Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.8, No.3, 2018


# Factors affecting sheep and goat flock dynamics and off-take under resource-poor smallholder management systems, southern Ethiopia

D.G. Talore[1#], Girma Abebe[2], Azage Tegegne[3], B.S. Gemeda[4]
1# P.O.Box 79, SARI, Areka Agricultural Research Center, Areka, Ethiopia
[2]Animal Breeder, Hawassa University, Hawassa, Ethiopia
[3] Principal Scientist, International Livestock Research Institute, ILRI, Addis Ababa, Ethiopia
[4]Senior Researcher, Adami Tulu Agricultural Research Center, Ziway, Ethiopia

**Abstract**
The flock dynamics and offtake of sheep and goats in three flock density group (sheep dominant site, SDS; goat dominant, GDS and mixed flock, MFS) were determined at Halaba district. Thirty, 15 and 15 randomly selected sheep, goat, and sheep and goat owning households were selected and monitored for 12-months from SDS, GDS and MFS, respectively. Birth, purchase and shareholding constituted 90.3, 6.5 and 2.18% as major entry routes, respectively, while sale, death and home slaughter constituted 52.9, 15.1, 12.7% as major exits, respectively. The overall offtake rate was 41.2% in sheep and 30.4% in goat's flocks. Generally, entry, exits and offtake rate was higher in the SDS. Flock density group, family and farm size, literacy level and animal number were shown to be affecting offtake rate and flock dynamics. There was clear supply, demand and price variations across seasons. Higher exits through sale during cropping season imply the significance of small ruminants in providing immediate cash income for resource-poor farmers. Improving market value-chain, technical backups and policy integration would help resource-poor farmers to exploit these indigenous and adaptable sheep and goat resources efficiently.
**Keywords**: binary logit; entry; exits; flock; offtake; smallholder; southern Ethiopia

## Introduction

Ethiopia is endowed with a large number (48.8 million) of goat and sheep with 18-19 breeds/types for sheep and 14 breeds/types for goats (Tesfaye, 2004; Gizew *et al.*, 2011; CSA, 2012), found in diversified ecology in the country. Small ruminants are an integral part of crop-livestock mixed faming systems of southern Ethiopia. Halaba sheep are categorized under Adilo type (Gizew *et al.*, 2011) while goats categorized under Arsi-bale populations (Tesfaye, 2004). Halaba sheep and goats is mainly kept by smallholder farmers, and the majority (98.5%) is of indigenous type. In this system, small ruminants play a significant role in socio-economic and socio-cultural benefits for the resource-poor households (Lebbie, 2004) and national economy (Kocho *et al.*, 2011). According to Issac and Titilayo (2012), small ruminants provide the easiest and most readily accessible source of credit available to meet immediate social and financial obligations.

In the mixed farming systems, sheep and goats are kept under traditional free roaming management, year-round breeding, with minimal inputs (Kocho *et al.*, 2011), under diverse local production objectives (Kebede *et al.*, 2012; Abera *et al.*, 2014; Deribe *et al.,* 2014). From his comprehensive survey, Kocho *et al* (2011) reported significant contribution of small ruminants to the household income and foreign currency. However, human population and consumption behavior has been changing considerably in Ethiopia due to the overall economic growth in the country.

Despite this fact, little has been documented on small ruminant's contribution to household income, offtake rate, reasons of exits and entries at producer's level. Moreover, as farming system has been undergoing changes, factors determining the current offtake rate and flock dynamics of the district is not known. Hence, the objective of this study was to assess flock dynamics and offtake rate through on-farm monitoring of the events in Halaba district.

## Materials and methods

### The study site

Halaba district is situated at South Nation, Nationalities and peoples region (SNNPR), 310 kms South of Addis Ababa. It is located at 7 17' N latitude and 38° 06' E longitude. Altitude of the district ranges from 1554 to 2149 meters above sea level (m. a.s.l) with the majority found at about 1800 m a.s.l. The annual rainfall varies between 857 to 1085mm and is in a bimodal pattern with light rains between March and April and heavy rains from July to October. There are three distinct seasons; dry (November to February), light rainy (March to June) and heavy rainy (July to October). The annual mean temperature varies from 17° C to 20° C with a mean of 18° c (IPMS, 2005).

 

**Sampling procedure and data collection**

This study was conducted at three flock density sites and the respective villages of Halaba district. A multistage stratified sampling technique was employed to select the participants, based on the size of land holding and sheep and goat density. In each site, adjacent villages were selected from sheep and goat keeping villages that have dry road accessibility. In addition, having at least three does and/or ewes per household was the criteria for household selection. A total of 60 households were selected; from which 30, 15, and 15 households were selected from sheep dominant site (SDS), mixed flock site (MFS) and goat dominant site (GDS), respectively. We took large number of households from SDS to include sufficient number of animals to be monitored due to small flock size in the SDS. Other site grouping criteria has been described by Kocho *et al* (2011) and Deribe *et al* (2014). All animals in the households were ear tagged for identification and all additions were also immediately tagged. Farmers had complete freedom to dispose or acquire animals as they saw fit. At the start of the study, animal age was determined by dentition, backed up by farmer's recall of animals born in the flocks. Animal numbers, entries and exits from the flocks, reasons for changes, and animal weights were recorded. Entries were recorded as births, purchases, shareholding, and other reasons such as loans to the farmer. Exits recorded as sales, deaths, shareholding, gifts out, slaughter for festivals and ceremonies, and other reasons such as thefts, and losses due to mechanical injuries.

**Data analysis**

Descriptive statistics was used to describe households and socioeconomic parameters (SPSS, 2013 ver 22.0). To determine effects of age of the head of the household, literacy, family size, farm size and animal number in terms of Tropical Livestock Units (TLUs) on flock dynamics, logistic regression was employed using the PROC GENMOD of the Statistical Analysis System (SAS, 2008). The literacy of the household head was considered as a binary variable, where 0 was assigned for those who could not read or write and 1 for the others. Family size which might affect the household livelihood strategy through labor supply or competition for resources was also considered. Farm size (ha) and animal number of the household was included as a measure of resource endowment.

The logit model is:

$Log\ (p\ i/1-p\ i) = \beta 0 + \beta 1a + \beta 2e + \beta 3h + \beta 4f + \beta 5n$

where, $p$=the probability that a household acquires or disposes sheep or goat,

$\beta 0, \beta 1, \beta 2, \beta 3, \beta 4$ *and* $\beta 5$ =regression coefficients

$a$=age of the household head

$e$=educational level in terms of literacy of the household head

$h$=household size

$f$=farm size and

$n$=Animal (sheep and goat) number

**Results and discussion**

**General characteristics**

Only seven of 60 household heads were females, with an average age of 45.9 years (range: 27–75). Regarding religion, majority (98.3%) of the households were Muslims. Mean family size was 6.4 (range: 1-16). From the monitored households, 18.33% were able to read and write, of which about 73% were from the SDS. Land and livestock demonstrated great variations across the flock density groups (Figure 1). Generally a bigger land and grazing lands were found in the GDS. The bigger land size and availability of browses was a reason for the higher ($P$<0.0001) number of goats in the GDS than other sites. Although the number of sheep in the SDS appeared to be higher by 62% and 43% compared to the GDS and MFS, statistically it was non-significant ($P$>0.05).

**Approximate position for Figure 1**

**Flock dynamics**

The mean flock size of sheep and goats was 6.1 and 4.5, respectively, (ranges from 2-19 sheep and 1-26 goats) (Table 1 and 2). Our finding showed that there was high coming into and going out from the flock in the area, particularly at early ages, which agrees with reports of Deribe *et al* (2014). Birth (90.3%), purchase (6.54%), shareholding (2.18%) and gifts back (0.94%) were the major entry routes (Table 1). The higher number of entries through birth found in our study agrees with previous studies (Legesse *et al.,* 2008; Kocho *et al.*, 2011). The total entries through home born (90.3%) was consistent with reports of CSA (2012), but higher than other reports (Kocho *et al.*, 2011). Shareholding is an important way of building flock by the resource-poor farmers. The community self-help through shareholding has been reported previously as a tool of initial flock establishment (Kocho *et al.,* 2011). In our study, at these particular sites, though there was a general flock declining trend (total entries minus total exit) at a rate of about 3.12%, the overall flock condition was nearly

 

stable.

Sale, mortality, slaughter, shareholding, gifts out and predators were the major exit routes in the small ruminant flocks (Table 2). Sell for income generation accounted more than half (52.9%) of the exits followed by home slaughtering (15.1%) for public holidays and religious festivals. The higher exit through sale is mainly attributed to the need of income among the households for purchasing agricultural inputs and household expenditures. Similar to our results, Legesse *et al* (2008) reported tight complementarities between crop and livestock production in the nearby district. The general higher exit through sale, compared to previous reports (Kocho *et al.,* 2011), is attributed to the emerging market opportunities in the area in the last five years.

Diseases (12.9%) and bloat/sudden deaths due to concentrate and forage bloats, and digestive disorders (4.53%) were reported to be a major cause of mortalities among sheep and goat flocks (Tables 3). The higher death was found in GDS, due to far distances from the veterinary services. Predation accounted for a total of 5.13% animal losses in the MFS. This is perhaps partly related to the topography of the area (gullies, ups and downs and gorges) that favor predators in the MFS. Smallholder farmers usually keep their animals housed at night to protect them from predation, which agrees with reports of Shenkute *et al* (2014). Similar to our results, higher losses (17.5%) through predation have been reported (Mapliyao *et al.*, 2012). Libbie (2004) reported higher exits (30%) through death under traditional management in Swaziland. Exits through death by either feed scarcity and/or plant poisoning have also been reported for Kombolcha and Halaba goats (Workneh, 2003; Desta and Oba, 2004; Kocho *et al.*, 2011) and elsewhere in Africa (Wilson and Ole, 1989; Mapliyao *et al.*, 2012).

**Table 1** Major sheep and goat entry routes and proportions (%) in the village flocks of Halaba district, southern Ethiopia (N= 60 households, n=number of entries)

| Entry routes | SDS | | | | GDS | | | | MFS | | | | Overall | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sheep | | Goats | | Sheep | | Goats | | Sheep | | Goats | | | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| Births | 101 | 82.1 | 22 | 84.6 | 34 | 85.0 | 55 | 90.2 | 71 | 97.3 | 7 | 87.5 | 290 | 90.34 |
| Purchase | 8 | 6.5 | 4 | 15.4 | 4 | 10.0 | 4 | 6.6 | 1 | 1.4 | 0 | 0 | 21 | 6.54 |
| Share holding[♣] | 3 | 2.5 | 0 | 0 | 1 | 2.5 | 2 | 3.3 | 0 | 0 | 1 | 12.5 | 7 | 2.18 |
| Gifts/inheritance | 1 | 0.8 | 0 | 0 | 1 | 2.5 | 0 | 0 | 1 | 1.4 | 0 | 0 | 3 | 0.94 |
| Total | 123 | 100 | 26 | 100 | 40 | 100 | 61 | 100 | 73 | 100 | 8 | 100 | 321 | 100 |

[♣]Shareholding means that flock owners with excess doe or ewe (dam) give for care taker (resource-poor farmers) for sharing the offspring's

**Table 2** Major sheep and goats exit routes and proportions (%) in the village flocks of Halaba district, southern Ethiopia (N=60 households, n=number of exits)

| Exit routes | Flock density group: Sheep dominant site | | | | Goat dominant site | | | | Mixed Flock site | | | | Overall | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sheep | | Goats | | Sheep | | Goats | | Sheep | | Goats | | | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| Sale | 70 | 54.7 | 18 | 56.3 | 22 | 56.4 | 30 | 54.5 | 20 | 42.6 | 15 | 50.0 | 175 | 52.87 |
| Home slaughter | 20 | 15.6 | 5 | 15.6 | 8 | 20.5 | 6 | 10.9 | 6 | 12.8 | 5 | 10.0 | 50 | 15.11 |
| Death (diseases) | 17 | 13.3 | 2 | 6.3 | 6 | 15.4 | 5 | 9.1 | 6 | 12.8 | 6 | 12.0 | 42 | 12.69 |
| Share holding | 11 | 8.6 | 6 | 18.7 | 0 | - | 0 | - | 1 | 2.1 | 0 | - | 18 | 5.44 |
| Predator | 2 | 1.6 | 0 | - | 0 | - | 3 | 5.4 | 10 | 21.3 | 2 | 4.0 | 17 | 5.13 |
| Bloat/sudden death[§] | 5 | 3.9 | 1 | 3.1 | 3 | 7.7 | 4 | 7.3 | 2 | 4.2 | 1 | 2.0 | 15 | 4.53 |
| Others[§§] | 3 | 2.3 | 0 | - | 0 | - | 3 | 5.4 | 2 | 4.2 | 1 | 2.0 | 10 | 3.02 |
| Poisonous plants | - | | - | - | - | - | 4 | 7.3 | - | - | - | - | 4 | 1.21 |
| Total | 128 | 100 | 32 | 100 | 39 | 100 | 55 | 100 | 47 | 100 | 30 | 100 | 331 | 100 |

[§]indicates death due to acidosis, sudden death due to concentrate and forage bloats, [§§]Transferring for risk aversion, mechanical damage, weak births and thefts

**Offtake rate**

The overall offtake rate of sheep and goats was 41.8 and 30.4%, respectively (Table 3). Generally, the offtake rate of sheep was found to be higher. The higher offtake rate in a sheep sub-system (SDS) is due to the proximity of the area to the emerging market, Adilo. In this system, there was also high rate of flock dynamism, resulting in the sale of animals at early ages. These results confirm reports of other studies (Legesse *et al.,* 2008; Kocho *et al.*, 2011) in the nearby districts. About 25.1% sale and 7.8% slaughters reported from traditional sheep production in the highlands of Ethiopia (Workneh *et al.*, 2003), was lower than the current results. Libbie (2004) reported 60% offtake through home slaughtering and 33% through commercial sales in the traditional management conditions. On the contrary, only 1% goats exited through home consumption in a village goat

 

herds in southwest Nigeria (Reynolds and Adediran, 1994). The higher offtake rate of sheep and goats in our study is due to the emerging market in the area and the presence of other national and international market outlets.

**Table 3** Frequency (%) annual offtake rate of sheep and goats as affected by flock density group in Halaba district, southern Ethiopia

| Species | Flock density group | Offtake | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Sales | | Slaughters | | Gifted out | | #Total offtake | |
| | | n | % | n | % | n | % | N | % |
| Sheep | SDS | 89 | 24.32 | 16 | 4.37 | 3 | 0.82 | 108 | 29.51 |
| | GDS | 18 | 4.91 | 1 | 0.27 | 0 | - | 19 | 5.19 |
| | MFS | 20 | 5.46 | 6 | 1.64 | 0 | - | 26 | 7.1 |
| | Total | 127 | 34.69 | 23 | 6.28 | 3 | 0.82 | 153 | 41.8 |
| Goats | SDS | 17 | 6.3 | 5 | 1.85 | 7 | 2.59 | 29 | 10.74 |
| | GDS | 26 | 9.63 | 9 | 3.33 | 6 | 2.22 | 41 | 15.19 |
| | MFS | 6 | 2.22 | 5 | 1.85 | 1 | 0.37 | 12 | 4.44 |
| | Total | 49 | 18.15 | 19 | 7.04 | 14 | 5.16 | 82 | 30.37 |

Percentage is in reference to the original inventory. #Offtake rate is calculated adding the proportion of sales, slaughtered and gifted out animals permanently

**Seasonal price pattern**

Prices of mature sheep and goats showed seasonal variations across the flock density groups (Fig 2). Generally, the price (US Dollar, US$) of sheep was higher in SDS compared to GDS and MFS while the reverse was true for the GDS. The practice of selling fattened animals in SDS is attributed to the higher price of mature animals, among others dry road and market accessibility. The lowest prices were observed during crop harvesting season (January-March) as supplies were too high. This is attributed to the increased income demand of households to purchase agricultural inputs (seed, fertilizer, herbicides, etc). The findings concur with other studies (Legesse *et al.*, 2008). Hence, small ruminants are used as a hedge for food crops and large ruminants. The higher sales found in the flocks in April, August and December is mainly related to the Ethiopian Easter, Muslim festivals and Ethiopian New Year, respectively. Home slaughtering for Muslim festivals and holidays is more important than other occasions (funerals, dowries) in the Halaba context. The findings confirm results of Kocho *et al* (2011) who reported seasonal variations in small ruminant's prices in the Adilo district. **Appr position for Figure 2**.

**Determinants of flock dynamics (entries and exits) and offtake**

Flock density group, Age of the household head, family and farm size, literacy level of the household heads and animal number were shown to influence the off take and flock dynamics (Table 4). Farmers at SDS showed less likely ($P$<0.05) to accept animals for shareholding mainly due to land scarcity. The impact of animal number was negative on shareholding ($P$<0.05) and gifts back ($P$<0.1). Farmers with more sheep and goats showed greater tendency of offering their animals for shareholding.

**Table 4:** Coefficients (standard errors) of logistic regressions for factors contributing to entries into and exits from flocks in Halaba district, southern Ethiopia

| Descriptors | Explanatory variables | | | | | |
|---|---|---|---|---|---|---|
| | Flock density group | Age of household head | Family size | Farm size | Literacy of household head | Animal number[>>] |
| Entries | | | | | | |
| Birth | -0.119 (0.080) | -0.040 (0.028) | 0.072* (0.033) | -0.055 (0.068) | -0.011 (0.007) | 0.014 (0.025) |
| Purchase | -0.127 (0.077) | -0.026(0.026) | 0.017 (0.032) | 0.055 (0.065) | 0.087 (0.139) | 0.068** (0.024) |
| Shareholding | -.0178* (0.070) | -0.037 (0.029) | 0.043 (0.029) | -0.104 (0.059) | 0.085 (0.128) | -0.006 (0.006) |
| Gifts (entry) | -0.095 (0.054) | 0.009 (0.040) | 0.014 (0.022) | 0.006 (0.046) | -0.045 (0.099) | -0.001*(0.005) |
| Exits | | | | | | |
| Sale | -0.165 *(0.076) | 0.049 (0.032) | 0.011* (0.029) | -0.060 (0.069) | 0.082 (0.125) | -0.016 (0.025) |
| Death (morality) | 0.183*** (0.051) | -0.004 (0.035) | -0.059 (0.019) | -0.186*** (0.047) | 0.042 (0.084) | -0.016 (0.017) |
| Home slaughter | 0.227 (0.057) | -0.001 (0.028) | -0.022 (0.022) | 0.026 (0.052) | 0.075 (0.093) | 0.129***(0.018) |
| Shareholding | -0.037 (0.058) | -0.065* (0.032) | -0.016 (0.022) | 0.005 (0.053) | 0.105 (0.095) | 0.070*** (0.019) |
| Gifts/inheritances | -0.014 (0.062) | -0.035 (0.034) | -0.074** (0.024) | -0.178 (0.057) | -0.011 (0.102) | -0.002 (0.020) |
| Predator | 0.155* (0.072) | -0.051 (0.034) | 0.021 (0.028) | 0.036 (0.066) | 0.040 (0.118) | -0.029 (0.023) |
| Others[§] | -0.025 (0.063) | -0.033 (0.038) | -0.080 (0.058) | -0.003 (0.020) | 0.081 (0.103) | 0.043 (0.024) |

*, **, ***Mean coefficient statistically significant at 10%, 5% and 1% levels of probability, respectively.
[>>]Measured in Tropical Livestock Unit, TLU, (0.7 TLU=1 head of cattle; 0.1 TLU=1 head of sheep or goat).
[§]Other represents animal losses by acidosis, mechanical damage, losses due to accidents, theft, etc.

Households with fewer families tended to be more likely ($P$<0.1) to sale sheep and goats, which agrees with

 

reports of other authors (Budisatria *et al.*, 2007; Legesse *et al.*, 2008) who showed labor shortage as one of the factors determining households for keeping sheep and goats or both. As more and more lands put under cultivation, larger number of households demonstrated less tendency of keeping goats than sheep. The impact of family size was negative and significant ($P$<0.05) for exits of animals through gifts/inheritances. Likewise, farm size significantly ($P$<0.01) affected the probability of sheep and goats exits through death. This is because households with small land size keep their animals tethered during most parts of the year. Households owning more number of animals showed higher tendency ($P$<0.01) to dispose their animals through home slaughter and/ or shareholding, which agrees with reports of Mapliyao *et al* (2012).

**Conclusion**

Small ruminants are an integral part of crop-livestock mixed farming systems of the Halaba district. They are kept by resource-poor farmers, with minimal inputs, to generate immediate cash income for household expenditures and agricultural inputs, and thus they are considered as a hedge for food crops and large ruminants. Farmers sale their animals at any ages, without any quality standard, might affect the overall flock productivity. Flock density group due to land and feed scarcity, family and farm size, and animal number were the major factors determining sheep and goats offtake and dynamics, and need to be considered in the improvement plan. Improving technical backups, market value-chain and policy integration would help resource-poor farmers to exploit the indigenous sheep and goat resources efficiently.

**Acknowledgements**

Smallholder sheep and goat owners are dully acknowledged for giving permission to their animals for routine monitoring. Financial support for this on-farm study was provided by Improving productivity and Market Success of Ethiopian farmers (IPMS), and Southern Agricultural Research Institute, SARI.

**Conflict of interest**: None

**References**

Abera, B., K Kefelegn, & Solomon, G. (2014), "Indigenous Breeding Practices and Selection Criteria of Sheep Breed in Selale Area, Central Ethiopia", *International Journal of Livestock Research*, 4: 1-8.

Armbruster, T. & Peters, K.J. (1993), "Traditional sheep and goat production in southern Côte d'Ivoire", *Small Ruminant Research*. 11: 289-304.

Budisatria, I.G.S., Udo, H.M.J, Eilers, C. & van der, Z.A.J. (2007), "Dynamics of small ruminant production: A case study of Central Java, Indonesia", *Outlook Agriculture*, 36:145–152.

Central Statistical Agency (CSA). (2012), "Report on Livestock and Livestock Characteristics. Agricultural Sample survey" *Federal Democratic Republic of Ethiopia Central Statistical Agency*. Vol.2, march 2012, Addis Ababa.

Deribe, G., Girma,A. & Azage, T. (2014), "Influences of non-genetic factors on early growth of Adilo lambs under smallholder management systems, southern Ethiopia", *Tropical Animal Health and Production*, 46: 323–329.

Desta, Z.H. & Oba, G. (2004), "Feed scarcity and livestock mortality in enset farming systems in the Bale highlands of Southern Ethiopia", *Outlook Agric*uture, 33: 277-280.

Gizaw, S., Komen, H., Hanote, O., van Arendonk, J.A.M., Kemp, S., Aynalem, H., Mwai, O. & Tadelle, D. (2011), "Characterization and conservation of indigenous sheep genetic resources: A practical framework for developing countries", *ILRI Research Report No. 27*, Nairobi, Kenya, 8-10.

IPMS (Improving Productivity and Market Success). (2005), "Halaba Pilot Learning Site diagnosis and program design", *IPMS, ILRI (International Livestock Research Institute)*, Addis Ababa, Ethiopia. Unpublished Report. pp 1-12.

Kebede, T., Haile, A. & Dadi, H. (2012), "Smallholder goat breeding and flock management practices in the central rift valley of Ethiopia", *Tropical Animal Health and Production*, 44: 999–1006.

Kocho, T., Abebe, G. Tegegne, A. & Gebremedhin, B. (2011), "Marketing value-chain of smallholder sheep and goats in crop-livestock mixed farming system of Alaba, Southern Ethiopia", *Small Ruminant Research*, 96:101–105.

Lebbie, S.H.B. (2004), "Goats under Household Conditions", *Small Ruminant Research*, 51: 131–136.

Legesse, G., Abebe, G., Siegmund-schultze, M. & Vallezarate, A. (2008), "Small ruminant production in two mixed-farming systems of southern Ethiopia: status and prospects for improvement", *Experimental Agriculture*, 44: 399–412.

Mapiliyao, L., Pepe, D., Marume, U. & Muchinje, V. (2012), "Flock dynamics, body condition and weight variation in sheep in two ecologically different resource-poor communal farming systems", *Small Ruminant Research*, 104: 45-54.

Reynolds, L. & Adideran, S. (1994), "Composition of village goat herds in Southwest Nigeria", *Small Ruminant*

 

*Research*, 13: 49-53.

SAS. (2008), "SAS Version 9.2", *SAS Institute Inc*., Cary, NC, USA.

SPSS. (2013), "Version 22. Software Package for Social Sciences for Window.

Shenkute, B., Legasse, G., Tegegne, A. & Hassen, A. (2010), "Small ruminant production in coffee-based mixed crop-livestock system of Western Ethiopian Highlands: Status and prospectus for improvement", *Livestock Research For Rural Development*, 22 (10) 2010.

Tesfaye, A.T., Yadav, B.R., Hanotte, O., & Jianlin, H. (2004), "Genetic characterization of indigenous goat populations of Ethiopia using microsatellite DNA markers", *PhD Thesis. KARNAL–132 001 (HARYANA), INDIA*. REGN. No.1062k01.

Wilson, R.T. & Ole, M.M. (1989), "Goat and sheep population changes on a Masai group ranch in south-western Kenya, 1978-1986", *Agricultural System*, 29: 325-337.

Workneh, A., King, J.M., Bruns, E. & Rischkowsky, B. (2003), "Economic evaluation of smallholder subsistence livestock production: lessons from an Ethiopian goat development program", *Ecological Economics*, 45: 473-485.