

Full Length Research Paper

Traditional sheep production systems and breeding practice in Wolayita Zone of Southern Ethiopia

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The study was conducted in Wolayita zone of Southern, Nations, Nationalities and People Regional State with the objectives to explain its production systems, breeding practice with major constraints of sheep productivity. Purposive sampling techniques were employed to select target farmers. Structured questionnaire, focused group discussions, secondary data sources and field observations were used to generate the required data. A total of 184 households were selected from four woredas (8 rural kebele) in both weyna-dega and dega agro-ecologies. The survey results revealed that the overall total family size and land holding were 6.4 and 1.1 ha, respectively and the overall mean sheep holding was 5.2 sheep per households. The purpose of keeping sheep was as source of income followed by manure and meat production. The key feed resources in both agro-ecologies were communal grazing and private pastures. Most important causes of sheep mortality in the study were disease and parasite, water and nutritional deficiency, drought and absence of animal clinic. The overall mean value of age at first lambing, lambing interval and twinning rate are 13.5, 7.9 months and 1.5 lambs, respectively. The constraints that delay sheep production in the study area was feed and grazing land shortages disease, drought, labor shortage, water shortage and loss of sheep by predators with index value of 0.30, 0.24, 0.16, 0.15, 0.09 and 0.05, respectively. It was concluded that indigenous sheep had a potential for multipurpose role to generate income for smallholders. Therefore, genetic improvement program should aim at farmers need to cope with trait preference and existing traditional herding and breeding practice.

Key words: Sheep production system, breeding practice, selection criteria, trait preferences.

INTRODUCTION

Sheep are the second most important species of livestock in Ethiopia. The estimated sheep population is about 27.3 million head (CSA, 2015) out of which, 99.9%

of the total sheep population is indigenous breeds (Gizaw et al., 2007). There are 14 traditional populations (Gizaw et al., 2007; Gizaw, 2008); Ethiopia has highly diversified

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indigenous sheep types which are parallel to the diversity in ecology (Galal, 1983), ethnic communities and production systems in the country (Solomon, 2008). Sheep can survive under harsh environments such as feed scarcity, disease challenges and are highly adapted to low-input systems (Markos et al., 2006). They are also considered as living banks for their owners and serve as a means of ready cash income to meet immediate needs such as acquiring agricultural inputs, paying school fees or tuition, taxes, medical bills and purchasing large animals and a reserve against economic and agricultural production hardship or monetary saving and investment in addition to many of other socio-economic and cultural functions (Markos, 2006)

The productivity of sheep as in case of most of the ruminants is markedly low due to several genetic and environmental factors besides the institutional, environmental and infrastructure constraints (Markos, 2006; Kosgey et al., 2007). Therefore, genetic improvement of the indigenous livestock through appropriate techniques or selection and breeding programme is the need of the day especially under such constraints (Yakubu, 2010).

Therefore, assessing the production system, indigenous knowledge of selection, management, identification of breeding goals, describing morphological characters and productivity level of the breed/type in their habitat are prerequisites to set up a genetic improvement program at the smallholder and pastoral levels (Kosgey et al., 2006b).

Wolayita zone is geographically located in Southern Nations, Nationalities and Peoples Regional State (SNNPRs). Even though the study area is rich in livestock resource very little has been done to characterize, identify and document the existing production systems of the zone. The overall objective of this study is, therefore, to describe the performance characteristic of indigenous sheep types and to assess the production system in the study areas.

The objectives of this study were to evaluate reproductive and production performance of Wolayita sheep under traditional management and describe their production system for the establishment of community-based sheep breeding strategy.

MATERIALS AND METHODS

Description of the study areas

The study was conducted in Wolayita zone of Southern Nations, Nationalities and Peoples Regional State (SNNPRS) of Ethiopia which is divided into 12 woredas and 302 rural and 22 urban kebeles. Wolayita zone possesses agroecological zones of 11% of wet highlands, 57% of intermediate wet highlands and 32% of semi-dry lowlands. Altitude in the zone ranges between 1500 and 2500 m.a.s.l. except for some parts where it falls below 1500 m. Mean annual rainfall in the area varies between 800 and 1400 mm. Average temperature varies between 17 to 31°C in the zone (CSA, 2009). According to South agricultural office report (2009), the

study area the livestock population in the study area encompassed 905523 cattle, 220,150 sheep, 112,550 goat, 524.281 poultry, 4,011Horse, 37,527 Donkey and 3,001 Mules. Out of which Sheep account for about 12.18% of the total livestock population.

Sampling techniques

A multi-stage purposive sampling technique was employed for selection of districts and peasant associations for the study. In the first stage, districts known for their sheep populations were identified and followed by identification of potential peasant association and villages. Potentials for sheep production and road accessibility were used as criteria in selecting the sites. Thus, four districts were purposively selected based on sheep population potential and road accessibility. From each districts two peasant associations was selected purposively based on the same criteria. A total of 184 households (23 from each PA and 46 from each district) were purposefully selected based on possession of sheep for interview.

Methods of data collection

Data were generated by administrating a structured questionnaire, organizing group discussion and from secondary data sources. The questionnaires were pre-tested before administration and some re-arrangement, reframing and correcting in accordance with respondent perception were done to get information on:

1. Socio economic characters like sex, age, education level, household size, and livestock possession, economic benefit of sheep and major production constraints;
2. Reproductive performances like age at first lambing interval, litter size (number of lambs born per ewe per lambing) and lambing pattern.
3. Breeding practices like sheep production objectives, selection criteria and castration practices.
4. Feed situation, like major feed sources, supplementation, grazing method and water source
5. Major diseases of sheep in the area
6. Routine husbandry practices like access for sheep extension, housing and so on;

Focused group discussions were held with elderly farmers in the study areas. The group was composed of youngsters, women sheep owners, village leaders and socially respected individuals who are known to have better knowledge on the present and past social and economic status of the area and incorporate local knowledge on sheep breed.

General information of the area, vegetation cover, topography, climate data and population size were obtained from secondary data and district office of agricultural and rural development of wolayita zone.

Data management and analysis

Data collected through questionnaire were entered into Statistical Package for Social Sciences (SPSS for window, 16.0, 2006). Chi-square was employed when required to test the independence of categories or to assess the statistical significance. Indices were calculated to provide ranking of selection criteria and the reasons of keeping sheep; and calculated as Index = Sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) given for an individual reason divided by the sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) for overall reasons. Similar indexes were calculated for ranking selection criteria for breeding females and males, constraints for sheep

Table 1. Demographic characteristics of the sample households in Wolayita zone Ethiopia (Mean \pm SD).

Descriptor	High-land N(92)	Mid-land N(92)	Over all mean N(184)
Family size	5.5 \pm 2.4 ^b	7.3 \pm 2.3 ^a	6.4 \pm 2.5
Sex of household head	Percent	Percent	Over all mean
Male	79.4	94.6	87
Female	20.6	5.4	13
Educational level	Percent	Percent	Over all
Illiterate	35.9	28.3	32.1
Read and write	28.3	28.3	28.3
From 5th-8 th Grade	22.8	27.2	25
Secondary school	13	15	14.1

$P \leq 0.01$, ^{a,b} values with different super scripts differ significantly across rows.

production and sheep diseases.

RESULTS AND DISCUSSION

General household characteristics

The study indicated that the majority (87%) of the families were headed by the males where as 16.7% of the proportion was headed by females (Table 1). Educational status of the respondents did not differ significantly across the studied sites. In contrast to the results of the present study higher proportion of illiterate and those with lower level of education were reported from Southern Ethiopia (Seduce, 2007). Larger family size as was observed, in the mid altitude areas which can be attributed to polygamy practiced in the area. The family size as observed in the study is comparable to the values reported by Seduce and Entries (2011) (Wolayita zone and Dawuro district) as well as Kebebe et al., 2006 (Umbulo-wacha watershed of Sidama). On the other hand, it is lower than the values reported by Endeshaw (2007) (from Dale district of Sidama zone).

The large numbers of breeding ewes in a flock is attributing to higher lamb numbers (as obtained in the present study) across both the agro-ecologies (Table 2). The results obtained in this study are similar to the observations of Zelalem and Fletcher (1991). However, the results further illustrate that there was no significant association between agro ecologies when it came to the numbers of lambs and rams. The results of the present findings were in agreement with the results obtained by Berhanu (1995) in South Western Ethiopia, and higher than the proportion of breeding ewes reported by Solomon et al. (2005) in East Wollega and West Shoa Zones as well as Tsedeke and Endrias (2011) for Wolayita and Dawuro zones.

Purpose of keeping sheep

The reasons for which sheep are reared by the agrarian

society in the studied area are presented in Table 3. The primary reason for rearing sheep in the study area is for generating additional sources of income this is closely followed by rearing them for obtaining manure and as a source of meat, while some of them reported that they rear sheep to meet the cultural and social obligations and only a few reported that sheep are reared for sacrificial rituals. The findings are similar to the observations of Markos (2006), Sisay (2006), Endeshaw (2007), Tsedeke (2007), Getahun (2008) and Belete (2009) from different parts of the country. In contrast to these findings, Kosgey (2004) reported low ranking of small ruminants for breeding purpose among the smallholders and pastoralists in Kenya. Tesfay (2008) also illustrated that the primary reason of keeping Afar sheep breed was for the purpose of milk yield. Different studies addressed the importance of multiple values of indigenous livestock breeds in developing countries under low input system (Kosgey, 2004; Mwacharo and Drucker, 2005; Wurzinger et al., 2006; Zewdu et al., 2008).

Labor division in sheep husbandry and decision making

The results from Table 4 indicated that the various management tasks which were undertaken mainly by the family members and involvement of individuals outside the family is exceptional across the study sites. The results indicate that marketing and breeding is the domain of the senior male family members, the results are similar with the observations of Verbeek et al. (2007) from Kenya. The results also indicated that a majority of the male respondents were involved in the treatment of the sick animals along with providing feed supplements to the flock. Most of the women were engaged in taking care of the sick animals and providing feed supplements to the animals, this may be because most of the women were home makers and stayed at home while the male members had other activities to perform. The younger members of the family were mostly engaged in herding

Table 2. Flock size and structures in the study areas.

Class of sheep	High-land		Mid -land		Over all	
	N	%	N	%	N	%
Lambs	158	34.4	187	37.9	344	34.4
Breeding ewes	236	51.4 ^a	238	48.3 ^b	469	51.4
Breeding rams	65	14.2	68	13.8	129	14.1

$\chi^2 \leq 0.05$, ^{a,b} values with different subscripts differ significantly across rows.

Table 3. Ranked purpose of keeping sheep as indicated by respondents (%).

Production objectives	1st	2 nd	3 rd	4 th	5 th	Index
Income	180	2	0	0	0	0.36
Manure	0	30	75	6	1	0.27
Meat	3	107	40	0	0	0.22
Social and cultural function	0	20	17	74	2	0.11
Sacrifices	0	1	0	26	42	0.04

Index = sum of [5 for rank 1 + 4 for rank 2 + 3 for rank 3+2 for rank 4+1 for rank 5] for particular trait divided by sum of [5 for rank 1 + 4 for rank 2 + 3 for rank 3+2 for rank 4+1 for rank 5] for all traits.

Table 4. Daily activities of the respondents on sheep managements (%).

Responsible bodies	Herding	Marketing	Breeding	Sick animals care	Feeding	χ^2 cal
Males \geq 15 years	75.2	94.8	92.5	88.7	85.7	8.9 *
Female \geq 15 years	58.1	67.7	47.3	90.6	89.5	4.5
Male <15 years	66.7	2.35	11.8	37.7	45.7	9.9
Female <15 years	48.6	-	6.5	30.2	34.3	9.7 *
Hired labor	3.8	-	3.2	-	-	-

* Chi-square significant at, $P < 0.05$.

the animals besides assisting their parents in the day to day livestock husbandry activities. The contribution of the hired labour is negligible in all the activities mentioned. There are both positive and negative aspects of the same, while in one hand engaging children can benefit the family by reducing the burden of hiring an external hand thus helping the resource challenged family but while on the other hand it also leads to higher school dropouts and thus spiraling into the vicious cycle of poverty.

Feed resources and grazing management

The results indicating the feed resources are presented in Figure 1. The results of the study indicate that there were hardly any differences between the two studied agro ecologies. According to the group discussions with the key informants, grazing on, crop residues (maize and sorghum stovers and straws from barley, tef, and wheat),

parts of root and tuber crops (cassava, sweet potato), sugar cane, grains, parts of enset and banana plants, weeds and tillers from crop fields and leaves and browses from local trees are major feed resources in different seasons of the year. Similar results were also reported by Tsegede and Endris (2011) under livestock rearing system in smallholder crop-livestock mixed farming system of Wolayita and Dawuro districts. Reports by Tsegede (2007) and Yeshitila (2007) indicated that farmers use crop fillers and tillers during the wet season in Alaba area of SNNPRS. Feed leftovers, local minerals (bole) and other agro industrial by-products especially from the local beverages are supplemented to improve utilization of crop residues and roughages. After crops are harvested, livestock freely graze on grazing and crop lands and afterwards either they graze (tethered) or under the supervision of herdsman. The results also indicate that most of the respondents, in high-land (44.5, 30.5 and 22.7%) and in mid altitude (44, 32.8 and 21.1%) depend on the grazing

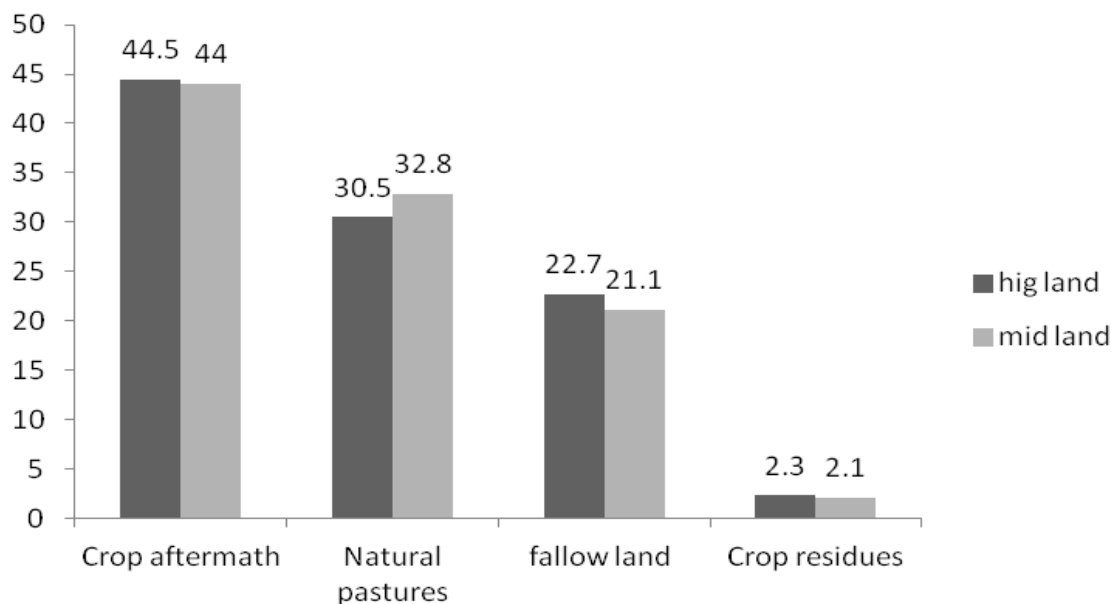


Figure 1. Common feed resources used in the study areas in High-land and mid-land agro-ecologies (%).

Table 5. Average days per week and hours in grazing of sheep (Mean \pm SE).

Items	High-land(n=92)	Mid -land(n=92)	Over all mean(n=184)
Time of grazing of sheep			
days per week	6.45 \pm 0.18	6.90 \pm 0.22	6.50 \pm 0.12
hours per days	6.50 \pm 0.16	6.90 \pm 0.21	6.90 \pm 0.15
Wet season (%)			
Free grazing	9.8	9.8	9.9
Tethered grazing	18.5	18.5	18.5
Herded	71.7	71.7	71.7
Dry season (%)			
Free grazing	37 ^a	32.6 ^b	34.8
Tethered grazing	43.5 ^b	59.8 ^a	51.7
Herded	19.6 ^a	7.6 ^b	13.6

^{a, b} Values across rows differ significantly; χ^2_{cal} , $P < 0.05$.

on crop aftermaths besides grazing the sheep on the natural pasture, fallow land and crop residues respectively. The observations are similar with those of Abule (2003), Teshome (2006), Seduce (2007) and Tesfaye (2008). According to Alemayehu (2003), as the quality and quantity of the forage is not similar the year round, the animals who do not receive the supplementation during the dry period usually lose weight and in some situation may also die. According to the key informants, aftermath is an important source of feed especially for the sheep; the same is available from the dry season till the short rainy season where after their importance declines considerably during the long rainy season.

The results (Table 5) further indicate sheep graze for six days a week and the number of hours was observed to be an average seven hours a day. The results are in agreement with that of Zewdu (2008) and Berhanu (1995) from Adiyo Kaka district and Jimma areas respectively and higher values have been reported by Abebe (1999) from Lallo-Mama district of Central Ethiopia. Management with respect to feeding or grazing was different for dry and rainy or cropping seasons. Tethered, herded and free grazing animals differ significantly ($P < 0.05$) across the two agro-ecological sites within the dry season. While in the rainy season the majority (71.7%) of sheep owners in this study areas herded their animals where as in dry season more than half (59.8%)

Table 6. Reason for tethered feeding of sheep as reported by households (%).

Reasons of tethering	High-land N(92)	Mid-land N(92)	Overall mean N(184)
To avoid crop and vegetation damage	90	93.8	92.7
To save labor	8.3	3.7	6.1
To protect from predators	1.7	2.5	1.3

Table 7. Common water sources of sheep in the study areas (%).

Water sources	High-land(92)	Mid-land (92)	Overall mean N(184)
River	75.0	81.1	78.05
Pond	6.5	6.5	6.5
Rain water	7.6	3.3	5.45
Deep well	10.9	8.7	9.8

Table 8. Watering frequency of sheep in the study areas (%).

Frequencies	High-land N(92)	Mid-land N(92)	Over all mean
Dry season			
Once a day	6.7 ^b	14.6 ^a	10.65
Twice a day	47.2 ^b	50 ^a	48.6
Three times a day	42.6 ^b	65.5 ^a	54.05
Four times a day	3.5 ^a	1.0 ^b	2.25
Wet season			
Once a day	49.9 ^a	22 ^b	35.95
Twice a day	37.5 ^b	60 ^a	48.75
Three times a day	8.8 ^b	10.5 ^a	9.65
Four times a day	3.8 ^b	7.5 ^a	5.65

^{a b} Values across rows differ significantly; χ^2_{cal} P<0.05.

of the farmers practiced tethering (Table 5).

The results in Table 6 indicate the primary reasons for practicing tethering was mainly to avoid crop and vegetation damage, protection against predators and to save labor respectively. Similar finding were observed in densely populated parts of southern Ethiopia by Tsedeke (2007).

Although tethering is labor intensive, most families use unpaid own or family labor. Access to fresh grass was provided by shifting the tethering sites. Systems that did not involve tethering were most often practiced by farmers with large flocks and sufficient grazing and labor. The limitations of tethering with regard to animal performance and grazing land condition warrant further investigations.

One of the most limiting factors in livestock production is availability of regular and clean drinking water. The results indicate that the main source of water in the study areas was from rivers followed by deep well, rain water and ponds (Table 7). The sources of water are similar in

both the agro ecologies while the importance of the same varied between the agro ecologies. Similar result was also reported by Tsedeke and Endries (2011) in Wolayita and Dawro zones while Tesfaye (2008) reported that water was not a limiting factor in small ruminant production in Metama district of Amhara Regional State. However, Abule (1998) reported river was the major water source in mid rift valley area for small ruminants especially for goats.

The results indicating the frequency of watering of the livestock in the two agro ecologies have been presented in Table 8. The results indicated that the frequency of watering varied with the season while two to three times a day watering was common during the dry season when the animals are tethered and feeding on crop residues. The frequency of watering was three times in a day in the midlands which may be attributed to higher temperature when compared to the highland. Moreover as the animals are unable to access water at their will frequent watering is necessary to satisfy their thirst. In the wet season the

Table 9. Types of sheep houses and confined during night for protection (%).

Type of housing	High-land N(92)	Mid -land N (92)	Overall mean (148)
In the family house	58.7	65.2	62.0
Attached to the main family house	10.9	10.9	10.9
Separate constructed house	30.4 ^a	23.9 ^b	27.2
Sheep confined			
Sheep alone	64.1 ^a	46.7 ^b	55.4
Sheep and goat alone	3.3	5.4	4.3
Sheep and other animals' together	25 ^b	46.7 ^a	35.9
Sheep and equines	7.6 ^a	1.1 ^b	4.3

^{a b} Values across columns differ significantly; $\chi^2_{cal} P < 0.05$

Table 10. Average holding of ram in two agro-ecology of the study areas (%).

Ram possession	High-land N(92)	Mid -land N(92)	Overall mean N(148)
Having breeding rams	42.4	41.3	41.8
Sources of breeding rams			
Own	18.5	22.8	20.7
Neighbors	80.4	76.1	78.3
Other sources	1.1	1.1	1.1

frequency of watering is less as the animals are able to obtain water from the vegetation around as they are less dependent on dry fodder.

Housing

The results from Table 9 indicate that most of the farmers keep the sheep within the family houses in both agro ecologies, followed by those who have separate housing for the animals and those who have constructed the sheep houses adjacent to their own. Keeping the animals within the family house may be a way to protect the animals from predators or from theft; however in doing so there is always a severe risk of zoonotic diseases which may affect the humans and animals alike. The result as assessed in the present study show similarity with the findings of Abule (1998), Samuel (2005), Endeshew (2007), Tsedeke (2007) and Zewdu (2008). However, Belete (2009) also reported that sheep and goats are sheltered in most cases in separate houses in Goma district. In these study sites, the number of sheep per households is small, so the farmers may use part of their house for sheep confinement. The results also indicated that in both the agro ecologies sheep are confined with other ruminants followed by those with the equines (in the highlands) and with the goats (in the midlands).

Breeding management

The results of Table 10 indicate that uncontrolled mating

was the common practices of mating in the study area. The study further indicate that a sizable number of farmers rear breeding rams In the absence of the breeding rams the respondents indicated that they borrowed the rams from their neighbors, indicating a high amount of inbreeding within the study area. Matings within the communal grazing area too have been reported by Tesfaye (2008) and Zewdu (2008). According to Kosgey (2004) inbreeding can be minimized by communal herding which allows breeding female from other flock to mix with breeding male of different flocks, early castration of undesired males and rotational use of breeding males.

Selection of parents of the next generation in both the rams and ewes was very common among the sampled farmers. Majority of the farmers reported that they recognize the importance of selection and practiced it to some extent however they had their own criteria for the same. In contrast to the rams, fitness and reproductive traits were more important for ewes. This is because of their belief that survival is more important than fast growth and good appearance of the lambs. Therefore, priority is given to such traits of the ewes that would ensure survival of the lambs. Respondents' index value of the study area is presented in Table 11. The results indicated that irrespective of the agro ecologies the lambing interval was considered to be of prime importance followed by mothering ability, shorter lambing interval prolificacy (twinning) and least priority was given to the coat color. The present observations are similar to those reported by Tesfaye (2008) While Zewdu (2008) indicated that the body size, color and tail formation were

Table 11. Overall ranking (irrespective of agro ecologies) regarding selection criteria for breeding females (%).

Selection criteria	1 st	2 nd	3 rd	4 th	Index
Lambing interval	35	23	76	13	0.44
Mothering ability	40	1	31	5	0.27
Twining	30.7	17	19	7.3	0.26
Coat color	3	0	5	4.6	0.03

Index = sum of [4 for rank 1 + 3 for rank 2 + 2 for rank 3+1 for rank 4] for particular trait divided by sum of [4 for rank 1 + 3 for rank 2 + 2 for rank 3+1 for rank 4] for all traits.

Table 12. Over all ranked selection criteria for breeding rams (%).

Selection criteria	1 st	2 nd	3 rd	4 th	5 th	Index
Appearance or conformation	31	73	11	21	0	0.28
Fast growth	31	19	68	19	2	0.25
Tail size and shape	65	17	6	2	25	0.23
Mating ability	1	24	9	39	48	0.13
Color	0	2	38	25	35	0.11

Index = sum of [5 for rank 1 + 4 for rank 2 + 3 for rank 3+2 for rank 4+1 for rank 5] for particular trait divided by sum of [5 for rank 1 + 4 for rank 2 + 3 for rank 3+2 for rank 4+1 for rank 5] for all traits.

Table 13. Reproductive performances of Wolayita sheep breed (Mean \pm SD).

Parameter	High-land	Mid -land	Over all
Age at first lambing (month)	14.2 \pm 6.2	12.8 \pm 6.3	13.5 \pm 6.3
Lambing interval (month)	8.1 \pm 4.6	7.8 \pm 2.4	7.9 \pm 3.6
Twining rate (percent)	1.5 \pm 0.5 ^b	1.7 \pm 0.6 ^a	1.5 \pm 0.6
Reproductive life span of female (years)	7.04 \pm 1.9	7.8 \pm 2.1	7.4 \pm 2.0
Average marketing age of male(months)	22.9 \pm 14.3 ^a	18.8 \pm 13.7 ^b	20.9 \pm 14.1
Average marketing age of female (months)	22.6 \pm 14.4 ^a	18.5 \pm 13.5 ^b	20.5 \pm 14.1
Age at first service of male (months)	7.1 \pm 2.1	7.1 \pm 2.1	7.11 \pm 2.1
Age at first service of female (months)	8.6 \pm 2.4 ^b	9.2 \pm 2.1 ^a	8.9 \pm 2.2

^{a,b} means with different super scripts differ significantly across rows.

the most highly rated traits in selecting breeding females in Bonga and Horro breeds. Breeding programs should be geared towards functional traits besides adequate management practices should go in line with genetic improvement programs.

The ranking of important traits as perceived by farmers for the breeds in the two agro ecology are summarized in (Table 12). Traits like appearance or body conformation, followed by fast growth, tail size and shape, mating ability while coat color type was the one which was least preferred trait. The results are in agreement with the findings of Jaitner et al. (2001) and Zewdu (2008).

Reproductive performances

Reproductive performances of Wolayita sheep populations

are presented in Table 13. Good reproductive performance is a prerequisite for any successful livestock production program. Previous study suggested that differences exist in reproductive performance between indigenous sheep breeds and their variation allow for the selection of suitable breeds for a given environment (Mukasa- Mugerwa and Lahlou-Kassi, 1995).

Age at first lambing

As indicated in Table 13, the average age at first lambing was higher in ewes reared in the highlands than those in midlands. This may be attributed to colder climate where the animals mature soon in comparison to those reared in relatively warm climate. There was no significant difference for the trait between the ewes reared in the two

Table 14. Overall ranking of sheep disease in Wolayita area.

Disease of sheep	1 st	2 nd	3 rd	4 th	Index
Sheep poxes(<i>Fentata</i>)	61	52	21	31	0.29
Foot and mouth disease	44	45	48	18	0.25
Liver flock	43	47	43	31	0.25
External parasites	34	22	45	62	0.21

Index = sum of [4 for rank 1 + 3for rank 2 + 2 for rank 3+1for rank 4] for particular trait divided by sum of [4 for rank 1 + 3 for rank 2 + 2 for rank 3+1for rank 4] for all traits.

agro ecologies. These findings were comparable to findings of Zewdu (2008) and Solomon (2007) for Bonga and Horro sheep and Gumuz sheep, respectively. The average AFL as observed was shorter than the values reported by Samuel (2005) and Mengiste (2008) for local Sheep in Adaa Liban, and for Washera sheep, respectively.

Lambing interval

The results further highlighted that there was no significant difference for lambing interval values ($p > 0.05$) between the two agro-ecological sites (Table 13). Lambing interval for High-land and Mid-land were; 8.1 and 7.8 months, respectively. The values for the trait was similar to those observed in the Bonga and Horro sheep as reported by Zewdu (2008) and longer than reported for Gumuz sheep by Solomon (2007). However, it is shorter than the values reported by Niftalem (1990) for Menz sheep and Aden (2003) for Dire Dawa sheep. The shortest lambing interval generally occurs in traditional production systems where uncontrolled breeding is the norm. Wilson and Murayi (1988) obtained a longer lambing interval for on-station managed long fat-tailed sheep in Rwanda than most of the intervals reported from African traditional systems where controlled breeding was not practiced.

The results related to the prolificacy rate as observed in the present study indicates that the average rate of twinning was higher in the mid -lands (1.7) than that of the highlands (1.5) which may be attributed to both genetic and environmental factors prevailing in the area. Similar observations had been put forward by Mukasa and Lahlou (1995) and also by Tibbo (2006). There was ($p < 0.05$) difference between the two agro-ecologies regarding this trait. However, similar values for the trait were reported by Solomon (1996) for Horro sheep. Tsedeke (2007) obtained higher values for the trait in Arsi Bale breed of sheep. The average age at first service indicated that the ewes in the highlands had matured ($P < 0.01$) earlier than those of the ewes reared in the midlands which can be attributed to better nutrition and also most probably due to lack of parasitic infestation in the cold arid climate. However, no differences were

observed in the trait for the rams which may not be clearly demarcated as the rams show sexual maturity at an early age especially under the uncontrolled mating system. The age at first service in this study is lower than what was reported by previously by Tesfaye (2008) in Menz and Afar sheep breeds reared by the smallholders and pastoralists. These values are however higher than the observations of Solomon (2007) for Gumuz sheep. The average reproductive life of the ewes in both the agro ecologies did not differ significantly between the agro ecologies, the values as obtained for the trait find similarity with the observations of Zewdu (2009). The average marketing ages of both sexes of sheep and in both the agro ecologies as presented in Table 13, the results indicate that rams and ewes of the mid-land mature ($P < 0.05$) earlier than those in the High-land.

Sheep health and diseases

The results pertaining to the different economically important diseases affecting sheep in the study area are presented in Table 14. The results indicate that the sheep foxes followed by Foot and mouth disease, Liver flock and Ticks, mites and flies are reported to be major external parasites affecting the flock. The weather conditions prevailing in the study area may be the cause of the diseases affecting the external bodies. Incidences of diseases affecting livestock in different parts of the country have also been reported by Berhanu (1995), Abebe (1999), Markos (2000), Markos (2006), Solomon and Gemeda (2000), Tsedeke (2007) and Tsedeke and Entries (2011). Most farmers treat liver fluke using albendazole which is a broad anthelmintic. Animal health expert reported concerns of resistance developed owing to improper utilization of the drug by the farmers.

The majority of the respondents in the studies area have access to veterinary services. However, the services were provided by payment and farmers complain for higher price they pay to treat their sick animals. These observations are similar to those reported by Belete (2009) farmers obtained drugs from government clinics (38%) and from both government and private clinics (52%). Some farmers, however, rely on the ethno veterinary medicines and they use the herbal

Table 15. Over all households rankings of causes of sheep death in Wolayita area (%).

Causes of death	1 st	2 nd	3 rd	4 th	5 th	6 th	Index
Disease and parasite infection	98	54	16	8	0	0	0.29
Water and feed deficiency	66	71	16	0	7	0	0.25
Drought	8	22	47	11	30	45	0.15
Absence of animal clinic	12	13	72	11	1	4	0.14
Lack of adequate trained veterinarian	1	8	6	64	18	9	0.09
Absence of adequate medicines	1	5	18	19	38	22	0.08

Index = sum of [6 for rank 1 + 5 for rank 2 + 4 for rank 3+3 for rank 4+2 for rank 5+1 for rank 6] for particular trait divided by sum of [6 for rank 1 + 5 for rank 2 + 4 for rank 3+3 for rank 4+2 for rank 5+1 for rank 6] for all traits

Table 16. Overall ranking of causes of lamb mortality at pre-weaning period (%).

Causes of mortality	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8th	Index
Dry season	104	11	10	6	2	10	2	19	0.2
Disease and parasite	30	7	54	37	13	2	1	0	0.16
Dystocia and accidents	19	27	19	25	44	5	5	0	0.16
In adequate feeding supply	2	45	49	23	3	5	4	0	0.14
Cold dry season & big rains	18	23	9	15	10	17	27	0	0.11
Short rains & dry season	2	43	4	10	16	19	23	5	0.1
Killed by predators'	3	8	11	28	23	1	4	8	0.07
Wet season	8	7	13	1	6	13	6	37	0.06

Index = sum of [8 for rank 1 + 7 for rank 2 + 6 for rank 3+5 for rank 4+4 for rank 5+3 for rank 6+2 for rank 7+1 for rank 8] for particular trait divided by sum of [8 for rank 1 + 7 for rank 2 + 6 for rank 3+5 for rank 4+4 for rank 5+3 for rank 6+2 for rank 7+1 for rank 8] for all traits.

extract of the plants *Ruta chalepensis* (tenadam), and *Allium sativum* (Garlic) for treating their sheep against liver fluke.

The results pertaining to the cause of mortality in the studied area as indicated in Table 15. The major cause of ovine mortality in the study were characterized by the index value of 0.29, 0.25, 0.15, 0.14, 0.09 and 0.08 were; disease and parasite infection, nutritional deficiency, drought, inadequacy of animal clinic service, lack of skilled man power to deliver proper livestock health services and lack of drugs in the vicinity, respectively. Causes of sheep death were similarity with the findings of Tsedeke and Endrias (2011) in Wolaita and Dawuro districts. The results as obtained in the study related to the farmers using antihelmenthic medicine without proper supervision and also the use of ethno veterinary medicine in treating diseases have also been reported by Aden (2003), Niftalem (1990) and Zewdu (2008). Therefore, for the breeding strategy to be realistic farmers should be encouraged to adopt proper and cost effective disease control measures and appropriate drugs should be available to farmers at the proper time besides strengthening the animal health services.

The results pertaining to causes leading to pre-weaning mortality as observed in the study area has been presented in Table 16. The major causes of death can be attributed to lack of proper nutrition of the dam especially

during the later stages of pregnancy or post parturition (during the dry season) and during which the fast growing fetus derives nutrition from the dam and in absence of the same may lead to dystocia and retained placenta besides low birth weight of the lambs (especially if there are twins) and also mortality in the first few days of birth, the observations find similarity with the findings of Gatenby et al. (1997) and Markos (2006). During the dry season the nutrition of the nursing dam is challenged and this leads to lack of milk to the neonates and hence can lead to mortality of the same. Nutritionally challenged neonates are also weak as their immune levels are generally low and thus are susceptible to various post-partum diseases and parasites. The results as obtained in the study are in consonance with the observations of Gatenby and Humbert (1991) and Ibrahim (1998). However, as there are environmental variations between years and also seasons within years the observations are in consonance with the reports of Gatenby et al. (1997).

The results related to the post weaning mortality (Table 17) as observed in the study are also in line with the observations of the pre-weaning mortality with major causes being attributed to dry season which is followed by lack of feed and fodder and parasites/diseases etc. The weak post weaned lamb would be weak and hence vulnerable to both diseases and parasites as it would not be able to compete with its strong littermates. It would

Table 17. Overall ranking of causes of lamb mortality at post-weaning period (%).

Cause of mortality	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	Index
Dry season	82	12	26	2	14	19	5	5	0.2
Inadequate feeding supply	21	49	54	12	5	2	2	0	0.18
Disease & parasite	39	18	29	52	3	6	0	0	0.17
Short rains & dry season	9	35	14	6	13	30	12	6	0.12
Cold dry season & big rains	13	20	3	21	12	12	23	10	0.1
Miss-mothering & accident	6	8	14	23	38	1	13	8	0.09
Killed by predators	6	11	11	21	25	5	4	10	0.08
Wet season	2	17	5	3	7	10	24	32	0.06

Index = sum of [8 for rank 1 + 7 for rank 2 + 6 for rank 3+5 for rank 4+4 for rank 5+3 for rank 6+2 for rank 7+1 for rank 8] for particular trait divided by sum of [8 for rank 1 + 7 for rank 2 + 6 for rank 3+5 for rank 4+4 for rank 5+3 for rank 6+2 for rank 7+1 for rank 8] for all traits.

Table 18. Overall ranking of major constraints of sheep production (%).

Problems	1 st	2 nd	3 rd	4 th	5 th	6 th	Index
Feed and grazing land shortages	117	41	8	1	1	1	0.3
Disease	42	62	40	11	0	1	0.24
Drought	7	41	27	22	31	15	0.16
Labor shortage	7	16	58	31	17	2	0.15
Water shortage	3	4	23	35	18	17	0.09
Predators	0	2	2	20	16	40	0.05

Index = sum of [6 for rank 1 + 5 for rank 2 + 4 for rank 3+3 for rank 4+2 for rank 5+1 for rank 6] for particular trait divided by sum of [6 for rank 1 + 5 for rank 2 + 4 for rank 3+3 for rank 4+2 for rank 5+1 for rank 6] for all traits.

Table 19. Overall ranking of reported reasons for feeds shortage in the study areas (%).

Reason of feed shortage	1 st	2 nd	3 rd	4 th	5 th	Index
Cultivation settlements and protection Grazing lands	41	30	45	18	9	0.23
Shrinking and decline of productivity	34	35	26	44	1	0.21
Drought	18	41	32	33	31	0.2
Increase of animal population	33	21	28	28	19	0.19
increase of human population	28	20	15	9	68	0.16

Index = sum of [5 for rank 1 + 4 for rank 2+3 for rank 3+2 for rank 4+1 for rank 5] for particular trait divided by [5 for rank 1 + 4 for rank 2+3 for rank 3+2 for rank 4+1 for rank 5] sum of for all traits.

eventually perish due to lack of nutrition, the observations finds consonance with the reports of Solomon et al. (1995), Yohannes et al. (1995), Markos (2000), Solomon and Gameda (2000) and Tsedeke (2007).

Constraints of sheep production

The major constraints in sheep production in the area are given in Table 18. The results indicate that feed and grazing land shortages, disease, drought, labor shortage, water shortage and loss of sheep by predators were major constraints affecting sheep production with index

values of 0.30, 0.24, 0.16, 0.15, 0.09 and 0.05, respectively. These constraints as explained by the respondents are not different from those reported by others researches (Abebe, 1999; Aden, 2003; Mulugeta, 2005, Fekert, 2009).

The overall reasons contributing to the feed shortage are presented in Table 19. The table indicates that the primary reasons for the feed shortage can be narrowed down to two basic factors, the first being influx of agriculture where the earlier grazing land is being used for agrarian activities and thus is leading to overgrazing in the existing land resources thus degrading the same further as the pasture is not getting enough time to

rejuvenate itself. Similar observations have also been reported from various locations within the country (Abule, 2003; Endeshaw, 2007; Getahun, 2008; Kedija, 2007; Teshome, 2006; Tesfaye, 2008, Belete, 2009).

Conclusion

From this study it could be concluded that the general production system and sheep management system in the study areas was characterized by mixed crop-livestock production system. Sheep play an important role in the livelihoods of people in the study area, and they have potential for greater contribution through better health management and genetic improvement. Based on growth and reproductive performance, the present studies demonstrate the detailed understanding of production system in order to design sustainable breeding strategies and management of animal genetic resources. In the study area, there are less frequent watering points, acute shortage of feed resources especially during December to April and high mortality among the lambs during pre-weaning period.

The main feed sources in both agro-ecologies were communal or natural pasture and private pasture grazing. Feed and grazing land shortages, disease, drought, labor shortage, water shortage and loss of sheep by predators were; major constraints affecting sheep production in the study area. Further researches are needed to increase the productivity of sheep in the study area as well as there should be developed alternative strategy to deal with the acute shortage of natural feed resources especially during the dry periods. Reasonably priced and easy techniques for feed conservation and strategic supplementation schemes should be required and made available to the farmers. In line with introduction of improved forages, inventory of the available local feed resources and utilization should be carried out for their efficient utilization and improvement.

CONFLICTS OF INTERESTS

The authors have not declared any conflict of interests.

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