

Survey of Goat Feed Sources and Supplements in Central Rift Valley of Ethiopia

Felekech Lemecha¹, Jamroen Thiengtham², Sayan Tudsri³
and Somkiert Prasanpanich^{2,*}

ABSTRACT

A survey was conducted in three districts of the East Shoa Zone in Fentale, Lume and Adami Tulu Jido Kombolcha (ATJK) districts, with the objective of describing the types and sources of goat feed and supplements. The study was carried out on 180 purposely selected households using a pre-tested structured questionnaire. The results of the analysis showed the presence of significant ($P < 0.05$) differences in the number of goats per household in Fentale (52.3), ATJK (20) and Lume (19.9) districts. Most respondents in Lume and ATJK districts reported communal/private natural pastures, crop stubble, crop residues, local browsing and fodder trees as the main sources of goat feeds. Communal grazing lands, browsing and fodder trees were found to be the dominant feed sources in Fentale district. The study also revealed a declining trend in the size and quality of natural grazing lands mainly due to crop expansion in Lume and ATJK districts and from drought and bush encroachment in Fentale district. The most common feed supplements were crop residues, legume trees, household waste, local brewery byproducts, green grass/hay, mineral soil and agro-industrial byproducts which were proportionately used in ATJK district at 25, 33.3, 8.3, 10, 20 and 3.3%, respectively. The corresponding figures for Lume district were 33.3, 30, 8.3, 3.3, 16.7 and 8.3%, respectively and for Fental district were 5, 58.3, 3.3, 10, 18.3 and 5%, respectively.

Keywords: survey, goats, feed source, supplement, Ethiopia

INTRODUCTION

Ethiopia's goat population is estimated at 22.8 million with about 27% of these found in crop/livestock mixed farming systems in the highlands and mid highlands and the balance are located in the arid and semiarid lowlands of pastoral and agro-pastoral farming systems (Mahammed *et al.*, 2012). The predominant goat production system in Ethiopia is traditional and characterized

by poor nutrition, poor management and a high prevalence of diseases, as goats are left to roam on communal grazing land, crop stubble, fallow lands, roads, riversides and bush areas in the dry season while they are forcibly limited to communal and private grazing lands in the wet season. Therefore, despite the large goat population in the country, productivity per animal unit and the contribution to the national economy is relatively low (Kebreab *et al.*, 2005). Many factors contribute to such low

¹ Oromia Agricultural Research Institute, Addis Ababa, Ethiopia.

² Department of Animal Science, Faculty of Agriculture, Kasetsart University, Bangkok 10900, Thailand.

³ Department of Agronomy, Faculty of Agriculture, Kasetsart University, Bangkok 10900, Thailand.

* Corresponding author, e-mail: agrskp@ku.ac.th

productivity levels, with poor nutrition perhaps the most important. The major animal feed resources in the study area include communal grazing land, crop stubble, roadside and riverside pasture, and crop residues which are very low in quality and quantity; moreover, there is a large fluctuation in their availability which might be considered to have a detrimental effect on animal productivity (Tessema and Ameha, 2003). Therefore, under such constraints, the strategic supplementation of natural-available goat feed with locally available feed supplements will support the animals and help goat producers to sustain reasonable production and productivity with their goats (Tolera *et al.*, 2000). However, the lack of up-date and locally specific information on goat feeding systems, feed supplement utilization and marketing are often major limitations to productivity and production improvement endeavors in goats (Ayele *et al.*, 2003). Therefore, the objective of this study was to assess and describe the major feed sources and feed supplements of goats in three major goat production districts of the Central Rift Valley of Ethiopia.

MATERIALS AND METHODS

Description of the study area

The survey was undertaken in three areas (Adami Tulu Jido Kombolcha [ATJK], Lume and Fentale districts) of the East Shewa Zone, Oromia Regional State, Ethiopia. The selection of districts was based on their proximity, goat population, relative activity in animal fattening, feed production and marketing, and representativeness of the two farming systems (crop/livestock and pastoral/agro-pastoral) and the two agro-ecological zones (semi-arid and arid). ATJK district is located in Oromia region, East Shoa Zone about 167 km south of Addis Ababa, the capital city of Ethiopia. The altitude of this district ranges from 1,500 to 2,000 m above sea level, with a bimodal rainfall pattern, having a main rainy season from June to September and the annual rainfall ranges from

650 to 750 mm (Central Agricultural Census Commission, 2003). Lume district is located about 70 km south of Addis Ababa, where the altitude ranges from 1,500 to 2,300 m above sea level. The district experiences a bimodal rainfall with a long rainy season from June to September and annual rainfall of 850 mm (Central Agricultural Census Commission, 2003). In both districts, the dominant farming system is crop/livestock mixed farming. Fentale district is located on the main road to Dire Dawa town at a distance of 400 km from Addis Ababa. The altitude ranges from 900 to 1,000 m above sea level. Here, the rainfall pattern of the district also follows a bimodal pattern with most rainfall during the main rainy season from July to September and an annual rainfall ranging from 550 to 700 mm (Central Agricultural Census Commission, 2003). Agro-ecologically, this district is categorized in the arid and semi-arid zone. The dominant farming system in this district is pastoral/agro-pastoral where livestock are relied on as the main source of livelihood and relatively large numbers of animal are owned (Alemayehu, 2003).

Sampling procedure

Informal and formal survey tools were used consisting of focus group discussion and sampled household interviews using a structured questionnaire. Accordingly, three *kebeles* (small local administrative units) per district were selected in ATJK, Lume and Fentale districts. Based on the goat flock distribution, *kebeles* were categorized into high, medium and low goat populations proportionally, and one *kebele* was then purposely selected from each level and a total of three *kebeles* per district were selected. Visits were made to the selected *kebeles* and 20 households per *kebele* were purposely selected based on the numbers of goats they owned. Prior to implementation of the survey, a structured questionnaire was framed and pre-tested. Accordingly, discussion using a checklist was held with key informants (leaders, elders, male and female youths) involved in

goat production, feed production, flour milling, oil processing and feed processing plants. The questionnaire was administered to the purposively selected 20 households in each selected *kebele* by enumerators trained for this purpose with close supervision by the principal investigator and a total of 180 sampled households were interviewed. In addition, secondary data were collected from the respective districts offices representing the Livestock Agency, Pastoral Commission, Agriculture and Rural Development, and Trading and Industry.

Data collection

Information on feed resource, types of feed supplement and their utilization were obtained. Furthermore, information on the availability of feed supplements, size of the goat population, flock structure and land holdings were assessed and collected. In addition, the availability of water, early intervention in goat feeding and management and feed production constraints were collected from the secondary sources.

Statistical analysis

The data were analyzed using the SPSS statistical package (SPSS version 17, SPSS Inc.; Chicago, IL, USA). Qualitative data were analyzed using descriptive statistics. Mean comparison were carried out using the Tukey test (Norusis, 2008).

RESULTS AND DISCUSSION

Land holding

The land size allotted to individual farmers by *kebele* according to the land reform declaration of 1975, depended on the family size, fertility of the land, number of *kebele* members and the total land area available within the *kebele* (Getachew *et al.*, 1993). Most farms in Ethiopia are fragmented and the smallholders who make up the crop-livestock mixed farming system are interdependent and consequently, the increasing human population coupled with diminishing

land resources and increasing urbanization are creating a growing number of landless people who are responsible for their own subsistence (Kebreab *et al.*, 2005). The average land holding per household across the study sites was 5.01 ha which just exceeds the range of national holdings of 2.01 to 5.00 ha for 32.6% of smallholder farmers in the country, and is within the range from 0.1 to 5.1 ha for about 42% of farmers in the Mid Rift Valley and for 33% of farmers at the national level (Central Agricultural Census Commission, 2003; Yeshitila, 2008). The total land holding was higher in ATJK district (4.69 ha) than in Lume (4.60 ha) with holdings being managed under the crop/livestock mixed farming system, while the majority of the land was commonly owned in Fentale district under the pastoral/agro-pastoral farming system (Table 1). The amount of total land is an important determinant of the availability of feed for grazing which comprises the major source of livestock nutrition in the Mid Rift Valley of Ethiopia (Deribe, 2009). Land allocated for different purposes including pasture was significantly ($P < 0.05$) higher in Fentale district than in ATJK and Lume districts. This indicates that grazing land is relatively more available under the pastoral/agro-pastoral farming system where an average of 0.1 ha or 4.5% of the land is covered with vegetation (Yeshitila *et al.*, 2008). In Lume and ATJK districts, approximately 69.35 and 52.24%, respectively, of the total land was allotted for crop production, implying that the majority of land is used for crop production and there is further encroachment into the grazing lands. Traditional grazing and grass hay making occurred every year on a contractual or rental basis. The area of land contracted or rented for crop farming and livestock grazing was smaller than the area owned by each household.

Goat holdings

The goat holdings in the study districts are described in Table 2. About 95% of the respondents in Fentale district possessed goats.

The number of goats reared per household in Fentale district was significantly higher ($P < 0.05$) than those in ATJK and Lume districts. The higher number of goats in Fentale district could be attributed to better adaptation, relatively adequate grazing land and the dependence of the pastoral system on livestock. The mean household holding of goats was 27.4 head which was much higher than in previous reports (FARM Africa, 1996; Workneh, 2000; Tsedeke, 2007) possibly due to the differences in the farming systems including the pastoral/agro-pastoral system of Fentale district where a large population of goats is raised.

The flock structure of all three districts comprised approximately 21, 18, 14, 36, 4 and 4% of kids, young female, young male, does, breeding male, castrated and fattening goats, respectively. Based on sex this amounted to approximately 63% females and 32% males which is very close to the

national flock composition of 68.84% females and 30.16% males (Central Statistical Agency, 2008) with the balance in both sets of data consisting of very mature animals of both sexes.

Types of feed supplements and utilization

Animal feed supplements were widely utilized by the smallholders in the study area to cope with the critical feed shortage from grazing/ browsing on natural communal and private grazing lands. The supplements were mainly crop residues such as wheat, tef (*Ergrostis abyssinica*) and pulse straw and maize/sorghum stover. In addition, legume trees, green grass/hay, house wastes, local alcohol byproduct and mineral soils were also used while industrial byproduct utilization by smallholders was very limited due to their low accessibility and the escalating price of these products (Table 3).

Table 1 Size of land holding and land use systems of households in three sampled districts.

Type of land	ATJK (ha)	Lume (ha)	Fentale (ha)	P-value
Crop	2.45	3.19	0.85	0.0001
Pasture	0.41	0.17	4.78	0.0001
Grazing	0.45	0.14	0.08	0.0001
Back yard	0.32	0.28	0.24	0.0301
Rent land for crop	1.04	0.79	0.01	0.0001
Rent land for grazing	0.02	0.03	0.01	0.6000

ATJK = Adami Tulu Jido Kombolcha.

Table 2 Goat holdings and flock structure of sampled households

Type of goat	ATJK	Lume	Fentale	SD	Confidence interval
Total goats	20	19.93	52.29	1.83	27.07 – 34.29
Kids	4.54	4.83	10.31	5.50	5.74 – 7.36
Young female	2.92	3.28	10.71	6.65	4.64 – 6.61
Young male	2.58	2.83	7.53	5.33	3.49 – 5.12
Does	6.25	6.13	20.53	11.39	9.23 – 12.63
Intact male	1.15	1.08	1.56	0.78	1.15 – 1.38
Castrated male	1.42	1.18	1.34	0.66	1.22 – 1.41
Fattened male	1.15	1.07	1.12	0.33	1.06 – 1.16

ATJK = Adami Tulu Jido Kombolcha.

Table 3 Feed supplement utilization of sampled households by district

Type feed supplement	ATJK		Lume		Fentale	
	Frequency	%	Frequency	%	Frequency	%
Crop residues	15	25	20	33.3	3	5
Legume trees	20	33.3	18	30	35	58.3
House wastes & local breweries byproducts	5	8.3	5	8.3	2	3.3
Green grass/hay	6	10	2	3.33	6	10
Mineral soils	12	20	10	16.7	11	18.3
Industrial byproducts	2	3.3	5	8.3	3	5
Total	60	100	60	100	60	100

ATJK = Adami Tulu Jido Kombolcha.

Crop residues

The proportions of respondent households who supplemented their goats with crop residues were 25, 33.3 and 5% for ATJK, Lume and Fentale districts, respectively. Furthermore, crop residues formed a larger proportion of the feed supplements available during the dry season than during the wet season as the green grass/hay offered during the wet season in most cases was reduced by half in the dry season. Moreover, most of the respondents reported that they deliberately underfed their goats during the dry season as one component of their strategy to cope with the feed shortage. However, if goats were not supplemented during the dry period, Alemayehu (2003) reported that the gain goats made in the wet season was then totally or partially lost in the dry season.

Legume trees, mineral soil and salt licks

Various trees and herbaceous and shrubby legumes of both local and exotic origins were being used as feed supplements for goats. The proportions of respondents using legume trees as supplements were 25, 30 and 58.3% for ATJK, Lume and Fentale districts, respectively. Tree legumes are used as potential feed supplements by smallholder farmers in the tropics due to their high crude protein content and degradability (Melaku *et al.*, 2003). However, about 90% of the respondents reported that important browsing species which were used as dry season forage had been wiped out

by the supply of materials for fuel and construction in urban areas. This is inconsistent with Banerjee *et al.*, (2000) who reported degradation of grazing land due to the expansion of cultivation, overgrazing and deforestation of woodland. In addition, a naturally obtained mineral soil locally known as '*bole*' was used as a supplement by smallholder farmers in the study area. The proportions of respondent households providing *bole* as a supplement for goats were 28.33, 16.66 and 18.66% for ATJK, Lume and Fentale districts, respectively. Furthermore, smallholders in ATJK district had better access because of the large amount of *bole* soil in the district which is commercially sold and used as a source of mineral soil by other neighboring districts. *Bole* mineral soil is rich in sodium but low in phosphorous and suggestions should be made on how to correct the phosphorus levels when it is fed in dry season supplemental diets based on crop residues and dry pastures (Adugna and Said, 1992).

Green grass, green maize stover and hay

The proportions of sampled households using these feed resources were 10, 3.3 and 10% in ATJK, Lume and Fentale districts, respectively. They were harvested from roadsides, irrigation areas, forest reserves, river banks and other public land for supplementing feed supplies as part of the strategy to cope with feed shortages.

House wastes, local alcohol byproducts and agro-industrial byproducts

House wastes and local alcohol byproducts known as 'areke', 'tela' and 'atela' were commonly used in ATJK, Lume and Fentale districts as supplements for goats by 8.3, 8.3 and 3.3% of respondents in those districts, respectively. On the other hand, 3.3, 8.3, and 5% of respondents in ATJK, Lume and Fentale districts, respectively, were providing agro-industrial byproducts as supplements to their goats during the dry season and drought periods to mitigate feed shortage but there was limited availability and accessibility to these resources by the smallholders.

Watering

The major sources of water for goats in the study area were lakes, rivers, ponds and pipe water. Furthermore, the shortage of water during the dry season was a critical problem in Lume and ATJK districts while in Fentale district, the shortage was a more critical constraint in both the dry season and during the frequently occurring droughts. The largest number of respondents to the questions on water (35, 43.3 and 40% in ATJK, Lume and Fentale districts, respectively) provided water to their goats in more than 4 d intervals. This was in agreement with Tsedeke (2007) and Deribe (2009) who reported an interval of 3–5 d for southern Ethiopia and the distance to access the water source was very far and the required time for fetching and returning with the water was about five hours. Different studies (Hadjigeorgioua *et al.*, 2000; Deribe, 2009) reported that due to the relationship between the water intake and the consumption of roughage, particularly during the dry season, the restricted availability of water may result in poor nutrition intake and digestion.

DISCUSSION

The mean household holding of goats was 31.17 head which was much higher than in earlier reports (FARM Africa, 1996; Workneh,

2000; Tsedeke, 2007). The reason was possibly due to the differences in the pastoral/agro-pastoral farming systems of Fentale district where large populations of goats are raised. The major feed resources for goats in the study area were natural communal/private pasture, crop stubble, local fodder trees, shrubs and browsing. A marked seasonal fluctuation in the quality and quantity of feed supply and the critical problem of feed shortage during the dry season and drought periods was observed in the study area. This was in agreement with the reports of Seyoum and Sileshi (1995), Tessema and Ameha (2003) and Yeshitila (2008) for the central highlands and southern part of the country. Smallholder households practiced feed supplementation for their goats as one coping strategy to alleviate the critical feed shortage. The major feed supplements identified were mainly crop residues such as tef, wheat and legume straws and maize/sorghum stover. This was consistent with the findings of Tessema and Ameha (2003) and Solomon *et al.* (2008) who reported that a large proportion of respondent households in the highlands and mid highlands practicing a crop/livestock mixed farming system fed their goats with crop residues and indicated that crop residues were becoming more important due to the steady conversion of grazing lands into cropping lands. Moreover, fodder trees, browsing and shrubs, green grass/hay, house wastes, mineral soils, local alcohol byproducts and agro-industrial byproducts, such as oil seeds and wheat bran, were also other essential feed supplements used in the study area. This was in agreement with the report of Yeshitila (2008) in southern Ethiopia and with Tolera (2007) and Belete (2009) in central and western Ethiopia.

CONCLUSION

The major feed supplements for goats were mainly straws, fodder trees (pods, leaves and twigs), cut grass/hay, mineral soils, house wastes and very limited amounts of agro-

industrial byproducts. However, the dominant feed supplement was crop residues which were seasonal in their availability and along with the other supplements (excepting agro-industrial byproducts), their nutrient composition declined as the dry season was prolonged. These constraints contributed to the increasing stress caused by the scarcity of goat feed in the study area and consequently contributed to the low productivity of the goats. Therefore, increasing the efficiency of the utilization of crop residues using feed technology improvement technologies, promoting local resource-based feed supplements and improving feeding and feed supplement management are paramount to solve the feed shortage problem in the study area.

ACKNOWLEDGMENT

The authors would like to thank the Rural Capacity Building Project of the Ministry of Agriculture of Ethiopia for funding the study as well as acknowledging the farmers and pastoralist households who shared their indigenous knowledge of goat management practices in their respective districts.

LITERATURE CITED

- Adugna, T. and A.N Said. 1992. Prospects for integrating food and feed production of Wolayita Sodo, Ethiopia, pp. 309–318. *In* J.E.S. Stares, A.N. Said and J.A. Kategile, (eds.). **The Complementarity of Feed Resources for Animal Production in Africa: Proceedings of the Joint Feed Resources Networks Workshop Held in Gabrone, Botswana.** 4–8 March 1991. African Feeds Research Network. Addis Ababa, Ethiopia.
- Alemayehu, M. 2003. **Country Pasture/Forage Resource Profiles: Ethiopia.** Research and Extension, FAO. Rome, Italy. 36 pp.
- Ayele, S., W. Assegid, M.A. Jabbar, M.M. Ahmed and B. Hurissa. 2003. **Livestock Marketing in Ethiopia: A Review of Structure, Performance and Development Initiatives. Socio-Economics and Policy Research Working Paper 52.** International Livestock Research Institute. Nairobi, Kenya. 35 pp.
- Banerjee, A.K., G. Anmu and E. Ermias. 2000. Selection and breeding strategies for increased productivity of goats in Ethiopia, pp. 70–79. *In* R.C. Merkel, G. Abebe and A.L. Goetsch, (eds.). **Proceedings of a Conference on the Opportunities and Challenges of Enhancing Goat Production in East Africa.** 10–12 November 2000. Institute for Goat Research. Langston University, OK, USA.
- Belete, S. 2009. **Production and Marketing Systems of Small Ruminants in Goma District of Jimma Zone, Western Ethiopia.** MSc. thesis. Hawassa University, Awassa, Ethiopia.
- Central Statistical Agency. 2008. **Agricultural Sample Survey 2006/07 Volume II: Report on Livestock and Livestock Characteristics (Private Peasant Holdings).** Central Statistical Agency of Federal Democratic Republic of Ethiopia. Addis Ababa, Ethiopia. 183 pp.
- Central Agricultural Census Commission. 2003. **Ethiopian Agricultural Sample Enumeration 2001/02 Results at Country Level: Statistical Report on Farm Management Practices, Livestock and Farm implements. Part II.** Artistic Publishing Press. Addis Ababa, Ethiopia. 350 pp.
- Deribe, G. 2009. **On-Farm Performance Evaluation of Indigenous Sheep and Goats in Alaba, Southern Ethiopia.** MSc. thesis. Hawassa University, Awassa, Ethiopia.
- FARM Africa. 1996. **Goat Types of Ethiopia and Eritrea, Physical Description and Management Systems.** International Livestock Research Institute. Nairobi, Kenya. 76 pp.
- Getachew, A., B. Hailu, N. Werkneh and A.

- Gezahegn. 1993. A survey of farming systems of vertisol areas of the Ethiopian highlands, pp. 29–49. *In* M. Tekalign, A. Abiye, K.L. Srivastara and D. Asgelil, (eds.). **Improved Management of Vertisols for Sustainable Crop-Livestock Production in the Ethiopian Highlands: Synthesis Report 1986-92**. Technical Committee of the Joint Vertisol Project. Addis Ababa, Ethiopia. 360pp.
- Hadjigeorgioua, I., K. Dardamanib, C. Goulasb and G. Zervasb. 2000. The effect of water availability on feed intake and digestion in sheep. **Small Rum. Res.** 37: 147–150.
- Kebreab, E., T. Smith, J. Tanner and P. Osuji. 2005. Review of under nutrition in smallholder ruminant production system in the tropics, pp. 3–95. *In* ILRI, (eds.). **Coping with Feed Scarcity in Smallholder Livestock Systems in Developing Countries**. International Livestock Research Institute. Nairobi, Kenya.
- Mahammed, B., A. Haile, H. Dadi and T.T Alemu. 2012. **Estimation of Genetic and Phenotypic Parameters for Milk Traits in Arsi Bale Goats in Ethiopia**. [Available from: <http://www.lrrd.org/lrrd24/6/bedh24098>]. [Sourced: 7 August 2013].
- Melaku, S., K.J. Peters, A. Tegegne. 2003. *In vitro* and *in situ* evaluation of selected multipurpose trees, wheat bran and *Lablab purpureus* as potential feed supplements to tef (*Eragrostis abyssinica*) straw. **Animal Feed. Sci. Technol.** 108: 159–179.
- Norusis, M.J. 2008. **SPSS Statistics 17.0: Statistical Procedure Companion**. Prentice Hall. Harvard, MA, USA.
- Seyoum, B. and Z. Sileshi. 1995. Chemical composition in-vitro digestibility and energy values of Ethiopian feedstuff, pp. 307–311. *In* ILRI, (eds.). **Third National Conference of Ethiopian Society of Animal Production (ESAP)**. 27–28 April 1997. Addis Ababa, Ethiopia.
- Solomon, B., M. Solomon and Y. Alemu. 2008. Potential use of crop residues as livestock feed resources under smallholder farmers condition in bale highlands of Ethiopia. **J. Trop. Subtrop. Agroecosyst.** 8: 107–114.
- Tessema, A and S. Ameha. 2003. Assessment of the livestock production system, available feed resource and marketing situation in Belesa Woreda: A case study in drought prone of Amahara region, pp. 165–175. *In* ESAP, (eds.). **Proceedings of the 10th Annual Conference of the Ethiopian Society of Animal Production**. 22–24 August 2003. Addis Ababa, Ethiopia.
- Tolera, A. 2007. The role of forage supplementation in smallholder mixed farming systems, pp. 165–186. *In* M.D Hare and K.Wongpichet, (eds.). **Forages: A Pathway to Prosperity for Smallholder Farmer. Proceedings of International Forage Symposiums**. Faculty of Agriculture. Ubon Ratchathani University, Ubon Ratchathani, Thailand.
- Tolera A., R.C. Merkel, A.L. Goetsch, T. Sahlu and T.Negesse. 2000. Nutritional constraints and future prospects for goat production in East Africa, pp. 43–57. *In* R.C. Merkel, G. Abebe and A.L., Goetsch, (eds.). **Proceedings of a Conference on the Opportunities and Challenges of Enhancing Goat Production in East Africa**. 10–12 November 2000. Institute for Goat Research. Langston University, OK, USA.
- Tsedeker, K. 2007. **Production and Marketing Systems of Sheep and Goats in Alaba, Southern Ethiopia**. MSc. thesis. University of Hawassa. Awassa, Ethiopia.
- Workneh A. 2000. **Do Smallholder Farmers Benefit more from Crossbred (Somali x Anglo-Nubian) than from Indigenous Goats?** PhD. thesis. Georg-August University of Göttingen. Göttingen, Germany.
- Yeshitila, A. 2008. **Efficiency of Livestock Feed Resources Utilization and Forage Development in Alaba Woreda, Southern Ethiopia**. MSc. thesis. Haramaya University. Dire Dawa, Ethiopia.