



INTERNATIONAL JOURNAL OF VETERINARY MEDICINE AND ANIMAL SCIENCE (IJVMAS)

VOLUME 1 ISSUE 1 (2023)



PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

Breeding Practices and Reproductive Performances of Goat in Dollo Zone, Somali Regional State, Ethiopia

Abdi Abdilahi^{1*}, Fosiya Hussein², Mahamed Hassen¹, Aden Omer¹

Article Information

Received: August 05, 2023

Accepted: September 08, 2023

Published: September 15, 2023

Keywords

*Goat, Breeding Practice,
Reproductive Performance*

ABSTRACT

The aim of this study was to assess the breeding practices and reproductive performance of goats in the Warder, Danod, and Daratole districts of Dollo zone, Somali Regional State, Ethiopia. A total of 156 households (52 from each district) who own goats were randomly selected for the study and interviewed using a pre-tested, semi-structured questionnaire. In addition, the relevant data for this study were collected through interviews with key informants, focus group discussions, and personal observations. The study revealed that the majority (41.7%) of the respondents herded goats together with sheep, followed by herding goats alone (39.7%). The majority (75.6%) of the goat owners practiced an uncontrolled breeding system. The use of communal grazing land, lack of awareness, and insufficient breeding bucks were the main reasons for the uncontrolled mating system. The breeding bucks are born in the flock, which indicates that inbreeding within the flock is expected to be high and knowledge of inbreeding appears to be limited. Furthermore, the findings of the study indicated pastoralists in the study area practiced castration of male goats, the main reason being the fattening purpose (50%) of increasing the sale price of animals at the market. Male Somali goats reached puberty at 9.17 ± 0.12 months, while females reached 7.66 ± 0.09 months. The average age at first kidding was 14.13 ± 0.11 months, and the average interval was 7.69 ± 0.05 months. The average reproductive life span of the doe was 13.34 ± 0.05 years. The average number of kids per doe in her life span was 9.02 ± 0.08 . In conclusion, the study indicates that the reproductive performance of goats was generally found to be low. Therefore, goat productivity would be improved if adequate attention is paid to creating awareness about inbreeding, providing appropriate extension services and increasing the adoption of improved technologies. Further studies are needed to be conducted in order to determine the major factors driving the low reproductive performance of goats in the study locations.

INTRODUCTION

Goats, being adapted to different agro-ecologies, reared by various ethnic communities, and found in all production systems (Gizaw *et al.*, 2010), are important components of the livestock sector in Ethiopia and are mainly kept for the purpose of meat, milk, and skin production and income generation by smallholder farmers throughout the country (Dhaba *et al.*, 2012).

Ethiopia possesses one of the largest goat populations in the continent that serves multiple functions to communities that herd them. The total goat population in Ethiopia is estimated at 52.5 million and in Somali Regional State, about 16.4 million goats, excluding the data of six zones, are reared in various agro-ecologies (CSA, 2021).

In Ethiopia, goat production accounts for 16.8% of the total meat supply (Sebsibe, 2008) and 16.7% of milk consumed in the country (Kocho, 2007). In Ethiopia, the average annual meat consumption per capita is estimated to be 8 kg/year which was lower than consumption of meat in the USA (124 kg per capita per year) and that of the global average meat consumption (38 kg/year) (Sebsibe, 2008). The average carcass weight of Ethiopian goats is 10 kg, which is the second lowest in sub-Saharan

Africa (Yami and Merkel, 2008).

Goat inhabits a wide range of environments, extending from tropical to cool temperate climates (Zelalem and Fletcher, 1991). The small body size, broad feeding habits, adaptation to unfavorable environmental conditions and their short reproductive cycle provide goats with comparative advantage over other species to suit the circumstances of especially resource poor livestock keepers (Umeta *et al.*, 2011).

Goat production in many parts of Ethiopia is of traditional (Yayneshet, 2010) and the country benefited little from this sub-sector. Low productivity and the absence of market-oriented production system limit the volume of marketable livestock (Shenkute *et al.*, 2010). Feed shortage and poor quality of the available feed resources constrain animal output (Yayneshet, 2010; Tolera *et al.*, 2012).

Breeding goats have huge socio-economic importance such as generating cash income, accumulating capital, and also play a vital role as sources of meat, milk, and wool for smallholder keepers in different farming systems and agro-ecological zones of the country (Misbah, 2013; Yemane *et al.*, 2020). The small body size, broad feeding habits, adaptation to unfavorable environmental

¹ Department of Animal and Range Sciences, College of Dry Land Agriculture, Jigjiga University, Jigjiga, Ethiopia

² Livestock and Forage Research Directorate, Somali Region Pastoral and Agro-pastoral Research Institute, Jigjiga, Ethiopia

* Corresponding author's e-mail: abdiabdilahi17@gmail.com

conditions, and their short reproductive cycle provide goats with a comparative advantage over other species to suit the circumstances of especially resource-poor livestock keepers (Gobena, 2016).

In Ethiopia, farmers have different breeding practices and traits preferences due to varying production systems and activities (Ahmed, 2017). Farmers breeding management decision is determined by the merit of livestock species and breed, breeding objectives, and the production environment (Gizaw *et al.*, 2010). Breeding objectives are affected by many factors and have to consider the needs and priorities of the animal owners, the consumers of animal products, and the food industry. In Ethiopia, goat keepers practiced different selection criteria to select the best-performing animals according to agro-ecology, production system, and culture of the community (Zergaw *et al.*, 2016; Ahmed, 2017).

Indigenous goats in Ethiopia are genetically less productive than temperate breeds (Bedhane *et al.*, 2012). Even though there are large populations of goats, their productivity and the contribution to the country's national economy are far below the potential which could be due to different factors such as lack of technical capacity, inadequate and poor-quality feeds, the prevalence of diseases, poor genetic potential, poor husbandry practices, slow growth rate, high mortality rate, low commercial off-take rate, lack of appropriate breeding strategies, and poor understanding of the production system as a whole (Gobena, 2016; Melesse, 2016).

The performance of indigenous goat breeds of Ethiopia is highly variable between different management systems and little attention has been paid to the development of goats (Dereje *et al.*, 2015). In the country, there is also the absence of pre-evaluation of the genetic and bio-economic feasibility of breeding programs (Gizaw *et al.*, 2018).

In pastoral and agro-pastoral areas like Dollo zone, goats are important components of the production system which benefit small holder farmers in generating cash income as well as milk. Despite their potential in the area, productivity of goat remains quite low. Besides, there is a limited information in regard to goat breeding practices, and this suggests that there is a need for research and it is crucial to systematically assess breeding practices, and reproductive performance of goats in order to plan and design appropriate development interventions that are relevant to the specific systems in the area. Therefore, the objective of this study was to assess the breeding practices and reproductive performance of goat in Dollo zone, Somali Region, Ethiopia.

MATERIALS AND METHODS

Description of the Study Area

This research work was conducted in three districts of Dollo zone, Somali regional State, Ethiopia. Dollo zone is one of the eleven zones in the Somali region of Ethiopia. Dollo zone is bordered on the southwest by Korehei

zone, on the northwest by Jarar zone, and on the northeast and southeast by Somalia. Warder is the administrative center of the zone and has a latitude and longitude of 6°58'N 45°21'E with an elevation of 541 meters above sea level. It has an annual average temperature of 28°C. Warder is 537 km from Jigjiga and 1131 km from Addis Ababa. Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia, this Zone has a total population of 306,488, of whom 175,624 are men and 130,864 are women. Livestock species such as goats, sheep, camels, and cattle are integral components of the livelihood of the communities in the zone.

Warder district is bordered on the southwest by the Korahe Zone, on the north by Danot district, and on the east by Geladi district. The average elevation in this district is 943 meters above sea level and it lies 6°50'N 45°30'E. Danot district is bordered on the south by Warder, on the west by the Korahe Zone, on the northwest by the Jarar Zone, on the north by Somaliland, on the east by Boh district, and on the southeast by Galadi. It lies 7°50'N 45°50'E. Daratole district is bordered on the south by Warder, on the west by the Korahe Zone, on the northwest by Danot district, on the east by Boh, and on the southeast by Galadi.

Study Design and Sampling Procedure

This study was a cross-sectional investigation to collect relevant information on goat husbandry practices and major constraints of goat production in the study area. The sample selection was conducted by using purposive sampling technique based on the abundance of goat rearing practices and road accessibility in consultation with zonal and district bureau of agriculture experts. Thus, in order to achieve the objective of the study, purposive sampling was applied on three districts among the seven districts of the zone which dominantly have the potential of goat production. Nine Kebeles (three from each district) were selected purposively based on the availability of goat as one of their key livestock species. Lastly, 156 households (52 households from each district) who own goats were selected randomly for this study.

Data Collection and Analysis

The relevant data for this study was collected by using semi-structured questionnaire that was prepared for interviewing selected goat owners, key informants interview and focus group discussions. One focus group discussion was held within each kebele with a minimum of eight members from each location. The data was analyzed using descriptive statistics such as mean and percentage, using SPSS (ver. 26.0) as well as MS Excel (2016) for data arrangement and simple calculations such as mean.

RESULTS AND DISCUSSION

Demographic Characteristics of the Households

Table 1 shows the sex, age, educational status and family size of the respondents in the study area. Majority of the

respondents were males (72.4%) while the rest (27.6%) were females. The overall average age of the respondents was 44.2 years old. Majority (76.9%) of the respondents were illiterate. The higher percentage of illiteracy is similar with the findings of Ma'alin *et al.* (2022) who reported a higher proportion of illiteracy and religious schools education for Shabele zone of the Somali region. Similarly, Bereda (2013) reported a higher proportion of illiteracy and religious schools' education for Godey and

Adadle districts of Somali region. The role of education is obvious in affecting household income, adopting technologies, demography, health, and as a whole the socio-economic status of the family as well (Kerealem, 2005). The overall average family size of the study districts was 5.90 ± 0.17 . However, the reported average family size in this study is lower than that of 6.41 ± 1.3 reported by Ma'alin *et al.* (2022) for Shabele zone of Somali region.

Table 1: Sex, age, educational level and family size of the respondents (%)

Variables	Districts (%)			
	Warder	Danod	Daratole	Overall
Sex				
Male	26.9	25	30.8	27.6
Female	73.1	75	69.2	72.4
Age (Mean \pm SE)	44.2 \pm 1.3	44.4 \pm 1.30	44.0 \pm 1.3	44.2 \pm 0.74
Educational level				
Illiterate	75	78.8	76.9	76.9
Primary school	17.3	15.4	17.3	16.7
Religious school	7.7	5.8	5.8	6.4
Family size (Mean \pm SE)	6.17 \pm 0.33	5.92 \pm 0.32	5.62 \pm 0.27	5.90 \pm 0.17

SE= standard error

Herding of Goats

Herding and grazing practices of goats in the study area are summarized in Table 2. Majority (46.2%) of the respondents reported that kids are separated from adult goats during herding. About 26.3% of the respondents indicated that males and females are herded together while 14.1% reported that all classes are herded together. In addition, about 13.5% of the respondents reported that males and females are separated during herding.

On the other hand, the study revealed that the majority of the respondents herded goats together with sheep, followed by herding goats alone (39.7%) and few (18.6%) of them herded goats with other livestock. This finding is in line with the study of Ambel *et al.* (2021) who reported that majority of the respondents in Meanit Goldiya (West Omo zone) and Guraferda districts herded their goats separately, followed by herding with sheep.

Table 2: Herding practices of goats in the study area

Parameters	Districts (%)			
	Warder	Danod	Daratole	Overall
Herding of goat during day				
Male & females separated	15.4	13.5	11.5%	13.5
Kids are separated	40.4	48.1	50.0%	46.2
All classes are herded together	17.3	13.5	11.5%	14.1
Males & females are herded together	26.9	25.0	26.9%	26.3
Goat flock herded with				
Together with sheep	34.6	50.0	40.4	41.7
With all other livestock	21.2	9.6	25	18.6
Herded alone	44.2	40.4	34.6	39.7

Breeding Practices and Management

Breeding practices and management of goats in the study area is illustrated in Table 3. Majority (75.6%) of goat owners have no control over the mating of their animals. The use of communal grazing land, lack of awareness and insufficient breeding bucks were the main reason for

uncontrolled mating. The study also revealed that the main purpose of keeping bucks in the study area was fattening (57.1%), socio-cultural functions (35.2%) and mating (7.7%) respectively as shown in Table 3. This finding is inline the finding of Gatew *et al.* (2017) who reported that majority of goat owners in Bati (88.78%), Borana

(98.48%) and Siti (98.26%) areas practiced uncontrolled natural mating due to extensive communal production system in all the study areas.

About 75% of the interviewed goat owners have their own bucks born in the flock and about 16.7% of the respondents use the breeding bucks of their neighbors or relatives. On other hand, 8.3% of the respondents obtained through purchasing (Table 3). Though, breeding

is one of the most important tools of improving animal performances none of the respondents reported to have basic breeding plan of their flock and mating of the flock was carried out randomly elsewhere in the field and/or during the night in the barn. This finding is in line with the report of Tesfaye and Tamir (2015) in Yabello district of Borana zone, Southern Ethiopia.

Table 3: Mating system, purpose of keeping bucks, and sources of breeding bucks in the study area

Variables	Districts (%)			
	Warder	Danod	Daratole	Overall
Mating system				
Controlled mating	21.2	32.7	19.5	24.4
Uncontrolled mating	78.8	67.3	80.8	75.6
Reasons of uncontrolled mating				
Goats graze together	53.8	50	55.5	53.2
Lack of awareness	30.8	17.3	17.3	21.8
Insufficient of bucks	3.8	0	7.7	3.8
Purpose of keeping bucks				
Mating	9.6	1.9	11.5	7.7
Socio-cultural	55.8	7.7	42.3	35.2
Fattening purpose	34.6	90.4	46.2	57.1
Sources of buck				
Born in the flock	69.2	80.8	75	75
Neighbor's buck	19.2	13.5	17.3	16.7
Purchased	11.5	5.8	7.7	8.3

Castration Practices

Pastoralists in the study area practiced castration of male goats for fattening purpose (50%) of increasing sale price of animals at market, breeding purpose (7.1%), and both breeding & fattening purpose (42.9%) concurrently (Figure 1). This finding is in line with the study of Ambel *et al.* (2021) who reported that majority (90.6%) of the goat owners in South western Ethiopia practiced castration to

improve fattening to obtain better market price, both for fattening and better temperament. However, this finding is in contrast with the finding of Angassa and Berhan (2015) who reported that pastoralists in Yabello district practice goat castration infrequently; blaming castrations affect the growth and sale price of animals at market. This was due to the fact that late castration cause shocks to the growth of animals (Yami and Merkel, 2008).

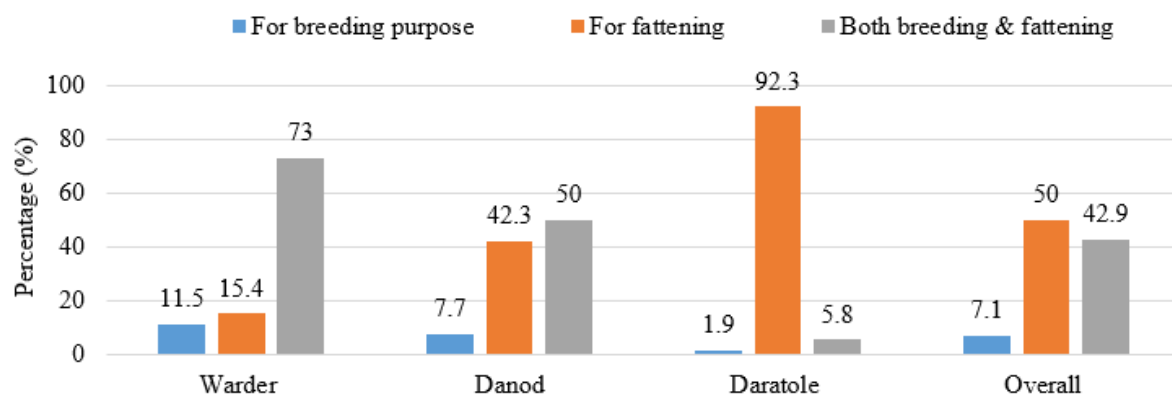


Figure 1: Reasons of castrating male goats in the study area

Reproductive Performance of Goats

Good reproductive performance is a prerequisite for any successful livestock production program. In any small ruminant production system, high reproductive

performance is a very important attribute and a major component of the overall production efficiency. Reproductive performances like age at puberty, age at first kidding, kidding interval, litter size and reproductive

life span of does are the most important traits of goat production. Reproductive performances of goat in the study area are summarized in Table 4.

According to the respondents, the age at puberty in Somali goats were 9.17 ± 0.12 months for males and 7.66 ± 0.09 months for females. This finding is within the range of age at sexual maturity reported for most of the tropical goat breeds under extensive system of management (Wilson, 1991; Farm-Africa, 1996).

The reported mean age at first kidding (AFK) for Somali goat was 14.13 ± 0.11 months. This is in agreement with that reported by Tsegaye (2009) for Metema goats that have mean AFK of 13.6 ± 2.44 months. This result is also in agreement with reported age at first kidding for Arsi-Bale goats which is 14.88 ± 0.3 months (Assefa, 2008).

Somali goat breed, according to the respondents had an average kidding interval of 7.69 ± 0.05 months. This result was shorter than the reported kidding interval for Abergelle and Central Highland goats which were 11.31 ± 2.21 and 10.3 ± 1.42 months, respectively (Deribe, 2008). This finding is also shorter than the average kidding interval of 8.41 ± 1.37 for Begait goats in western Tigray (Abraham *et al.*, 2017). Similarly, this result is shorter than the reported kidding interval for Metema goats which was 8.4 ± 1.37 months as reported by Tsegaye (2009).

Moreover, the reported kidding interval for Somali goats in this study area is in the range of kidding interval for most East African goats that ranged from 236-265 days (Wilson and Durkin, 1986). The kidding interval implies the possibility of achieving three kidding over a two-year period.

Higher longevity under adverse conditions is one of the adaptation traits of tropical livestock. The mean reproductive life span of does in the flock was reported 13.34 ± 0.05 years which is greater than that of 11.44 ± 1.17 years for Begait goats (Abraham *et al.*, 2017).

The average number of kids per doe per lifespan was 9.02 ± 0.08 . This is shorter than 15.32 ± 1.76 kids reported for Begait goats (Abraham *et al.*, 2017). The difference might be due to the management conditions mainly feed availability and nutrition.

Goat is the most prolific ruminant of all domesticated ruminants in tropical and sub-tropical regions. The reported average litter size for Somali goats in this study was 1.25 ± 0.03 . This finding is lower than the average Litter Size estimated for local goats in Alaba, Southern Ethiopia, which is 1.47 (Deribe, 2009). The reported litter size (1.07) and twinning rate (2.5%) of Short-eared Somali and Afar goats kept under on-station management system (FARM-Africa, 1996) are relatively small.

Table 4: Reproductive performance (Mean \pm SE) of goats in the study area

Reproductive traits	Districts			
	Warder	Danod	Daratole	Overall
Age sexual maturity- male (months)	8.84 ± 0.21	9.36 ± 0.20	9.30 ± 0.20	9.17 ± 0.12
Age sexual maturity- female (months)	7.69 ± 0.15	7.67 ± 0.15	7.61 ± 0.16	7.66 ± 0.09
Age at first kidding (months)	14.03 ± 0.17	14.21 ± 0.20	14.15 ± 0.20	14.13 ± 0.11
Kidding interval (months)	7.67 ± 0.09	7.73 ± 0.10	7.69 ± 0.09	7.69 ± 0.05
Liter size (number)	1.25 ± 0.06	1.27 ± 0.06	1.23 ± 0.05	1.25 ± 0.03
Reproductive life span of does (years)	13.34 ± 0.10	13.36 ± 0.09	13.32 ± 0.10	13.34 ± 0.05
Number of kids/doe/lifespan	9.13 ± 0.17	9.0 ± 0.12	8.94 ± 0.12	9.02 ± 0.08

CONCLUSION

Uncontrolled natural mating was a prevalent practice in the area because of the extensive communal production system and a lack of awareness and knowledge. The breeding bucks are born in the flock, which indicates that inbreeding within the flock is expected to be high and knowledge of inbreeding appears to be limited. Male Somali goats reached puberty at an average age of 9 months, while females reached puberty at an average age of 7.66 months. The average age at first kidding was 14 months, and the average interval was 8 months. The average reproductive life span of the flocks was 13 years. The average number of kids per doe in her lifespan was 9, and the average litter size was 1.25. In conclusion, the study indicates that the reproductive performance of goats was generally found to be low. Therefore, goat productivity should be improved through awareness creation about inbreeding, increasing adoption of improved technologies, and providing appropriate

extension services. The study suggests further studies in order to determine the major factors driving the low reproductive performance of goats in the study locations.

REFERENCES

- Abraham, H., Gizaw, S., & Urge, M. (2017). Begait goat production systems and breeding practices in Western Tigray, North Ethiopia. *Open Journal of Animal Sciences*, 7(02), 198-212. <https://doi.org/10.4236/ojas.2017.72016>.
- Ambel, S., Bayou, E., & Genzebu, D. (2021). Indigenous Goat Husbandry Practices and Its Production Environment in Case of South Western Ethiopia. *American Journal of Zoology*, 4(1), 1-8. <https://doi.org/10.11648/j.ajz.20210401.11>.
- Assefa, E. (2008). Assessment of production and marketing system of goats in Dale District, Sidama Zone. MSc thesis (Animal Production). 170p. Awassa (Ethiopia): Hawassa University. <https://hdl.handle>.

- net/10568/697
- Bedhane, M., Haile, A., Dadi, H., & Alemu, T. (2012). Estimates of genetic and phenotypic parameters for milk traits in Arsi-Bale goat in Ethiopia. *Livestock Research for Rural Development*, 24(6).
- Bereda, W. (2013). On-Farm Phenotypic Characterization of Black Head Somali Sheep and Their Role for Pastoral and Agro-Pastoral Community in Gode Zone, Somali Region. An MSc Thesis Presented to the School of Graduate Studies of Haramaya University, Ethiopia.
- CSA (Central Statistical Agency) (2021). Agricultural Sample Survey of 2020/21 (2013 E.C). Volume II. Report on Livestock and Livestock Characteristics (Private Peasant Holdings), Central Statistical Agency, Addis Ababa, Ethiopia.
- Dereje, T., Mengistu, U., Getachew, A., & Yoseph, M. (2015). A review of productive and reproductive characteristics of indigenous goats in Ethiopia. *Livestock Research for Rural Development*, 27(2).
- Deribe, B. (2008). Growth, reproductive performance and carcass characteristics of Abergelle and central highland goat types under traditional and slightly improved management in Sekota Woreda. MSc, School of Graduate Studies of Haramaya University, Haramaya, Ethiopia.
- Dhaba, U., Belay, D., Solomon, D., & Taye, T. (2012). Sheep and goat production systems in Ilu Abba Bora Zone of Oromia Regional State, Ethiopia: feeding and management strategies. *Global Veterinaria*, 9(4), 421-429. <https://www.cabdirect.org/cabdirect/abstract/20123396404>
- FARM-Africa. (1996). Goat Types of Ethiopia and Eritrea. Physical description and management systems. Published jointly by FARM-Africa, London, UK and International Livestock Research Institute, Nairobi, Kenya.
- Gatew, H., Hassen, H., Kebede, K., Haile, A., Lobo, R. N. B., Yetayew, A., & Rischkowsky, B. (2017). Husbandry practices and phenotypic characteristics of indigenous goat populations in Ethiopia. *African Journal of Agricultural Research*, 12(36), 2729-2741. <https://doi.org/10.5897/AJAR2016.11282>
- Gizaw, S., Abegaz, S., Abebe, A., Muluneh, D., & Tesfay, Z. (2018). Livestock breeding strategy for Ethiopia: Small ruminant breeding strategy (2018-2030). Addis Ababa, Ethiopia: Ministry of Agriculture and Livestock.
- Gizaw, S.; Tegegne, A.; Gebremedhin, B.; Hoekstra, D. 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. 58p. Nairobi (Kenya): ILRI. <https://hdl.handle.net/10568/2238>
- Gobena, M. M. (2016). Production performance, challenges and opportunity of goat production in Ethiopia. *Advances in Life Science and Technology*, 50(2224-7181), 26-35. <https://core.ac.uk/download/pdf/234687434.pdf>
- Kerealem, E. (2005). Honeybee production system, opportunities and challenges in Enebesar midir woreda (Amahara region) and Amaro special woreda (SNNPR), Ethiopia. Unpublished M.Sc. Thesis, Alemaya University, Alemaya.
- Kocho, T.K (2007). Production and marketing systems of sheep and goats in Alaba, Southern Ethiopia. An MSc Thesis, Hawassa University, Ethiopia.
- Ma'alin, A., Abdimahad, K., Hassen, G., Mahamed, A. & Hassen, M. (2022). Management Practices and Production Constraints of Indigenous Somali Cattle Breed in Shabelle Zone, Somali Regional State, Ethiopia. *Open Journal of Animal Sciences*, 12, 103-117. <https://doi.org/10.4236/ojas.2022.121008>.
- Melesse, A. (2016). Effect of flushing with energy and protein source diets on the reproductive performances of meat goats with high and low body condition scores. *Global Journal of Science Frontier Research: Agric. Vet.*, 16(2), 1-7. 28.
- Misbah, F. (2013). Community-based characterization of Afar goat breeds around Aysaita district of Afar region. An M.Sc. Thesis. Jimma University, Jimma, Ethiopia:).
- Sebsibe, A. (2008). Sheep and goat meat characteristics and quality. Sheep and Goat Production Handbook for Ethiopia. Ethiopian Sheep and Goats Productivity Improvement Program (ESGPIP), Addis Ababa, Ethiopia. 323-328.
- Shenkute, S., 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). <http://www.lrrd.org/lrrd22/10/shen22186.htm>
- Tesfaye, A., & Tamir, B. (2015). Assessment of goat production and marketing practices, constraints and opportunities in Yabello District of Borana Zone, Southern Ethiopia. *International Journal of Innovative Research and Development*, 4(11), 2278-0211.
- Tolera, A., Yami, A., & Alemu, D. (2012). Livestock feed resources in Ethiopia: Challenges. Opportunities and the Need for Transformation. National feed committee report, Ethiopian animal feed industry association (EAFIA) and the ministry of agriculture and rural development (MoARD). Image enterprise PLC, Addis Ababa, Ethiopia. 50p
- Tsegaye, T. (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 (Animal Nutrition). 108p. Haramaya (Ethiopia): Haramaya University. <https://hdl.handle.net/10568/707>
- Umata, G., Duguma, M., Hundesa, F., & Muleta, M. (2011). Participatory analysis of problems limiting goat production at selected districts of East Showa zone, Ethiopia. *African Journal of Agricultural Research*, 6(26), 5701-5714. <https://doi.org/10.5897/AJAR11.314>.

- Wilson, R. T. (1991). Small ruminant production and the small ruminant genetic resource in tropical Africa (Vol. 88). Food and Agriculture Organization of the United Nations, Rome, Italy.
- Wilson, R. T., & Light, D. (1986). Livestock production in central Mali: economic characters and productivity indices for traditionally managed goats and sheep. *Journal of Animal Science*, 62(3), 567-575. <https://doi.org/10.2527/jas1986.623567x>
- Yami, A. & Merkel, RC (2008). Economic significance of sheep and goats. In: Alemu and Yami and R.C. Markel (Eds). Sheep and Goat Production Handbook for Ethiopia. Ethiopia Sheep and Goats Productivity Improvement Program (ESGPIP). Addis Ababa, Ethiopia. 2-24.
- Yayneshet, T. (2010). Feed resources availability in Tigray region, northern Ethiopia, for production of export quality meat and livestock. Examples from selected Woredas in Tigray Region State. Consultation report submitted to the Ethiopia Sanitary and Phytosanitary Standards and Meat Marketing Program. 87.
- Yemane, G., Melesse, A., & Taye, M. (2020). Evaluation of production systems and husbandry practices of Ethiopian indigenous goats. *Online Journal of Animal and Feed Research*, 10(6), 268-277. <http://eprints.science-line.com/id/eprint/41/>
- Zelalem, A., & Fletcher, I. (1991). Small ruminant productivity in the central highlands of Ethiopia. In Proceedings of the 4th National Livestock Improvement Conference (NLIC), Addis Ababa, Ethiopia (pp. 13-15)
- Zergaw, N., Dessie, T., & Kebede, K. (2016). Indigenous breeding practices and selection criteria of goat owners in Konso and Meta-Robi districts, Ethiopia: implications for designing community-based breeding strategy. *Livestock research for Rural Development*, 28, 133.