# Goat Production Practices and Constraints in Mixed Crop Livestock and Agro-Pastoral Production Systems of Dire Dawa Administration, Ethiopia

**Tesfu Tadesse[1]*, Getachew Animut[2], and Mitiku Eshetu[1]**

[1]Haramaya University, School of Animal and Range Sciences, P.O. Box 138, Dire Dawa, Ethiopia
[2]Ethiopian Agricultural Transformation Agency, P.O. Box 708, Addis Ababa, Ethiopia

**Abstract:** A survey was conducted to assess goat production system and production constraints under two farming systems (Agro-pastoral (AP) and mixed crop livestock (MCL)) in the rural areas of Dire Dawa Administration, Ethiopia. Semi structured questionnaire was used to collect information from 150 goat owning households. Household goat holding was higher in AP (32.00±2.3) as compared to MCL farming system (14.13±1.08). Lower age at first kidding (16.08±0.24 months) and shorter kidding interval (7.64±0.11 months) was reported in MCL as compared to AP farming system (17.00±0.21 and 8.23±0.14 months, respectively). Age at marketing in AP (13.83±0.89 months) was lower than MCL farming system (17.55±0.75 months). In both farming systems, cash income from sales of live goat was the primary objective of goat production. Grazing on natural pasture in wet season and crop stubble after crop harvest were the main sources of feed. About 79.3% of the total respondents have got their own buck. Higher proportion of respondents in AP farming (84%) practice breeding buck selection as compared to MCL farming system (53.3%). In both farming systems, size, parent performance and body conformation were the three main criteria to select breeding buck. Goats are kept overnight in an open kraal in AP farming (72%) and with human in the same main living house in MCL farming system (48%). Feed scarcity was ranked as the first important constraint of goat rearing, while disease and predator attack in MCL, and scarcity of water and market access in AP farming system ranked as second and third important constraints, respectively. Thus, enhancement of goat production in the study area requires improvement in quality and quantity of the available feed, improved breeding practices, housing practices, utilization of health services, and access to water and market.

**Keywords**: *Breeding, Feeding, Flock structure, Productivity*

## Introduction

Goats are among the most abundant species of domestic animals in the world and are kept in different geographical and climatic conditions (Petrovic *et al.*, 2012). They play vital role in the livelihood of small scale farmers by providing milk and meat for household consumption and cash income from sales of live animal and their products (Endeshaw, 2007; Homann *et al.*, 2007; Shalander *et al.,* 2010; Isaac and Titilayo, 2012; Rawat *et al.*, 2015). In the tropics, goats are kept under varying ecological conditions and different husbandry systems (Peter, 1987). Ethiopia's goat population is estimated to be about 29.11 million (CSA, 2015). They form important economic, social and cultural functions and represent an important component of the mixed farming systems in the highlands and extensive pastoral and agro-pastoral production systems in the lowlands of the country (Endashaw *et al.*, 2013). According to Peacock (1996) the differences of goat management practices among different goat production systems emanate from the local circumstance that drives goat production such as climate, resource availability, production objective, and availability of technologies. Similarly, the existing goat production system in Ethiopia is the result of natural production environment and socio-economic circumstances of the producers at large (Solomon *et al.,* 2010).

Due to increase in urban populations with higher incomes and accompanied dietary changes, the demand for livestock products is increasing. Thus, improving production and productivity of goat can be one way of meeting the increasing demand, particularly for meat, and there by create an opportunity to improve the livelihood of small scale producers through increased off take. Nevertheless, designing an appropriate intervention to enhance goat production and productivity requires a clear understanding of the socioeconomic characteristics of the producers, production objectives, the production environment, husbandry practices, utilization of available resource, and production constraints that prevail in different production systems. However, information on production constraints and husbandry systems practiced under the natural production environments and socio-economic circumstances of the different

*Corresponding Author. E-mail: tadessetestad@yahoo.com


ISSN 2616-8804 (Print)

production systems, particularly in Eastern Ethiopia, is inadequate in general and lacking in the current study area. Therefore, this study was aimed to generate information on purposes of goat production, flock performance, husbandry practices and constraints of goat production in two goat production systems, i.e. mixed crop livestock and agro-pastoral farming systems of Dire Dawa Administration, Ethiopia.

## Materials and Methods

### *Study Site*

The study was conducted in Dire Dawa Administration (DDA) which is geographically located between 9° 27` to 9° 49` N and 41° 38`to 42° 19' E longitude and found in the eastern part of Ethiopia at about 515 km away from the capital Addis Ababa and 330 km to the west of the Republic of Djibouti (IDP, 2006). The altitude of DDA ranges 960-2450 meter above sea level (masl). Using the 1500 masl contour as a line of separation, it is divided into two broad agro-ecological zones. The area with altitude below 1500 masl is lowland (*Kolla*) agro-ecological zone (AEZ), while areas above 1500 masl is categorized as midland (*Woina Dega*) AEZ (DDAEPA, 2011). The north eastern part of DDA is relatively sparsely populated lowland exhibiting pastoral and agro-pastoral farming system and the southeastern part of the administration comprises of escarpment with mixed crop livestock farming system (DDAC, 2004).

### *Site Selection*

The study was done in purposively selected rural kebeles (RKs) of DDA. Areas where goat production is practiced and representing the two farming systems (mixed crop livestock and agro-pastoral production system) were selected in consultation with experts of Agricultural Office of the Administration and through rapid field visit made in the area. Accordingly, three RKs per production system were selected for the study. Eje Annenie, Jelobelina and Wahil RKs were selected from mixed crop livestock (MCL) farming system and Jeldesa, Aseliso and Legedini were selected from the agro-pastoral (AP) farming system.

### *Sampling and Data Collection*

Based on the recorded list of residents available in the development agent's office, a total of 150 goat producing households; twenty five from each of the six PAs were selected using systematic random sampling techniques. Semi-structured questionnaire and focus group discussion were the methodologies used to collect data. The questionnaire were prepared to collect information on household characteristics, type of livestock holding, flock structure, initial sources of goat assets, purpose of keeping goats, feed resources, feeding calendar, breeding practice, productivity of goats, housing system and constraints of goat production in the area. Interviews were held with each respondent with the help of trained enumerators. Focus group discussions were made with experts of regional agricultural office and animal health laboratory of DDA, and key informant farmers known for their goat rearing experience in the study areas.

### *Data Analysis*

Data obtained from the interview were analyzed using descriptive statistics with SPSS Statistics for Windows (SPSS Version 20, 2011). Because of the number of observed counts obtained in each cell, Pearson's Chi-square ($\chi 2$) test was used for categorical variables to assess statistical significance differences in household income sources, initial sources of goat asset, supplemental feeding practices, buck ownership, selection practices of mating time and breeding buck and housing systems between the production systems. Independent t-test was employed to compare livestock holding, goat flock structure and flock productivity between the two production systems. Moreover, indices were calculated to provide overall ranking on the purposes of keeping goats, criteria's for breeding buck selection and production constraints using the formula: Index = sum of [4 for rank 1 + 3 for rank 2 + 2 for rank 3 + 1 for rank 4] given for an individual purpose or trait divided by the sum of [4 for rank 1 + 3 for rank 2 + 2 for rank 3 + 1 for rank 4] given for all traits.

## Results and Discussion

### *Household Characteristics and Income Sources*

About 46, 86 and 66.7% of the respondents fall within the age category of 31-40 years, were headed by male and illiterate, respectively. The overall average family size was 5.91±0.16. Crop farming, animal farming and non-farm activities were sources of income for the respondents (Table 1). Of all the respondents, about 71.4% households depend on crop and animal farming while 26% respondents generate additional income from non-farm economic activities indicating the need for many farmers to diversify their income source. Relatively more households in MCL as compared to the AP production system were involved in non-farm economic activities (Table 1). Among others, the proximity to Dire Dawa town, better road access and availability of transport services in the MCL areas might have contributed for more respondents in MCL farming areas to be engaged in non-farm economic activities.

### *Livestock Holding*

Livestock holding of respondents in the study area is indicated in Table 2. Comparable numbers of cattle and sheep per respondent existed in the two production systems while the number of goats and camels were higher in AP farming system indicating their better adaptation to the production environment and importance in the livelihood of the producers. Due to the diversity of plants they utilize, their tolerance to drought and higher reproductive rates, goats has

comparative advantage over cattle in semi-arid areas that allow farmers to make more efficient use of the available natural resources (Homann *et al*., 2007). The average goat flock size per household for AP farming system in this study was in agreement with the 32.8 reported by Girum *et al*. (2014) for the same area and higher than the 15.54 reported for pastoral (P)/AP farming system by Dereje *et al*. (2014b).

Table 1. Sources of household income by production system (percentage of respondents)

| **Income sources** | MCL (n= 75) | AP (n= 75) | p-value |
|---|---|---|---|
| Crop and animal farming | 68.0 | 74.7 | 0.24 |
| Animal farming only | 1.3 | 4.0 | 0.31 |
| Animal and non-farm sources | 1.3 | 8.0 | 0.06 |
| Crop, animal and non-farm sources | 29.3[a] | 13.3[b] | 0.01 |

[ab]*Percentages in the same row with different superscripts are significantly different (p<0.05); MCL= Mixed crop livestock production system; AP= Agro-pastoral production system; n= Number of respondents; p-value is a chi-square probability.*

Table 2. Average livestock holdings of households by production system (number of animals)

| **Livestock type** | MCL (n= 75) | AP (n= 75) | SEM | p-value |
|---|---|---|---|---|
| Cattle | 3.31 | 3.35 | 0.27 | 0.94 |
| Sheep | 4.67 | 6.53 | 0.69 | 0.18 |
| Goat | 14.13[b] | 32.00[a] | 1.47 | 0.00 |
| Camel | 0.12[b] | 1.09[a] | 0.14 | 0.00 |

[ab]*Means in the same row with different superscripts are significantly different (p <0.05); MCL= Mixed crop livestock production system; AP= Agro-pastoral production system; n= Number of respondents; p-value is a chi-square probability; SEM= Standard error of the mean.*

### *Goat Flock Structure and Productivity as Perceived by Respondents*

**Flock structure:** Due to higher number of breeding doe's in AP farming system, the number of goat in all age category were higher as compared to MCL farming system (Table 3). In MCL farming system, the percentage proportion of kids below three months of age (7.1%), male 6-12 months of age (9.3%), and breeding doe (52.3%) in the flock was higher than 5.5, 8.2, and 49.8%, respectively found in AP farming system. The lower proportion of kids below three months of age obtained in AP farming system in the present study could be due to the scarcity of feed at the time of the data collection, as a result of which some respondents of AP farming system practice controlled mating to avoid kidding at this time of the year. The relatively lower proportion of grower male (6-12 months of age) and breeding doe's could be the result of the lower age at marketing of goats and the higher age at first kidding of the doe's, respectively in AP farming as compared to MCL farming system (Table 4). The higher proportion of breeding does followed by kids in both farming system was in agreement with reports of other studies in Ethiopia (Tesfaye, 2009; Solomon, 2014). The proportion of breeding doe in this study was higher than 42.4% reported by Girum *et al*. (2014) for the same area, 37.5% reported by Dereje *et al*. (2014a), while it agrees with 53.5% reported for Dale District by Endeshaw (2007), but was lower than 63% reported by Homann *et al*. (2007). Higher proportion of breeding doe's kept in both production systems shows farmers intention to increase flock size through increased number of births (Dereje *et al*., 2014a).

Table 3. Goat flock size and structure by production system (number of goats)

| **Classes of goat** | MCL (n= 75) | AP (n= 75) | SEM | p-value |
|---|---|---|---|---|
| Kids (< 3 month) | 1.0[b] | 1.77[a] | 0.09 | 0.00 |
| Male (3-6 month) | 0.88[b] | 2.24[a] | 0.12 | 0.00 |
| Female (3-6 month) | 0.84[b] | 2.33[a] | 0.12 | 0.00 |
| Young doe (6-12 month) | 1.95[b] | 4.40[a] | 0.22 | 0.00 |
| Young buck (6-12 month) | 1.32[b] | 2.63[a] | 0.14 | 0.00 |
| Breeding Doe | 7.39[b] | 15.95[a] | 0.75 | 0.00 |
| Castrate | 0.21[b] | 0.93[a] | 0.11 | 0.00 |
| Mature buck >1year | 0.55[b] | 1.83[a] | 0.11 | 0.00 |

[ab]*Means in the same row with different superscripts are significantly different (p <0.05); AP= Agro-pastoral production system; MCL= Mixed crop livestock production system; n= Number of respondents; SEM= Standard error of the mean; p-value is a chi-square probability.*

**Reproductive performance and slaughter age:** The overall average age at first kidding (AFK) and kidding interval (KI) were 16.54 and 7.93 months, respectively. Except for age at first service of the buck (AFS), differences were found in other performance traits between the two production systems. Lower AFK and short KI were reported in MCL farming system as compared to AP farming system (Table 4). This difference could be attributed to the practice of controlled mating among some respondents of AP farming to avoid kidding during seasons of feed scarcity and differences in the production environment.

Song *et al.* (2006) ratified that age at first kidding is highly variable and contingent on the growth rate and management system used. The overall mean AFK in the present study is higher than 14.88 months reported for Sidama goat (Endeshaw, 2007), 13.6 months for goats in Metema area of Amhara region (Tesfaye, 2009) and Central Highland goats (Mengistie *et al.*, 2013) and 14.75 months for goats in Shabelle zone of South Eastern Ethiopia (Alefe, 2014) and lower than 18.3 months reported for Short eared Somali goats (Dereje *et al.*, 2014a). The kidding interval value in this study is in line with the 8 month reported for Borena goats of Bale Zone of Oromiya region (Belete, 2013), 8.04 months for Arsi Bale goats (Tatek *et al.,* 2004) and 8.75 months for Somali goats (Dereje *et al.*, 2014a) while it was lower than the value of 10.26 months reported for Central Highland goats (Mengistie *et al.*, 2013) and the range of 9 - 12 months for central highland goats (Markos, 2000). The average age at marketing of goat obtained in AP farming system was lower than the value in MCL farming system. The overall average age at marketing in this study was higher than the mean marketing age of 11.67 and 12.33 month for male and female goats, respectively, reported for Borena goats of Bale Zone of Oromiya region (Belete, 2013) and lower than 22.7 months reported for Somali goats (Dereje *et al.*, 2014a). Key informants revealed that in AP farming system, age at marketing of goat is determined, in most cases, by the amount of cash needed and presence of alternative financial sources in the household. The presence of market demand for different age groups was also mentioned as a factor affecting the age of goat at marketing.

Table 4. Flock productivity as perceived by respondents by production system (in months)

| **Parameters** | MCL (n= 75) | AP (n= 75) | SEM | p-value | Minimum | Maximum |
|---|---|---|---|---|---|---|
| AFS | 10 | 9.76 | 0.09 | 0.20 | 8 | 14 |
| AFK | 16.08[a] | 17.00[b] | 0.16 | 0.01 | 12 | 20 |
| KI | 7.64[a] | 8.23[b] | 0.09 | 0.001 | 6 | 10 |
| AM | 17.55[b] | 13.83[a] | 0.6 | 0.002 | 5 | 36 |

*[ab]Means in the same row with different superscripts are significantly different (p <0.05); MCL= Mixed crop livestock production system; AP= Agro-pastoral production system; n= Number of respondents; SEM= Standard error of the mean; AFS= Age at first service of buck; AFK= Age at first kidding; KI= Kidding interval; AM= Age at marketing of the goat.*

***Initial Sources of Goat Assets***

Gift and purchase were initial asset sources of goat flock for the majority of respondents (Table 5). The study showed that gift was relatively more important in the AP than MCL farming system. Focus group discussions in both farming systems revealed that the provision of beginning stock to newly married family member is long time inherited culture. In MCL farming system, both livestock and crop farm land are important productive resources mostly obtained by inheritance from parents. Thus, newly married household members, in addition to animals will also get agricultural land from parents while in areas where AP farming system is practiced, crop farming is unreliable and livestock is the most important productive resource given to the newly married household members in most cases.

Table 5. Initial sources of goat assets by production system (percentage of respondents)

| Sources of stock | MCL (n= 75) | AP (n= 75) | p-value |
|---|---|---|---|
| Gift | 64[a] | 85.3[b] | 0.00 |
| Purchase | 22.7[b] | 10.7[a] | 0.04 |
| Gift & purchase | 13.3[b] | 4[a] | 0.04 |

*[ab]Percentages in the same row with different superscripts are significantly different (p <0.05); MCL= Mixed crop livestock production system; AP= Agro-pastoral production system; n= Number of respondents; p-value is a chi-square probability.*

***Purpose of Goat Production***

Income from sales of live goat was the primary important purpose of goat production in both farming systems (Table 6). All (100%) households in AP farming system ranked income from sales of live goat as the first purpose of goat production while 73.3% of the households in MCL farming system ranked income from sales of live goats as the first purpose of goat production. Home consumption of milk and cash income from sales of goat milk ranked second and third in both farming systems, while household consumption of meat in MCL and means of capital asset in AP farming system were the fourth ranked purposes. Purposes of goat rearing in the current study area agree well with results of previous studies (Semakula *et al.*, 2010; Arse *et al.*, 2013; Dereje *et al.*, 2014b; Hulunim, 2014; Solomon, 2014; Yilkal, 2015).

***Local Feed Resources and Their Seasonal Availability***

The feed resources available in the study area were natural pasture, crop stubble, crop aftermath, crop farm boundary, crop residues, pods of acacia tree, local fodder trees and agro-industrial by-products (Table 7). The availability and use of these feed resources vary among months and seasons of the year. In both farming systems, natural pasture is the major feed source for goats for about 7-8 months of the year. However, biomass yield varies during this period depending on amount and distribution of rainfall. In the main rainy season (June to August/September),

pasture condition is generally good with peak biomass yield in August in AP farming, and August and September in MCL farming system after which the biomass starts to decline. The depletion of feed from natural pasture in November for AP farming and December for MCL farming system coincides with crop harvesting time that provides crop stubble and farm boundary for grazing. Here, grasses, browses, forbs, weeds, crop stubble and crop aftermath are available for use. All respondents noted the presence of supplementation practice when feed from crop stubble is scarce (Table 8). Pods of *Acacia spp.* and branches of *Zizyphus spina-christi* are most important sources of supplements used during this period.

Table 6. Purposes of keeping goats by production system

| **Purposes** | MCL (n= 75) | | AP (n= 75) | |
|---|---|---|---|---|
| | HH | Index | HH | Index |
| Income from sale of goat | 75 | 0.36 | 75 | 0.40 |
| For household milk consumption | 67 | 0.27 | 62 | 0.24 |
| Income from sale of milk | 51 | 0.18 | 50 | 0.15 |
| Household meat consumption | 58 | 0.11 | 50 | 0.09 |
| Saving capital | 49 | 0.09 | 63 | 0.11 |

*HH= Number of respondents ranking a purpose as important (i.e., ranks 1, 2, 3, or 4); MCL= Mixed crop livestock production system; AP= Agro-pastoral production system; n= Number of respondents.*

Table 7. Seasonal availability and utilization of major local feed resources in MCL and AP farming system

| | Months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Major feed source** | Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sept | Oct | Nov | Dec |
| **MCL farming system** | | | | | | | | | | | | |
| Communal pasture | ——— | | | ** | * | ** | **** | ***** | ***** | **** | ** | * |
| Stubble grazing, Aftermath & farm boundary | *** | * | ——— | | | | | | | * | *** | **** |
| Crop residue | *** | *** | ——— | | | | | | | | * | xxx |
| Pods & branches of local fodder trees | *** | ** | * | ——— | | | | xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx | | | | |
| **AP farming system** | | | | | | | | | | | | |
| Communal pasture | ——— | | | ** | ** | ** | **** | ***** | **** | ** | * | ——— |
| Stubble, aftermath & farm boundary | * | ——— | | ** | ** | ——— | | | | ** | **** | * |
| Crop residue | *** | * | ——— | | | | | | | * | xxxxx | xxx |
| Pods & branches of local fodder trees | ** | * | ——— | | | | xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx | | | | | **** |

*——= Not available; *= Low to not available; **= Low to medium; ***= Medium; ****= Medium to high; *****= High; x= Reserve for other time; MCL= Mixed crop livestock farming system; AP= Agro-pastoral farming system.*

Table 8. Feed supplementation practice by MCL and PA production system (percentage of respondents)

| **Supplementation practice and type** | MCL (n= 75) | AP (n= 75) | p-value |
|---|---|---|---|
| Supplementation practice | 100 | 100 | 0.5 |
| Agro-industrial by-product | 54.7 | 60 | 0.31 |
| Crop residue | 73.3 | 58.7 | 0.09 |
| Lobbing trees | 100 | 100 | 0.5 |

*MCL= Mixed crop livestock production system; AP= Agro-pastoral production system; n= Number of respondents; p-value is a chi-square probability.*

During periods of feed scarcity, about 66% of the total respondents supply crop residues for goats while 26% provide for cattle only. Sorghum stover in MCL farming and sorghum and maize stovers in AP farming system are the dominant crop residues available for feeding goats. At the peak periods of feed scarcity, about 57% of the respondents purchase agro-industrial by-products (wheat milling byproducts). Moreover, moving animals to other areas as a means of escaping periods of critical feed scarcity was practiced by 40% and 1.3% respondents of AP and MCL farming system, respectively. Generally the study revealed that February, March, April, May and first half of June in MCL farming system and January to March and first half of June in AP farming system were months of serious feed scarcity while from July to October in

MCL farming and from July to September in AP farming system were identified as months of good feed availability.

***Goat Breeding***

About 79.3% of the total respondents have their own breeding buck (Table 9). The proportion of buck owning households in this study was higher than 33 to 60% reported by others (Homann *et al*., 2007; Tsedeke, 2007; Tesfaye, 2009; Semakula *et al*., 2010; Mahilet, 2012). Strong positive correlation was found between number of breeding does and breeding buck (r=0.71) indicating that large flock owning farmers have more breeding buck. The ratio of buck to breeding doe was 1:5.64 in MCL farming and 1:7.42 in AP farming system indicating that relatively higher numbers of doe are kept per buck in AP farming system. Relatively lower ratio of buck to breeding doe was reported for the two major goat-keeping states of India, Uttar Pradesh (1:11-18) and Rajasthan (1:35) (Shalander *et al.,* 2010) while a higher ratio of 1:4 was reported in Sidama Zone by Endeshaw (2007). Relatively higher proportion of respondents in AP farming system select time for goat mating which is likely to have goats kidding during feed available season. This was reported to be done by simply keeping bucks at home or separate from the does on the grazing land. The value for the practice of controlled mating in AP farming system was higher than 26.3% for AP farming system in Oromiya Regional State (Workneh *et al*., 2004), and 11.3% and 12.9% reported for Gwanda and Tsholotsho districts in Zimbabwe (Homann *et al*., 2007), agreed with 27.22% reported partial controlled mating in Western Ethiopia (Ahmed *et al*., 2015) and lower than 85.7% reported for pastoral farming system in Oromiya Regional State (Workneh *et al*., 2004).

Table 9. Buck ownership, practice of selection of breeding buck and mating time by production system (percentage of respondents)

| **Description** | MCL (n=75) | AP (n=75) | p-value |
|---|---|---|---|
| Own buck | 73.3 | 85.3 | 0.05 |
| Select breeding buck | 53.3[a] | 84.0[b] | 0.00 |
| Select time for mating | 2.7[a] | 34.7[b] | 0.00 |

*[ab]Percentages in the same row with different superscripts are significantly different (p <0.05); MCL= Mixed crop livestock production system; AP= Agro-pastoral production system; n= Number of respondents; p-value is a chi-square probability.*

Higher proportion of households in AP farming system practice selection of breeding buck as compared to the MCL farming system indicating the presence of higher intent to enhance goat production in AP farming system and farmers knowledge on importance of breeding as management tool. Body size, body conformation, parent performance, pelage color and libido are the major criteria for breeding buck selection (Table 10). In both farming systems, body size ranked first indicating the need to have fast growing and big sized progeny that fetch better market price at a relatively early age. In MCL farming system, parent performance and body confirmation were the second and third important traits while parent performance was preceded by body confirmation in AP farming system. In AP farming system, relatively better importance was given for libido and pelage color as compared to the MCL farming system indicating that selection in the AP farming system is based on multiple traits. Similar selection criterion with variable order of importance was reported by Endeshaw (2007) and Hulunim (2014).

Table 10. Criteria used for selection of breeding buck by production system

| | MCL (n= 40) | | AP (n= 63) | |
|---|---|---|---|---|
| **Selection criteria's** | HH | Index | HH | Index |
| Body size | 40 | 0.37 | 63 | 0.35 |
| Body conformation | 40 | 0.23 | 58 | 0.22 |
| Parent performance | 37 | 0.24 | 44 | 0.18 |
| Pelage color | 14 | 0.07 | 39 | 0.12 |
| Libido | 16 | 0.06 | 45 | 0.13 |
| Polledness | 13 | 0.05 | 3 | 0.005 |

*HH= Number of respondents ranking selection criteria's (i.e., ranks 1, 2, 3, or 4); MCL= Mixed crop livestock production system; AP= Agro-pastoral production system; n= Number of respondents.*

***Goat Housing***

The proportion of respondents practicing different goat housing systems varied between the two production systems (Table 11). About 94.7% of the respondents in MCL farming system noted that goats are kept overnight either in a house together with human or in a separate roofed house with other animals; while the majority of the respondents in AP farming system (72%) keep their goats outdoor in non-roofed thorn fenced kraals with other animals indicating the importance of housing to protect predation rather than keeping the animal from climatic extremes. Key informants of AP farming system perceived that the variation between the climatic

extremes in the area is not beyond the physiological tolerance of goats. Kraal housing of animals in pastoral and agro-pastoral areas is a common practice and has been reported for Sitti Zone of Somali Regional State of Ethiopia and Borena and Bale zones of Oromia Regional State (Belete, 2013; Hulunim, 2014) and Gewane district of Afar Regional State (Seifemichael, 2013).

Table 11. Goat housing system practiced in the study area by production system (percentage of respondents)

| **Housing type** | MCL (n= 75) | AP (n= 75) | P-value |
|---|---|---|---|
| Main house without partition | 18.7[b] | 0[a] | 0.00 |
| Main house with partition | 29.3[b] | 9.3[a] | 0.00 |
| Separate house with other animals | 46.7[b] | 18.7[a] | 0.00 |
| Open kraal | 5.3[a] | 72[b] | 0.00 |

*[ab]Percentages in the same row with different superscripts are significantly different (p<0.05); MCL= Mixed crop livestock production system; AP= Agro-pastoral production system; n= Number of respondents; p-value is a chi-square probability.*

***Constraints of Goat Production***

In this study, except for feed scarcity which was ranked as the primary constraint of goat rearing in both farming systems, the orderly importance of other constraints vary between the two production systems (Table 12). Goat health problems and predator attack in MCL farming system, and scarcity of water and poor market access in AP farming system ranked second and third, respectively. This variation could be attributed to the insufficient number of watering points, lack of enough water from the source, the drying out of the sources in dry season, and the long distance travelled to reach the nearby livestock market, as reported by key members of AP farming system. Moreover, the survey result showed that higher proportion of respondents in AP farming system (92%) use veterinary service to treat sick animals as compared to the proportion in MCL farming system (36%) where about 60% of the respondents rely on traditional goat treatment. Similar constraints with different order of importance were reported in most traditional goat production systems. Feed scarcity is the most important constraints reported in all production systems. Similar to the result for AP farming system in this study, Girum (2010) reported that Afar region pastoralists identified feed scarcity as a major constraint followed by shortage of water. Similarly, major constraints and their order of importance reported for West Gojjam Zone of Amhara Region (Bekalu, 2014) agree with the result for MCL farming system obtained in the present study. Lower price was reported as a main problem of goat-keeping in Uttar Pradesh and Rajasthan states of India (Shalander *et al.,* 2010).

Table 12. Ranking constraints of goat production by production system

| **Constraints** | MCL (n= 75) | | AP (n= 75) | |
|---|---|---|---|---|
| | HH | Index | HH | Index |
| Feed scarcity | 75 | 0.38 | 75 | 0.36 |
| Disease and parasite | 67 | 0.26 | 47 | 0.13 |
| Predator attack | 34 | 0.09 | 20 | 0.04 |
| Scarcity of water | 15 | 0.03 | 69 | 0.26 |
| Poor market access | 31 | 0.07 | 50 | 0.14 |
| Lack of labor | 7 | 0.01 | 11 | 0.02 |
| Lack of technical support | 33 | 0.07 | 24 | 0.05 |
| Lack of credit facility | 37 | 0.08 | 4 | 0.005 |

*HH= Number of respondents ranking selection criteria (i.e., ranks 1, 2, 3, or 4); MCL= Mixed crop livestock production system; AP= Agro-pastoral production system; n= Number of respondents.*

## Conclusion

Goat production is an important component of the farming operation and contributes a substantial amount to the livelihood of farming households mainly as a source of cash income, milk and meat sources. Farmer's practice of breeding buck selection and providing supplementary feed for goats from local feed sources as well as industrial byproducts during feed scarce dry season imply the importance of goat in the household economy and farmer's intention to improve productivity. However, goat productivity is challenged by scarcity of feed, water, health problem, poor access to market, poor housing system and predator attacks. Thus, the identified constraints should be component of the goat production improvement plan with their respective order of importance in the two production systems.

## Acknowledgements

We are grateful to the Education Sector Development Program (ESDP) of Italy for funding this research through Haramaya University. All the development agents, farmers and office experts who participated in this study are highly acknowledged.

## Conflict of Interests

The authors declare that they have no competing interests.

## References

Ahmed Seid, Kefelegne Kebede & Kefena Effa (2015). Breeding Objective, Selection Criteria and Breeding Practice of Indigenous Goats in Western Ethiopia: Implications for Sustainable Genetic Improvement. *Greener Journal of Agricultural Sciences,* 5 (5): 167-176.

Alefe Takele (2014). Phenotypic Characterization of Indigenous Goat Types and their Production System in Shabelle Zone, South Eastern Ethiopia, MSc Thesis, Haramaya University, Haramaya, Ethiopia.

Arse Gebeyehu, Feyisa Hundessa, Gurmessa Umeta, Merga Muleta & Girma Debele (2013). Assessment on challenges and opportunities of goat farming system in Adami Tulu, Arsi Negelle and Fantale districts of Oromia Regional State, Ethiopia. *African Journal of Agricultural Research,* 8 (1): 26-31.

Bekalu Muluneh (2014). Phenotypic Characterization of Indigenous Goat Type and their Production System in West Gojjam Zone, Amhara National Regional State, Ethiopia, MSc Thesis, Haramaya University, Haramaya, Ethiopia.

Belete Asefa (2013). On Farm Phenotypic Characterization of Indigenous Goat Types and their Production System in Bale Zone of Oromia Region, Ethiopia, MSc Thesis, Haramaya University, Haramaya, Ethiopia.

CSA (Central Statistical Authority) (2015). *Agricultural sample survey*. Volume II. Report on livestock and livestock characteristics (private peasant holdings). Statistical Bulletin 578. CSA, Addis Ababa, Ethiopia.

DDAC (Dire Dawa Administrative Council) (2004). *Dire Dawa Administrative Council integrated resources development master plan study project*; phase 2: 2 (2). Addis Ababa, Ethiopia.

DDAEPA (Dire Dawa Administration Environmental Protection Authority) (2011). Dire Dawa Administration program of Adaptation to climate change. Dire Dawa Administration, Dire Dawa, Ethiopia.

Dereje Tadesse, Mengistu Urge, Getachew Animut & Yoseph Mekasha (2014a). Flock structure, level of production, and marketing of three Ethiopian goat types kept under different production systems. *Livestock Research for Rural Development*, 26 (79).

Dereje Tadesse, Mengistu Urge, Getachew Animut & Yoseph Mekasha (2014b). Perceptions of households on purpose of keeping, trait preference, and production constraints for selected goat types in Ethiopia. *Tropical Animal Health and Production*, 46: 363-370.

Endashaw Terefe, Yibra Yaqob, Kidanie Dessalegn, Abebe Tafa, Ashebir Kifle, Weldegebrel Gebregziabher & Weldegebrel Tesfamariam (2013). Market weight and carcass characteristics of intact yearling afar goats under semi-intensive feeding management. *International Journal of Livestock Production*, 1 (2): 33-38.

Endeshaw Assefa (2007). Assessment of Production and Marketing System of Goats in Dale District, Sidama Zone, MSc Thesis, Hawassa University, Aawassa, Ethiopia.

Tatek Woldu, Hailu Dadi, Mieso Guru & Dadi Gelashe (2004). Productivity of Arsi Bale goat types under farmers' management condition: a case of Arsi Negelle. In: proceedings of the 13th annual conference of the Ethiopian Society of Animal Production (ESAP), August 25-27, 2004, Addis Ababa, Ethiopia, pp: 67-71.

Girum Gebreyesus (2010). Community-based participatory characterization of the short-eared Somali goat population around Dire Dawa, MSc Thesis, Haramaya University, Haramaya, Ethiopia.

Girum Gebreyesus, Aynalem Haile & Tadelle Dessie (2014). Ethno-Veterinary Knowledge and Practices of Issa-Somali Pastoralists around Dire Dawa, Eastern Ethiopia. *International Journal of Research and Reviews in Pharmacy and Applied Science*, 4 (1): 910-921.

Homann, S., van Rooyen, A., Moyo, T. & Nengomasha, Z. (2007). Goat production and marketing: Baseline information for semi-arid Zimbabwe. Bulawayo, Zimbabwe: International Crops Research Institute for the Semi-Arid Tropics, pp: 84.

Hulunim Gatew (2014). On-Farm Phenotypic Characterization and Performance Evaluation of Bati, Borena and Short Eared Somali Goat Populations of Ethiopia, MSc Thesis, Haramaya University, Haramaya, Ethiopia.

IDP (Integrated Development Plan) (2006). Annual report. Dire Dawa Administration, Dire Dawa.

Isaac, B. O. & Titilayo, B. O. (2012). Small Ruminants as a Source of Financial Security: A Case Study of Women in Rural Southwest Nigeria. IMTFI (Institute for Money, Technology and Financial Inclusion) Working Paper 2012-2.

Mahilet Dawit (2012). Characterization of Hararghe Highland Goat and their Production System in Eastern Hararghe, Ethiopia, MSc Thesis, Haramaya University, Haramaya, Ethiopia.

Markos Tibbo (2000). Livestock production constraints in a M2-2 sub-agro ecological zone with special reference to goat production. In R.C. Merkel, G. Abebe and A. L. Goetsch (Eds.), Proceedings of a conference on opportunities and challenges of enhancing goat production in East Africa, Debub University, Awassa, Ethiopia. November 10 to 12, 2000. E (Kika) de la Garza Institute for Goat Research, Langston University, Langston, OK, pp: 113-117.

Mengistie Taye, Belay Deribe & Mussie Hailemelekot (2013). Reproductive Performance of Central Highland Goats under Traditional Management in

Sekota District, Ethiopia. *Asian Journal of Biological Sciences*, 6: 271-276.

Peacock, C. (1996). Improving goat production in the tropics. A Manual for Development workers. Published jointly by FARM-Africa and Oxfam (UK and Ireland), Oxfam, UK, pp: 387.

Peters, K. J. (1987). Evaluation of goat populations in tropical and subtropical environments. ILCA (International Livestock Centre for Africa). *Bulletin*, 28: 14-21.

Petrovic, C. V., Ilic, Z., Ruzic, M. D., Petrović, M. P., Petrovic, M. M., Tomic, Z. & Marinkov, G. (2012). Analysis of environmental and genetic factors in growth characteristics of Balkan goat. *Biotechnology in Animal Husbandry*, 28 (2): 275-282.

Seifemichael Mamo (2013). Phenotypic characterization of indigenous afar goat breed and husbandry practices of pastoralists in afar region, MSc Thesis, Haramaya University, Haramaya, Ethiopia.

Semakula, J., Mutetikka, D., Kugonza, R. D. & Mpairwe, D. (2010). Smallholder Goat Breeding Systems in Humid, Sub-Humid and Semi-Arid Agro-Ecological Zones of Uganda. *Global Veterinaria*, 4 (3): 283-291.

Shalander, K., Rama-Rao, C. A., Kareemulla, K. & Venkateswarlu, B. (2010). Role of Goats in Livelihood Security of Rural Poor in the Less Favored Environments. *Indian Journal of Agricultural Economics*, 65 (4): 760-781.

Solomon Abegaz (2014). Design of community based breeding programs for two indigenous goat breeds of Ethiopia, Doctoral Thesis, BOKU-University of Natural Resources and Life sciences, Department of Sustainable Agricultural systems, Vienna, Austria, pp: 115. Retrieved from https://cgspace.cgiar.org/bitstream/handle/10568/53927/Thesis_SolomonAbegaz.pdf?sequence=1&isAllowed=y

Solomon Gizaw, Azage Tegegne, Berhanu Gebremedhin & Dirk Hoekstra (2010). Sheep and goat production and marketing systems in Ethiopia: Characteristics and strategies for improvement. *IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 23*. ILRI (International Livestock Research Institute), Nairobi, Kenya, pp: 58.

Song, H. B., Jo, I. H. & Sol, H. S. (2006). Reproductive performance of Korean native goats under natural and intensive conditions. *Small Ruminant Research*, 65: 284-287.

SPSS (Statistical Package for the Social Sciences). (2011). *IBM SPSS Statistics for Windows, Version 20.0. Armonk*, NY: IBM Corp. Inc.

Rawat, S. K., Narayan, S., Awasthi, M. & Dwivedi, S., (2015). Socio-Economic Analysis of Goat Rearing Farmers in Mahoba District of Bundelkhand. Agro Economist - An *International Journal*, 2 (2): 29-34.

Tesfaye Tsegaye (2009). Characterization of Goat Production Systems and on- Farm Evaluation of the Growth Performance of Grazing Goats Supplemented with different Protein Sources in Metema Woreda, Amhara Region, Ethiopia, MSc Thesis, Haramaya University, Haramaya, Ethiopia.

Tsedeke Kocho (2007). Production and Marketing Systems of Sheep and Goats in Alaba, Southern Ethiopia, MSc Thesis, Hawassa University, Awassa, Ethiopia.

Workneh Ayalew, van Dorland, A. & Rowlands, J. (2004). Design, execution and analysis of the livestock breed survey in Oromiya Regional State, Ethiopia. Oromiya Agricultural Development Bureau. Addis Ababa, Ethiopia, and ILRI, Nairobi, Kenya, pp: 260.

Yilkal Tadele (2015). Small Ruminant Production and Marketing: Constraints and Opportunities in Chencha and Mirab Abaya Districts, Southern Ethiopia. *World Journal of Biology and Medical Sciences*, 2(1): 14-32.