# FATTENING PRACTICES FEED RESOURCES AND MARKETING SYSTEM OF SMALL RUMINANTS IN PERI-URBAN AND URBAN AREA OF DODOLA TOWN, WEST-ARSI, OROMIA, ETHIOPIA

MSc THESIS

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# FATTENING PRACTICES FEED RESOURCES AND MARKETING SYSTEM OF SMALL RUMINANTS IN PERI-URBAN AND URBAN AREA OF DODOLA TOWN, WEST-ARSI, OROMIA, ETHIOPIA

BY

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(SPECIALIZATION: ANIMAL PRODUCTION)

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We, the undersigned as the members of the board of the examiners of the final MSc open defense by **Gamada Karicho**, have read and evaluated his entitled "**Fattening practices, feed resources and marketing system of small ruminants in peri-urban and urban areas of Dodola town, West-Arsi, Oromia, Ethiopia"**, and examined the candidate. This is to certify that the thesis has been accepted in partial fulfilment of the requirement for the **degree of master of sciences (MSc)** in animal and range science with the specialization in **Animal production**.

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# DEDICATION

This thesis is dedicated to all of my beloved family, especially for my mother Luncho Woticha for nursing me by taking care of both the father and mother and with unconditional love and great sacrifice. This piece of work also dedicated to my brother Gemechis Karicho for his ceaseless encouragement and for cherishing me with a devoted partnership in the success of this piece of work.

# STATEMENT OF THE AUTHOR

I declare and confirm that this thesis is my genuine work and all source of materials used for this thesis have been profoundly acknowledged through citation. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of this thesis. This thesis has been submitted in partial fulfillment of the requirements for the masters of Science (MSc) degree at Hawassa University, and it is deposited at the University library to be made available for users under the rule of the library. I declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma or other certificate. Brief quotation from this thesis may be allowable without requiring special permission, provided that accurate and complete acknowledgement of the source is made.

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# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ASL | Africa Sustainable Livestock |
| CF | Crude fiber |
| CP | Crude protein |
| CSA | Central Statistical Agency |
| DM | Dry matter |
| DTADO | Dodola Town Agricultural Development Office |
| DTFEDO | Dodola Town Finance and Economy Development Office |
| DTLDO | Dodola Town Livestock Development Office |
| EARO | Ethiopian Agricultural Research Organization |
| EE | Ether extract |
| EMDTI | Ethiopian meat and dairy industry development institute |
| EGAS | Ethiopian Geospatial Agency Satellite |
| FAO | Food and Agricultural Organization |
| GDP | Growth Domestic Product |
| ILCA | International Livestock Centre for Africa |
| ILRI | International Livestock Research Institute |
| LMIS | Livestock Marketing Information System |
| MOA | Ministry of Agriculture |
| N | Nitrogen |
| NFE | Nitrogen free extract |
| NGO | None Governmental Organization |
| SSA | Sab-Saharan Africa |
| SPSS | Statistical Package For Social Science |
| USD | United State Dollar |

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**Fattening Practices Feed Resources and Marketing System of Small Ruminants in Peri-Urban and Urban Areas of Dodola Town, West-Arsi, Oromia, Ethiopia**

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**Advisor: Temesgen Desalegn (PhD): Hawassa University**

## ABSTRACT

*The study was conducted in peri-urban and urban areas of Dodola town in Dodola woreda, West Arsi Zone of Oromia Regional State, Ethiopia, with the objectives of identifying and generating comprehensive information on fattening practices, feed resources, and marketing system of small ruminants. The study is composed of two parts; a Survey part and Laboratory analysis part. For the survey parts, a total of 147 respondents were randomly selected from four purposively selected kebeles. The closed and open-ended questionnaire were used for collecting quantitative and qualitative data. The collected data were analyzed using SPSS, version 26 software. Independent sample T-test means comparison was employed for quantitative data. The index was computed for the ranked data. The overall average land holding of the respondents was 1.8±0.2 hectares, out of which 1.6±0.1 hectare was allocated for crop production. Livelihood of the society was highly depended on crop production (61.2%), followed by mixed crop and livestock production (22.4%). The major purpose of small ruminant fattening was to generate income (44.90%), however fattening practice held was a traditional system (85.71), with a low (3.2±0.1) average number of fattened sheep and/or goats per fattening cycles. Available feed resources were seasonal based, thus natural pasture (59.18%) and crop residues (61.22%) were used during wet and dry season, respectively. Improved forage production and utilization as well as urea treatment was not adopted in the study areas. Free grazing (71.43%) was dominant feeding system in the study areas. For the laboratory part; Totally 11 feed samples were taken for laboratory analysis. Six feed samples from both peri-urban and urban, three feed samples from urban, and two feed samples from peri-urban area. The average (Mean ± SE) chemical composition (DM, CP, EE, Ash, NDF, ADF and ADL) of feed resources were determined on DM basis. The actual dry matter contents of selected feed types were ranged between 33.9±0.4 of mixed grass in peri-urban area to 86.8±0.1 of screened barley by-product in urban area. The highest (28.6±0.0) CP content was recorded in linseed cake, whereas crop residues contain low (3.2±0.1-4.7±0.0 of barley straw and 3.8±0.0-4.5±0.0 of wheat straw) CP contents in current study area. On the other hand, crop residues contain high content of NDF, ADF and ADL than other feed types selected in current study area. Small ruminants marketing in study area was seasonal, where target markets (71.4%) were used for selling. Producers-small traders (58.50%) selling was identified as the main market channel, with high number of small traders (67.35%) as market actors. Decline in grazing land, feed shortage and disease and parasite were the top three challenges, whereas small starting budget, increased price and high market demand were ranked as 1st, 2nd and 3rd opportunities of small ruminants fattening in current study areas.*

***Key Words:*** *Challenges, Fattening practices, Feed resources, Feeding system, Marketing system, Opportunity*

# 1. INTRODUCTION

Ethiopia is endowed with a huge livestock population in Africa, estimated at 70 million cattle, 42.9 million sheep, 52.5 million goats, about 2.15 million horses, 10.80 million donkeys, 0.38 million mules, about 8.1 million camels, 7 million bee colonies and about 57 million chickens (CSA, 2021). Livestock production plays an important role to smallholder farmers, and the national economy of the country in generating income, creating job opportunities, ensuring food security, providing services, and contributing to asset, social, cultural and environmental values (Endalew and Ayalew, 2016). For the national economy, livestock contributes about 45% of the agricultural gross domestic product, 18.7 % of the national gross domestic product and between 16 – 19 % to the total foreign exchange earnings of the country (Eshetie *et al.,* 2018) and the subsector supports and sustains livelihoods of about 80% of the rural population (Ayalew *et al.,* 2019; Abebe *et al.,* 2022). However, the livestock production and management system are mainly extensive, where Indigenous breeds are kept under low-input/low-output husbandry practices.

Ruminants are among the major economically important livestock in Ethiopia, playing an important role in the livelihood of resource-poor farmers and are mainly kept for immediate cash sources, milk, meat, hide, skin, wool, manure, and saving (Hagos *et al.,* 2017; Hagos *et al.,* 2018). The annual contribution of ruminants to meat production in Ethiopia was estimated to be over 3.2 million tones representing over 72 % of the total meat production (Issack *et al.,* 2017), and over 50 % of the total meat output in Sub-Saharan Africa (Wabalo and Anja, 2018). The majority of meat produced in Ethiopia is beef (28.9%) followed by mutton (24.3%), goat meat (21.8%), chicken (15.9%), and camel meat 9.2% (Gezahagn and Mekonnen 2022). Small ruminants are a very common asset in Ethiopian household's economy and about 70% of the total population depend on small ruminants for their livelihoods (ASL, 2018). Small body size, broad feeding habits, disease resistance, ability to walk a long distance to search for feed, high tolerance to adverse climatic conditions with endurance of drought and to low and fluctuating nutrient availability, and their short reproductive cycle provide small ruminants with comparative advantage over other species to suit the circumstances of especially resource poor livestock keepers (FAO, 2004; CTA, 2007 and Kosgey *et al.,* 2008).

Even though Ethiopia is the largest livestock population, the production of sheep and/or goats meat is still low (Gezahagn and Mekonnen, 2022) and small ruminant fattening has not been fully utilized for several reasons, including feed shortage, diseases and parasites, season (drought), shortage of grazing land, market access, breeds, veterinary and extension services and other infrastructure. Among those constraints inadequate supply of quality and quantity feed, drought, diseases and parasites, breed and markets were the main reasons for low productivity of the indigenous small ruminants in Ethiopia (Abera, 2021).

Feeds are the major factor that determines the production potential of livestock and is crucial for the fulfillment of the nutritional requirements of animals. Ruminant feed resources in Ethiopia are pasture grazing (private grazing, communal land grazing, fallow grazing, roadside grazing), crop residues, crop stubble, browses, and non-conventional feeds (such as household food leftovers, weeds, crop tillers and fillers), improved forages (Tsedeke, 2007; Belete *et al.,* 2015). The contribution of these feed resources, however, depends on the agro ecology, the types of crops produced, accessibility, and production system (Azage *et al*., 2013).

### 1.1. Statement of Problem and Justification

In the present study area, small ruminants are one of the most important and integral components of crop-livestock farming activities, and play an important role in the livelihood of the engaged respondents through income generation, source of meat for home consumption, buying food materials, saving account, teaching children, pay taxes, buying input for crop production, emergence use, source of manure, etc. (ARDODW, 2021; DTADO, 2023). However, no work has been done to characterize fattening practices, feeds resources, feeding system, and associated factors affecting small ruminant fattening and marketing. There was also scanty information on chemical composition of major feed resources used for fattening, and it has not yet been documented in the literature. Generating data on fattening practices, major feed resources, chemical composition of major feeds, feeding system and marketing of small ruminants in the current study area could have paramount importance in identifying the existing fattening practice, available feed resources and marketing of the small ruminants.

The baseline information collected in this study could serves the stakeholders and police makers to follow and design the most appropriate fattening system, proper utilization of available feeds, feeding, management system and marketing to improve small ruminant's productivity, and could serve as a baseline for further researches. Therefore, this study was intended to address these issues in peri-urban and urban area of Dodola town, West-Arsi, Oromia, Ethiopia with the following objectives.

## 1.2. Objectives

### 1.2.1. General objective

- To assess fattening practice, feed resources, and marketing of small ruminants in peri-urban and urban area of Dodola town, west-Arsi, Oromia Ethiopia.

### 1.2.2. Specific objectives

- To assess fattening practice, feeds and feeding system and evaluate chemical composition of major feeds of small ruminants in study areas
- To assess marketing system of small ruminants in peri-urban and urban area of Dodola town.
- To assess challenges and opportunities of small ruminants fattening in peri-urban and urban area of Dodola town.

# 2. LITERATURE REVIEW

## 2.1. Small Ruminants Fattening System in Ethiopia

Despite the wide distribution and large size of the Ethiopian sheep and goat population, their productivity is low; they grow slowly and lamb/kid mortality is high (Legese *et al.,* 2014). This may be due to different factors such as poor nutrition, prevalence of diseases, lack of appropriate breeding strategies and poor understanding of the production system as a whole (Tsegaye, 2009). There is an urgent need to increase the productivity of sheep and goats to improve household income and nutrition, and to meet the demands of the growing human population and foreign markets (Legese *et al.,* 2014). Meat production offers opportunity to serve a vast export market as well as Ethiopia's domestic market. The total meat production increases from 66,380 tons with 28,630 tons from sheep and 37,750 tons from goat in 2001 year to 285, 490 tons with the share of 147,740 tons from sheep and 137,750 tons from goat in 2020 year (Diribi and Aman, 2022).

The trend of small ruminant meat production in Ethiopia shows that, it is rising moderately, of course with some fluctuations from 2001 to 2020 (FAOSTAT, 2022). However, there is no specialized meat animal breeds and fattening system in Ethiopia, when compared with that of commercial/intensive cow-calf, stocker and finisher beef cattle production systems found in USA, Australia, Canada and other European countries (Agus and Widi, 2018). According to MOA (1996), in Ethiopia there are three different types of fattening systems. Those are traditional, by-product based fatting and Harerghe fattening system. These systems practiced not only for cattle fattening, but also for sheep and/or goats fattening practice in Ethiopia (Deginet, & Abiy. 2020).

### 2.1.1. Traditional fattening system

This system generally depends on free grazing of natural or planted pastures with no or variable degrees of supplementation. In these systems, livestock are typically fed on natural grazing land and supplemented with locally available feed materials. This system is widespread across rural areas and is practiced by smallholder farmers who rely on subsistence farming. Animals require a long period of time to attain market weight and condition. Meat yields obtained from this type of animals are low and of poor meat quality, and the farmers return is often inadequate. Feed shortages, particularly in the dry season, can limit the effectiveness of fattening. Limited access to veterinary services may lead to health issues affecting productivity. It is also associated with huge fluctuations in the weights and conditions of the animals depending on feed availability (Deginet, & Abiy, 2020).

### 2.1.2. By-product based fattening system

By-product-based fattening is a more intensive system that uses agricultural by-products and crop residues to supplement the diet of small ruminants. This system has gained importance due to its potential to improve the weight gain of animals and increase productivity, especially in areas with better access to crop production and by-products. Agro-industrial by-products produced in Ethiopia includes; by-products from flour milling, oil processing, sugar factory, cereal milling by- product and brewery by-products (Deginet, & Abiy, 2020). Most of the time this type of feed is used by the commercial feedlots than small scale fattening. Crop residues are becoming increasingly important as sources of roughage in feedlots. Field crops produce large quantities of crop residues (straws, stoves and haulms) in addition to their main product- grain. These include cereal straws (e.g. teff, wheat, barley, maize, sorghum etc.), grain legume haulms (e.g. haricot beans, field peas, chickpeas, lentils, groundnut etc.). The by-product-based system may incorporate better management practices, such as mixed feeding with a combination of dry matter, grains, and protein-rich supplements. This system aims to achieve rapid weight gain within a short time frame. It offers more access to veterinary services, including regular deworming, vaccinations, and disease control, ensuring better health and productivity.

### 2.1.3. Harerghe fattening system

Farmers keep a small number of sheep, and goats mainly one and some of them two, which are mostly purchased from market, fattened and sold for meat (Shitahun, 2009). The system is largely based on cut-and-carry feeding of individually tethered animals. Grazing is rare (Belete *et. al.,* 2010). The Harerghe highland fattening system depends upon thinning from annual crops during the growing season and feeding to the individually tethered animals on cut and carry system and on stored crop residues during the dry season. The major feed resources are sorghum and maize strove, maize and sorghum leaves, thinned maize and sorghum seedlings and sterile plants, and weeds grown in crop fields (Adugna, 2008; Gebregziabher and Gebrehiwot, 2011).

## 2.2. Indigenous Breeds of Small Ruminants

Most of the Ethiopian sheep and goat breeds are indigenous to the country representing about 99.52% of the sheep and 99.90% of the goats are exclusively indigenous breeds (CSA, 2021). Indigenous sheep and goat genetic resources have developed specific adaptations to survive and produce under adverse local environmental conditions and to perform better under low input system (Markos, 2006). Sheep found in Ethiopia could fall into different breeds and types whose distribution ranges from midland to highland environments (Diribi and Aman, 2022).

Sheep were domesticated as dual-purpose animals to produce wool and meat, early people would have valued sheep milk as well (Diribi and Aman, 2022). As in many African countries, the indigenous sheep of Ethiopia actually comprises goat with a wide range of morphologic or genetic diversity (Diribi and Aman, 2022). Currently, six breed group and nine breeds of indigenous sheep in Ethiopia named based on their physical characteristics, genetic differences at the DNA level, tail type/shape and fiber type (Awgichew and Abegaz, 2008). The indigenous goats of Ethiopia actually comprises goats with a wide range of morphologic or genetic diversity (Diribi and Aman, 2022). Currently, four families and twelve breeds of indigenous goats are found in Ethiopia, based on their physical characteristics and genetic differences at the DNA level (Alemu, 2004).

Table 1. Indigenous Breeds of small ruminants in Ethiopia.

| **Breed groups, sheep breed and population** | | | **Goat families and breeds** | |
|---|---|---|---|---|
| Breed group | Sheep breed | Population | Family name | Goat breed |
| Short-fat tailed | Simien | Simien | Nubian family | Nubian |
| | Short-fat tailed | Sekota, Farta, Tikur, Wollo, Menz | | |
| Long-fat-tailed | Horro | Horro | Rift valley family | Afar |
| | Arsi | Arsi-Bale, Adilo | | Abergelle |
| Washera | Washera | Washera | | Arsi-Bale |
| | | | | Woito-Guji |
| Thin-tailed | Gumuz | Gumuz | Somali family | Hararghe Highland |
| | | | | Short-eared Somali |
| | | | | Long-eared Somali |
| Bonga | Bonga | Bonga | Small East African family | Central Highland |
| Fat-rumped tail | Afar | Afar | | Western Highland |
| | Blackhead Somali | Blackhead Somali | | Western Lowland |
| | | | | Keffa |
| (Source: Gebremichael, 2008) | | | (Source: Hamito, 2009) | |

## 2.3. Feed Resources and Feeding System of Small Ruminants in Ethiopia

### 2.3.1. Major feed resources of small ruminants in Ethiopia

Livestock production throughout the world is dependent on a variety of feed resources. Major livestock feed resources in Ethiopia are natural pasture, crop residues, improved pasture and forage, agro-industrial by-products, conserved forages and other by-products like food and vegetable refusal, pods and leaves of trees, of which the first two contribute the largest share (Tolera *et al.,* 2012).

According to Hagos *et al.,* (2018) small ruminant feed resource in Ethiopia are mainly natural pasture, crop residue, fallow land and locally available brewery by-product (Atela) and salt. The fibrous agricultural residues contributes a major parts of livestock feed especially in the populated countries where land is prioritized for crop cultivation. Pasture grazing and crop residues are the major feed resources while improved feed was the least available feed resources for livestock production in Ethiopia. However, availability of the feedstuff is highly related with the agro-ecology, location, season, level of fattening enterprise, land availability, type of farming system and other related factors (Tolera *et al.,* 2012).

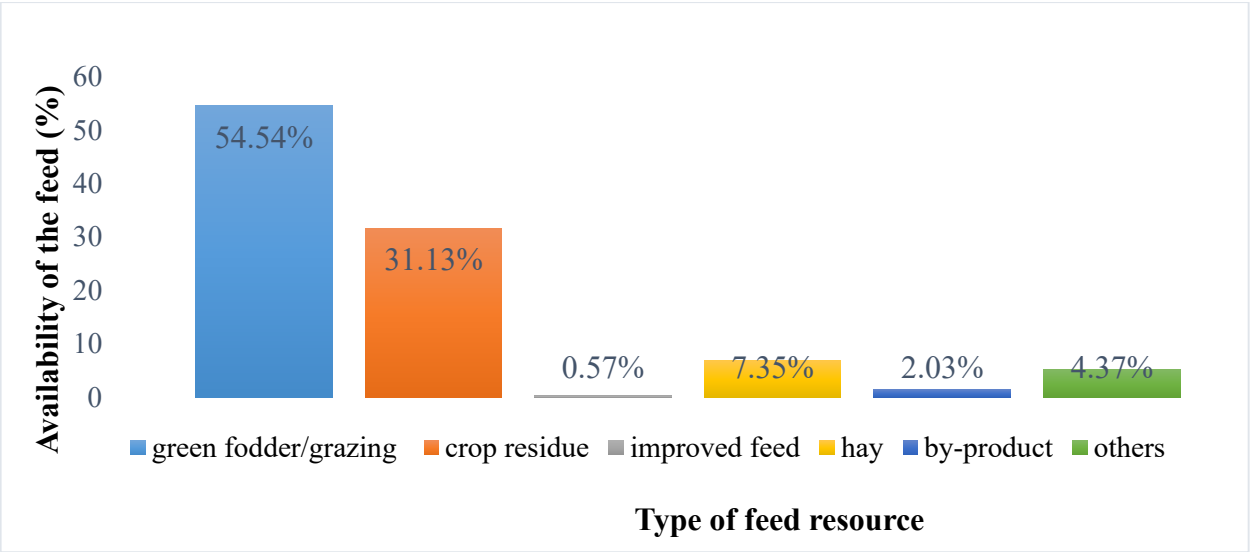
Natural pastures are naturally occurring grasses, legumes, herbs, shrubs and tree foliage that are used as animal feed. They are used either by direct in situ grazing or browsing by livestock or can be harvested and conserved as hay for using period of lean feed availability (Tolera *et al.,* 2012). Estimates of productivity of natural pasture vary probably due to variations in ecology, rainfall, soil type, season of the year, stage of growth and cropping intensity. Accordingly quantity and quality of feed obtained from natural pasture particularly decline in dry season.

Crop residues includes cereal straws and Stover, grain legume haulms and other by-products such as sweet potato vines, cassava tops, sugarcane tops and enset by-products. However, the principal crop residues used for animal feeding are the straws of cereals (teff, barely, wheat, maize, sorghum and millet); pulse crop residues (faba beans, chicken peas, haricot beans, field peas and lentils) (Tolera *et al.,* 2012). Accordingly, Tolera *et al.* (2012), reported that crop residues contribute to about 50% of the total feed supply in Ethiopia. Contributions of crop residues reach up to 80% in the dry seasons (Tolera *et al.,* 2007). However the actual quantities of crop residues available for livestock feeding is reduced by the costs of collection, transport, storage and processing, seasonal availability, other alternative use and wastage. The nutritive value of crop residue is variable depending on the species and variety of the crop, time of harvest, handling and storage and other factors (Tolera *et al.,* 2012). Cereal straw and Stover are generally characterized by relatively low nutrient content, high fiber content, low digestibility, and low voluntary intake by animals (Mohammed, 2015).

Fodder trees and shrubs are important animal feeds in Ethiopia especially in arid, semi-arid and mountain zones, where large number of the country's livestock is found (Alemayehu, 2004). Most browse species have the advantage of maintaining their greenness and nutritive value throughout the dry season when grasses dry up and deteriorate in quality and quantity (Rangnekar, 1992). The leaves and pods from fodder trees and shrubs are rich in CP, vitamins and mineral elements and lower in fiber content than dry grasses forage and crop residues (Tolera *et al.,* 2012).

Improved pasture and forages have, been grown and used in government ranches, state farms, farmers' demonstration plots and dairy and fattening areas (Alemayehu, 2004). Forage crops and grasses grown to feed dairy cattle include oats, vetch, fodder beet, elephant grass, siratro, desmodium, Rhodes grass, phalaris, sesbania, leucaenia and tree Lucerne (Mohammed, 2015). Despite the advantages of improved pasture and forage crops, due to unprecedented population increase, land scarcity and crop dominated farming, there has been limited introduction of improved pasture and forages to smallholder farming communities and the adoption of this technology by smallholder mixed farmers has been generally slow (Alemayehu, 2002; Mekoya *et al.,* 2008).

Agro-industrial by products produced in Ethiopia includes by-products from flour milling, oil seed cakes, sugar factory (molasses), abattoir and breweries. Milling by-products include bran and related by-products such as wheat short, wheat middling, rice bran and screening. These feed ingredients are the main constituents of concentrate feeds. These by-products are mainly used for dairy, fattening and commercial poultry production and the scope for their wider use by smallholder producers is low due to availability and price (Tolera *et al.,* 2012). The use of agro-industrial by-products for supplementary feeding is justified when the forage supply is inadequate for the animals' needs, in terms of either quantity or quality. Feed resource for small ruminants are of two source; inside the farm (farmer's own farm) and outside of the farm. Feed source from outside of the farm may include communal land, government provision, charity from NGO, purchased from other source etc.




(Source: CSA, 2021)

Figure 1. Livestock feed resources and proportion in Ethiopia.

### 2.3.2. Chemical composition of major feed in Ethiopia

Better understanding of chemical composition of available feed resources contribute to highlight potential gaps for quality improvement and proper utilization of the available feeds for livestock productivity improvement. However, lack of information on the nutritional quality of feeds could result in poor performance and susceptibility of livestock to the diseases (Tamene *et al.*, 2022). Different feed types are available in Ethiopia. These are broadly grouped into concentrates and roughage feeds. The main sources of concentrate feeds are agro-industrial by-products, whereas the main sources of roughages are natural pastures, crop residues, and cultivated forage and pasture crops (Tolera *et al.,* 2012). Agro-industrial by-products are rich in energy and/or protein.

They have low fiber content; high digestibility and energy values compared to commonly available feed resources in Ethiopia such as straw (Seyoum and Zinash, 1989). Wheat bran is the most common milling by-product used for livestock feeding in Ethiopia. Wheat bran can be used a source of energy and protein. It contains easily digestible carbohydrates, which are readily digested in the rumen with high energy yielding potential.

Wheat bran contains 15-18% crude protein. Wheat middling represent another by-product of the wheat milling industry. They are good sources of crude protein and supplemental energy. They also have about 92% of the energy value and contain nearly 40% NDF, which is highly digested in the rumen. The oilseed cakes are rich in protein, which may vary from 20 to 50% depending upon the type of oilseed and the method of extraction of oil. However, the protein content of most oilseed cakes such as noug and linseed cake lies within the range of 28-35% The energy content varies from 2.03 to 3.7 Mcal ME/kg DM depending on processing method (Tolera *et al.,* 2012).

Grain represents a concentrated feed resources. Maize, wheat, barley, oats, sorghum and rice are usually highly digestible (80-85%), rich in energy and have a protein content of 8-12% of DM. Depending upon availability and price, cereal grains and grains damaged during processing could be used as sources of high-energy feeds. Substantial amount of screenings and damaged grains are produced during grain processing and seed cleaning. Screenings of barley and wheat have potentially high contribution to the diet of farm animals and has 12% of crude protein content (Tolera *et al.,* 2012).

The nutritive value of crop residues is variable depending upon the species and variety of the crops, time of harvest, handling and storage conditions and other factors. Cereal straws and strove are generally characterized by relatively low nutrient content, high fiber content, low digestibility, and low voluntary intake (limited consumption) by animals. Roughage feeds with NDF content of less than 45% are categorized as high quality, 45-65% as medium quality and those with more than 65% as low quality roughages (Sigh and Ousting, 1992). The NDF content of crop residues was found in the range of 66.5 %– 77.2 % reported by Girma *et al.*, (2014) in southern part of Ethiopia, while Tamene *et al.,* (2022) reported NDF content of crop residues (maize stover, barley straw, wheat straw, teff straw etc.) was ranged from 69.3±2.9 - 82.6±0.0. Solomon *et al.,* (2008) also reported that, all crop residues had higher than 70% NDF contents. Without supplementation, crop residues cannot satisfy even maintenance requirements of animals because of low N, high cell wall and slow digestion leading to a negative N balance, loss of body weight and productivity and even death of the animals. Urea treatment of cereal straws remarkably increases crude protein content, intake, and digestibility (Tolera *et al.,* 2012).

### 2.3.3. Supplementation and low quality feed treatment

Among the various constraints limiting production and productivity of livestock in Ethiopia, poor quality and quantity of animal feed is the major one. Next to natural pasture, crop residues are the major feed resource in Ethiopia. However, crop residues are generally characterized by low crude protein content but high cell wall constituents. Digestibility of crop residues is also low and vary with crop type from which the residues are produced. Because of low N, high cell wall and low digestibility, animals fed on a sole crop residues diet cannot maintain their N balance. The energy supply of a sole cereal crop residue diet is marginal to maintenance requirement of the animals. Animal production on such a diet, therefore, requires supplementation with energy sources especially fermentable carbohydrate. The provision of readily fermentable carbohydrate improves utilization of ammonia for microbial growth. Digestibility, quality and intake of straw can also be increased by physical, biological, and chemical treatment, and if accompanied by supplementation, better animal responses can be attained (Seyoum, 2007).

## 2.4. Small Ruminants Feeding System in Ethiopia

Livestock owners in Ethiopia follows different feeding systems for efficient utilization of the available feeds. Free grazing is the most common feeding system in range land livestock farming areas. Animals graze on pasture land, along roads and rivers and around homesteads in mixed farming areas (Duressa *et al.,* 2014; Feyissa *et al.,* 2014), and animals free range in the lowlands. Stall feeding is dominant in urban and pre-urban fattening system and stall feeding is common in some places in the mixed farming system, where crop residues, forage, and weeds are given to the animals (Duguma *et al.,* 2012; Geleti *et al.,* 2014b). In some places, like Harerghe district of Oromia region, animals are tethered during crop cultivation, but freely graze after harvesting season. Some farmers mix crop residue with oil cake and wheat bran to increase its palatability, and some farmers provide improved forage and hay to fattening animals (Duguma *et al.,* 2012). Seasonal purchase of concentrates for fattening animals is also common in some places in Ethiopia (Feyissa *et al.,* 2014).

## 2.5. Length of feeding period and fattening frequency of small ruminants

For most rural small ruminant fatteners, the fattening practice is seasonal based. The length of small ruminant fattening period is influenced by factors such as nutrition, animal breed, and environmental conditions. Thus, it is vary primarily depending on the availability of quality and quantity feed for fattening. Typically, the fattening period for small ruminants in Ethiopia ranges from three to six months. Otherwise, there also consideration of a minimum of two months of fattening length can be achieved per a year (Animut and Jane, 2014). The variability in the fattening period is also linked to market demands and seasonal availability of feed resources. The feeding length, and live weight were founded to be the indicators of finishing period of fattening animals. At the end fatteners finish feeding period and supply their animals to the market for selling (Birhan *et al,* 2018).

More frequent fattening is practiced in urbanized and commercial areas, while in rural regions, fattening is generally done once or twice a year, often during the dry season when supplementary feeds are needed. It mainly associated with market demand for fattened sheep and/or goats and due to feed availability for fattening. Informants from regional research offices and Bureau of Agriculture or Livestock Development Agency of the Amhara region, Wollega, Keffa, and Woliata Zones noted that, two to three (2-3times/years) fattening cycles was commonly used by rural farmers (Deginet, & Abiy, 2020).

## 2.6. Management Practice of Small Ruminants

The livestock production system is predominantly extensive, with indigenous breeds and low-input/low-output husbandry practices. Management systems are designed and executed in such a way that livestock attain optimum growth and remains healthy. Proper handling and management of meat animals is essential for improving performance and productivity of meat animals. Aspects of animal management are recognized as breeding, weeding, feeding and heeding. Breeding includes selection of both male and females based on their superior genetic makeup, known genetic potential and desirable qualities. Weeding aims at culling of uneconomic or diseased stock at proper time (Management Entity, 2021).

In Ethiopia, there are several endemic animal diseases caused by bacteria, viruses, protozoa, and parasites that compromise the productivity of livestock. Heeding implies good livestock management and supervision including housing, sanitation, hygiene and day-to-day care of animals. Generally, management of meat animals includes proper selection of animals and their day-to-day care, adequate housing and comfortable environment, adequate feed and fodder as per the requirements, culling of diseased and low or unproductive animals and control of animals from harsh environment and diseases (Management Entity, 2021).

## 2.7. Small Ruminants Marketing in Ethiopia

Livestock marketing involves the sale, purchase or exchange of products such as live animals, and livestock products such as milk, meat, skins, wool and hides for cash or goods in kind (ILCA, 1990; Addis, 2017). In Ethiopia, farmers who live in rural area sell livestock and livestock products to cover household cash expenses and to purchase crop input. Live animals are marketed through traditional marketing routes developed over the years which were based on visual assumption (‘eye-ball’) on body condition of animals. Livestock may pass from producers (fatteners) to primary markets to secondary and tertiary markets to reach the consumer (Matawork, 2017).

### 2.7.1. Market channels

Marketing channel is an organized network of different agencies and institutions in which combination perform all the activities required to link producers with consumers to accomplish the marketing tasks and only a small portion of goods and services is consumed at the point of production and only a small fraction of any output is purchased by the ultimate consumers directly from the final producers. Thus, marketing channel is a marketing process which performs several functions by bridging the gap between production and consumption. It is a systematic knowledge of the flow of goods or services from their production areas to the final market or end users. The number and type of market participants are different along the different market channels (Jaleta, 2011).

### 2.7.2. Market actors and price of fattened animals

Many actors are involved in livestock product marketing, they are broadly classified as: livestock producers, traders, processors, retailers, food service providers, and consumers. The market actors may be involved only in sheep or goats, or sheep and/or goats transactions (Asfaw *et al.,* 2011). The actors in the live animal trade are producers, local traders, middle or larger scale traders, butchers, and consumers (Alemayehu, 2011). The main animal collection points for most export abattoirs and live animal exporters are purchasing agents assigned in major marketing areas, small and large scale traders, and livestock trading cooperatives (Asegede *et al.,* 2015). Livestock producers are usually less informed about price, supply, and demand situations. Market information is crucial to producers, wholesalers and consumers to help them make decisions on what and whether to buy and sell. In general, information is required on prices, traded or available quantities, forecasts of future supplies and demand, and general market conditions. Information must be relevant, accurate and timely and reflect all sectors of the market, especially consumer demand (ILRI, 1995).

Nearly in all parts of the country, there is no regular market information on prices and supplies, nor formalized grades and standards of sheep and goat, and other livestock (Kebede and Ray, 1992; Ayele *et al.,* 2003). Livestock are generally traded by 'eye-ball' pricing, and weighing livestock is uncommon. Animals are sold on a per head basis and price agreement reached by a long one-on-one bargaining between a seller and a buyer. Under such circumstances, prices paid will reflect buyers' preference for various animal characteristics (weight, sex, age, condition, breed, color), the purpose of animals purchased (for resale, slaughter, fattening or reproduction), the season of the year (occurrence of religious and cultural festivals) and the bargaining skills of buyers and sellers (Kebede and Ray, 1992; Jabbar, 1998; EARO, 2000; Ehui *et al.,* 2000; Ayele *et al.,* 2003). Marketing of sheep and/or goats is characterized by strong seasonality and subject to fluctuation. Demand and price increases during festival periods. The major reasons for the meat animals price variation across months/seasons are the change in seasonal feed and water availability, market problems (trader availability, fluctuation of prices and lack of infrastructure), the socioeconomic factors (fasting periods, holidays) and conflict also play a role in livestock price variation (Asfaw *et al.*, 2011).

## 2.8. Challenges and Opportunities of Small Ruminant Fattening in Ethiopia

### 2.8.1. Challenges of small ruminants fattening

The major constraints for sheep and goats fattening practice in Ethiopian farmers were feed shortage, diseases and parasites, drought, shortage of grazing land, market access, veterinary services, extension services and other infrastructure. Among those constraints inadequate supply of quality feed, drought, diseases and parasites were the main reasons for low productivity of the indigenous sheep and goat breeds and are the major limiting factors of productivity in Ethiopia (Firew, 2007). Ethiopian livestock marketing has a different stage. However, it is a personalized business with irregular buyers and sellers and with several brokers. Only 20% of live animal exports go through official channels, while the remaining 80% are traded informally (FAO, 2019). Hence, smallholder farmers face many challenges in livestock marketing, including weak bargaining power, a lack of market information, high transaction costs, and limited physical access to markets, poor infrastructure, unorganized markets, and weak institutional support systems (Tigabie *et al.,* 2021).

### 2.8.2. Opportunities for small ruminants fattening

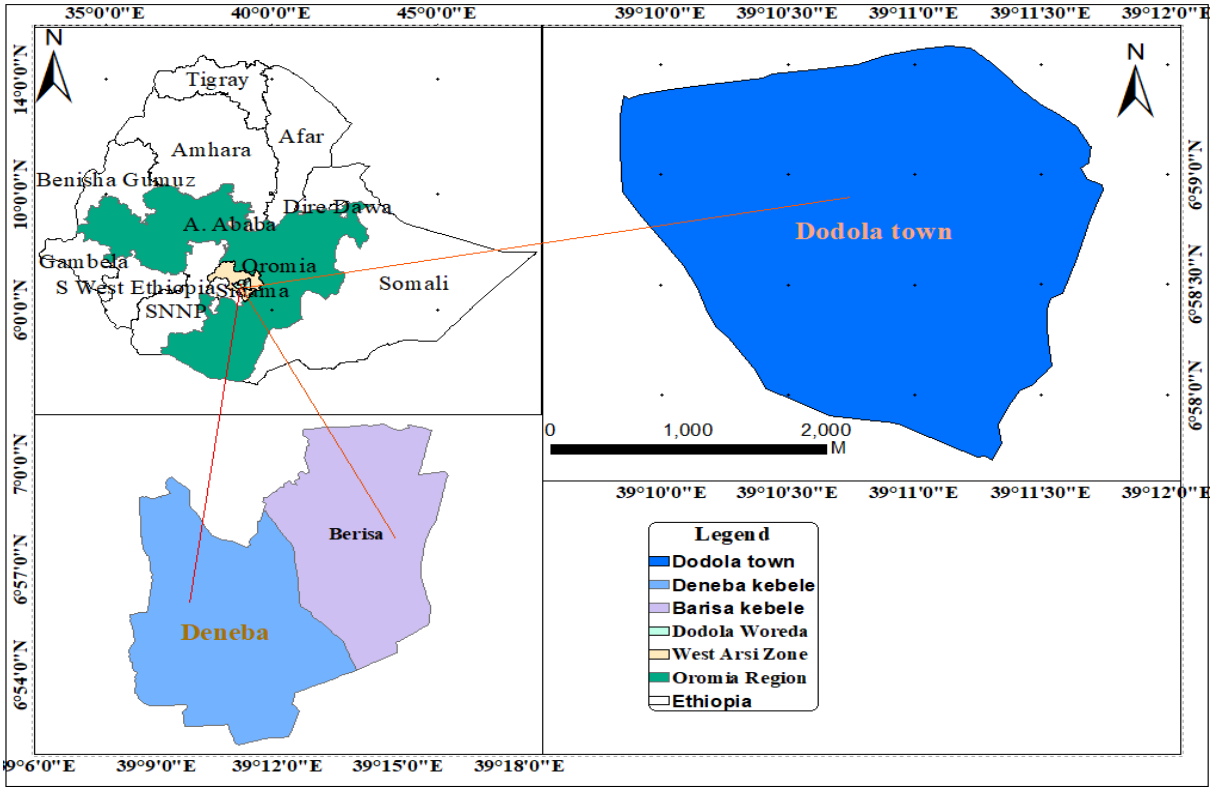
The rapid growth in demand for meat products in the world is a great opportunities for livestock resource-rich countries like Ethiopia to exploit. Recently, there has been a trend of continuous and rapid increases in global consumption, production, and trade of livestock products in developing countries. The factors leads to such increased demand are; population growth, urbanization, rise in income in growing urban centers of developing countries, international influences (globalization and more liberal international trade), and technological changes in the production, communication, and transport sectors (Asfaw *et al.,* 2011). In general, the opportunities of livestock marketing in Ethiopia are resource availability; demand availability both regional and in the Middle East; proximity to the markets of neighboring countries; development of export-abattoirs and their substantial demand for lowland animals, and the tendency of both the government agencies and NGOs to work towards integrating the pastoral marketing cooperatives with the export abattoirs supply chains (Amanuel, 2019).

# 3. MATERIALS AND METHODS

## 3.1. Description of Study Area

The study was conducted in peri-urban and urban area of Dodola town. Dodola woreda is found in the North-East of West Arsi zone. The woreda is 320km faraway from Addis Ababa and 70km from Shashemene town (Mekonnen and Girma, 2023)**.** The Woreda shares bounders with Hasasa in the north, Kokosa and Kofale in the west, Adaba in the East, and Nensebo in the south. Dodola woreda holds total human population of 301,403 out of which 147,565 were men and 153,838 were women (DWFEDO, 2023). Dodola woreda has an elevation of 2300-3550m a. s. l. with an area of 1432.46 $km^2$. Agro-climate zone of Dodola woreda is divided mainly into semi-humid (95%) and cool humid (5%) due to variation in altitude (Mekonnen and Girma, 2023). Topographically, Dodola woreda divided in to high land (55%), midland (15%) and low land (30%) and the rainy season starts in March and extends to October with the highest concentration in June, July, and August. The mean annual temperature of the woreda is found between 9$^o$c to 26$^o$c. On average, the woreda gets annual mean rainfall of 805mm to 1260mm (ARDODW, 2021). Berisa and Dennaba were the two kebeles of Dodola woreda and they were one of the kebeles surrounding Dodola town. This two kebeles were found between 7$^o$0’0”N latitude and 39$^o$18’0”E longitude (EGS, 2020).

Dodola town is the administrative center of the woreda. The town is located between 6$^o$59’0”N latitude and 39$^o$12’0”E longitude with an elevation of 2362 to 2493m a. s. l. It has an area of about 1680ha and is found in cool and humid (woyina-dega) agroecology. The annual temperature and rainfall of the Dodola town ranged between 15$^o$c to 21$^o$c and 815mm to 1200mm, respectively (DTADO, 2023). Dodola town holds a total human population of 47,672 of which 24,935 are men and 22,737 are women (DTFEDO, 2024). Dodola town Livestock population was estimated at 59,590 cattle, 46,000 sheep, 45,000 goats, 5000 Horses and 2000 Donkeys (DTLO, 2022). The town is divided into two Kebeles (Anole and Madda Wabe). The livelihood of the population was primarily based on crop production followed by trading and animal production.




Source: EGS, 2021

Figure 2. Map of the study location

### 3.2. Study Kebeles Selection, Sample Size Determination and Sampling Methods

Before deciding the target kebeles, a discussion was held with the Dodola town livestock office to select potential kebeles with small ruminants fattening practices in Dodola town. Further discussion was held with rural livestock offices of Dodola woreda to select potential kebeles with small ruminants fattening practices around Dodola town. By this base, two kebeles (Anole and Madda Wabe) were selected from Dodola town, and two kebeles (Dennaba and Berisa) were selected from peri-urban area of Dodola town purposively. Totally, four kebeles were selected, and the total population and number of target population were identified from the residents' list obtained from the recent statistical data of the respective kebeles. Random sampling technique was used by lottery method to select respondents and respondents having at least one fattening sheep and/or goat/s who were engaged in fattening practice were selected.

For sample size determination, the author applied the formula from Yamane (1967) with a 93% confidence level and 7% precision level. By using this formula, 147 sample size was calculated from the total target population (521) of the study area as follows.

$$n = \frac{N}{1 + \mathrm{N(e)^2}}$$

Where "n" was the desired sample size, "N" was the total respondents, "e" was acceptable margin of error. The respective number of respondents from each kebele were selected by the proportion of the target population of the kebeles to the sample size as follows.

$$\acute{\mathrm{n}} = \frac{\mathrm{n\,k}}{\mathrm{N}}$$

Where "ń" was proportionate number of respondents from each kebele, "n" was the total number of sample size, "k" (k1, k2, k3 and k4) represents the total number of sheep and/or goats fatteners per each kebele and "N" was the total number of target population in study areas. To increase the reality of the result, a sample was taken following the ICARDA (2018) guidelines for each kebeles proportionally. By this base, the following sample size was determined.

Table 2. Target population and sample size of the current study areas.

| No | Kebeles | Location | Total number fatteners per Kebele | Respondent per kebele |
|---|---|---|---|---|
| | Berisa | Peri-urban | 167 | 47 |
| | Dennabe | Per-urban | 120 | 34 |
| | Anole | Urban | 130 | 37 |
| | Medda Wabe | Urban | 104 | 29 |
| **Total** | | | **521** | **147** |

### 3.3.Source of Data and Methods of Data Collection

#### 3.3.1. Survey data collection

Both primary and secondary data were collected. To collect primary data closed and open-ended survey questionnaire was developed and administered to randomly selected respondents based on the set of questions about the study objectives by trained enumerators with close supervision of the researcher. Accordingly, information was collected on socio-economic characteristics of the respondents (sex, marital status, age, source of income, family size, land holding and allocation and occupation), purposes of keeping livestock and small ruminants, source of small ruminants for fattening, fattening system, major feed resource and feeding systems, management (feeding, watering, housing and health care), breed, marketing, challenges and opportunities of small ruminants fattening. For market surveying, information was collected by interviewing sheep and/or goat producers to assess market information, market channels, market actors, pricing methods, and demand for fattened small ruminants in the market.

For secondary data; previous studies, guidelines, manuals, literatures, and documented data were reviewed to assess the fattening system, marketing, and major feed and feeding system, constraints and opportunities small ruminants in Ethiopia as well as in study areas. In study areas, secondary data was used as the reference for human population, number of livestock, coverage of land in hectare, annual temperature and rain fall, location and elevation of the study areas. This information was taken from both Dodola woreda and Dodola town livestock development office, agricultural office, finance development office and kebele administrative office.

##### 3.3.1.1. Focus group discussion

For focus group discussion, elders, feed traders, extension workers and farmers who have experience with fattening practices, feed resources, feeding, and marketing system of small ruminants were selected with the help of agricultural extension workers. One focus group discussion consisting of eight (four male and four female) participants was made per each study

location to support the questionaries' data and the researcher facilitated the discussion at all points. The main discussion points included in the group discussion checklist were livestock keeping, small ruminant fattening (sheep and/or goats, breed used and their source), feeds used (roughage, concentrate and other), feeding systems (grazing and/or browsing, stall feeding and tether feeding), marketing system, challenges, and opportunities of small ruminants fattening.

#### 3.3.1.2. Field observation

Sheep and/or goats fattening practice, husbandry practice, major feed resources and any other event needed to investigate were observed by the researcher and trained group to strengthen information obtained by questionnaire.

#### 3.3.1.3. Key informants interview

Local extension workers, sheep and/or goat traders, and veterinary technicians of the study area were interviewed for key information, so that the information was triangulated between information obtained from FGD and survey questionnaire data. The KII interview was held with extension agents to get detailed information about small ruminants fattening system, major available feed resources (roughage, concentrate, nonconventional), feeding system (grazing and browsing, stall feeding and tethering) challenges and opportunities of small ruminants fattening and marketing in the study area.

### 3.3.2. Major feed sample collection and preparation

Major feed resources used by the fatteners in the study areas were identified after survey data collection. Eleven feed samples, five feeds namely; natural pasture (mixed grass), crop residues (barley straw and wheat straw), and fodder trees (Carissa edulis/Agamsa and Olea europea/Ejersa) leaves were identified from peri-urban area, and six feeds namely; natural pasture (mixed grass), crop residues (barley straw and wheat straw), agro-industrial by-products (wheat bran and linseed cake) and screened barley by-product were identified from urban area.

Representative samples of identified feeds were collected from different parts of the grazing site by using (0.5m x 0.5m) quadrant and feeds in the quadrant were completely cut-off manually by sickle from each study site. For stored feeds, long pipe was used to take feed samples from different length (vertical and horizontal) side of the standing sack randomly. Feed samples collected from all grazing site, and feed storage areas were mixed, labeled, chopped, and weighted per feed type in each site. Accordingly, after mixing, sub-sampled, and partly discarded, a sufficient amount of feed samples was taken to Hawassa University Animal Nutrition Laboratory for lab analysis. Then samples were-oven dried at 60$^{o}$C for 48hrs to obtain the constant weight and ground in Willey Mill to pass through a 1mm sieve size. The dried sample was packed into the air-tight plastic bag until determination of chemical composition in the Hawassa University Animal nutrition laboratory. For further determination of feed's chemical composition on a DM basis, feed samples were-oven dried at 105$^{o}$C overnight and dry matter (DM) was obtained.

### 3.4. Analysis of Feed's Chemical Composition

Dry matter-based feed sample's chemical composition analysis was undertaken for crude protein (CP), ether extract (EE), ash, neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) content of the feeds. Crude protein (CP) was determined as N x 6.25, after nitrogen (N) has been determined by using Kjeldahl method. Ash content was determined by burning feed samples in a muffle furnace at 550$^{o}$C for 3 hours. Ether extract (EE) was determined by dissolving pre dried feed sample with petrol ether and extracted for 3 hour following the procedure of AOAC, (1995). Neutral detergent fiber, acid detergent fiber and acid detergent lignin has been determined following Van Soest method of fiber determination (Van Soest *et al.,* 1991) at Hawassa University, animal nutrition laboratory.

### 3.5. Data Management and Statistical Analysis

Data collected from household and laboratory data were coded, entered, and managed in Excel spreadsheet, and transferred into SPSS software, version 26. Descriptive statistics like frequency, percentages, mean and standard error and important procedures were employed during the analysis of primary data and presentation of the result. Descriptive statistics were employed to summarize and describe categorical variables. A chi-square ($X^2$) test was employed to test the independence of the categories and to assess statistical significance. For quantitative data, an independent sample T-test means comparison was employed. Index for multiple response data was computed for the first top three ranks by the following formula. Index = sun of (3x1$^{st}$rank + 2x2$^{nd}$rank + 1x3$^{rd}$rank) given for an individual attribute divided by the sum of (3x1$^{st}$rank + 2x2$^{nd}$rank + 1x3$^{rd}$rank) given for total attributes.

$$\text{Index} = \frac{[\text{Rn} * \text{C1} + \text{Rn} - 1 * \text{C2} + \cdots + \text{R1} * \text{Cn}]}{[\text{Rn} * \text{C1} + \text{Rn} - 1 * \text{C2} + \cdots + \text{R1} * \text{Cn}]}$$

Where: Rn = value for least ranked attribute (in this case the least ranked attribute was 3$^{rd}$, then Rn = 3, Rn-1 = 2, and R1 = 1). Cn = Value for count of the least ranked attribute (in this case, the count for 3$^{rd}$ rank = $C_n$, Count of 2$^{nd}$ rank = $C_n$-1 and Count of the 1$^{st}$ rank = $C_1$.

# 4. RESULTS AND DISCUSSION

## 4.1. Socio-Economic Characteristics of Respondents in Study Areas

The gender, age, and marital status of the respondents are summarized in Table 4. As survey result indicated, sex of the respondents practicing small ruminants fattening in current study areas were dominated by males over the females in both peri-urban and urban area, respectively. This result indicates that, fattening practice was majorly practiced by males while a females had less contribution. This might be due to the attitude of the people toward the fattening practice and societal custom and norms in which seeking for the job was male's responsibility. The current finding was consistent with the finding of Tulu (2021), who reported that the majority of the household heads engaged in to small ruminant fattening were males in the Mid Rift Valley of Ethiopia.

The result also indicated that a large number of fatteners were found in 38-47 years of age, followed by 28-37 years of age in both peri-urban and urban areas, respectively. However, the contribution of the farmers with an age of 18-27 years and >47 years in fattening practice was low in both peri-urban and areas. The current finding was agreed with the finding of Tariku *et al.* (2021), who reported that the majority of the sheep keepers were found between the age of 40 and 50 years in Aroresa and Loka Abaya of Sidama Region.

The marital status of the respondents in the current study areas was almost similar ($P>0.05$) between peri-urban and urban areas. As the result indicates, majority of interviewed respondents both in peri-urban and urban areas were married. It seems that small ruminants fattening practice was highly practiced by the married respondents, while single peoples were less participated in small ruminant fattening practice in study areas and Widowed rate was also low in current study areas. The result was in line with the findings of Diriba *et al.* (2021), who reported that out of all respondents 91.3% were married in Genji district of west Wollaga and Bachano and Monenus (2020), reported that the majority of the respondents were married in Adiyo District in Keffa Zone.

Table 3. Gender, age and marital status of respondents in study areas

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Sex of the respondents** | | | | | | | 0.001 | 0.977 |
| Male | 76 | 93.8 | 62 | 93.9 | 138 | 93.9 | | |
| Female | 5 | 6.2 | 4 | 6.1 | 9 | 6.1 | | |
| **Age of the farmers** | | | | | | | 5.94 | 0.114 |
| 18-27 years | 7 | 8.6 | 2 | 3.0 | 9 | 6.1 | | |
| 28-37 years | 25 | 30.9 | 20 | 30.3 | 45 | 30.6 | | |
| 38-47 years | 40 | 49.4 | 28 | 42.4 | 68 | 46.3 | | |
| >47 years | 9 | 11.1 | 16 | 24.2 | 25 | 17.0 | | |
| **Marital Status of the farmers** | | | | | | | 2.49 | 0.287 |
| Single | 4 | 4.9 | 1 | 1.5 | 5 | 3.4 | | |
| Married | 77 | 95.1 | 64 | 97.0 | 141 | 95.9 | | |
| Widowed | 0 | 0.0 | 1 | 1.5 | 1 | 0.7 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

The educational background, occupation, and source of income of the respondents in the current study areas are summarized in Table 5. The educational background of the respondents engaging in small ruminant fattening generally ranged from illiterates to degrees in both peri-urban and urban areas. From the result, the majority of the farmers engaged in small ruminant fattening were illiterate in peri-urban followed by fatteners having grade 5-8 education. However, farmers having grades 1-4, grades 9-10, grades 11-12, diplomas and degree education were less participated in sheep and/or goat fattening in peri-urban areas. In urban areas majority of the farmers engaged in small ruminant fattening were in grades 11-12 followed by the farmers in grades 9-10. However, participation of uneducated farmers, farmers having grades 1-4, grades, 5-8, diplomas, and degree education in small ruminants fattening was low (Table 5).

There was a statistically significant (P<0.001) difference between peri-urban and urban areas in terms of the educational level of the farmers engaged in small ruminants fattening practice. This might be due to awareness of the society toward the education. This finding is agreed with the finding of (Deginet and Abiy, 2020; Muhammed, 2015), who reported a high number of illiteracy in Anlemora Woreda, Hadiya zone, but several illiteracy was lower than 48.7% reported by Chufa *et al.* (2022), in Derashe District of Southwestern Ethiopia.

Results of survey data indicated that the majority of the respondents who engaged in small ruminant fattening were farmers in peri-urban and urban areas. The reasons behind the increased interest of the farmers towards small ruminants fattening in the current study areas were low initial capital, increased demand of small ruminants through time, a short period of fattening, high market demand for small ruminants' meat and conducive environment for fattening (Table 36). In contrast, businessman, employed man, unemployed man and students were less engaged in to sheep and/or goats fattening in peri-urban than (P<0.001) urban areas. This might be due to the attitude of those people towards sheep and/or goats fattening in study areas. The current finding result was in line with the findings of Boloche *et al.* (2022), who reported 79.40% of farmers in Soro district of Hadiya zone, Southern Ethiopia, and Afiras (2019) who reported 85.6% of farmers in Esera District, Dawuro zone.

As it shown in Table 5, the main source of income of the respondents in the study area was from different alternatives, such as animal production, crop production, both animals and crop production, traders, and monthly salary, animals and crop production. In both peri-urban and urban areas, the main source of income of the respondents highly depended on crop production, followed by both crop and animal production, while other respondents use only animals, only trade or monthly salary, animals and crop production as a main source of income were low. This might be because, the area is found in a mixed (crop and livestock) farming system. However, there is a difference between peri-urban and urban areas in the case of getting income from trade (Table 5). This investigation was in line with the finding of Tariku *et al.* (2021), who reported that the main source of income in the dry season was crop selling in Aroresa and Loka Abaya of Sidama Region.

Table 4. Educational level, occupation, and source of income of the farmers in study areas

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Educational Level of the farmers** | | | | | | | 31.5 | 0.000 |
| Illiteracy | 43 | 53.1 | 14 | 21.2 | 57 | 38. 8 | | |
| Grade 1-4 | 2 | 2.5 | 3 | 4.6 | 5 | 3.4 | | |
| Grade 5-8 | 17 | 21.0 | 5 | 7.6 | 22 | 15.0 | | |
| Grade 9-10 | 10 | 12.4 | 17 | 25.8 | 27 | 18.4 | | |
| Grade 11-12 | 7 | 8.7 | 18 | 27.3 | 25 | 17.0 | | |
| Diploma | 1 | 1.2 | 6 | 9.1 | 7 | 4.8 | | |
| Degree | 1 | 1.3 | 3 | 4.6 | 4 | 2.7 | | |
| **Major Occupation of the farmers** | | | | | | | 22.2 | 0.000 |
| Farmer | 73 | 90.1 | 38 | 57.6 | 111 | 75.5 | | |
| Business man | 4 | 4.9 | 7 | 10.6 | 11 | 7.5 | | |
| Employee | 2 | 2.5 | 11 | 16. 7 | 13 | 8.8 | | |
| Unemployed | 2 | 2.5 | 9 | 13.6 | 11 | 7.5 | | |
| Student | 0 | 0.0 | 1 | 1.5 | 1 | 0.7 | | |
| **Main source of income of the farmers** | | | | | | | 9.8 | 0.044 |
| Animal production | 8 | 9.9 | 2 | 3.0 | 10 | 6.8 | | |
| Crop production | 52 | 64.2 | 38 | 57.6 | 90 | 61.2 | | |
| Traders | 1 | 1.2 | 7 | 10.6 | 8 | 5.4 | | |
| Animal and crop production | 18 | 22.2 | 15 | 22.7 | 33 | 22.4 | | |
| Salary, animal and crop prodn. | 2 | 2.5 | 4 | 6.1 | 6 | 4.1 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.2. Family Size and Land Holding in Study Areas

The average family size, land holding, and Land use patterns of the respondents in the study areas are summarized in Table 6. As survey results indicated, there was no statistically significant ($P>0.005$) difference between the two locations (peri-urban and urban) in terms of average family size per household. This may be due to the reality that, the two locations share the same culture, living style and religion, because they were closely connected. The current finding agreed with the average family size (6.26) reported by Abera *et al.* (2022), in Dodota District of Arsi Zone and average family size 6.23±0.50 reported by Afiras (2019) in Esera district of Dawuro zone, southern Ethiopia.

The wider land holding was recorded in peri-urban areas than urban areas and there is highly significant ($P<0.001$) difference between the two locations (peri-urban and urban) in terms of land holding per hectare per household in study areas (Table 6). This might be due to the urban expansion in urban areas. The current finding result is in line with 1.77ha reported by Endashaw (2007), in the Dale district of Sidama regional state and 2.14±0.06ha by Mohammed (2015), in Jimma Zone, but lower than finding of Aman *et al*. (2021), who reported average land holding of 4.2±2.6 in the Central Rift Valley of Oromia Region.

According to survey result, farmers in the current study areas were allocated their land for crop production as well as for animal grazing/browsing purposes. All of the farmers in peri-urban areas, and about half of the farmers in urban areas used part of their land for crop production. Similarly, about half of the farmers in peri-urban areas also use a small part of their land for grazing purpose in addition to crop production (Table 6). The result of present study revealed that, from the average total hectares of land owned by respondents in study areas, a large part was covered by cropping land than grazing land. This might be due to the farming system in an area was dominated by a mixed (crop-livestock) farming system and greater priority is given to crop production than livestock rearing for the livelihood of respondents in the areas. There is a high significant ($P<0.001$) difference between the two locations regarding land allocation for grazing, fallow grazing and fodder tree utilization purposes (Table 6). This might be due to a lack of the land in urban areas because of urbanization.

The current finding is agreed with the finding of Mezgebu *et al.* (2022), who reported that from the overall average total hectares of land owned by sampled respondents in all the study areas, a large part was covered by cropping land than grazing land in East Gojjam Zone, Amhara Region, Ethiopia.

Table 5. Family size and land holding of the household in study areas

| Variables | Study Location | | | | | | P-Value |
|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | |
| | n1 | Mean ± SE | n2 | Mean ± SE | N | Mean ± SE | |
| Family Size | 81 | 6.1 ± 0.3 | 66 | 6.5 ± 0.3 | 147 | 6.3 ± 0.2 | 0.251 |
| Land Holding | 81 | 2.3 ± 0.2 | 29 | 0.6 ± 0.6 | 110 | 1.8 ± 0.2 | 0.000 |
| **Land allocation** | | | | | | | |
| Crop land | 81 | 1.9 ± 0.1 | 29 | 0.6 ± 0.1 | 110 | 1.6 ± 0.1 | 0.000 |
| Grazing land | 41 | 0.6 ± 0.0 | 0 | 0.0 | 41 | 0.6 ± 0.0 | 0.000 |
| Fallow land | 2 | 0.4± 0.1 | 0 | 0.0 | 2 | 0.4 ± 0.1 | 0.000 |
| Fodder land | 9 | 0.5 ± 0.1 | 0 | 0.0 | 9 | 0.5 ± 0.1 | 0.000 |

n1 = number peri-urban respondents; n2 = number of urban respondents; SE = standard error of the mean.

### 4.3. Cereal Crops and Crop Residues Produced in Study Areas

Major crops and crop residues produced in the study areas are summarized in Table 7. Cereal crops produced in the current study areas were wheat, barley, maize and teff in both peri-urban and urban areas. The overall percentage of crop production showed that, wheat was the first crop produced in the study area followed by barley. This in turn indicated that, respondents in current study areas were highly depend on wheat as source of income and food for home consumption. There is high significance ($p<0.001$) difference between study locations in terms of crop production (i.e. crops were highly produced in peri-urban than urban area). This might be due to scarcity of the land allocated for crop production in urban area, because of urbanization.

Additionally, the results also indicated that the teff was produced to a small extent in peri-urban areas. The current investigation was agreed with Amare and Serekebirhan (2019), who reported that wheat was the major crop grown around Midre-Kebid Abo Monastery of Gurage Zone. The results also indicated that the availability of the crop residues produced was related to the availability of type of cereal crops dominating the areas. However, the amount of crop residues produced in urban area was significantly ($P<0.001$) lower than in peri-urban areas. This may be related to the type and level of cereal crops produced in study areas.

Table 6. Major crops produced by the farmers in study areas

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Main crop produced** | | | | | | | 63.90 | 0.000 |
| Wheat | 59 | 72.8 | 20 | 30.3 | 79 | 53.7 | | |
| Barley | 12 | 14.8 | 7 | 10.6 | 19 | 12.9 | | |
| Maize | 3 | 3.7 | 2 | 3.0 | 5 | 3.4 | | |
| Teff | 7 | 8.6 | 0 | 0.0 | 7 | 4.8 | | |
| **Main crop residue produced** | | | | | | | 66.88 | 0.000 |
| Barley straw | 14 | 17.3 | 9 | 13.6 | 23 | 15.7 | | |
| Wheat straw | 54 | 66.7 | 16 | 24.2 | 70 | 47.6 | | |
| Teff straw | 9 | 11.1 | 0 | 0.0 | 9 | 6.1 | | |
| Maize strove | 4 | 4.9 | 4 | 6.1 | 8 | 5.4 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.4. Types of Livestock and Purpose of Keeping Livestock

#### 4.4.1. Type of livestock kept by the respondents in study areas

The total average and livestock composition kept are summarized in Table 8. The higher ($p<0.001$) number of total livestock was recorded in peri-urban compared to the urban area. This might be due to a lack of land for grazing and livestock feed shortage in urban areas. Livestock composition kept by the respondents in the current study areas were cattle, sheep, goat, donkey, horse and chicken. From the total livestock species owned by the respondents, ruminant animals (cattle, sheep and/or goats) contained a high proportion, while donkey, horse, and chicken covered small proportion. The present result is comparable with the finding of Mezgebu *et al.* (2022), who reported that ruminant animals (goats, cattle, and sheep) covered the highest species composition in East Gojjam Zone, Amhara Region, Ethiopia.

However, the average number of cattle, sheep, and donkeys kept by the farmers was significantly ($P<0.005$) higher in peri-urban areas than in urban areas. In contrast, the average number of goats was quite similar in peri-urban and urban areas. The result also indicated that farmers in the peri-urban areas kept a higher number of cattle followed by sheep, goat, chickens, donkeys and horses, whereas in urban areas farmers kept a relatively high number of goats followed by sheep, cattle, chicken, donkey, and horses. This might be due to the reality that, small-sized animals require small space, small amount of feed, small initial starting and working budget etc. and vice versa (Table 8). As the overall average indicates number of cattle kept by the respondents was 3.2±0.2 which is low. This finding is agreed with the finding of Abera *et al.* (2014), who reported a 3.3±0.0 average number of cattle in Baresa watershed, Ethiopia and lower than 5.1±0.1 reported by Mamo (2020), in Chalia district west Shoa Zone and higher than 2.4 reported by Selamawit and Matiwos (2015), in Gedio Zone of Southern Ethiopia. Similarly, the overall average number of sheep and goats kept by the farmers (3.5±0.1 and 3.4±0.1) were low in both peri-urban and urban areas respectively. This finding is in line with 3.99 reported by Dhaba, *et al.* (2012), in the Illu abba bora Zone of the oromia region, and agreed with 3.46 reported by Selamawit and Matiwos (2015), in Gedio Zone of Southern Ethiopia.

Table 7. Types and average number of livestock kept by the farmers in study area

| Livestock type kept | Study Location | | | | | | P-Value |
|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | |
| | n1 | Mean ± SE | n2 | Mean ± SE | N | Mean ± SE | |
| Number of livestock | 81 | 13.8 ± 0.8 | 66 | 9.9 ± 0.5 | 147 | 12.0 ± 0.5 | 0.000 |
| Cattle | | 4.2 ± 0.4 | | 2.2 ± 0.2 | | 3.2 ± 0.2 | 0.000 |
| Sheep | | 3.9 ± 0.2 | | 3.1 ± 0.2 | | 3.5 ± 0.1 | 0.001 |
| Goat | | 3.1 ± 0.2 | | 3.6 ± 0.2 | | 3.4 ± 0.1 | 0.062 |
| Donkey | | 0.7 ± 0.1 | | 0.3 ± 0.1 | | 0.5 ± 0.1 | 0.003 |
| Horse | | 0.3 ± 0.1 | | 0.2 ± 0.1 | | 0.3 ± 0.0 | 0.205 |
| Chicken | | 1.3 ± 0.3 | | 0.8 ± 0.2 | | 1.1 ± 0.2 | 0.165 |

n1 = number peri-urban respondents; n2 = number of urban respondents; N = number of the total respondents; SE = Standard error of the mean.

### 4.4.2. Purpose and trends of keeping livestock in study areas

The purpose of keeping livestock (cattle, sheep, goat, donkey, horse and chicken) is summarized in Table 9. Livestock were kept for multi-purpose (meat, milk, income source, hide/skin and wool, draught power and manure), through which the farmers fulfill their immediate and long-term needs in the study areas. They confer a certain degree of security in times of crop failure, as they were a "near-cash" capital stock in study areas. The top three (1$^{st}$, 2$^{nd}$ and 3$^{rd}$) purposes of keeping livestock in the peri-urban areas were plowing, source of income, and milk, whereas milk, income, and meat were ranked as the top three (1$^{st}$, 2$^{nd}$ and 3$^{rd}$) purpose of keeping livestock in an urban areas (Table 9). The primary reason why the farmers in the peri-urban area ranked plowing as the first (1$^{st}$) rank might be due to that the area was found in a mixed (crop-livestock) production system. Farmers in urban areas raised milk as fist (1$^{st}$) purpose of keeping livestock. This might be due to market accessibility, high demand of the milk and an increased price of the milk over the time in urban area. This finding agreed with the finding of Birara and Zemen (2016), who reported the role of livestock as a source of income, food, power and organic fertilizer from Bahir Dar University, Ethiopia.

Table 8. Purpose of keeping livestock in study areas.

| Purpose of keeping livestock | Study Location | | | | | | | | | | Overall |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | | | | Urban | | | | | |
| | Rank | | | | | Rank | | | | | |
| | 1st | 2nd | 3rd | Sum | Index | 1st | 2nd | 3rd | Sum | Index | Index |
| Meat | 13 | 10 | 13 | 94 | 0.18 | 14 | 13 | 16 | 76 | 0.19 | 0.19 |
| Milk | 12 | 29 | 7 | 101 | 0.20 | 28 | 22 | 12 | 127 | 0.32 | 0.26 |
| Income | 21 | 18 | 10 | 109 | 0.21 | 19 | 20 | 11 | 99 | 0.25 | 0.23 |
| HS and wool | 0 | 1 | 6 | 8 | 0.02 | 0 | 0 | 0 | 0 | 0.00 | 0.01 |
| Ploughing | 33 | 19 | 26 | 163 | 0.32 | 3 | 5 | 12 | 52 | 0.13 | 0.23 |
| Transport | 1 | 1 | 12 | 17 | 0.04 | 3 | 6 | 9 | 37 | 0.09 | 0.07 |
| Manure | 1 | 2 | 7 | 14 | 0.03 | 0 | 0 | 5 | 5 | 0.02 | 0.03 |

*Index = sun of ($3x1^{st}$rank + $2x2^{nd}$rank + $1x3^{rd}$rank) given for an individual attribute/sum of ($3x1^{st}$rank + $2x2^{nd}$rank + $1x3^{rd}$rank) given for total attributes*

Trends of livestock keeping is presented in Table 10. Respondents in the current study areas stated that, even if livestock are an important resource for the livelihood of the society, the number of livestock kept by the farmers showed a decreasing status. The majority of the respondents in both peri-urban and urban areas stated that the trends of livestock numbers compared over the past ten years were in decreasing trends. However, a small proportion of respondents stated that increase and stable trend (Table 10). This might be due to urbanization, land scarcity and increased pressure to allocate land for crop production, instead of livestock grazing which led to a significant decrease in the number of livestock kept by farmers.

Table 9. Trends of livestock keeping over past ten years in study areas

| Variables | Study location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Trends of livestock keeping** | | | | | | | 0.39 | 0.822 |
| Increase | 18 | 22.2 | 17 | 25.8 | 35 | 23.8 | | |
| Decrease | 47 | 58.0 | 35 | 53.0 | 82 | 55.8 | | |
| Stable | 16 | 19.8 | 14 | 21.2 | 30 | 20.4 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.4.3. Purpose of keeping small ruminants in study areas

The purpose keeping small ruminant is summarized in Table 11 below. Respondents in study areas were kept small ruminants for multi-purpose (like meat, milk, source of income, live asset, skin and wool, and manure). As the current finding indicated, majority of the respondents in both peri-urban and urban areas were kept small ruminants for income source (1$^{st}$), followed by live asset (2$^{nd}$), milk and meat (3$^{rd}$) and manure (4$^{th}$). Meat was ranked as the 3$^{rd}$ purpose of keeping small ruminants in peri-urban area. However, in urban area milk was ranked as 3$^{rd}$ purpose of keeping small ruminants. The current finding was in line with finding of Afiras (2019) in Esera Ditrict of Dawuro Zone Southern Ethiopia, Mamo (2020), in Chalia District West Shoa Zone, Lakew *et al.* (2021) in Eastern Ahmara region, Belete (2009) in Goma District of Jimma Zone and Diriba *et al.,* (2021) in Genji district of West Wollega, Western Oromia, Ethiopia, who reported majority of the respondents were keeping small ruminants for income purpose. The present result is similar to the reports of different scholars in Ethiopia (Alemu, 2015; Gatew, 2014; Tesema, 2019), who mentioned a source of cash income as the primary purpose of goat keeping. The same result also reported by Fikru and Gebeyew (2015), who reported that, about 53.3% of the small ruminant keepers keep them mainly for income generation purpose in Degehabur Zone, Eastern Ethiopia.

Table 10. Purpose of keeping small ruminants in study areas.

| Purpose of keeping small ruminants | Study Location | | | | | | | | | | Overall |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | | | | Urban | | | | | |
| | Rank | | | | | Rank | | | | | |
| | 1st | 2nd | 3rd | Sum | Index | 1st | 2nd | 3rd | Sum | Index | Index |
| Meat | 17 | 17 | 21 | 102 | 0.21 | 12 | 12 | 16 | 76 | 0.19 | 0.20 |
| Milk | 9 | 24 | 7 | 82 | 0.17 | 14 | 18 | 10 | 88 | 0.22 | 0.20 |
| live asset | 21 | 19 | 16 | 117 | 0.24 | 17 | 21 | 14 | 107 | 0.27 | 0.26 |
| Income | 34 | 20 | 27 | 169 | 0.35 | 23 | 13 | 23 | 118 | 0.30 | 0.33 |
| Manure | 0 | 0 | 10 | 10 | 0.02 | 0 | 2 | 3 | 7 | 0.02 | 0.02 |

*Index = sun of (3x1$^{st}$rank + 2x2$^{nd}$rank + 1x3$^{rd}$rank) given for an individual attribute/sum of (3x1$^{st}$rank + 2x2$^{nd}$rank + 1x3$^{rd}$rank) given for total attributes*

### 4.5. Small Ruminants Fattening Practice in Study Areas

#### 4.5.1. Fattening experience and source of fattening small ruminants in study areas

Fattening experience of the fatteners and source of fattening small ruminants in current study areas are given in Table 12. Sheep and/or goat fattening practice was widely adopted in current study areas. As the result indicates, respondents in the current study areas had varied years of experience with sheep and/or goats fattening. Accordingly, their years of fattening experience ranged from 1 year to more than 10 years in both peri-urban and urban areas. However, the majority of the fatteners in peri-urban area had the experience of more than 10 years on small ruminants fattening, while small proportion of the fatteners had an experience less than 5 years (less than 1 year and 1 to 5 years). The current result is agreed with finding of Mezgebu *et al.* (2022), who reported 15.4±9.8, 12.6±6.8 and 12.5±7.1-year average goat keeping experience of goat keepers in Bibugn, Goncha Siso Enesie, and Hulet Eju Enesie districts of East Gojjam Zone, Amhara Region, Ethiopia. On the other hand, the majority of small ruminant fatteners in urban areas had experience ranging from 5 to 10 years (1-5 and 5-10 years) on small ruminant fattening, followed by the fatteners having more than 10 years of experience (Table 12).

The higher fattening experience of the farmers was recorded in peri-urban areas than urban areas. The results also showed that, the majority of the farmers were engaged in sheep fattening, while parts of them fattening goats and shoats. Farmers used different source of sheep and/or goats for fattening purposes. As the result indicates, the source of fattening sheep and/or goats was their own flock, farm gate, and local market in peri-urban and urban areas. For peri-urban fatteners, the main source of sheep and/or goats for fattening was their own flock, followed by buying from local markets, and on-farm buying. However, fatteners in urban areas were use the local markets, followed by own flock, and farm gate, which was significantly ($P<0.005$) different from a major source of sheep and/or goats in the peri-urban areas. This might be due to the existing available source for both peri-urban and urban area. The current result is agreed with finding of Mezgebu *et al.* (2022), who reported that, major source of the goats is purchasing from the market in East Gojjam Zone.

Table 11. Fattening experience and source of fattening small ruminants in study areas

| | **Study location** | | | | | | **$X^2$** | **P-Value** |
|---|---|---|---|---|---|---|---|---|
| | **Peri-urban** | | **Urban** | | **Overall** | | | |
| | **n1** | **%** | **n2** | **%** | **N** | **%** | | |
| **Fattening experience of the farmers** | | | | | | | 9.51 | 0.023 |
| <1year | 2 | 2.5 | 0.0 | 0.0 | 2 | 1.4 | | |
| 1-5 years | 16 | 19.8 | 26 | 39.4 | 42 | 28.6 | | |
| 5-10 yeas | 30 | 37.0 | 24 | 36.4 | 54 | 36.7 | | |
| >10 years | 33 | 40.8 | 16 | 24.2 | 49 | 33.3 | | |
| **Type of small ruminant fattened by the farmers** | | | | | | | 0.26 | 0.877 |
| Only sheep | 39 | 48.1 | 30 | 45.5 | 69 | 46.9 | | |
| Only goats | 25 | 30.9 | 23 | 34.8 | 48 | 32.7 | | |
| Both sheep and goat | 17 | 21.0 | 13 | 19.7 | 30 | 20.4 | | |
| **Source of fattening small ruminants** | | | | | | | 14.38 | 0.001 |
| Use own flock | 44 | 54.3 | 21 | 31.8 | 65 | 44.2 | | |
| Buy on farm | 9 | 11.1 | 2 | 3.0 | 11 | 7.5 | | |
| Buy from local market | 28 | 34.6 | 43 | 65.2 | 71 | 48.3 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.5.2. Economic importance of fattened small ruminants in study areas

The economic importance of fattened small ruminants and the level of profitability of the farmers are presented in Table 13. As computed by Table 11 above, the first objective of the farmers behind fattening small ruminants was to generate income source. Furthermore, the current result indicated that, majority of the respondents use income obtained from fattening sheep and/or goats for different purpose such as, buying inputs for crop production, followed by saving account, food for home consumption, school expense and pay tax in study areas. This might be due to the current study areas were found in mixed (crop-livestock) farming system. This finding is agreed with finding of Dhaba *et al.* (2012), who reported that small ruminants are mainly kept for income generation in many parts of Ethiopia to obtain cash income for household expenses, such as buying grains for household consumption, buying agricultural inputs such as fertilizer and improved seed and paying the medical and school expenses of household members in Ilu Abba Bora Zone of Oromia Regional State, Ethiopia.

The current investigation also showed that, the farmers were profited from sheep and/or goats fattening. However, level of profitability of the farmers were varied among the fatteners (i.e. poorly profited, moderately profited and highly profited). Majority of them were stated that, they were moderately profited from sheep and/or goats fattening, followed by those farmers who were highly and poorly profited based on the income obtained from sheep and/or goat fattening, and the purpose of using income in the study area (Table 13). The variability in the farmers' profitability may be due to factors like organized feeding systems, access to veterinary services, market proximity and other inputs. Thus, farmers with organized feeding systems, access to veterinary services and market proximity may be highly earned, while those farmers with limited access to improved feeds and basic veterinary care may profited moderately. In contrast, farmers with minimal input used, limited market access and access to veterinary services may be poorly profited. The current finding is comparable with the finding of Habane *et al.* (2024), who suggested that factors such as animal quality, management practices, and market conditions can influence the profitability of fattening small ruminants from Ellele Woreda, SRS, in Ethiopia.

Table 12. Use of income from fattened sheep and/or goats and profitability in study areas

| Variables | Study Location | | | | | | $X^2$ | P-value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Use of income from shoats fattening** | | | | | | | 6.13 | 0.189 |
| Buying food for home | 15 | 18.5 | 15 | 22.7 | 30 | 20.4 | | |
| Saving account | 21 | 25.9 | 15 | 22.7 | 36 | 24.5 | | |
| School expenses | 9 | 11.1 | 1 | 1.5 | 10 | 6.8 | | |
| Pay tax | 3 | 3.7 | 2 | 3.0 | 5 | 3.4 | | |
| Input for crop production | 33 | 40.7 | 33 | 50.0 | 66 | 44.9 | | |
| **Level of profitability of the farmers** | | | | | | | 2.95 | 0.229 |
| High profited | 29 | 35.8 | 21 | 31.8 | 50 | 34.0 | | |
| Moderate profited | 49 | 60.5 | 45 | 68.2 | 94 | 64.0 | | |
| Poor profited | 3 | 3.7 | 0 | 0.0 | 3 | 2.0 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.5.3. Selection criteria of fattening sheep and/or goats in study areas

The selection criteria for fattening sheep and/or goats are summarized in Table 14. Selection criteria used by the fatteners in the study areas were sex, age, health, cost, boy condition, size, and color. As the result indicates health condition, age, and size were ranked as top three criteria used by the farmers to select sheep and/or goats for fattening purpose in peri-urban area, while health body condition, age and sex were ranked as top three selection criteria for sheep and/or goats selection in urban area. The current finding was comparable with finding of Diriba *et al.,* (2021), who reported wealth, age and body size as the first, second and third criteria of sheep selection for fattening purpose in Genji district of west Wollaga of western Oromia.

Table 13. Selection criteria used by the household to select sheep and/or goats for fattening

| Selection Criteria | Study Location | | | | | | | | | | Overall |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | | | | Urban | | | | | |
| | Rank | | | | | Rank | | | | | |
| | 1st | 2nd | 3rd | Sum | Index | 1st | 2nd | 3rd | Sum | Index | Index |
| Age | 28 | 21 | 7 | 133 | 0.27 | 14 | 15 | 14 | 86 | 0.22 | 0.25 |
| Sex | 8 | 13 | 2 | 52 | 0.11 | 8 | 5 | 8 | 42 | 0.11 | 0.11 |
| Health | 32 | 20 | 4 | 140 | 0.29 | 31 | 17 | 2 | 129 | 0.32 | 0.31 |
| Cost | 4 | 5 | 22 | 44 | 0.09 | 3 | 7 | 14 | 37 | 0.09 | 0.09 |
| Size | 2 | 14 | 29 | 63 | 0.13 | 3 | 4 | 13 | 30 | 0.08 | 0.11 |
| Color | 2 | 2 | 7 | 17 | 0.04 | 4 | 6 | 4 | 28 | 0.07 | 0.06 |
| Body condition | 4 | 7 | 10 | 36 | 0.07 | 4 | 12 | 10 | 46 | 0.11 | 0.09 |

*Index = sun of (3x1$^{st}$rank + 2x2$^{nd}$rank + 1x3$^{rd}$rank) given for an individual attribute/sum of (3x1$^{st}$rank + 2x2$^{nd}$rank + 1x3$^{rd}$rank) given for total attributes, BC = body condition.*

#### 4.5.3.1. Age categories and method of age determination in study areas

The preferred age of sheep and/or goat, the reason for preferred age and method of age determination are summarized in to Table 15. As the result indicates farmers under take fattening practice of sheep and/or goats with different age categories, such as three-six months, seven-ten months and above ten months in both peri-urban and urban areas. However, the farmers preferred sheep and/or goat with three-six age interval, while small proportion of the farmers preferred to fatten sheep and/or goats in seven-ten months and above ten months of age. This indicates, the majority of the farmers in study areas prefer young aged sheep and/or goats for fattening purposes. This might be due to their small starting budget, faster weight gain, better feed conversion efficiency and greater market demand, than older fattened sheep and goats. Age categories of the sheep and/or goats preferred for fattening showed significant ($p<0.005$) difference between peri-urban and urban areas. This finding was in line with finding of Diriba *et al.* (2021), who reported that, younger animals at finishing may have tender carcasses and greater market demand than fattened older animals.

Respondents mentioned different reasons behind using different age categories. Such reasons were, a small starting budget, short fattening period, feed required only for weight gain, and fast-to-reach finishing period as mentioned by the respondents. However, the main reason why the farmers prefer young aged sheep and/or goats for fattening was its small starting budget in both peri-urban and urban areas (Table 15).

Interviewed respondents stated that there were different methods to determine the age of sheep and/or goat during selection (Table 15). Animal age can be estimated by looking at the size, number and wear of teeth, since smallholder sheep and/or goat producers in Ethiopia rarely keep birth records. Dentition, age estimation and owner asking were the main methods used by the fatteners to determine age of small ruminants in both peri-urban and urban areas. The majority of the fatteners both in peri-urban and urban areas were use the dentation method to determine age of sheep and/or goat, followed by a small proportion of the fatteners who estimate the age of the animals and asked the owners of sheep and/or goats about the age during buying and selling. The current investigation result is comparable with the finding of Vatta *et al.* (2006), who reported that dentition as the main way of estimating ages of sheep and/or goats in South Africa.

Table 14. Age category, reason for specific age preference and method of age determination

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Preferred age** | | | | | | | 8.50 | 0.001 |
| Three-six months | 60 | 74.1 | 60 | 90.9 | 120 | 81.6 | | |
| Seven-ten months | 17 | 21.0 | 3 | 4.6 | 20 | 13.6 | | |
| Above ten months | 4 | 4.9 | 3 | 4.6 | 7 | 4.8 | | |
| **Reasons for specific age preference** | | | | | | | 6.28 | 0.099 |
| Small starting budget | 45 | 55.6 | 48 | 72.7 | 93 | 63.3 | | |
| Short fattening period | 13 | 16.1 | 4 | 6.1 | 17 | 11.6 | | |
| Feed only for weight gain | 8 | 9.9 | 3 | 4.6 | 11 | 7.48 | | |
| Fast to reach finishing period | 15 | 18.5 | 11 | 16.7 | 26 | 17.7 | | |
| **Methods of age determination** | | | | | | | 1.73 | 0.421 |
| Owner asking | 11 | 13.6 | 14 | 21.2 | 25 | 17.0 | | |
| Dentition | 54 | 66.7 | 42 | 63.6 | 96 | 65.3 | | |
| Age estimation | 16 | 19.8 | 10 | 15.2 | 26 | 17.7 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.5.4. Small ruminants fattening system in study areas

The fattening system, reason for using by-product based system, highly costive input and status of getting training about modern fattening practice and management system are summarized in Table 16. Fatteners used traditional and agro-industrial by-product-based fattening system in both peri-urban and urban areas. However, majority of farmers used traditional system in both cases. The method was highly depends on natural pasture and free grazing system. The result also indicated that, a small proportion of farmers in both peri-urban and urban areas were practice by-product-based fattening system.

The finding is agreed with Jemberu *et al.* (2022), who reported that small ruminant production in Ethiopia is largely based on traditional subsistence production with limited commercialization and modernization in northwest of Ethiopia. This investigation is also agreed with the findings of Deginet, & Abiy (2020), who reported majority of the farmers were use traditional fattening system in Anlemo woreda, Hadiya Zone of Ethiopia, and Abera and Elias (2019), who reported that, about 93% of respondents practice traditional small ruminants fattening system, while 7% was practiced agro-industrial by-product-based fattening system in East Badewacho Woreda, Hadiya Zone Southern Ethiopia.

The reason behind using by-product-based fattening systems were lack of grazing land and feed shortage, high quality of agro-industrial by-product feeds and low quality of available feed resources in study areas. However, the main reason of the case in peri-urban area was the quality of agro-industrial by-product feed rather than lack of grazing land, while in urban area the method was used because of grazing land shortage (Table 16). Out of the input used for fattening, feed was the high costive input for small ruminant fattening, followed by water and drug in both peri-urban and urban areas. The result indicated that both water and drugs were more easily accessible ($p<0.005$) in urban area than peri-urban areas.

Respondents in study areas stated that, they were using local breeds of small ruminants for fattening. However, a small number of the farmers were stated that, they do not have any information about type of breed used for fattening in study areas. Key informant and focus group discussion were stated that, breeds of sheep and/or goats kept by the society in the study area was Arsi-Bale breed, which was locally dominating the area. Training about modern fattening system and management practices is another input for fatteners, which increases farmers' profitability from the fattening practice. Unfortunately, the majority of the farmers in current study area were not access to any information about modern fattening practices and management system of small ruminants. However, small proportion of them got some information about modern fattening practices and management systems of small ruminants in both peri-urban and urban areas, respectively.

As the result indicates, farmers in urban areas got an information and training about modern fattening practices and management of small ruminants than farmers in peri-urban areas. This might be due to the reality that, urban areas was a wider range of information than rural areas.

Table 15. Fattening system, by-product based system and status of getting training

| Variables | Study Location | | | | | | $X^2$ | P-value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Fattening System** | | | | | | | 1.49 | 0.223 |
| Traditional system | 72 | 88.9 | 54 | 81.8 | 126 | 85.7 | | |
| By-product based system | 9 | 11.1 | 12 | 18.2 | 21 | 14.3 | | |
| **Reason for agro industrial by-product utilization** | | | | | | | 7.36 | 0.061 |
| Lack of land & feed shortage | 4 | 4.9 | 10 | 15.2 | 14 | 9.5 | | |
| Low quality of available feed | 5 | 6.2 | 1 | 1.5 | 6 | 4.1 | | |
| Availability by-product feeds | 0 | 0.0 | 1 | 1.5 | 1 | 0.7 | | |
| **Highly costive input** | | | | | | | 11.17 | 0.004 |
| Feed | 66 | 81.5 | 65 | 98.2 | 131 | 89.1 | | |
| Water | 9 | 11.1 | 0 | 0.0 | 9 | 6.1 | | |
| Drugs | 6 | 7.4 | 1 | 1.5 | 7 | 6.1 | | |
| **Breed of shoats** | | | | | | | 1.65 | 0.199 |
| Local breed | 59 | 72.8 | 54 | 81.8 | 113 | 76.9 | | |
| No idea | 22 | 27.2 | 12 | 18.2 | 34 | 23.1 | | |
| **Got training on modern fattening** | | | | | | | 2.16 | 0.142 |
| Yes | 15 | 18.5 | 19 | 28.8 | 34 | 23.1 | | |
| No | 66 | 81.5 | 47 | 71.2 | 113 | 76.9 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

## 4.6. Major Feed Resources and utilization in the study areas

### 4.6.1. Major feed resources in study areas

Feed resources in current study areas are given in Table 17. Feed is the key and high-cost input for small ruminant fattening. The current finding indicated that, livestock feed resources in the study areas were natural pasture, crop residues, improved forages, agro-industrial by-products, fodder trees and screened barley by-product (yewofco tirag). Accordingly, respondents in peri-urban areas ranked natural pasture, crop residues, and agro-industrial by-products as the 1st, 2nd and 3rd (top three) feed resources used for small ruminants fattening. This indicates that farmers in the peri-urban areas used natural pasture as the main feed resource for small ruminants fattening, especially during the wet season followed by the crop residues (during the dry season). This finding is agreed with finding of Tolera *et al.* (2012) and Muhammed (2015), who reported natural pasture and crop residue as major feed resources for highlands of Ethiopia and Shewangzaw and Adis (2016), who reported that, main feed resource of small ruminants were natural pasture and crop residues in North Gondar Zone.

In urban area crop residues, agro-industrial byproducts and natural pasture were ranked as 1st, 2nd and 3rd major feed resource used for small ruminants fattening. This result is in agreement with the finding of Abera *et al.* (2014) and Samuel (2014), who reported that natural pasture, crop residues, aftermath grazing, hay, agro-industrial by-products, commercial concentrate and non-conventional feeds were the most important feed resources used in different parts of Ethiopia. As the result indicates, production and utilization of improved forage were less adopted in peri-urban and urban areas. It was due to a lack of land, lack of seed and lack of awareness about the importance of improved forage as an animals feed resource. This finding agreed with the finding of Afras, (2019), who reported that growing improved forage was not a common practice due to a lack of awareness of farmers on improved forage species, lack of land and improved forage seed supply and adoption of farmers to cultivate improved forages in Esera District, Dawuro Zone of Southern Ethiopia. It is also supported by the idea from FGD. Fodder tree were used only in peri-urban area while screened barley by product was used in urban areas.

Table 16. Major feed resource in the study areas

| Major feeds | Study Location | | | | | | | | | | Overall |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | | | | Urban | | | | | |
| | Rank | | | | | Rank | | | | | |
| | 1st | 2nd | 3rd | Sum | Index | 1st | 2nd | 3rd | Sum | Index | Index |
| Natural pastures | 52 | 18 | 11 | 203 | 0.42 | 11 | 14 | 12 | 73 | 0.18 | 0.30 |
| Crop residues | 26 | 46 | 8 | 178 | 0.37 | 37 | 19 | 6 | 155 | 0.39 | 0.38 |
| Improved forages | 0 | 1 | 4 | 6 | 0.01 | 0 | 2 | 6 | 10 | 0.03 | 0.02 |
| AIB-P | 4 | 7 | 29 | 55 | 0.11 | 7 | 20 | 23 | 84 | 0.21 | 0.16 |
| Fodder trees | 0 | 7 | 30 | 44 | 0.09 | 0 | 0 | 0 | 0 | 0.0 | 0.05 |
| SBB-P | 0 | 0 | 0 | 0 | 0.0 | 11 | 13 | 17 | 76 | 0.19 | 0.10 |

*Index = sun of (3x1$^{st}$rank + 2x2$^{nd}$rank + 1x3$^{rd}$rank) given for an individual attribute/sum of (3x1$^{st}$rank + 2x2$^{nd}$rank + 1x3$^{rd}$rank) given for total attributes; AIB –P = Agro-industrial by-products; SBB-P = Screened barley by-product.*

### 4.6.2. Seasonal availability of feed resource in study areas

The seasonal availability of the feed resource is presented in Table 18. As the result indicates, feed resources in the study areas were seasonal (wet season and dry season). Accordingly, during the wet season farmers in study areas used a different type of feed resources such as natural pasture, crop residues, improved forages, fodder trees, AIB-p (agro-industrial by-products) and SBB-p (screened barley by-products) with different level of availability. Out of those feeds, natural pasture was the first available and mainly used feed resource during the wet season (June-October), followed by crop residues, and became scarce during the dry season (November – February). However, availability and utilization of improved forages, AIB-p (agro-industrial by-products) and SBB-p (screened barley by-products) was low in both peri-urban and urban areas (Table 20). This finding was agreed with the finding of Mengistu *et al.* (2016), who reported that natural pasture availability occurred in June-November in Kedida of Gambela District, Ethiopia. During dry season (November – February) natural pasture and cultivated forages became scarce and the majority of farmers shifted toward using crop-residues because crop residues were highly available both in peri-urban and urban areas during this period.

As it has been seen from the Table 18 below, respondents in peri-urban area also use fodder trees, agro industrial by-products and screened barley by product. However, utilization of screened barley by-product as major feed was less adopted in peri-urban area. On the other hand, respondents in urban area were use agro industrial by-product and screened barley by-product in addition to crop residues as major feed for small ruminants fattening. Opposed to peri-urban area, fodder trees were not available in urban area during both wet and dry season. This result is agreed with findings of Mohamed and Abate (1995), who reported that, in dry season (October-February), there was a short rainy season, feed supplies declined, straw and other crop residues became gradually available from Addis Ababa, Ethiopia.

Table 17. Seasonal availability of the feed resources in study areas

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Wet season (June - October) available feeds** | | | | | | | 26.19 | 0.000 |
| Natural pasture | 58 | 71.6 | 29 | 43.9 | 87 | 59.18 | | |
| Crop residues | 5 | 6.2 | 16 | 24.2 | 21 | 14.3 | | |
| Cultivated forages | 1 | 1.2 | 0 | 0.0 | 1 | 0.7 | | |
| Fodder trees | 7 | 8.6 | 0 | 0.0 | 7 | 4.8 | | |
| Agro industrial by-product | 6 | 7.4 | 14 | 21.2 | 20 | 13.6 | | |
| Screened barely by-product | 4 | 4.9 | 7 | 10.6 | 11 | 7.5 | | |
| **Dry season (November - February) available feeds** | | | | | | | 19.53 | 0.000 |
| Crop residues | 50 | 61.7 | 40 | 60.6 | 90 | 61.2 | | |
| Fodder trees | 15 | 18.5 | 0 | 0.0 | 15 | 10.2 | | |
| Agro industrial by-product | 14 | 17.3 | 17 | 25.8 | 31 | 21.1 | | |
| Screened barely by-product | 2 | 2.5 | 9 | 13.6 | 11 | 7.5 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.6.3. Crop residues, agro-industrial by-products and fodder trees used in study areas

Crop residues, industrial by products and fodder trees used by the respondents are summarized in Table 19. Crop residues used are barley straw, wheat straw, teff straw, maize strove and mix of barley and wheat straw. The obtained result indicated that, majority of the respondents preferred to use barely straw and mix of barley and wheat straw as major feed of small ruminant than utilization of sole wheat straw or teff straw in both peri urban and urban areas. The reason behind preference of barley straw than other type of crop residues was the fattener's traditional judgment about productivity, palatability and moisture holding of the barley straw compared to wheat straw, teff straw and maize strove in study areas. This finding is in line with the finding of Mamo (2020), who reported major crop residues and its utilization from Chalia District, West Shoa Zone and Hussein (2017), who reported that, the farmers prefer barley straw as animals feed than other crop residues in Kofele District, Western Arsi Zone, Ethiopia.

As it summarized in to Table 19 below, respondents interviewed that, different type of agro industrial by-products, such as wheat bran, molasses and linseed cake were used by the fatteners as supplementary feed for small ruminants in peri-urban and urban areas. Accordingly, from industrial by-products, wheat bran was highly utilized by the fatteners, followed by both wheat bran and linseed cake, linseed cake and both wheat bran and molasses utilization in both peri-urban and urban areas. This finding was more or less comparable with the finding of Mamo (2020), who reported wheat bran as major supplementary feed used in Chalia District West Shoa Zone.

Respondents also stated that, in peri-urban area there were number of fodder trees which used for browsing purpose. As they stated out of those trees, Carissa edulis (locally named, Agamsa) and Olea europea (locally named, Ejersa) were the two main fodder trees used as the major browsing trees. They also used as the supplementary feeds for small ruminants especially during dry season due to their long time greenness. In contrast, small proportion of the farmers from peri-urban and all of the farmers in urban were stated that, there was no fodder trees at all. There is highly significance ($P<0.001$) difference between peri-urban and urban area in case of fodder tree availability and utilization (Table 19).

Table 18. Crop residues, agro industrial by products and fodder trees used.

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Crop residue used** | | | | | | | 10.44 | 0.034 |
| Barley straw | 41 | 50.6 | 47 | 71.2 | 88 | 59.9 | | |
| Wheat straw | 5 | 6.2 | 5 | 7.6 | 10 | 6.8 | | |
| Teff straw | 3 | 3.7 | 2 | 3.0 | 5 | 3.4 | | |
| Maize stove | 0 | 0 | 1 | 1.5 | 1 | 0.7 | | |
| Mix of wheat and barley straw | 32 | 39.5 | 11 | 16.7 | 43 | 29.3 | | |
| **Agro industrial by-product used** | | | | | | | 4.43 | 0.351 |
| Wheat bran | 44 | 54.4 | 35 | 53.1 | 79 | 53.7 | | |
| Wheat bran and molasses | 10 | 12.4 | 3 | 4.6 | 13 | 8.9 | | |
| Linseed cake | 10 | 12.4 | 14 | 21.2 | 24 | 16.3 | | |
| Wheat bran and linseed cake | 17 | 21.0 | 14 | 21.2 | 31 | 21.1 | | |
| **Fodder trees used** | | | | | | | 124.77 | 0.000 |
| Carissa edulis (Agamsa ) | 12 | 14.8 | 0 | 0.0 | 12 | 8.2 | | |
| Olea eurupea (Ejersa) | 12 | 14.8 | 0 | 0.0 | 12 | 8.2 | | |
| Carissa edulis and Olea eurupea | 51 | 63.0 | 0 | 0.0 | 51 | 34.7 | | |
| No fodder tree | 6 | 7.4 | 66 | 100.0 | 72 | 49.0 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.6.4. Feed shortage and coping mechanism in study areas

#### 4.6.4.1. Months of feed shortage in study areas

Months of feed shortage, Cause of feed shortage and coping mechanism from feed shortage are summarized in Table 20. All respondents in the current study areas stated that, there was a feed shortage in peri-urban and urban areas. However, months of the year when feed shortage occurred vary respective to the feed type. Natural pasture shortage occurred start from November to February both in peri-urban and urban areas, respectively. Small numbers of respondents in urban area stated that, there was year round (September - August) shortage of natural pasture (Table 20). This might be due to lack of grazing land in urban area. This finding agreed with the finding Tesema *et al.* (2023), who reported seasonal feed shortage from South and North Wollo Zone and Mengistu *et al.* (2016), who reported that, natural pasture shortage was occurred in December-May in Kedida Gamela District, Southern Ethiopia.

On the other hand, majority of the respondents were reported that, crop residues shortage was occurred started from June - October in peri-urban and urban areas. There were also shortage of crop residues between Novembers to May. In contrast, small number of respondents in urban area reported that, year round availability of crop residues (Table 20). This might be due to the matter of storing crop residues during surplus feed was exist. This finding was in line with the finding of Tesema *et al*. (2023), who reported that, seasonal feed shortage in south and north Wollo zone of Ethiopia.

#### 4.6.4.2. Reason for feed shortage in study areas

Reason of feed shortage is presented in Table 20. There were a number of reasons behind the feed shortage in current study areas, such as crop land expansion, decline in land productivity, increased human population and grazing land reduction. Grazing land reduction and crop land expansion were the first and the second cause of feed shortage in peri-urban area followed by decline in productivity of land and increased human population.

This finding is agreed with finding of Dhaba *et al.* (2012), reported that, the main reason for feed shortage were expanding crop cultivation, shortage of grazing land, decline in productivity of grazing land, increase animal and human population in Ilu Abba Bora Zone, Oromia, Ethiopia and muhammed (2015), who reported that, feed constraint was mainly related to shortage of grazing land due to increased population and competition of the available land for crop production.

In urban area, grazing land reduction and increased number of population were the two major cause of feed shortage followed by the decline in productivity of the land. Reason for feed shortage was showed highly significance ($P<0.001$) different between peri-urban and urban area. This finding also agreed with finding of Afras, (2019), who reported that, major reason of feed shortage was expansion of crop cultivation, shortage and decline in production of grazing land, weather condition, and increment in number of animal and human population Esera District, Dawuro Zone, Southern Ethiopia,

#### 4.6.4.3. Coping mechanism for feed shortage in study areas

There were a different method used by the respondents to cope-up from loss of livestock due to feed shortage during dry season. Such mechanisms were, store and preserve the feed, selling sheep and/or goats, purchase concentrate feed, and store and purchase concentrate. Majority of respondents were store and preserve the feed at time of feed shortage while others were selling sheep and/or goats, purchase concentrate feed, and store and purchase concentrate feeds (Table 20). The present result is agreed with finding of Muhammed (2015), who reported, rent grazing land, reduction of stock and intensive use of crop residues and conserved feed as traditional feed scarcity coping mechanisms in three selected districts of Jimma zone, Southwest Ethiopia.

Table 19. Months of feed shortage, reasons and coping mechanism in study areas

| Variables | Study Location | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | $X^2$ | P-Value |
| **Natural pasture shortage** | | | | | | | 7.68 | 0.006 |
| November – February | 81 | 100.0 | 60 | 90.9 | 141 | 95.9 | | |
| September – august | 0 | 0.0 | 6 | 9.1 | 6 | 4.1 | | |
| **Crop residues shortage** | | | | | | | 11.98 | 0.003 |
| November – may | 5 | 6.17 | 1 | 1.52 | 6 | 4.1 | | |
| June – October | 76 | 93.8 | 57 | 86.4 | 133 | 90.5 | | |
| No shortage | 0 | 0.0 | 8 | 12.1 | 8 | 5.4 | | |
| **Reason for feed shortage** | | | | | | | 50.51 | 0.000 |
| Crop land Expansion | 31 | 38.3 | 0 | 0.0 | 31 | 21.1 | | |
| Decline in land productivity | 3 | 3.7 | 4 | 6.1 | 7 | 4.8 | | |
| Increased population | 2 | 2.5 | 25 | 37.9 | 27 | 18.4 | | |
| Grazing land reduction | 45 | 55.6 | 37 | 56.1 | 82 | 55.8 | | |
| **Coping mechanism for feed shortage** | | | | | | | 2.26 | 0.521 |
| Store and preserve feed | 37 | 45.7 | 29 | 43.9 | 66 | 44.9 | | |
| Selling animals | 8 | 9.9 | 7 | 10.6 | 15 | 10.2 | | |
| Purchase concentrate | 21 | 25.9 | 12 | 18.2 | 33 | 22.5 | | |
| Store and purchase | 15 | 18.5 | 18 | 27.3 | 33 | 22.5 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.6.4.4. Feed storage and improved forage production in study areas

Feed storage and method of storing the feed in study areas are summarized in Table 21. Availability of the feeds in the current study area was season based, so that majority of the respondents store different type of feeds to cope-up the problem faced due to feed shortage.

Accordingly, types of feed stored by the respondents were natural pasture, wheat straw, barley straw, teff straw and mixed barley and wheat straw. Wheat straw, barley straw and mix of wheat and barley straw were the major feed type stored by the respondents in the current study areas followed by teff straw and natural pasture. During wet season natural pasture availability was occurred. However, storage of natural pasture was not well adopted in current study area, rather they preferred to field grazing and/or collect and immediately feed by the animals. Even if the pasture was collected from different fields and carried to the homestead, it was immediately offered to the animals rather than store it for the time of feed shortage. This might be due to the awareness level of the respondents towards the storing surplus natural pasture for the time of feed shortage (dry season).

Fatteners used different methods for feed storage, such as baling under the shade, stacks under the shade and stacks without the shade (Table 21). As the result revealed, majority of the farmers were store the feeds by stacking it without the shade near to the homestead in peri-urban and urban areas. However, small proportion of the farmers were store the feed by baling and stacking it under the shade.

Improved forage production and utilization was not widely adopted in current study areas. Majority of the respondents were reported that, they didn't produce improved forages. The reasons behind the cases, were lack of awareness, lack of the land, and lack of the seed both in peri-urban and urban areas. Lack of the land and lack of awareness were the two major problems raised by the farmers, followed by the lack of the seed in peri-urban and urban areas. This result also agreed with the idea from FGD and KII. The result was agreed with the finding of Hussein (2017), who reported improved forage seed availability and low awareness were the main reason for low productivity of natural pasture in Kofele District of Western Arsi Zone.

Table 20. Feed storage and method of storing the feed in study areas

| Variables | Study Location | | | | | | X2 | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Do you store the feed** | | | | | | | 2.50 | 0.114 |
| Yes | 77 | 95.1 | 58 | 87.9 | 135 | 91.8 | | |
| No | 4 | 4.9 | 8 | 12.1 | 12 | 8.2 | | |
| **Type of Stored feed** | | | | | | | 3.51 | 0.621 |
| Natural pasture | 3 | 3.7 | 3 | 4.6 | 6 | 4.1 | | |
| Wheat straw | 31 | 38.3 | 23 | 34.9 | 54 | 36.7 | | |
| Barley straw | 19 | 23.5 | 11 | 16.7 | 30 | 20.4 | | |
| Teff straw | 10 | 12.4 | 10 | 15.2 | 20 | 13.6 | | |
| Mix of wheat and barley straw | 14 | 17.3 | 11 | 16.7 | 25 | 17.0 | | |
| **How do you store feed** | | | | | | | 3.24 | 0.357 |
| Baled under shade | 1 | 1.2 | 2 | 3.0 | 3 | 2.0 | | |
| Stack under shade | 27 | 33.3 | 19 | 28.8 | 46 | 31.3 | | |
| Stack without shade | 49 | 60.5 | 37 | 56.1 | 86 | 58.5 | | |
| **Produce improved forage** | | | | | | | 1.60 | 0.206 |
| Yes | 5 | 6.2 | 8 | 12.1 | 13 | 8.8 | | |
| No | 76 | 93.8 | 58 | 87.9 | 134 | 91.2 | | |
| **Why not produce improved forage** | | | | | | | 3.35 | 0.341 |
| No idea | 32 | 39.5 | 18 | 27.3 | 50 | 34.0 | | |
| Lack of the land | 31 | 38.3 | 29 | 43.9 | 60 | 40.8 | | |
| Lack of the seed | 13 | 16.1 | 11 | 16.7 | 24 | 16.3 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.6.5. Sources of feeds and major feeds purchased in study areas

Source of the feed and major feed purchased are summarized in Table 22. As the result indicated fatteners in peri-urban area get feed resource from four source, such as own farm, purchase feeds, purchased and own farm and communal land. Major source of the feed for peri-urban farmers was from own farms, followed by both from own farm and purchased feed, purchased feed and communal land grazing. On the other hand, majority of the farmers in urban area obtain feed resources from three main source. However, the main source of feeds for urban farmers was purchasing, followed by both own farm and purchasing and own farms. Source of major feed show highly significance (P<0.001) difference between peri-urban and urban. This might be due to shortage of grazing land in urban area due to urbanization. Major feeds purchased were wheat bran, linseed cake, SBB-p (screened barley by product) and crop residues with a different level of utilization in peri-urban and urban areas.

Table 21. Source of major feed and major feed purchased in study areas

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Source of major feed resource** | | | | | | | 29.89 | 0.000 |
| From own farm | 38 | 46.9 | 11 | 16.7 | 49 | 33.3 | | |
| Communal land | 10 | 12.3 | 0 | 0.0 | 10 | 6.8 | | |
| Purchased feeds | 16 | 19.8 | 32 | 48.5 | 48 | 32.7 | | |
| Own farm and purchased | 17 | 21.0 | 23 | 34.8 | 40 | 27.2 | | |
| **Major feed purchased** | | | | | | | 14.29 | 0.003 |
| Wheat bran | 48 | 59.3 | 24 | 36.4 | 72 | 49.0 | | |
| Linseed cake | 7 | 8.6 | 8 | 12.1 | 15 | 10.2 | | |
| Wheat bran and linseed cake | 22 | 27.3 | 18 | 27.3 | 40 | 27.2 | | |
| SBB-p and crop residues | 4 | 4.9 | 16 | 24.2 | 20 | 13.6 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents; SBB-p = screened barley by product.

### 4.6.6. Supplementation and low quality feed treatment

#### 4.6.6.1. Supplementary feed, season and frequency of supplementation

Supplementary feeds, season and frequency of supplementation are given in Table 23. The result from current study indicated that, all of the respondents were offer supplementary feed to small ruminants. Types of supplementary feed used were wheat bran, salt and home refusal, molasses and linseed cake with variable degree of supplementation. Majority of the respondents in peri-urban area were use salt and home refusal as first supplementary feed, followed by the molasses, wheat bran and linseed cake. This finding was agreed with the finding of Afiras (2019), who reported that, majority of the respondents were use home refusal and salt/local mineral in Esera ditrict of Dawuro zone.

In urban area, majority of the respondents were use wheat bran as the first supplementary feed, followed by molasses, salt and home refusal and linseed cake as supplementary feed for small ruminants. It seems that, wheat bran was highly utilized in urban area than in peri-urban, while respondents in peri-urban area were highly depended on salt and home refusal feeds as supplementary feed for small ruminants. In general, as the result indicated, there was highly significance ($P<0.001$) difference between peri-urban and urban areas in terms of the type of the supplementary feeds used.

Supplementary feeds were highly used during dry season than in wet season in both peri-urban and urban areas. However, small number of respondents were use supplementary feed in both wet and dry season but frequency of supplementing was not similar. During wet season, majority of the farmers in peri-urban area were supplied small ruminants with supplement feed once per day, while small proportion of the respondents offer supplement feeds twice a day and every time it available (Table 23). The current finding was comparable with the finding of Afiras (2019), who reported that, majority of the respondents supplement sheep and/or goats once a day. On other hand, in urban area majority of the farmers provide supplement feeds to small ruminants twice per day, followed by offer supplementary feeds every time it available, once and three times a day (Table 23).

Frequency of supplementing in wet season showed highly significance (P<0.001) difference between peri-urban and urban areas. During dry season, majority of farmers in peri-urban and urban areas supplement sheep and/or goats twice a day followed by once a day, every time supplementary feeds available and three time a day, respectively.

Table 22. Supplementary feed, season and frequency of supplementing in study areas

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Supplementary feed used** | | | | | | | 19.36 | 0.000 |
| Wheat bran | 18 | 22.2 | 34 | 51.5 | 52 | 35.4 | | |
| Salt and home refusal | 34 | 42.0 | 10 | 15.2 | 44 | 29.9 | | |
| Molasses | 21 | 25.9 | 12 | 18.2 | 33 | 22.5 | | |
| Linseed cake | 8 | 9.9 | 10 | 15.2 | 18 | 12.2 | | |
| **Season of using supplementary feed** | | | | | | | 8.02 | 0.018 |
| Dry season | 66 | 81.5 | 40 | 60.6 | 106 | 72.1 | | |
| wet season | 6 | 7.4 | 12 | 18.2 | 18 | 12.2 | | |
| Both season | 9 | 11.1 | 14 | 21.2 | 23 | 15.7 | | |
| **Frequency of supplementing in wet season** | | | | | | | 55.69 | 0.000 |
| Once a day | 56 | 69.1 | 6 | 9.1 | 62 | 42.2 | | |
| Twice a day | 16 | 19.8 | 37 | 56.1 | 53 | 36.1 | | |
| Every time | 9 | 11.1 | 18 | 27.3 | 27 | 18.4 | | |
| Thrice a day | 0 | 0.0 | 5 | 7.6 | 5 | 3.4 | | |
| **Frequency of supplementing in dry season** | | | | | | | 4.42 | 0.219 |
| Once a day | 22 | 27.2 | 10 | 15.1 | 32 | 21.7 | | |
| Twice a day | 35 | 43.2 | 37 | 56.1 | 72 | 49.0 | | |
| Thrice a day | 7 | 8.6 | 8 | 12.1 | 15 | 10.2 | | |
| Every time | 17 | 21.0 | 11 | 16.7 | 28 | 19.1 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

#### 4.6.6.2. Feed treatment and methods of treating the feed in study areas

As it summarized in Table 24 below, all of the respondents in the study areas were treat low quality feeds in order to improve intake, palatability and nutritional content of low quality feeds. Types of the feed treated were barley straw, mix of wheat and barley straw and wheat straw in both peri-urban and urban areas. However, farmers in study areas concentrated to treat barley straw, followed by mix of wheat and barley straw and wheat straw, respectively. This might be accounted to the preference of the farmers toward the use of barley straw than other crop residues. Feed resources were traditionally (chopping, soaking and supplementing) treated, whereas modern methods (like, chemical, biological, and urea treatment) were less adopted in study areas. Urea treatment is easily affordable, practiced and utilized method of feed treatment in many part of the Ethiopia. However, it was not adopted in current study area, due to lack of awareness and experience about urea treatment which agreed with the idea from FGD.

Table 23. Feed treatment and methods of treating low quality feeds in study areas

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Type of treated feeds** | | | | | | | 1.73 | 0.421 |
| Barley straw | 56 | 69.1 | 50 | 75.7 | 106 | 72.1 | | |
| Wheat straw | 10 | 12.4 | 4 | 6.1 | 14 | 9.5 | | |
| Barley and wheat straw | 15 | 18.5 | 12 | 18.2 | 27 | 18.4 | | |
| **Methods of treating the feeds** | | | | | | | 6.88 | 0.032 |
| Chopping and soaking | 26 | 32.1 | 22 | 33.3 | 48 | 32.7 | | |
| Supplement with concentrate | 5 | 6.2 | 13 | 19.7 | 18 | 12.2 | | |
| Chopping & supplement | 50 | 61.7 | 31 | 47.0 | 81 | 55.1 | | |
| **Why not urea treating** | | | | | | | 4.55 | 0.033 |
| Lack of awareness | 73 | 90.1 | 51 | 77.3 | 124 | 84.3 | | |
| Lack of urea | 8 | 9.9 | 15 | 22.7 | 23 | 15.7 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.6.7. Small ruminants feeding system in study areas

Small ruminant feeding system practiced in current study area were free grazing/browsing, stall feeding and tether feeding. As the result indicates, free grazing was widely practiced in both peri-urban and urban area with relatively small difference (Table 25). However, stall feeding and tether feeding were not widely adopted in both peri-urban and urban areas, with quite adopted stall feeding in urban area than peri-urban area and vice versa. This might be due to level of awareness of the fatteners toward the feeding system, level and type of input used for small ruminant fattening in the study area. The finding was comparable with the finding of Afras (2019), in Esera District, Dawuro Zone, Southern Ethiopia and Fikru and Gebeyew (2015), in Degehabur Zone, Eastern Ethiopia who reported that, free grazing was major feeding system.

There was a significance ($p<0.001$) deference in terms of type of grazing land used. In peri-urban area majority of fatteners were use private grazing land, followed by grazing aftermath, communal land grazing and road and river side grazing, respectively (Table 25). This result was in line with the finding of Gedefaw and Gebremariam (2019), who reported that majority of the respondents had private grazing land in Habru district. However, in urban area fatteners were use grazing aftermath, followed by road and river side grazing. This might be due to lack of private grazing land because of urbanization. The overall outcome of this finding also showed that, stubble grazing was the main type of free grazing in study area (Table 25). This finding is in line with finding of Abera *et al.* (2022), who reported that, grazing aftermath was the major grazing type in dry season after crop harvested Arsi zone of Oromia Regional state, Ethiopia.

Herding system adopted during free grazing/browsing were sheep and/or goats alone, sheep and/or goat with cattle and all animals together in both peri-urban and urban areas. However, majority of the farmers herding sheep and/or goats separately. There is a significance ($p<0.005$) difference between peri-urban and urban areas in case of livestock herding system. This might be due to the difference between feeding behavior of larger sized animals and small sized animals. This finding was comparable with the finding of Hailemariam *et al.* (2013), who reported that majority of the respondents herding sheep and/or goats separately in Gamogofa of southern Ethiopia,

The result also agreed with the finding of Yadeta *et al.* (2016) in Ada Barga and Ejere Districts of west Shoa Zone, Ethiopia and Fikru and Gebeyew (2015), in Degehabur Zone, Eastern Ethiopia, who reported that majority of the respondents herding sheep and/or goats separately. In peri-urban area, major feed used during stall feeding were barley straw and wheat bran, while farmers in urban area were use barley straw, wheat bran and linseed cake. However, major feed type used during stall feeding in both peri-urban and urban areas was barley straw, followed by the wheat bran and linseed cake.

Table 24. Feeding system, grazing land, herding system and stall feed used in study areas

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Feeding system** | | | | | | | 7.42 | 0.024 |
| Free grazing/browsing | 61 | 75.3 | 44 | 66.7 | 105 | 71.4 | | |
| Stall feeding | 8 | 10.0 | 17 | 25.8 | 25 | 17.0 | | |
| Tether feeding | 12 | 14.8 | 5 | 7.6 | 17 | 11.6 | | |
| **Type of grazing land used** | | | | | | | 59.67 | 0.000 |
| Private grazing | 35 | 43.2 | 0 | 0.0 | 35 | 23.8 | | |
| Communal land | 12 | 14.8 | 0 | 0.0 | 12 | 8.2 | | |
| Road and river side | 10 | 12.3 | 9 | 13.6 | 19 | 12.9 | | |
| Stubble grazing | 16 | 19.8 | 40 | 60.6 | 56 | 38.1 | | |
| **Herding system** | | | | | | | 14.21 | 0.003 |
| Sheep and/or goats alone | 33 | 40.7 | 34 | 51.5 | 67 | 45.6 | | |
| Sheep and/or goats with cattle | 20 | 24.7 | 10 | 15.2 | 30 | 20.4 | | |
| All animals together | 20 | 24.7 | 5 | 7.6 | 25 | 17.0 | | |
| **Type of the feeds used during Stall feed** | | | | | | | 8.16 | 0.043 |
| Barely straw | 5 | 6.17 | 12 | 18.2 | 17 | 11.6 | | |
| Wheat bran | 3 | 3.70 | 3 | 4.6 | 6 | 4.1 | | |
| Linseed cake | 0 | 0.0 | 2 | 3.0 | 2 | 1.4 | | |

n1 = peri-urban respondents; n2 = urban respondents; $X^2$ = Chi – square; N= total respondents

#### 4.6.7.1. Feeding length and frequency of small ruminants fattening in study areas

Feeding length and frequency of small ruminants fattening in study areas are summarized in Table 26. Fatteners in current study areas reported that, length of fattening period was vary among fatteners which can be prolonged from three months up to above six months. As the result indicates, majority of the fatteners finish fattening period in three months, followed by four months in peri-urban and urban areas. However, there was a prolonged fattening period from five months to above six months in peri-urban area. The variability in length of fattening period may be due to environmental effect (availability and quality of input, especially feeds), genetic effect (feed conversion efficiency), fattening system used, age and the like. This finding is agreed with the finding of Deginet and Abiy (2020), who reported that majority of the fatteners finish small ruminant fattening in three months followed by four months in Anlemo woreda, Hadiya Zone, Ethiopia and Sime *et al.* (2023), who reported that the average fattening period of small ruminants ranged from three months to seven months in Dodota Woreda, Arsi Zone, Ethiopia.

The obtained result also indicated that, fatteners were decide finishing period based on number of criteria, like anticipating current and future price, sheep and/or goats live weight change and pre-decided feeding period. However, majority of small ruminants fatteners were depends on demand change (increased price on the market), followed by sheep and/or goats live weight change and pre-decided feeding length in both peri-urban and urban areas.

As it illustrated by Table 26, frequency of small ruminants fattening in study areas was ranged from once a year up to three time per year. The current result revealed that, majority of fatteners in current study areas were fatten sheep and/or goats once per year, while small proportion of the interviewed respondents were practice sheep and/or goats fattening two times and three times per year in both peri-urban and urban areas. This finding is agreed with the finding of Deginet and Abiy (2020), who reported that, majority of the fatteners fatten small ruminants 1x/year, followed by 2x/year and 3x/year in Chengi district of Anlemo woreda, Hadiya Zone, Ethiopia

Table 25. Length of feeding, finishing period and frequency of small ruminants fattening.

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Length of feeding period** | | | | | | | 3.38 | 0.337 |
| Three month | 55 | 67.9 | 48 | 72.7 | 103 | 70.1 | | |
| Four month | 22 | 27.2 | 18 | 27.3 | 40 | 27.2 | | |
| Five month | 3 | 3.7 | 0 | 0.0 | 3 | 2.0 | | |
| >Six month | 1 | 1.2 | 0 | 0.0 | 1 | 0.7 | | |
| **Criteria of finishing period** | | | | | | | 1.87 | 0.392 |
| Anticipating the future price | 37 | 45.7 | 23 | 34.9 | 60 | 40.8 | | |
| Animals live weight change | 22 | 27.2 | 23 | 34.9 | 45 | 30.6 | | |
| Pre-decided feeding length | 22 | 27.2 | 20 | 30.3 | 42 | 28.6 | | |
| **Frequency of fattening** | | | | | | | 2.89 | 0.236 |
| Once per year | 55 | 67.9 | 36 | 54.6 | 91 | 61.9 | | |
| Twice per year | 21 | 25.9 | 23 | 34.9 | 44 | 29.9 | | |
| Thrice per year | 5 | 6.2 | 7 | 10.6 | 12 | 8.2 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

#### 4.6.7.2. Number of small ruminants fattened per fattening cycle in study areas

Number of fattened sheep and/or goats per fattening cycle is summarized in to Table 27. Results of current investigation indicated that, average number of sheep and/or goats fattened per fattening cycles as well as per year was low both in peri-urban and urban areas. This indicates that, even if small ruminants fattening widely practiced in the current study area, low attention was given to the quantity of small ruminants fatted per fattening cycles in current study areas. This might be due to lack of new initiative, training and feed shortage. This finding result was agreed with the finding of Diriba *et al.,* (2021), who reported that, majority of the farmers fatten 2-3 sheep per fattening cycles in Genji district of West Wollega, Western Oromia, Ethiopia.

Table 26. Number of sheep and/or goats fattened per fattening cycle in study areas

| Variables | Study location | N | Mean ± SE |
|---|---|---|---|
| Number of sheep and/or goats | Peri-urban | 81 | 3.5 ± 0.1 |
| fattened per fattening cycle | Urban | 66 | 2.8 ± 0.1 |
| Total | | 147 | 3.2 ± 0.1 |

### 4.6.8. Chemical composition of major feeds in study areas

Chemical composition of major feed utilized in the current study area is summarized in Table 28. As it seen from Table 28, there was a difference between peri-urban and urban in case of feed type utilized and chemical composition of selected feed resources. For example, fodder trees were not available in urban area as livestock feed, while farmers in peri-urban area were not well adopted to use agro-industrial by-product due to lack of industrial by-product in peri-urban area. On the other hand, there were also feed types (natural pasture and crop residue) commonly used by the farmers in both peri-urban and urban areas. The actual dry matter contents of selected feed types were ranged between 33.9±0.4 of mixed grass in peri-urban area to 86.8±0.1 of screened barley by-product in urban area.

The average chemical composition of selected natural pasture (mixed grass) in study areas are summarized in Table 28. As it has seen from the result, actual dry matter content of mixed grass was almost similar across the study location. The actual dry matter content of mixed grass in current study areas was in line with the result of Gashu *et al.* (2017), who reported that, DM values of native grasses ranging from 35.17 to 44.97% in Chire district, Southern Ethiopia. The result also revealed that, mixed grass contain relatively high content of ash compared to other feed resource selected in study areas, however the ash content of mixed grass was more or less similar across the study location. There is no significance ($P>0.05$) difference between peri-urban and urban areas in terms of dry matter and ash contents of mixed grass. The current result is agreed with the finding of Dirsha *et al.* (2018), who reported that, ash contents of natural pasture was ranged between 10.88 to 11.97% in Dega and Weinadega area of Gurage zone and 11.18% reported by Boloche *et al.* (2022), in Soro district of Hadiya zone, Southern Ethiopia.

The crude protein (CP) content of mixed grass in current study areas was relatively high next to agro industrial by-products. The current result also show that, mixed grass in peri-urban area contain significantly ($P<0.001$) high amount of CP content than that of in urban area. The current result about CP content of mixed grass was agreed with finding of Tamene *et al.* (2022) who reported that, the CP content of grass species was ranged between 8.46±0.06 to 12.90±0.43 in Haru District, Ethiopia.

As it seen from Table 28 below, EE, NDF and ADF contents of mixed grass didn't show significant ($P>0.005$) between urban and peri-urban areas. The current result of EE, NDF and ADF content of mixed grass was in line with finding of Tamene *et al.* (2022), who reported that, the EE and NDF content of grass species was ranged between 1.08±0.04 to 1.86±0.24 and 61.84±1.77 to 74.48±0.79, respectively in Haru District, Ethiopia. However, ADL content of mixed grass in peri-urban area was lower than mixed grass in urban area (Table 28). The ADL content of mixed grass in currently studied area was higher than 3.80% reported by the Boloche *et al.* (2022), in Soro District of Hadiya Zone.

The average chemical composition of selected crop residues (barley straw and wheat straw) were presented in Table 28. As the result indicates DM, EE and ADL contents of barley straw were more or less similar between peri-urban and urban area. Thus, statistically no significance ($P>0.005$) difference between urban and peri-urban areas. On the other hand, ash, crude protein and acid detergent fiber contents of barley straw were vary between peri-urban and urban areas. The result indicates that, barley straw in peri-urban area contain high content of Ash, than that of in urban area, whereas high crude protein (CP), and acid detergent fiber (ADF) content of barley straw was recorded in urban area (Table 28). The result for Ash content in barley straw in currently studied area was comparable with 11.18% reported by the Boloche *et al.* (2022), in Soro District of Hadiya Zone, whereas CP and NDF contents of barley straw in current study areas was comparable with 4.72±0.08 and 75.30±1.53, respectively reported by Tamene *et al.* (2022) in Haru District, Ethiopia..

As the result indicates, Wheat straw contain relatively similar contents of DM, CP, EE, NDF, ADF and ADL in both peri-urban and urban area, thus it showed no significant (P>0.005) difference between peri-urban and urban areas. However, ash and CP content of wheat straw was significantly (P<0.005) higher in peri-urban, while wheat straw in urban area contain high content of ADL than that of in peri-urban area (Table 28). The resulted difference may be attributed to crop variety, soil type, and temperature, harvesting and handling of the straw in studied areas. Moreover, like a barley straw, wheat straw contain low CP content which is below to maintenance requirement (7% CP) compared to other feed resources.

In contrast, wheat straw contain high contents of NDF, ADF and ADL compared to other feed resources selected in current study areas, unless treated which may limit intake as well as digestibility of ruminant animals due to high content of fiber. The NDF content of wheat straw obtained in the current study was in line with the range 66.5% - 77.2%, 72.1±1.3 - 77.6±1.7 and 82.34% reported by Girma *et al.* (2014), Tamene *et al.* (2022), and Boloche *et al.* (2022), respectively (Table 28). Similarly, the ADL content of wheat straw is agreed with 7.26% reported by the Boloche *et al.* (2022) in Soro District of Hadiya Zone.

The average (Mean ± SE) chemical composition of selected agro-industrial by-products (wheat bran and linseed cake) and none conventional (screened barley by- product) feed from urban area were summarized in Table 28. The present result revealed that, wheat bran contain high content of CP than all selected feed types in urban area next to the linseed cake. It also contain low contents of EE, NDF and ADL than mixed grass, barley straw, wheat straw and linseed cake. This make wheat bran be used as the strategic supplementary feed with low quality feeds like natural pasture and crop residues, especially during dry season in both peri-urban and urban areas. This shows that, wheat bran had low content of fibers than all feed types selected in the current study areas. DM, Ash, CP, EE, NDF, and ADL content of wheat bran in current study (urban) area were more or less comparable with 89.4%, 4.45%, 3.18%, 14.65%, 40.82%, and 3.27% respectively, reported by Boloche *et al.* (2022) in Soro District of Hadiya Zone (Table 28). Similarly, Lonsdale (1989), reported 14.65% crude protein (CP) content of wheat bran.

The current result revealed that, Linseed cake contain high content of CP than all other selected feeds in studied areas. On the other hand, linseed cake contain low contents of fiber particles (NDF, ADF and ADL) compared to other feed resources selected from current study areas. It seems that, linseed could be used as the potential supplementary feed to fulfil nutritional requirement of animals feeding on low quality feed types. The result shows that, CP, NDF, ADF AND ADL of linseed cake were comparable with 29.6%, 31.2%, 19.2% and 7.2%, respectively reported by Seyoum *et al.* **(**2007).

Results also indicates that, screened barley by-product had high dry matter content, followed by wheat straw, barley straw, linseed cake and wheat bran in descending order. In contrast, screened barley by-product contain medium to low content of NDF ADF and ADL as compared to other feed resources in study areas (Table 28). It contain CP content above maintenance requirement (7%) of ruminant animals, so that screened barley by-product could be used as main feed resource as well as potential supplementary feed for small ruminants fattening.

Interviewed respondents in peri-urban area stated that, fodder tree leaves were used as the major feeds and as the supplementary feeds for small ruminants due to their long time greenness, especially during dry season. Result also indicates that, they contain high CP content next to selected agro-industrial by products (wheat bran and linseed cake). However, fodder trees (Carissa edulis/agamsa and Olea europea/ejersa) leaves contain medium to low fiber (NDF, ADF and ADL) contents compared to other feed types selected from current study areas. The Ash, CP, NDF and ADF contents of fodder trees leaves selected from current study areas were in agreement with 8.3±0.1 - 13.1±0.3, 7.6±0.2 - 23.1±0.4, 39.7±2.8 - 63.5±2.5 and 31.7±1.4 - 47.2±0.8 range, respectively reported by Tamene *et al.* (2022) in Haru District, Ethiopia (Table 28).

Table 27. Chemical composition (Mean ± SE) of major feeds in study areas

| Feed stuffs | Feed type | Study location | Chemical composition (Mean ± SE) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | DM | Ash | CP | EE | NDF | ADF | ADL |
| Natural pasture | Mixed grass | Urban | 32.8±0.1 | 12.3±0.4 | 11.4±0.0 | 1.9±0.0 | 57.3±4.4 | 33.8±2.0 | 5.9±0.2 |
| | | Peri-Urban | 33.9±0.4 | 13.3±0.1 | 12.8±0.0 | 1.7±0.0 | 63.7±0.2 | 32.9±0.3 | 4.5±0.0 |
| | | P-Value | 0.209 | 0.139 | 0.000 | 0.126 | 0.282 | 0.721 | 0.017 |
| Crop residues | Barley straw | Urban | 78.5±1.6 | 8.5±0.0 | 4.7±0.0 | 2.9±01 | 77.6±0.3 | 54.5±1.9 | 8.0±0.0 |
| | | Peri-Urban | 83.4±0.9 | 10.8±0.1 | 3.2±0.1 | 3.0±0.1 | 75.4±2.2 | 42.0±8.7 | 7.6±0.4 |
| | | P-Value | 0.117 | 0.003 | 0.030 | 0.158 | 0.198 | 0.048 | 0.303 |
| | Wheat straw | Urban | 78.6±5.0 | 10.5±0.0 | 3.8±0.0 | 2.7±0.1 | 78.5±2.0 | 63.5±0.8 | 10.1±0.8 |
| | | Peri-Urban | 84.2±0.4 | 11.3±0.1 | 4.5±0.0 | 2.8±0.0 | 76.9±4.1 | 62.4±0.4 | 7.5±0.2 |
| | | P-Value | 0.379 | 0.020 | 0.002 | 0.667 | 0.323 | 0.376 | 0.042 |
| Fodder trees | Carissa edulis | Peri-Urban | 39.5±0.5 | 7.2±0.3 | 12.0±0.5 | 1.7±0.0 | 43.9±2.3 | 40.3±1.0 | 6.8±0.7 |
| | | P-Value | - | - | - | - | - | - | - |
| | Olea europea | Peri-Urban | 48.8±0.8 | 5.6±0.5 | 11.1±0.1 | 1.8±0.7 | 46.0±0.5 | 27.7±0.6 | 6.1±0.5 |
| | | P-Value | - | - | - | - | - | - | - |
| Agro industrial by-product | Wheat bran | Urban | 80.6±4.2 | 5.1±0.1 | 14.5±0.0 | 2.3±0.4 | 37.3±1.2 | 35.9±1.5 | 5.8±0.1 |
| | | P-Value | - | - | - | - | - | - | - |
| | Linseed cake | Urban | 83.3±3.9 | 10.1±0.2 | 28.6±0.0 | 2.6±0.3 | 34.6±7.9 | 32.9±8.3 | 5.7±0.2 |
| | | P-Value | - | - | - | - | - | - | - |
| | Screened barley by-product | Urban | 86.8±0.1 | 7.2±0.3 | 12.1±0.0 | 2.9±0.2 | 40.5±1.8 | 42.3±1.2 | 7.3±1.7 |
| | | P-Value | - | - | - | - | - | - | - |

SE=standard error, DM=dry matter, CP=crude protein, EE=ether extract, NDF=neutral detergent fiber, ADF= acid detergent fiber, ADL= acid detergent lignin, SBB= screened barley by-products.

## 4.7. Management of Small Ruminant in Study Areas

### 4.7.1. Housing of small ruminant in study areas

The current result revealed that, all of the respondents in current study areas were housing small ruminants, however type of house was different among the individual farmers. Majority of them were use separate house both in peri-urban and urban areas. The result also indicates that, small proportion of the respondents in both peri-urban and urban areas were use adjoin house, while respondents in peri-urban area were also use main house (Table 29). Type of house used showed highly significance ($P<0.001$) difference between peri-urban and urban areas. This might be due to the farmers' awareness toward the housing system. This outcome is in line with the finding of Hundie and Geleta (2016), who reported that, 83.33% of respondents were use separate house in Horro guduru and east Wollaga zone.

The farmers were prepare the house in two main ways, such as confine sheep or goats in separate house and confining both sheep and/or goats in the same house in both peri-urban and urban areas. Accordingly, majority of the farmers in peri-urban area housing both sheep and/or goats together in the same house, while small proportion of the farmers were housing them separately. In contrast, majority of the farmers in urban area were confine sheep or goats in separate house. However, small proportion of them were also use common house for both sheep and/or goats (Table 29). There is highly significance ($P<0.001$) difference between peri-urban and urban areas in terms of sheep and/or goats housing. This might be due to the farmers' awareness level toward the confinement system. The result is agreed with finding of Fikru and Gebeyew (2015), who reported that, 64.4% of households shelter their animals in separately constructed house in Degehabur Zone, Eastern Ethiopia. The house was used for different purpose, such as protecting small ruminants from thieves and predators, protecting small ruminant from heavy rain, sun and strong wind, closely supervene of small ruminants and providing supplementary feed to small ruminants in peri-urban and urban areas. The main objective of housing in peri-urban area was to protect small ruminants from thief and predators, followed by keeping small ruminants from heavy rain, sun and strong wind, close supervision and providing supplementary feed to small ruminants in descending order.

On the other hand, the main objective of housing in urban area was to protect small ruminants from heavy rain, sun light and strong wind, followed by close supervision of small ruminants, protecting small ruminants from thief and predators, and to provide small ruminants with supplementary feeds (Table 29). There is highly significance (P<0.001) difference between peri-urban and urban areas related to purpose of housing. The current finding was more or less comparable with the finding of Afiras, (2019), from Esera District, Dawuro Zone, of Southern Ethiopia and Sisay and Kefyalew, (2015), who reported that, small ruminant owners house their sheep and/or goats to protect them from predators, adverse climatic condition and to provide supplement in the evening in Goma district, Jimma Zone Oromia and in Degahabur Zone, Eastern Ethiopia respectively

Table 28. Type of house and purpose of housing small ruminants in study areas

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Type of house** | | | | | | | 20.66 | 0.000 |
| Main house | 12 | 14.8 | 0 | 0.0 | 12 | 8.2 | | |
| Adjoin house | 18 | 22.2 | 4 | 6.1 | 22 | 15.0 | | |
| Separate house | 51 | 63.0 | 62 | 93.9 | 113 | 76.9 | | |
| **How animals are confined** | | | | | | | 63.48 | 0.000 |
| Alone | 19 | 23.5 | 59 | 89.4 | 78 | 53.1 | | |
| Sheep and/or goats | 62 | 76.5 | 7 | 10.6 | 69 | 46.9 | | |
| **Purpose of housing** | | | | | | | 20.13 | 0.000 |
| To protect thief and predator | 37 | 45.7 | 10 | 15.2 | 47 | 32.0 | | |
| To protect sun, rain and wind | 32 | 39.5 | 30 | 45.5 | 62 | 42.2 | | |
| For close supervision of shoats | 7 | 8.6 | 19 | 28.8 | 26 | 17.7 | | |
| To provide supplement feed | 5 | 6.2 | 7 | 10.6 | 12 | 8.2 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.7.2. Health care for small ruminants in study areas

#### 4.7.2.1. Major disease effecting small ruminants in study areas

A disease was the major bottleneck to sustainability and achievement of livestock production and productivity in general and to small ruminants in particular. Diseases have numerous negative impacts on productivity of animals (i.e. death of animals, loss of weights, slow down growth, poor fertility performance, decrease in physical power and the likes) (CSA, 2021), Small ruminant fatteners in current study area were affected by number of disease. From type of disease found in current study areas, contagious caprice pleuro-pneumonia (CCPP) (locally called sombee hoolaa fi re'ee), listeriosis (locally called martoo), diarrhea (locally called albaatii) and fasciolosis (locally called maalullaa) were most economically important type of disease. Respondents ranked the top three disease namely, CCPP, diarrhea and listeriosis followed by fasciolosis as 1st, 2nd and 3rd disease affecting small ruminants in peri-urban and urban areas (Table 30). The current finding is in line with the finding of the Sime *et al.* (2023), who reported that, pneumonia, diarrhea, listeriosis and fasciolosis as small ruminant's disease in Dodota woreda, Arsi zone, Ethiopia. The result also agreed with idea from KII.

Table 29. Major disease effecting small ruminants in study areas

| Major disease | Study Location | | | | | | | | | | Overall |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | | | | Urban | | | | | |
| | Rank | | | | | Rank | | | | | |
| | 1st | 2nd | 3rd | Sum | Index | 1st | 2nd | 3rd | Sum | Index | Index |
| CCPP | 47 | 22 | 8 | 193 | 0.40 | 44 | 15 | 5 | 167 | 0.42 | 0.41 |
| Listeriosis | 5 | 26 | 18 | 85 | 0.18 | 7 | 16 | 15 | 68 | 0.17 | 0.18 |
| Diarrhea | 27 | 24 | 10 | 139 | 0.29 | 11 | 30 | 18 | 111 | 0.28 | 0.29 |
| Fasciolosis | 2 | 8 | 45 | 67 | 0.13 | 4 | 5 | 27 | 49 | 0.13 | 0.13 |

Index = sun of (3x1strank + 2x2ndrank + 1x3rdrank) given for an individual attribute/sum of (3x1strank + 2x2ndrank + 1x3rdrank) given for total attributes

#### 4.7.2.2. Treatment methods and source of drugs and vaccine in study areas

As it summarized in Table 31, respondents in the study areas were treat small ruminants in different ways, such as treating by traditional plants, call for veterinarian at home, take animals to service center and treat animals at home by drug purchased from the shop. Accordingly, majority of the respondents in peri-urban area were treat small ruminants at home by purchasing drugs from the shop, followed by traditional plant treatment, call for veterinarian and take the animals to the service center in descending order. On other hand, majority of the respondents in urban area were treat small ruminants by taking them to the veterinary service center in the town, followed by farmers call for veterinarian and treat at home by drugs purchased from the shop . There was a highly significance ($p<0.001$) difference between peri-urban and urban areas based on the ways of treating small ruminants. This might be due to the matter of availability of veterinary service and household's awareness about use of veterinary service. This finding is in line with the finding of Fikru and Gebeyew (2015), who reported that, households treated sick animals by ethno-veterinary practice, treatments of local Elders and use nearby veterinary clinic in Degehabur Zone, Eastern Ethiopia, and Sime *et al.* (2023), who reported that, majority of the family take sick animals to veterinary center in Dodota woreda of Arsi zone.

Majority of the respondents from both peri-urban and urban areas get a veterinary service, while small proportion of them were not access to veterinary service (Table 31). There were two main source of veterinary drugs and vaccine. The first source was from Public veterinary service, which serve the farmers as a major source of veterinary drugs and vaccine both in peri-urban and urban areas. The second source was from Private veterinary service, where small number of farmers use it as source of veterinary drugs in peri-urban and urban areas, respectively. The current result is in line with the finding of Tariku *et al.* (2015), who reported that, public veterinary service, private veterinarians, traditional healers and NGOs are the main source of veterinary services in Ada' a District of Oromia Region, Ethiopia. The interviewed respondents stated that, they were get vaccine at different time. Accordingly, majority of respondents in peri-urban area reported that, they were facing the problem of getting vaccine at right time of requirement, but they got a vaccine after some animals died, while small numbers of respondents in peri-urban areas got vaccine before disease outbreak and immediately at disease outbreak.

However, relatively high number of respondents in urban area got a vaccine before disease outbreak, while others got soon after disease outbreak and later after some animals died (Table 31). There was highly significance (P<0.001) difference between peri-urban and urban in terms of getting vaccine at right time of requirement. It might be due to accessibility of veterinary service center in urban area than peri-urban area.

Table 30. Method of treatment and source of drugs and vaccine for small ruminants

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Treatment method** | | | | | | | 104.14 | 0.000 |
| By traditional plant | 18 | 22.2 | 0 | 0.0 | 18 | 12.2 | | |
| Call for veterinarian | 2 | 2.5 | 9 | 13.6 | 11 | 7.5 | | |
| Take animals to service center | 2 | 2.5 | 49 | 74.2 | 51 | 34.7 | | |
| Home treat by drug from shop | 59 | 72.8 | 8 | 12.1 | 67 | 45.6 | | |
| **Get veterinary service** | | | | | | | 1.05 | 0.305 |
| Yes | 68 | 84.0 | 51 | 773 | 119 | 81.0 | | |
| No | 13 | 16.1 | 15 | 22.7 | 28 | 19.1 | | |
| **Source of drugs and vaccine** | | | | | | | 3.22 | 0.200 |
| Public veterinary service | 48 | 59.3 | 42 | 63.6 | 90 | 61.2 | | |
| Private veterinary service | 20 | 24.7 | 9 | 13.6 | 29 | 19.7 | | |
| **When do you get a vaccine** | | | | | | | 35.73 | 0.000 |
| Before disease outbreak | 6 | 7.4 | 24 | 36.4 | 30 | 20.4 | | |
| Soon as disease outbreak | 17 | 21.0 | 19 | 28.8 | 36 | 24.5 | | |
| Later after animals died | 45 | 55.6 | 8 | 12.1 | 53 | 36.1 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.7.3. Source of water and small ruminants watering in study areas

Source of water and watering system of small ruminants are summarized in Table 32. The result indicated, all of the respondents in study areas provide plenty of water for small ruminants. Source of water during wet and dry season were different. Such source were river water, pipe water, deep well water, and both river and pipe water. In peri-urban area, the main source of water during wet season were pipe water and river, followed by deep well and both river and pipe water (Table 32). In urban area main source of water during wet season was a pipe water, followed by both river and pipe, and river. There was highly significance ($P<0.001$) difference between peri-urban and urban areas related to source of water used during wet season. This may be the matter of availability of river water and pipe water in peri-urban and urban area respectively. This finding was in line with the finding of Yemane *et al.* (2020), who reported that, major source of water during wet season was river in Jimma zone.

During dry season, the main source of water for peri-urban and urban areas was pipe water. However, even if they use pipe water as a main source, there was highly significant ($P<0.001$) difference between peri-urban and urban area in terms of source of water used during dry season, especially in case of using river, deep well and both river and pipe water. The current finding was comparable with the finding of Afiras (2019), who reported that, majority of the respondents were use river and pipe water in Esera ditrict of Dawuro zone southern Ethiopia.

As it presented in Table 32, watering frequency was depended on the season in both peri-urban and urban areas. Accordingly, majority of respondents were watering sheep and/or goats once per day during wet season. However, small number of respondents were watering small ruminants twice per day, any time it required and once in every two days. On the other hand, during dry season majority of the respondents in peri-urban area were watering small ruminants twice a day, followed by every time water required and once a day. However, in urban area majority of the respondents were watering small ruminants at any time they require a water, followed by twice a day and once a day, and it showed a significance ($P<0.005$) difference (Table 32). This might be emanated from availability of the water resource and weather condition of the environment with respect to the season.

The current finding was in line with the finding of Afiras (2019), who reported that, watering frequency was once per day during wet season and twice per day during dry season in Esera ditrict of Dawuro zone southern Ethiopia and Hussein (2017), who reported that watering frequency was once per day in Kofele District of Western Arsi Zone.

Table 31. Source water and small ruminants watering in study areas

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Source of water in wet season** | | | | | | | 33.84 | 0.000 |
| River Water | 31 | 38.3 | 4 | 6.1 | 35 | 23.8 | | |
| Pipe water | 32 | 39.5 | 53 | 80.3 | 85 | 57.8 | | |
| Deep well | 9 | 11.1 | 0 | 0.0 | 9 | 6.1 | | |
| River and pipe | 9 | 11.1 | 9 | 13.6 | 18 | 12.2 | | |
| **Source of water in dry season** | | | | | | | 34.67 | 0.000 |
| River water | 27 | 33.3 | 0 | 0.0 | 27 | 18.37 | | |
| Pipe water | 48 | 59.3 | 66 | 100 | 114 | 77.55 | | |
| Deep well | 2 | 2.5 | 0 | 0.0 | 2 | 1.36 | | |
| River and pipe | 4 | 4.9 | 0 | 0.0 | 4 | 2.72 | | |
| **Watering frequency in wet season** | | | | | | | 8.74 | 0.033 |
| Once a day | 69 | 85.2 | 46 | 69.7 | 115 | 78.2 | | |
| Twice a day | 5 | 6.2 | 8 | 12.1 | 13 | 8.8 | | |
| Every two day | 2 | 2.5 | 0 | 0.0 | 2 | 1.4 | | |
| Any time required | 5 | 6.2 | 12 | 18.2 | 17 | 11.6 | | |
| **Watering frequency in dry season** | | | | | | | 15.16 | 0.001 |
| Once a day | 3 | 3.7 | 1 | 1.5 | 4 | 2.7 | | |
| Twice a day | 58 | 71.6 | 28 | 42.4 | 86 | 58.5 | | |
| At any time required | 20 | 24.7 | 37 | 56.1 | 57 | 38.8 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.8. Small Ruminants Marketing System in study areas

#### 4.8.1. Market place, market information and target market used in study areas

Market place, market information and target market used in study areas are summarized in Table 33. Result of current finding showed that, respondents were buy and sell sheep and/or goats on two places namely, farm gate (on farm selling) and on market (Dodola livestock market). Majority of the farmers sold their animals (sheep and/or goats) on Dodola livestock market. However, small proportion of the respondents also sold their animals at farm level. The result also indicated that, majority of the respondents in peri-urban and urban areas were access to market information, while some of them were faced lack of market information during small ruminant marketing. There was significance ($P<0.005$) deference between peri-urban and urban areas in terms of access to market information (Respondents survey result, 2025).

Source of market information for small ruminant fatteners in current study area were, media (radio and TV), brokers and pre-selling market observation. However, fatteners from both peri-urban and urban area were got major information from brokers, followed by per-selling market observation and media (radio and/or VT). However, there is a significant ($P<0.005$) deference across the study location in terms of major source of information. This finding is agreed with the finding of Belete (2009), who reported that major source of information were traders and neighbors in Goma District of Jimma Zone. Moreover, the fatteners were in lack of real market information from government. This may leads the fatteners to sale their animals to inappropriate market at low price in both peri-urban and urban areas.

As the current finding result showed, large proportion of the respondents in both peri-urban and urban areas fatten sheep and/or goats for the target markets. Type of target market used also depends on holidays such as New Year festival, Meskal, Christmas and Eid Al-fetri and Al-Adha. As an overall percentage of target market used indicates, majority of the farmers sold sheep and/or goats on Christmas holiday, followed by Eid Al-fetri and Al-Adha, New Year festival and meskal in both peri-urban and urban areas. This might be due to the fact that increased price of animals during the holidays.

This finding is agreed with finding of Abera (2022), who reported that, domestic demand for sheep and/or goats' meat is quite seasonal as it follows the religious calendar of fasting periods and festivities such as New Year, Christmas, Easter, Ramadan, and Arafa in Arsi Zone.

Table 32. Marketing place, market information and target market used in study areas

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Market for buying and selling shoats** | | | | | | | 0.94 | 0.333 |
| On farm selling | 6 | 7.4 | 8 | 12.1 | 14 | 9.5 | | |
| Dodola town | 75 | 92.6 | 58 | 87.9 | 133 | 90.5 | | |
| **Do you get market information** | | | | | | | 9.67 | 0.002 |
| Yes | 70 | 86.4 | 66 | 100 | 136 | 92.5 | | |
| No | 11 | 13.6 | 0 | 0.0 | 11 | 7.5 | | |
| **Source of information** | | | | | | | 0.76 | 0.016 |
| Medias | 1 | 1.2 | 2 | 3.0 | 3 | 2.0 | | |
| Brokers | 52 | 64.2 | 46 | 69.7 | 98 | 66.7 | | |
| Market observing | 17 | 21.0 | 18 | 27.3 | 35 | 23.8 | | |
| **Do you fatten shoats for target market** | | | | | | | 2.31 | 0.128 |
| Yes | 62 | 76.5 | 43 | 65.2 | 105 | 71.4 | | |
| No | 19 | 23.5 | 23 | 34.9 | 42 | 28.6 | | |
| **Target market used** | | | | | | | 3.80 | 0.434 |
| New year | 10 | 12.4 | 4 | 6.1 | 14 | 9.5 | | |
| Meskal | 2 | 2.5 | 1 | 1.5 | 3 | 2.0 | | |
| Christmas | 27 | 33.3 | 23 | 34.9 | 50 | 34.0 | | |
| Eid al-Fetri and Eid al-Adha | 23 | 28.4 | 15 | 22.7 | 38 | 25.9 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

### 4.8.2. Market channels, market actors and pricing small ruminants in study areas

Market channels, market actors and pricing of small ruminants are summarized in Table 34. A number of market channels of small ruminants were identified in current study areas. These channel were producers - home consumers, producers - brokers - small traders, producers - small traders and producers - small traders - large traders, in which majority of the farmers sell their animals to small traders (producers-small traders). Market actors of livestock market in current study areas includes small traders, brokers, home consumers and butcher men. This finding was agreed with finding of Assefa and Ayza, (2020), who reported that, market actors as local farmers and traders, small traders in Duna Woreda, Hadiya zone, Southern Ethiopia.

Livestock pricing depends on physical (phenotypic) characterization like, eye ball estimation, body conformation and touch and feeling of the animals (sheep and/or goats) on the market and at farm gate in both peri-urban and urban areas. Touch and feeling was the major way of pricing sheep and/or goats, followed by eye ball estimation and body conformation of animals in current study areas. Sellers raised different reason behind use of touch and feeling method during small ruminants pricing. These reasons includes mischief way pricing, will of a buyer and real way of pricing. It also stated that, will of the buyers was the main reason behind touch and feeling during small ruminant pricing in study areas. The result is agreed with finding of Kocho *et al.* (2011), from Alaba, Southern Ethiopia and Terefe *et al.* (2012), from East Showa Zone, who reported that, price of animals at different marketing channels mainly determined by one-to-one bargaining depending on the characteristic of the animals.

The power of deciding price during sheep and/or goats selling shared between sellers, traders and agreement of both sellers and traders, in which agreement of sellers and buyers was the first way of deciding the price, followed by sellers and traders, respectively. This finding was agreed with finding of Deginet and Abiy (2020), who reported that price agreement reached by negotiation of buyers and sellers on market in Anlemo woreda, Hadiya Zone, Ethiopia, and Kocho *et al.* (2011), from Alaba, Southern Ethiopia and Terefe *et al.* (2012), from East Showa Zone, who reported that, price of animals at different marketing channels mainly determined by one-to-one bargaining depending on the characteristic of the animals.

Table 33. Market channels, market actors, pricing and price decider in study areas

| Variables | Study Location | | | | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | Urban | | Overall | | | |
| | n1 | % | n2 | % | N | % | | |
| **Market channels** | | | | | | | 4.73 | 0.193 |
| Producers-consumers | 6 | 7.4 | 11 | 16.7 | 17 | 11.6 | | |
| Producers-brokers-small traders | 19 | 23.5 | 17 | 25.8 | 36 | 24.5 | | |
| Producers-small traders | 44 | 54.3 | 26 | 39.4 | 70 | 47.6 | | |
| producer-small traders-large traders | 12 | 14.8 | 12 | 18.2 | 24 | 16.3 | | |
| **Market actors** | | | | | | | 0.23 | 0.973 |
| Home consumers | 8 | 9.9 | 8 | 12.1 | 16 | 10.9 | | |
| Brokers | 15 | 18.5 | 12 | 18.2 | 27 | 18.4 | | |
| Small traders | 55 | 67.9 | 44 | 66.7 | 99 | 67.4 | | |
| Butcher men | 3 | 3.7 | 2 | 3.0 | 5 | 3.4 | | |
| **Ways of pricing** | | | | | | | 0.13 | 0.936 |
| “Eye ball” estimation | 14 | 17.3 | 11 | 16.7 | 25 | 17.0 | | |
| Body conformation | 10 | 12.4 | 7 | 10.6 | 17 | 11.6 | | |
| Touch and feeling | 57 | 70.4 | 48 | 72.7 | 105 | 71.4 | | |
| **Why use touch and feel** | | | | | | | 5.22 | 0.073 |
| Mischief | 20 | 24.7 | 7 | 10.6 | 27 | 18.4 | | |
| Will of buyers | 49 | 60.5 | 50 | 75.8 | 99 | 67.4 | | |
| Real way of pricing | 12 | 14.8 | 9 | 13.6 | 21 | 14.3 | | |
| **Decider of price during selling** | | | | | | | 0.28 | 0.875 |
| Sellers | 38 | 46.9 | 33 | 50.0 | 71 | 48.3 | | |
| Traders | 2 | 2.5 | 1 | 1.5 | 3 | 2.0 | | |
| Sellers and traders | 41 | 50.6 | 32 | 48.5 | 73 | 49.7 | | |

n1 = number peri-urban respondents; n2 = number of urban respondents; $X^2$ = Chi – square; N = number of the total respondents.

## 4.9. Challenges and Opportunities of Small Ruminants fattening in Study Areas

### 4.9.1. Challenges of small ruminants fattening in study areas

Farmers in the current study areas faced the problems of feed shortage, decline in grazing land, water shortage, disease and parasite, extension service, lack of credit and support service, lack of appropriate breeds, lack of technology, and effect of drought in study area. Out of challenges hindering fattening practice; feed shortage, decline in grazing land and disease and parasite were ranked as top three (1st, 2nd and 3rd ) challenges of small ruminant fattening in peri-urban areas (Table 35). This in investigation is more or less comparable with the finding of Mamo (2020), who reported major challenges of sheep fattening in Chalia District West Shoa Zone. Similarly, farmers in the urban area were ranked lack of grazing land, feed shortage, and disease and parasites as 1st, 2nd and 3rd challenges affecting small ruminant fattening in current study areas.

Table 34. Challenges of small ruminants fattening in study areas

| Major Challenges | Study Location | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | | | | Urban | | | | | Overall |
| | Rank | | | | | Rank | | | | | |
| | 1st | 2nd | 3rd | S | I | 1st | 2nd | 3rd | Sum | Index | Index |
| Feed shortage | 42 | 16 | 8 | 166 | 0.34 | 15 | 15 | 12 | 87 | 0.22 | 0.28 |
| Grazing land decline | 26 | 33 | 4 | 148 | 0.31 | 34 | 17 | 6 | 142 | 0.36 | 0.33 |
| Water shortage | 3 | 9 | 2 | 29 | 0.06 | 1 | 2 | 0 | 7 | 0.02 | 0.04 |
| Disease &parasite | 5 | 7 | 30 | 59 | 0.12 | 7 | 16 | 22 | 75 | 0.19 | 0.16 |
| Extension service | 0 | 6 | 25 | 37 | 0.08 | 0 | 1 | 4 | 6 | 0.02 | 0.05 |
| Credit and support | 3 | 2 | 7 | 20 | 0.04 | 9 | 12 | 12 | 63 | 0.16 | 0.10 |
| Lack of breed | 0 | 2 | 2 | 6 | 0.01 | 0 | 1 | 1 | 3 | 0.01 | 0.01 |
| lack of technology | 2 | 1 | 2 | 10 | 0.02 | 0 | 1 | 4 | 6 | 0.02 | 0.02 |
| Drought | 1 | 3 | 2 | 11 | 0.02 | 0 | 0 | 3 | 3 | 0.01 | 0.02 |

S=Sum, I=Index, *Index = sun of (3x1st rank + 2x2nd rank + 1x3rd rank) given for an individual attribute/sum of (3x1st rank + 2x2nd rank + 1x3rd rank) given for total attributes*

### 4.9.2. Opportunities for small ruminants fattening in study areas

Fatteners in the current study area were use different opportunities as a new initiative to start small ruminant fattening or stay as the small ruminant fatteners over long period of time. Such opportunities include, small space and starting budget requirement (small business), increased price of small ruminants through the time, short fattening period, high market demand and conducive living environment of small ruminants (Table 36). Accordingly, farmers from both peri-urban and urban areas ranked small space and starting budget requirement and increased price of small ruminants through the time as 1st and 2nd opportunities for small ruminants fattening (Table 36). Additionally, fatteners in peri-urban area ranked conducive living environment as 3rd opportunity, whereas high market demand of small ruminants was ranked as 3rd opportunity of small ruminants fattening in urban area. This might be due to the reality that farmers from both peri-urban and urban areas were living under the same condition and sharing the same working habit. The current investigation was in line with finding of the Afras (2021), who reported low start-up cost, rising demand for sheep and/or goats, and prolificacy as opportunities of small ruminant production in Ethiopia. The idea from focus group discussion and key informant interview also agreed with the current investigation result.

Table 35. Opportunities for small ruminants fattening in study areas

| Opportunities | Study Location | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peri-Urban | | | | | Urban | | | | | |
| | Rank | | | | | Rank | | | | | |
| | 1st | 2nd | 3rd | S | I | 1st | 2nd | 3rd | S | I | I |
| Small space and budget | 43 | 17 | 9 | 172 | 0.36 | 20 | 16 | 14 | 106 | 0.27 | 0.32 |
| Increased price | 25 | 39 | 8 | 161 | 0.33 | 22 | 14 | 4 | 98 | 0.25 | 0.29 |
| Short fattening period | 7 | 7 | 4 | 39 | 0.08 | 6 | 8 | 6 | 40 | 0.10 | 0.09 |
| High market demand | 4 | 7 | 28 | 54 | 0.11 | 7 | 17 | 22 | 77 | 0.20 | 0.16 |
| Conducive environment | 3 | 9 | 33 | 60 | 0.12 | 10 | 12 | 17 | 71 | 0.18 | 0.15 |

S=Sum, I=Index, *Index = sun of (3x1st rank + 2x2nd rank + 1x3rd rank) given for an individual attribute/sum of (3x1st rank + 2x2nd rank + 1x3rd rank) given for total attributes.*

# 5. CONCLUSION AND RECOMMENDATIONS

## 5.1. Conclusion

In the current study areas fattening practice of small ruminants were mainly practiced by males, while a female respondents had a few contribution. The dominant fattening system practiced by fatteners was traditional system in both peri-urban and urban areas. Fatteners in the current study areas use different criteria to select sheep and/or goats for fattening. Health condition, age and size were ranked as top three criteria used by the farmers to select sheep and/or goats for fattening in peri-urban area, while health condition, age and sex were ranked as top three selection criteria in urban area. The main purpose of fattening small ruminants in study areas were income source, which the fatteners use it for buying input for crop production, saving account for emergency time, food for home consumption, school expense and for paying tax.

The current result indicated that, feed resource found in current study areas were natural pasture, crop residues, agro industrial by-products, fodder trees and screened barley by-product, out of which natural pasture, crop residue and agro-industrial byproduct were ranked as the top three feed resources used for small ruminants fattening in peri-urban and urban areas. The average chemical composition (DM, Ash, CP, EE, NDF, ADF and ADL) of major feeds (Mixed grass, crop residues, agro industrial by-products and some fodder trees) used by the fatteners was determined, and showed poor (crop residues) to high (AIBP) quality feeds in terms of the chemical compositions analyzed.

Free grazing/browsing was the dominant feeding system practiced, in which private grazing land and stubble grazing were used in peri-urban and urban areas respectively. All of the fatteners in the study areas were use Dodola livestock market for buying and selling their animals, in which majority of the fatteners sell their animals to small traders followed by the brokers. Feed shortage, decline in grazing land, and disease and parasite were ranked as a top three challenges affecting fatteners in study area. On the other hand, low initial capital, increased demand of small ruminants through the time, short fattening period, high market demand for small ruminants' meat and conducive living environment were the opportunity sides for small ruminant fattening in the current study areas.

## 5.2. Recommendations

**Based on the current study results, the following recommendations have been forwarded:**

- Small ruminants were fattened in traditional way mainly by free grazing and traditional management system. Fattening frequency as well as number of fattened animals per fattening cycle were also low. The new initiatives and awareness about modern fattening practice and management system should be created, to enhance small ruminant's productivity and fattener's profitability.
- Improved forage production and utilization was less adopted. To improve the productivity of small ruminants and reduce production cost as well as to mitigate feed shortage, stakeholders should aware the fatteners about improved forage production, conservation and utilization.
- Crop residues were a major feed used for small ruminants fattening, especially during dry season. However, urea treatment was not adopted in current study area. To improve nutritional quality of crop residues and to cope-up with a feed shortage, awareness should be created on method of urea treatment and its utilization.
- Fatteners where access to poor source of market information about demand and price as well as pricing method is subjective during small ruminants buying and selling. Market channels was majorly performed between producers-small traders. To enhance fattener's benefit from small ruminants fattening, market information, pricing method and market actors as well as market-oriented production system and market linkage should be taken in to account.

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# 7. APPENDIX

**Individual household survey questionnaire**

District _____. Zone_____. Woreda_____. Kebele _____. Date of interview_____.

**I. Household characteristics**

1. Name of the farmer: _____.
2. Sex of the farmer: 1. Male 2. Female
3. Age of the farmer (years): 1. < 18 2. 18 - 27, 3. 28-37, 3. 38-47, 4. 48 and above.
4. Marital status: 1 Single. 2 Married. 3. Divorced 4. Divorced
5. Family size: How many family do you have? Total _____.
6. Education level: 1. Illiterate, 2. Grade 1-4, 3. Grade 5-8, 4. Grade 9-10, 5. Grade 11-12, 6. Diploma 7. Degree.
7. What is your major occupation? 1. Farmer 2. Business man 3. Employee 4. Unemployed 5. Student 6. Other _____.
8. Major source of income: 1. Animal production 2. Crop production 3. Trade 4. Animal and crop 5. Month salary, animal and crop production
9. Land holding (ha): 1. Total land _____ 2. Crop land ____ 3. Grazing land 4. Fodder land ____ 5. Fallow land ____ 6. Other_____.
10. Major crop produced: 1. Wheat 2. Barely 3. Maize 4. Teff

**II. Livestock Resource and Purpose of Keeping livestock**

1. What type of livestock do you keep? 1. Cattle and Shoat. 2. Shoat 3. Cattle, shoat, Horse and Donkey 4. Other _____
2. How many livestock number do you keep?

| Livestock type | Remark |
|---|---|
| Cattle | |
| Sheep | |
| Goats | |
| Chicken | |
| Horse | |
| Donkey | |

3. Why do you keep your livestock? 1. Meat 2. Milk 3. Income source 4. Skin and wool 5. Manure 6. All 7. Others _____

4. Which one is the most important for you from the above purpose? Rank it according to importance order.

| No. | Purpose of keeping livestock | Rank |
|---|---|---|
| 1. | Meat | |
| 2. | Milk | |
| 3. | Income source | |
| 4. | Hide, Skin and wool | |
| 5. | For ploughing | |
| 6. | Manure | |
| 7. | Others | |

5. What are the livestock population trends looks like over ten years ago? 1. Increasing 2. Decreasing 3. Stable

**III. Sheep and/or goats fattening practice**

1. Are you engaged in sheep and/or goats fattening? 1. Yes 2. No
2. If yes, for how long did you work as sheep and/or goats fatteners? 1. < 1year, 2. 1-5 years 3. 5-10 years 4. >10years.
3. From where, (source) do you get sheep and/or goats for fattening? 1. Own flock 2. Farm get 3. Local market 4. From traders
4. Which one is better source for you? Why? _____.

| Source of fattening animals | Type of animals | | Remark | |
|---|---|---|---|---|
| | Sheep | Goats | Sheep | Goats |
| Own flock | | | | |
| From farmers of same village | | | | |
| Local market | | | | |
| From traders | | | | |
| Others | | | | |

5. What criteria do you consider during selecting animals for fattening?

| Criteria to be considered | Animals to be selected | | Rank | |
|---|---|---|---|---|
| | Sheep | Goats | Sheep | Goats |
| Sex | | | | |
| Age | | | | |
| Health | | | | |
| Price | | | | |
| Size/ frame | | | | |
| Color | | | | |
| Others | | | | |

6. What is preferred age/s of shoats selected for fattening? 1. < 3 months 2. 3-6 months 3. 7-10 months 4. > 10 months

7. For Q5, reason out why such age is preferred. 1. Small space and starting budget 2. Short fattening period 3. Feed required only for weight gain 4. Faster to reach finishing period 5. Other _____.
8. For Q5, how could you know perfect age of sheep and/or goats selected for fattening? 1. Own record 2. Asking owners 3. Dentition 4. Prediction 5. Other _____.

**IV. Purpose of keeping and use of fattened sheep and/or goats**

1. For what purpose sheep and/or goats? 1. Meat 2. Milk 3. Income source 4. Skin and wool 5. Manure 6. All 7. Others _____
2. If Q1 is income source, for what purpose do you use the income you got your fattened animals?

| Use of fattened animals | Remark |
|---|---|
| Buying food for home consumption | |
| Saving account | |
| School fee for children | |
| Pay taxes | |
| Input for crop production | |
| Other | |

3. For past ten years, how do you see profitability from shoats fattening? 1. No profitable 2. Poorly profitable 3. Moderately profitable 4. Highly profitable

**V. Sheep and/or goats fattening system**

1. Which fattening system do you practice? Remark it.

| Fattening system | Animals type | | Remark | |
|---|---|---|---|---|
| | Sheep | Goats | Sheep | Goats |
| Tradition ( free grazing) system | | | | |
| By-product (industrial by-product based system) | | | | |
| Harerghe (tethering) system | | | | |
| Other | | | | |

2. By- product based, why do you use this system? 1. Lack of the land 2. Quality of the feed 3. Product availability 4. Other_____.
3. For your fattening system, which input is the most costive? 1. Feed 2. Water 3. Drugs and vaccines 4. Others _____ _____ _____ _____.
4. Do you get any training on modern shoats fattening and business management? 1. Yes 2. No

**VI. Fattening shoats breed**

1. Which sheep breed type do you use for fattening purpose? 1. Local breed 2. Exotic breed 3. Cross breed. 4. I don't know Specify their name_____.

2. Which goat breed type do you use for fattening purpose? 1. Local breed 2. Exotic breed 3. Cross breed 4. I don't know Specify their name_____.

## VII. Major feed resource and source of feed for sheep and/or goats

1. Which type of feed resource are majorly used for shoats fattening? 1. Natural pasture 2. Crop residues 3. Cultivated pasture and forages 4. Agro-industrial by-products 5. Fodder tree 6. Others _____, _____, and _____.
2. If Q1 is crop residues, what type of crop residues do you use? 1. Barely straw 2. Wheat straw 3. Teff straw 4. Maize strove 5. Palm straw 6. Oat straw 7. Others _____
3. Which one is most important and preferable for you? Remark them.

| Crop residues | Remark | |
|---|---|---|
| | Sheep | Goat |
| Barely straw | | |
| Wheat straw | | |
| Teff straw | | |
| Maize strove | | |
| Oat straw | | |
| Others | | |

Why? _____.

4. If Q1, is agro-industrial by-product, List their name with respect to its importance._____.
5. If Q1 is fodder tree, which type of fodder do you use? List them._____.
6. In which season the above feeds are available? Please specify them with respect to availability season.

| Animals | Major feed type | Season of availability | | | |
|---|---|---|---|---|---|
| | | Wet season | Remark | Dry season | Remark |
| Sheep | Natural pasture | | | | |
| | Crop residues | | | | |
| | Cultivated forages | | | | |
| | Agro-industrial by-product | | | | |
| | Others | | | | |
| Goat | Natural pasture | | | | |
| | Brose trees | | | | |
| | Crop residues | | | | |
| | Cultivated forages | | | | |
| | Agro-industrial by-product | | | | |

7. Is there a feed shortage in this area? 1. Yes 2. No
8. If yes, in which months of the year feed resource become scarce and feed shortage occur? Specify it in the table below.

| No | Feeds type | Months of the year | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug |
| 1. | | | | | | | | | | | | | |
| 2. | | | | | | | | | | | | | |
| 3. | | | | | | | | | | | | | |
| 4. | | | | | | | | | | | | | |

1. What is the main reason for feed shortage? 1. Expanding of crop cultivation 2. Decline in productivity of grazing land 3. Increasing animal population 4. Decline in grazing land 5. Other.
2. What you will do and how could you pass this hard time? 1. Preserve and store the feed. 2. Obligated to sell the animals 3. Obligated to purchase concentrate feed 4. Others _____.
3. Do you store feed for your animals? 1. Yes 2. No
4. If yes for Q3, which feed? 1. Grass and pasture 2. Wheat straws 3. Barley straws 4. Maize strove 5. Teff straws 6. Sorghum strove 7. Others _____.
5. How do you store the feed? 1. Baled without shed 2. Baled under shed 3. Stalk under shed 4. Stalk without shed 5. Other _____.
6. Do you produce cultivable forages? 1. Yes 2. No
7. If yes, what type of forages do you produce? 1. ____2. ____3.____4.____5._____6.___.
8. If no, why? 1. I don't know about it. Lack of land 3. Lack of seed. 4. Other_____.
9. From where do you get major feed for your fattening animals? 1. Own farm 2. Communal land 3. Government provision 4. NGOs provision 5. Purchase from other source 6. Other
10. If it purchased from other source, which feed and how many (birr) it cost per Kg of feed?

| No. | Major Feed purchased from other source | Cost (birr)/Kg of feed |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |

**VIII. Supplementation and low quality feed treatment**

1. Do you provide your fattening animals with supplementary feed? 1. Yes 2. No
2. If no, why? 1. Expensive 2. Not available 3. No need of it 4. Other _____.
3. If yes, what type of feed do you use as supplementary feed?

| Type supplementary feed | Type of animals | | Remark | |
|---|---|---|---|---|
| | Sheep | Goats | Sheep | Goats |
| Food leftover | | | | |
| Fruit leftover | | | | |
| Maize | | | | |
| Wheat bran | | | | |
| Salt | | | | |
| Other | | | | |

4. When do you provide your animals with supplementary feed? 1. Dry season 2. Wet season
5. How often do you offer supplements to your sheep and/or goats? 1. Once a day 2. Twice a day 3. Every time available 4. Other_____.

**IX. Small ruminants feeding system**

1. Which feeding system do you use during feeding your animals? 1. Free grazing and browsing 2. Stall feeding 3. Tether feeding 4. Other
2. Under free grazing system which type of land do you use for grazing? 1. Private grazing 2. Communal grazing 3. Road side grazing 4. Grazing aftermath 5. River side grazing 6. Other
3. How your animals are graze or browse? 1. Alone 2. Sheep and/or goats 3. All together 4. Other_
4. If stall feeding used, what type of feed do you use? Specify,

**X. Length of Feeding period and frequency of small ruminant fattening**

1. How long do you fed your animals to finish fattening period?

| Feeding period | Fattened animals | | Remark | |
|---|---|---|---|---|
| | Sheep | Goats | Sheep | Goats |
| Three months | | | | |
| Four months | | | | |
| Five months | | | | |
| Six months | | | | |
| Above six months | | | | |

2. If feeding period is above six months, why the reason behind prolonged feeding period? Specify, _____.
3. How you decide end of finishing period and which one is better for you?

| Criteria used to decide finishing period | Fattened animal type | | Remark | |
|---|---|---|---|---|
| | Sheep | Goats | Sheep | Goats |
| Anticipating current and future price | | | | |
| Animals live weight change | | | | |
| Pre-decided feeding length | | | | |
| Others | | | | |

4. Per year, how many time do you fatten your animals?

| Frequency of fattening | Fattened animal type | | Remark | |
|---|---|---|---|---|
| | Sheep | Goats | Sheep | Goats |
| Once | | | | |
| Twice | | | | |
| Thrice | | | | |
| Fourth | | | | |
| Other | | | | |

5. How many sheep and /or goats do you fatten per each fattening cycles? _____.

## XI. Management of small ruminant

1. If you housing your animals, which type of house do you use? 1. Main house 2. Adjoin house 4. Separate house 5. Other
2. How do you confine you animals? 1. Alone 2. Sheep and/or goats 3. Others _____.
3. Why do you provide shelter for animals? 1. Protect from predators 2. Protect from sun, rain and wind 3. For close supervision 4. Provide supplement 5. Others._____.
4. What prevailing and economically important disease are found in this area? List and rank them.

| No. | Most important disease | Animals | | Rank | |
|---|---|---|---|---|---|
| | | Sheep | Goats | Sheep | Goat |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |
| 4. | | | | | |

5. What done when sheep and/or goats get sick? _____.
6. Do you get veterinary service? 1. Yes 2. No
7. If yes, from where do you get vaccine and drugs to treat animals? _____.
8. How could you get veterinary service? 1. before outbreak 2. Immediately after outbreak 3. Later after animals some died 4. Other _____.
9. Do you provide your animals with plenty and quality of water? 1. Yes 2. No
10. If yes, what are the common source of water for you?

| No | Source of water | Dry season | Wet season |
|---|---|---|---|
| 1. | River water | | |
| 2. | Pipe water | | |
| 3. | Deep well | | |
| 4. | Others | | |

11. In what frequency you offer your animals with water?

| Frequency of watering | Wet season | | Remark | Dry season | | Remark |
|---|---|---|---|---|---|---|
| | Sheep | Goat | | Sheep | Goat | |
| Once a day | | | | | | |
| Twice a day | | | | | | |
| Every two days | | | | | | |
| Any time required | | | | | | |

## XII. Sheep and/or goats Marketing system

1. Where do you sell your fattened sheep and/or goats? 1. On farm selling 2. Dodola market 3. Other _____.

2. Do you ever get market information and animal price? 1. Yes 2. No
3. If yes, from where do you get? 1. Government 2. NGOs 3. Medias (Radio, TV) 4. Brokers 5. Others, specify_____.
4. Do you practice fattening of sheep and/or goats for targeted market season? 1. Yes 2. No

5. If yes, which type of animals in which season?

| Target market /season of the year | Type of animals | | Remark | |
|---|---|---|---|---|
| | Sheep | Goats | Sheep | Goats |
| New year festival | | | | |
| Meskel | | | | |
| Christmas | | | | |
| Eid Alfetri and Eid Al adha | | | | |
| Others | | | | |

**XIII. Small ruminants marketing channels**

1. How often the fattened animals are arrive a consumer's hand start from the hand of producers? _____.

**XIV. Market actors, selling and pricing method of sheep and/or goats**

1. To whom you sell your fattened animals? 1. Home consumers 2. Middlemen of the same village.3. Small traders 4. Butcher men 5. Larger traders 6. Other. Specify, _____.
2. How do you sell (pricing) fattened sheep and/or goats? 1. Body weight basis 2. "Eye ball" estimation 3. Body conformation 4. Touch and feeling 5. Others specify, _____.

| Criteria for selling/pricing sheep and/or goats | Type of animals | | Remark | |
|---|---|---|---|---|
| | Sheep | Goats | Sheep | Goats |
| Body weight basis | | | | |
| "Eye ball" estimation | | | | |
| Body conformation | | | | |
| Touch and feeling | | | | |
| Others | | | | |

3. Why you prefer this method? 1. Mischief during weighing scale 2. It is will of buyers 3. It is real way of pricing 4. Others specify, _____.
4. Who decide the price of fattened animals on market days at market place? 1. Seller (fatteners) 2.Traders 3. Government 4. Both seller and traders

## XV. Challenges and opportunities of small ruminant fattening

1. Is there any challenges which hinder sheep and/or goats fattening and marketing? 1. Yes 2. No
2. If yes, what major challenges affect sheep and/or goats fattening are there? Rank.

| No. | Major challenges | Rank |
|---|---|---|
| 1. | Feed shortage | |
| 2. | Decline in grazing land | |
| 3. | Water shortage | |
| 4. | Disease and parasite | |
| 5. | Marketing problem | |
| 6. | Lack of extension service | |
| 7. | Lack credit and support | |
| 8. | Inadequate veterinary service | |
| 9. | Lack of appropriate breed | |
| 10. | Lack of appropriate technology | |
| 11. | Drought | |

3. For sheep and/or goats fattening in your area, what opportunities is/are there?

| No | Major opportunities | Rank |
|---|---|---|
| 1. | High market demand | |
| 2. | Development of export abattoir | |
| 3. | Conducive environment | |
| 4. | Population growth | |
| 5. | Require small space and starting budget | |
| 6. | Short fattening period | |
| 7. | Increased price of fattened animals | |

**Focus group discussion and key informant interview checklist**

Discussion points for focus group discussion (FGD)

1. What fattening practices of small ruminants looks like in this area?
2. Which fattening and feeding system of small ruminants is/are commonly practiced in this area?
3. What major feed resources are used for small ruminants fattening in the area?
4. What the treatment of the low quality feeds looks like?
5. What major challenges and opportunities are faced the fatteners in this area?
6. What production and utilization of the improved forage is looks like in this area?
7. What marketing system of small ruminants looks like in this area?

Interview points for key informant interviews (KII)

1. Which fattening system of the small ruminants is commonly practiced in the area?
2. Which type of major feed resources are used by the fatteners?
3. What feeding system of small ruminants fattening is commonly practiced?
4. Which breed type of sheep and/or goats is/are exist and used for fattening in this area?
5. Are the fatteners get any training about modern fattening, feeding and management system of small ruminants?
6. What marketing of small ruminants look like in the areas?
7. What major problems affect small ruminant fatteners in the area?
8. What major type of small ruminants' disease is/are found in the area?
9. How the fatteners keep their animals health?
10. What opportunities are there for small ruminants fattening in the area?

Figure 1. Major crop residue used (barley straw on the left side and wheat straw the on right side).

Figure 2. Major industrial by product (wheat bran on left side and linseed cake on the right side)

Figure 3. Browsing fodder tree (Carissa edulis, locally named: Agamsa)

Figure 4. Type of house (Separate House on left side, and Adjoin with Main house on right side)

## BIOGRAPHICAL SKETCH

The author, Gamada Karicho was born in June 4, 1990 in North East of West Arsi Zone, from his father Karicho Chawicha and his mother Luncho Woticha. He attended his elementary education (1-8) at Chokorsa primary school from 2006 to 2013, junior high school education (9-10) at Gata Secondary school from 2014 to 2015 and preparatory education (11-12) at Dodola preparatory school from 2016 to 2017. Then he joined Debark University College of Agriculture and Environmental Science in 2018 and was awarded a BSc degree in Animal Science in January 2021. Soon after graduation, the author was employed at Debark University College of Agriculture and Environmental Science in Animal Science Department, and served as the graduate assistance I in 2021/2022. Then the Author joined the school of graduate studies of Hawassa University in 2022 to pursue his master of science in Animal Production under the school of Animal and Range Science.