	1	3	2	21	17

N = Number of respondents; AFL = Atella and food leftover; AO = Atella only; FO = Food leftover only; MGA = Maize grain and atella; MGAFL = Maize grain, atella and food leftover; MGO = Maize grain only; NR = No response

Private and communal grazing lands are common in the area. Farmers on average had 0.04 ha private grazing land. There were several communal grazing lands per kebele. The total area of the communal grazing lands among kebeles was different. In general, the area of the communal grazing lands has decreased according to 48% of the farmers response, as the communal grazing lands were cultivated for crop production and used for other purposes (to build schools, clinics and others). The decline in productivity is associated with increase in livestock population in the area has increased while the area of the communal grazing lands has decreased. Based on observations during the informal survey, the communal grazing lands in the highland kebeles were overgrazed.

About 42.5% of the respondents fed crop residues to sheep. Finger millet straw, maize stover and *tef* straw feeding to sheep during feed scarcity periods was common (April – August). Farmers sprinkle salt solution on *tef* straw before feeding it to the animals to increase its palatability. According to literature values, the nutritive value of the main feed resources found in the study area is poor; the feed resources are low in CP and digestibility (Table 4). So, supplementation of animals with better quality feeds, especially during the dry season is essential.

Table 4. Estimated mean chemical composition of the major feed resources

Feed type	DM	OM	ADF	NDF	ADL	CP	Ca	P
Natural pasture (Dry season)*	-	-	-	-	-	3.2	-	-
Natural pasture (Rainy season)*	-	-	-	-	-	12.1	-	-
Atella	91.33	94.19	-	-	-	18.38	0.62	0.42
Wheat straw	91.38	90.34	51.89	81.08	6.52	6.10	-	0
Maize stover	91.15	92.52	47.35	70.69	5.63	4.59	0.13	0.12
Finger millet straw	89.73	89.89	40.93	69.54	3.99	4.12	0.60	0.32
Barley straw	91.12	92.44	48.28	73.89	6.16	2.35	0.44	0.13
Tef straw	91.72	92.23	44.65	76.44	5.44	4.18	0.36	0.15
Sesbania sp.	89.74	88.09	13.82	20.48	4.03	28.15	-	0.32
Noug seed cake	92.27	89.69	31.55	37.61	12.38	31.44	0.76	1.15
Maize grain	91.46	92.86	4.38	-	0.81	5.93	0.06	0.31

ADF = Acid detergent fiber; ADL = Acid detergent lignin; Ca = Calcium; CP = Crude protein; DM = Dry matter; NDF = Neutral detergent fiber; OM = Organic matter; P = Phosphorus
Source, ILRI (2008)
*Source, EARO (2001b)

Sesbania, Napier grass, Rhodes grass and oats were among the improved forages planted and used in the area. Among these improved forage crops sesbania is common in the area. Farmers give sesbania leaves to cattle mainly and to sheep occasionally. Farmers plant sesbania around their homestead. Farmers have a few number of sesbania plants per household.

There was feed shortage problem both during the dry and the rainy seasons. About 46% of the respondents encountered feed shortages in sheep production in the study area. Feed shortage occurs in the dry season from February to May and in the rainy season, from July to end of October as most of the land will be covered by food crops during this season. On average, there was a deficit of 0.7 ton DM feed per household per year (Table 5). As there was feed shortage problem during the rainy season in the highland kebeles, some farmers have allocated private grazing lands from their landholdings to their livestock. Farmers supplement feed to their animals from their private grazing lands from July to end of October. During feed scarcity period in the rainy season farmers either graze their animals on these private grazing lands or mow the grass and supplement their animals at home. Feed supplementation from private grazing lands is done for all livestock species especially to cattle. In addition to the above practices, supplementing maize leaves, maize plants having no cobs and weeds from maize fields were also practiced in the highland kebeles from July to end of October.

Farmers bought few materials for sheep production from the market. They mainly bought salt (73% of respondents) and noug seed cake (7%). In general, buying feed resources from the market for sheep production was not common.

Table 5. Estimated feed balance per household per year in the highland kebeles of Burie District

Source of feed for livestock per HH	Total feed produced (Ton DM) per HH
Feed produced from natural pasture, private grazing land and stubble	1.4
Feed produced from crop residues	6.3
Overall feed produced per HH	7.7
Total feed requirement per year per HH	8.4
Feed balance	- 0.7

HH = Household; DM = Dry matter

Housing of sheep

Farmers in the area use different types of sheep houses. Sheltering sheep in the main house is predominant in the area (58%) followed by sheep houses constructed attached to the main house (33%). Separately constructed sheep house (9%) is also found in the area. Sheep houses were made of locally available materials. The types of materials used for wall construction of sheep houses were different between the highland and the lowland kebeles. The wall was usually made of eucalyptus tree wood in the highland kebeles and while lowland tree wood is used in the lowland kebele. The wall was usually plastered with mud in

the highland kebeles while plastering with mud in the lowland kebele was not usually common as the ambient temperature in the area is high. In all places, the roof is usually made of corrugated iron sheet (90%). The dominant floor type was usually earth both during the dry (70%) and rainy (52%) seasons (Table 6). Wood and stone paving of floors was usually practiced during the rainy season when the floor gets moist and dirty. Wooden paved floors are better for sheep production. But as it entails wood and labour for its construction it is not widely used in the area. In all places, sheep houses were well ventilated. This condition is important to remove heat, moisture and pollutants (ammonia) from the house.

Cleaning of sheep houses was common in the study area. Cleaning frequency differed between seasons, altitude and floor types (Table 7). The highland kebeles cleaned sheep houses more frequently than the lowland kebele. Wooden paved floors were less frequently cleaned. Cleaning of sheep houses was not common on observant days (Sundays, St. Mary's day, etc) especially in the highland kebeles as most of the population in these kebeles were Orthodox Christian followers. Cleaning was usually the responsibility of women and children.

Table 6. Type of floor adopted by farmers during the dry and rainy seasons in the study kebeles of Burie District

Type of floor	Dry Season N = 127		Rainy season N = 127	
	N	%	N	%
Earth	89	70	66	52
Stone	29	23	46	36
Wood	9	7	15	12

N = Number of respondents

Table 7. Cleaning frequency of sheep houses by farmers during the dry and rainy season in the study kebeles of Burie District

Frequency of cleaning	Dry Season N = 127		Rainy season N = 127	
	N	%	N	%
Daily	59	46.5	99	78
1 time per week	28	22	10	8
2 times per week	20	16	15	12
3 times per week	20	16	3	2

N = Number of respondents

The house type and its conditions affect animals' health and productivity. As most of the farmers in the study area have corrugated iron sheet roofed sheep houses this may predispose the animals to cold stress and respiratory diseases especially during the rainy season. There is no adequate cleaning of sheep houses when they were separately constructed. From

observations made (dry season) during the informal survey, it was evident that most of the sheep houses were not cleaned daily. Consequently, the floors were not clean and dry. This may be a better place for disease causing organisms to multiply and proliferate. In addition, in some cases the floor was not smooth and had protruding stones and surfaces which may injure the animals and predispose them to infections.

Diseases and disease control

Sheep diseases were one of the main constraints for sheep production in the area. Foot rot, skin disease, pasteurellosis, orf and internal parasites were the main sheep diseases in the area. Especially pregnant and lactating ewes in the highland kebeles were affected by diseases. As the animals marketed are introduced from different places into the district, these animals may introduce diseases into the sheep flocks in the area. When animals get sick farmers got most of the animals treated at public veterinary clinics except Boko Tabo kebele (Table 8). Treating animals using drugs bought from the market is common especially in the lowland kebele as the public veterinary clinic is very remote from their residences. Farmers buy drugs is mainly private veterinary clinics. Farmers who practice medication using drugs had no training or education in veterinary science.

Table 8. Measures taken by farmers when animals get sick in the study kebeles of Burie District

Measures taken	Woheni Durebetie N = 38		Woyenema Ambaye N = 39		Denbun N = 30		Boko Tabo N = 20	
	N	%	N	%	N	%	N	%
Treatment at public vet clinic	35	92	38	97	22	73	6	30
Farmers treatment using drugs	1	3	0	0	6	20	12	60
Traditional treatment	1	3	0	0	1	3	2	10
Sale	0	0	0	0	1	3	0	0
other	1	3	1	3	0	0	0	0

N = Number of respondent

On average, one household lost 0.7 heads of sheep (n = 127, SD = 1.32) the previous year (Table 9). There was no difference ($P>0.05$) in the number of sheep deaths per HH per year among the study kebeles. According to the respondents in the area there was a difference in disease tolerance between sheep breeds. Horro sheep was believed to resist diseases better than Washera (59% of respondents). Due to this reason farmers in the highland kebeles are currently rearing more Horro sheep and the crossbreds.

Table 9. Mean number of sheep deaths per HH per year in the study kebeles of Burie District

Name of kebele	Number of sheep Mean±SE*	N
Woheni Durebetie	0.5±0.13	38
Woyenema Ambaye	1.1±0.27	39
Denbun	0.5±0.18	30
Boko Tabo	1.0±0.35	20

*Non-significant
SE = Standard error; N = Number of respondents; Means with the same superscript letter within a column are not significantly different (P>0.05)

Farmers frequently dewormed their sheep per year. About 95% of the farmers dewormed their ewes once every year while 80% of the farmers dewormed their ewes 2 to 4 times per year. Most farmers bought anthelminitics from public vet clinics (59%). Farmers believed that giving anthelminitics frequently improves the sheep condition and productivity and prevents the animals from infectious diseases. Due to this reason giving anthelminitics to sheep by some farmers was done beyond recommended rates. In general, as the animals because free from parasites they may become healthier and more disease tolerant.
There seems to be a relationship between disease occurrence and feed scarcity and nutrient deficiency period in the area. Feed and nutrient deficiency occurs from July to end of October and again from February to May. According to the respondents in the study area sheep in the area get sick during these periods. This may be due to low feed intake and nutrient deficiency which may predispose the animals to low disease resistance. In the lowland kebele, sheep were mainly sick from August to November and several sheep die during this period in this area. In the highland kebeles, sheep mainly got sick and die in September and October.

Based on farmers' opinion, veterinary services given in all the study kebeles were not adequate. The veterinary clinics were far from most of the farmers' residences. On average, veterinary clinics are 6 km away from the farmers' residences. Taking sick animals to remote veterinary clinics on foot will take time and expends farmers' time and labour in vain. In addition, during peak labour months (mostly in the rainy season) farmers spend most of their time on crop production. So, when animals get sick during this time farmers retain the animals at home to save labour and time. In addition to the above problems, farmers said that drugs were not usually available when they take sick animals to the rural veterinary clinics. Men were usually responsible to get sick animals treated in veterinary clinics.

Sheep marketing

Sheep rearing is one of the main cash income sources for the farmers in the study area. There were three sheep market places in the District. Generally, male sheep at young age were sold on market. One household in the study area sold on average 1.1 heads of sheep (n = 127, SD 1.40) per year. Farmers usually sold sheep during Easter, New Year and Christmas. During this period there were more consumers on market and market prices for sheep were higher. During festivals the demand is very high and the animals sold fetch better prices. On average, there was a market price of 10.8 Birr per kg of BW during the study period.

Sheep production constraints

There are several sheep production constraints in the study area (Table 10 and 11). According to EARO (2001b), feed shortage, diseases and parasites, animal management, genotype and genetics and socio-economic and institutional constraints are the main problems in sheep and goat production in the country. According to Abebe *et al.* (2000), feed shortage in the dry and rainy season, diseases, inadequate veterinary service and lack of capital are the main sheep production constraints in Lallomamma Mider District, North Shoa. From the current study it was observed that the severity and scope of the sheep production constraints differed from kebele to kebele, even within the same kebele. For instance, water shortage was the main problem in Boko Tabo kebele, but it was not the main problem in the highland kebeles. There was a difference between the informal and formal survey results in the priority of constraints (Table 10 and 11). This may be due to the perception and analysis of constraints by farmers during the formal survey as there were no experts to assist the farmers assess thoroughly the impact of constraints on sheep production.

Table 10. Rank of sheep production constraints in the study kebeles of Burie District (Informal survey result)

Constraint identified	Woheni Durebetie	Woyenema Ambaye	Denbun	Boko Tabo	Total score	Priority in the District
Sheep diseases	1	1	1	2	5	1
Lack of adequate vet service	2	8	2	3	15	2
Feed shortage	3	4	5	8	20	3
Theft	5	5	6	7	23	8
Labour shortage	5	6	4	8	23	6
Shortage of capital	4	8	3	8	23	7
Water shortage	5	8	8	1	22	5
Marketing problem	5	2	8	5	20	4

Table 11. Rank of sheep production constraints in the study kebeles of Burie District (Formal survey result)

Constraint identified	1st Priority (5)	2nd Priority (4)	3rd Priority (3)	4th Priority (2)	5th priority (1)	Total weighted score	Priority in the District
Sheep diseases	84	14	11	1	1	512	1
Lack of adequate vet service	1	13	22	23	5	174	5
Feed shortage	4	8	7	4	0	81	8
Labour shortage	1	5	12	10	10	91	6
Shortage of capital	17	14	9	8	8	192	3
Knowledge shortage	0	6	14	8	7	89	7
Marketing problem (remote market places)	6	16	16	13	9	177	4
Predators	7	24	13	7	10	194	2

Discussion

Households and farm characteristics in the study area

The study area is characterized by mixed crop-livestock system. On average, land holding per household in the area was 1.3 ha (n = 126, SD = 1.05). This figure is lower than the figure reported by IPMS (2007) for Burie District. Farmers in the lowland kebele (Boko Tabo) had more ($P<0.05$) land per household than those farmers found in the highland kebeles (Woheni Durebetie, Woyenema Ambaye and Denbun). There was no relationship between the size of landholding and the size of sheep owned by a household. As 57% of the sheep producers are uneducated, this condition has an impact on technology adoption by the sheep owners.

Sheep production purpose and sheep breeds in the study area

According to Gatenby (1986), Ethiopia is one of the important sheep rearing countries in Africa. Smallholder sheep producers in the study area rear sheep for two main purposes: for cash income and home slaughter during festivals. Farmers use sheep manure for crop production. In addition to the income farmers get from sheep selling this practice increases income indirectly. Most of the farmers slaughter or sell sheep during Easter, New Year and Christmas. According to Devendra and McLeroy (1982), most traditional sheep in the tropics are maintained as subsistence animals supplying meat, skins, hair, manure and to some extent wool. The farmers in the study area are subsistence sheep producers. According to Moti *et al* (2009), the production decisions of subsistence farmers are based on production feasibility

and subsistence requirements and selling only whatever surplus is left after household consumption requirements are met.

There are 9 sheep breeds in Ethiopia. Among the 9 sheep breeds in the country two sheep breeds are found in the study district: Horro and Washera sheep breeds which are fat-tailed. In addition, there is a crossbred between Horro and Washera which are fat-tailed. Based on average adult body weight Horro breed is heavier than Wahera breed (35.4 kg vs 32.8 kg). According to this study, there were more Washera sheep (98.0%) in the highland kebele and more Horro sheep (91.6%) in the lowland kebele. There was a difference in the sheep flock breed composition among the study kebeles. This finding is in agreement with Gatenby (1991), that states that two widely-spaced areas have different sheep breed but those areas between these areas have intermediate sheep breeds.

According to the farmers' response, there was originally Horro breed in the lowland kebele and Washera breed in the highland kebeles a decade or two decades earlier. Currently, farmers are introducing new indigenous sheep breeds to their area for different purposes. Horro breed is being introduced to the highland kebeles for crossbreeding purposes as it is considered by the farmers as more disease tolerant than Wahera breed. This needs further study in the future. On the other hand, Washera breed is being introduced to the low land kebele as it is condidered by the farmers more preferable on local market and fetches better prices than Horro breed.

Feed resources

Natural pasture and crop stubble grazing are the main feed resources for sheep production in the study area. To feed the growing human population grazing lands are being converted into crop lands. About 48% of the farmers responded that the communal grazing lands had decreased in area. This resulted in more animals grazing on a limited area of grazing land. This further resulted in overgrazing and poor productivity of grazing lands. On average, there was a deficit of 0.7 ton DM feed per household per year in the highland kebeles. To overcome the feed shortage problem farmers implement different strategies. Some farmers (30%) have private grazing lands to supplement their animals during feed scarcity period in the rainy season. In addition, farmers supplement weeds from crop lands, weak maize plants, and maize leaves during this period.

The main feed resources in the area are natural pasture and stubble grazing. These feed resources are low in CP content and poor in digestibility. According to Gatenby (1991), the minimum protein level for maintenance is about 8% on dry matter basis. More productive sheep, rapidly growing lambs and lactating ewes, need about 11% CP in the feed on dry matter basis. Supplementing sheep with better quality feed resources during this period is essential to improve sheep productivity. If increased productivity is needed, efforts should be made to increase the quantity as well as the quality of feed given (Charry *et al*., 1992).

There were different feed supplements for sheep in the study area. The main locally available feed supplements are maize grain, food left over and *Atella*. From these feed supplements *Atella* has high CP content in some cases it is reported that its CP content is 20.2% (Adugna, 2007) and can be used as a protein supplement to sheep production during the dry season (Table 4). Feeding *Atella* during this period might not be possible, because it is not available year round. It is mostly available when the farmers make the local alcoholic beverage.

In the farmering system sesbania is available by most households and can be used as a protein supplement. According to Abebe (2008), supplementation of *Sesbania sesban* at 30% of the ration of ewes improves growth rate and reproductive performance of sheep. According to the same source, lambs fed sesbania at 95% of the suppelem had an ADG of 35 g per day. Supplementation with sesbania improved the proportion of ewes conceived by 17% over supplementation with concentrates (Abebe, 2008). Generally, it is concluded that *Sesbania sesban* is a potential supplement and can be used to substitute commercial concentrates for smallholder farmers in the Ethiopian highlands.

From the agro-industrial by-products available Noug seed cake is common in the study area. It is used by some of the farmers for sheep fattening purpose. In the lowland kebele, there are more indigenous fodder trees available in the grazing lands. According to Gatenby (1991), fodder trees are fed to sheep in many parts of the world. Many species are legumes and their leaves have very high levels of protein. But several species contain harmful substances, particularly tannins, so only small quantities of these feed should be fed to sheep. Feeding locally available protein supplements is feasible and makes the sheep production more economical.

Feed shortage occurs two times per year. From July to end of October crop lands are covered by food crops. As the grazing land will be overgrazed and poor in productivity, the animals have less feed to eat during this season. There was a relationship between feed shortage and sheep disease and death incidence period. Sheep morbidity and death is high from July to end of October may be due to severe feed shortage which may predispose the animals to low disease resistance. In addition to this, during feed shortage period the sheep may consume poisonous plants which may predispose them to diseases and death.

According to respondents there is a difference between the two sheep breeds in feed demand. Horro breed demands more feed than Washera breed. In addition, Horro breed is non-selective than Washera breed. According to Gatenby (1991), larger sheep eat more feed than smaller sheep. Due breed and body size difference, Horro sheep may require more feed than Washera sheep within the same environment and physiological status.

The farmers expend less money on feed for sheep production. Most of the farmers (73% of respondents) buy salt for sheep supplementation purpose. However, some of the farmers (7% of respondents) buy noug seed cake for sheep fattening purpose. These feed costs are low considering the amount of supplement given and the price of these feed resources. According to Charray *et al.* (1992), the level of expenditure on feed is related to the production system employed.

Housing of sheep

The sheep houses are constructed from locally available materials. Construction of the sheep house from locally available materials makes it economical. However, houses constructed from locally available materials are less durable and can be destroyed by fire easily when compared with modern structures. Most of the sheep houses are corrugated iron sheet roofed houses (90%) may predispose sheep to cold stress and eventauully to respiratory diseases. As most of the sheep house floor surfaces are rough this may injure the sheep and predispose

them to infections. Sheep house cleaning frequency differs between house types, agro-climatic zones and seasons. During the rainy season floors get muddy easily and cleaning frequency is more frequent. In addition, as the ambient temperature is high in the lowland kebele the floors get dry easily so the households clean floors less frequently when compared with the highland kebeles. As most of the disease causing organisms are killed by sunlight and drying, the sheep house should be kept light, well ventilated and the floor dry (Gatenby, 1991).

Diseases and disease control

Veterinary service provison is low. Generally, veterinary clinics are remote from farmers' residences. Hence, farmers who are located in remote areas from the veterinary clincics buy drugs from the market and treat their animals themselves. They do not have training or education on veterinary science. Hence, this practice encourages disease resistant microbes to develop in animal health. This practice is more common in the lowland kebele (60% of respondents) as the farmers are located far from the veterinary clinics. Since farmers buy the drugs they use mostly from private veterinary clinics, there should be strict regulation on this practice as it affects animal health in the area in general. To alleviate the veterinary service provision problem in the area construction of new veterinary clinics in remote areas is essential.

Animals which originated in one place are considered to be more disease resistant to the locality and more adaptable (Gatenby, 1991). But Washera breed is currently considered to be susceptible to diseases and Horro breed which is not common in the highland kebeles previously is now considered to be more disease tolerant by local farmers. The cause of the susceptibility of Washera breed to diseases is not clear and it needs further study.

Sheep marketing

The income one household gains depends on the number of animals reared and their productivity. As the number of animals reared is few and as there are several constraints which affect sheep productivity, the income farmers get from sheep production may be limited. As the production system is subsistence-oreinted sheep producers were not targeting markets in their sheep production decision (Moti *et al*., 2009). As growing lambs are sold or slaughtered at an early age before breeding, this may degrade the productivity of the sheep flock through genetic material loss.

Sheep production constraints

Among the constraints considered sheep diseases, feed shortage and lack of veterinary service are the main ones. Disease mainly occurs during feed shortage periods. According to Gatenby (1986), to alleviate these problems sheep production should not be considered in isolation from other entrrprises. In addition, to bring successful improvements in sheep production the biological, social and economic factors should be considered thoroughly. The type of improvement appropriate for a particular area depends on the system of production and the constraints acting on it (Gatenby, 1986). Disease lowers the productivity of animals. Disease mainly occurs during feed shortage periods. Feed shortage may predispose the animals to low disease resistance. According to Gatenby (1991), well-fed animals are less

likely to become ill than underfed animals. In addition, during feed shortage period (dry season) animals may consume poisonous plants. Sheep death occurs mainly at the end of the rainy season. This may be due to feed shoratgae and the suitability of the environment for the disease causing organisms during this period. The introduction of animals into the area from different places for marketing may introduce diseases into the area. Vaccination is not common in the area probably because of the fact that farmers are not aware of the importance of vaccination.

Feed shortage is very severe especially in the highland kebeles. This problem is caused by cultivation of grazing lands for crop production as the human population is increasing. This resulted in overgrazing and poor productivity of grazing lands. Most of the locally available feed resources are poor in nutritive value. According to Gatenby (1991), the minimum protein level required for maintenance is about 8% in the dry matter. The utilization of improved forages and agro-industrial by-products in the study area is low. To improve feed quantity and quality, several measures should be taken. Introduction and production of improved forages and better utilization of the available feed resources are the main alternatives. Forage development strategies which fit the farming system should be implemented. According to Gatenby (1986), growing improved forages needs great resources and practices which need more resources that are more applicable in intensive sheep production systems. As the study area is one of the main maize and wheat growing areas, undersowing forage legumes with these crops is a suitable strategy (Daniel, 1996). According to the same source this practice increase both forage production and soil fertility. Growing improved forages on private grazing lands is feasible to increase feed production in the area. Improved forages are better in productivity and nutrient composition than indigenous ones (Alemayehu, 2002). Better utilization of the available impoved forages in the area especially sesbania is essential. Supplementaion of improved forages should be done strategically during feed and nutrient scarcity periods. In addition to forage crops, utilization of better quality locally available household by-products (Atella and food leftover), indigenous fodder trees and agro-industrial by-products are additional alternatives to alleviate the feed scarcity and quality problems.

Those farmers who are remote from veterinary clinics buy drugs from the market and treat their animals themselves. This practice is not advisable as it may produce disease resistant microbes in animal health.

CONCLUSION AND RECOMMENDATIONS

Generally, there are better indigenous sheep breeds in the study area, Horro and Washera. But sheep diseases, feed shortage and lack of adequate veterinary service are the main constraints which decrease sheep productivity and farmers income in the area. The sheep production in the area should be made more market-oriented to make the sheep owners in the area beneficial from sheep production. To bring improvements in sheep production in Burie District, sheep diseases should be studied in detail and better control measures planned and implemented. Disease control measures should be accompanied by better feeding and management of the animals. Those farmers who treat their animals themselves using drugs should be prohibited. Vaccination of animals should be encouraged. Awarenees creation through training on the importance of vaccination and the danger of treating animals by farmers using drugs themselves should be given. To alleviate the veterinary service provision

construction of veterinary clinics in remote areas is essential. In addition, provision of adequate drugs and adequate number of veterinary personnel is also essential.

To control the diseases and make the animals healthy veterinary service provison is not the only opition. As the severity of diseases depend on the standard of flock management and feeding, veterinary inputs should not be given in isolation. Feeding the animals better, cleaning sheep houses daily and making them clean and dry, insulating the roofs of corrugated iron sheet roofed sheep houses may improve the health of the animals and their productivity. On the contrary, it is agrued that veterinary inputs keep more animals alive and aggravate the problem of scarce resources, feed resources. This will result in less productivity of the animals.

Increasing the farmers' awareness of the danger of using drugs themselves to treat animals should be encouraged. Furthermore, controlling those private veterinary clinics who sell drugs to farmers is also important. Generally, construction of new veterinary clinics in remote rural areas is essential. In addition to construction, provison of adequate drugs and veterinary personnel to these clinics is also essential.

Introduction and production of improved forages is essential. But forage development strategies which fit the farming system should be identified and practiced. The socio-economic feasibility of integrating forage legumes with cereal crops in the study area should be studied further.

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