Original Research

EAST AFRICAN JOURNAL OF PASTORALISM
Volume 5 Issue 1

Assessment of Cattle Management Practices and Evaluation of Nutritional Quality of Major Available Feed Resources in Adadle District of Shabele Zone, Somali Region, Ethiopia

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ABSTRACT

A cross-sectional study was carried out to assess husbandry practices and production constraints of cattle breed in the Adadle district of Shabelle Zone, Somali Regional State. Two production systems, pastoral and agro-pastoral, were considered for the study. Three kebeles were randomly chosen from each production system based on their cattle-producing potential. About 150 cattle producer households were randomly selected from purposively selected rural kebeles to assess the production practices and their major constants in the district (2 production systems*3 RKs*25 households). This study also examined the chemical composition of five common natural pasture grasses—Chrysopogon plumulosus, Pennisetum thunbergii, Cynodon dactylon, Brachiaria cornata, and Grass S.p.p. with a focus on their nutritional value during wet and dry seasons. Feed types were selected based on group discussions about their abundance and cattle consumption patterns. The study revealed that majority of the households in pastoral areas that were interviewed (84.0%) had male heads of household, while only (16.0%) had female heads. Cattle housing was open kraal fenced with the thorned plenty acacia trees and calves were housed separately from other cattle. The production of milk was the main objective of maintaining cattle in both places, followed by income generation. The average daily milk production of the local cows in pastoral production was (3.13±1.0) liters, which was lower than the average daily milk production from agro-pastoral production (3.16+1.03), respectively. Animals traveled long distances to watering points (>5 km) during dry season, while in wet season, animals were watered in nearby water sources. In pastoral production, however, the lack of veterinary services (6.7%), feed shortages (60%), and water shortages (20%), as well as parasites and diseases (13.3%) and disease outbreaks (14.3%), were all regarded as significant productivity barriers for cattle. To this end, it is imperative to make a significant effort to solve the feed scarcity through efficient hay and crop residue conservation and usage. Thus, it is necessary to enhance feed resources and control animal diseases in order to improve management and production practices. Furthermore, results indicate that while DM content ranged from 89.21% to 90.98% during the wet season and 91.01% to 91.79% in the dry season, significant seasonal differences were observed for CP, ADL, ADF, and ash content in pastoral production ($P < 0.05$). The average CP levels were notably below the requirements for tropical animals, with the highest CP concentrations found in Brachiaria cornata (6.03%) and Cynodon dactylon (5.98%). In agro-pastoral production, DM, CP, ash, ADL, ADF, & NDF did not show significant seasonal variation ($P>0.05$). Overall, grasses exhibited low nutritional content, with higher NDF levels potentially restricting feed intake and overall livestock performance. The findings underscore the need for improved forage management and supplementation strategies to enhance livestock nutrition in these production systems.

Key Words: Pastoral Agro-pastoral, Natural pasture, Cattle production, Nutrition, feed resources

1. Introduction

Ethiopia boasts a diverse livestock population, including approximately 61.59 million cattle, 36.81 million goats, 32.85 million sheep, 2.07 million horses, 9.22 million donkeys, 0.35 million mules, 3.73 million camels, and 48.13 million poultry (CSA, 2020). Among these, cattle husbandry plays a crucial role in the socio-cultural fabric of traditional societies. Cattle serve various purposes: bulls are used as draft animals, cows provide milk, and calves are raised for meat and hides, while manure is utilized as fertilizer (Abera, 2018). In 2018, Ethiopia produced approximately 3.1 billion liters of cow milk, with an average lactation period of around six months and a daily yield of approximately 1.37 liters per cow (CSA, 2018). This sector is vital for food security, particularly for smallholder farmers, including pastoralists who depend heavily on cattle. Additionally, cattle provide draught power for agricultural activities (Melaku, 2011) and can be sold during times of scarcity, serving as collateral for informal loans and fulfilling various socio-cultural roles (Ulfina et al., 2005). Cattle contribute to the livelihoods of 12.5 million households, accounting for 70% of the population (FAO, 2018). Despite the large cattle population, productivity remains low due to inadequate nutrition, frequent disease outbreaks, water shortages, and a lack of effective

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Article Information:
Article Received for review: 14 April 2024
Article Reviewed: 22 April 2024
Revised Comments: 15 June 2024
Accepted for publication: 28 July 2024
Available Online: 31 July 2024
How to Cite this Article:
Abdi S B, Mahamed H, Kownin A (2024): Assessment of Cattle Management Practices and Evaluation of Nutritional Quality of Major Available Feed Resources in Adadle District of Shabele Zone, Somali Region, Ethiopia East African Journal of Pastoralism, 5(1):1-11.

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livestock extension services (Haile et al., 2011). Cattle are raised across various agro-ecological zones, from highland mixed farming systems to lowland extensive, transhumant, or nomadic systems (FAO, 2018).

The most common barrier to cattle productivity in the country is a lack of feed (Alemayehu, 2005). Furthermore, better feed technology uptake and use remained restricted (Deribe Gemiyo et al., 2013). In Ethiopia, livestock, especially cattle, are almost entirely fed natural grass and crop residues, both of which are nutritionally deficient. Furthermore, the usage of enhanced forages and agro-industrial byproducts is rather limited. Even still, the quantity of this poor-quality feed is limited, and it becomes more acute during the dry season in both the highlands and lowlands(**?**). The importance of key feed supplies, their nutritional value, and related farmer preferences and appraisal have not, however, been adequately examined and documented. Lack of feed in the lowlands, particularly during the dry season, leads cattle and livestock keepers to journey considerable distances in search of food. Such techniques expose herders and animals to various risks, such as livestock sickness, clan warfare, and others, and reduce livestock productivity. Furthermore, soil and pasture damage has resulted (Deribe Gemiyo et al., 2013). Natural pasture, crop residues, hay, agro-industrial by products, improved forage, and other feeds (**?**) account for 54.59, 31.06, 6.81, 1.53, 0.31, and 5.11 % of Ethiopia's total livestock feed supply, respectively (CSA, 2017b).

Natural pasture is the primary feed resource during the wet season, while crop residues play a significant role during the dry season (Gelayenew et al., 2016). Natural pasture covers nearly a quarter of the country's total land area (Ulfina et al., 2005). However, due to seasonal variations in rainfall, poor pasture management, and conversion of natural pasture into crop fields (Kebede et al., 2016), the productivity of grazing lands in most parts of Ethiopia is extremely low (Ulfina et al., 2005). Animal feeds such as natural pasture, 3 fodder crops, fodder trees, crop residues, and non-conventional feeds are used in different parts of Ethiopia, according to Sefa (2017). Green fodder (grazing) is the most common type of feed (54.59%), followed by crop residues (31.60%), hay (6.81%), and industrial byproducts (1.53%). (CSA, 2017a). According to, feed is a constraint for livestock production in Ethiopia in terms of both quantity and quality. During the dry season, the problem of feed scarcity becomes even more severe (Zewdie, 2010). In the highlands, even during good rainy seasons, forage is insufficient to feed livestock (Melese et al., 2014).

According to data obtained from around the country, available feed covers 78.2 % of demand (Sefa, 2017). A review of the types and suppliers of livestock feed should be conducted to improve animal production and productivity (Endale, 2015). Further research is needed to analyze feed intake, digestibility, amount of inclusion (supplementary feeds), animal reactions, and anti-nutritional variables in order to more efficiently utilize these indigenous and well-adapted feed supplies for sustainable animal production (Deribe, 2015). Understanding the chemical composition and nutritive values of major feed resources in the study area is essential to improving cattle production and productivity, as well as providing appropriate knowledge to smallholder farmers, which could then improve feed supply and design feeding alternatives during the year's worst seasons to avoid livestock feed shortages. To this end, the research began by identifying the key feed resources available and assessing their nutritional quality.

Adadle District is the largest of the Shebelle zone's ten districts. Despite the district's large animal population, there is still mismanagement and a lack of knowledge regarding crop-residue enhancement and residue use efficiency. Apart from that, there is a lack of proper range management methods, as well as poor cattle management in terms of feeding, healthcare, housing, and watering, all of which can affect cattle production performance. As a result, unless proper improvement measures are implemented, farmers may not derive a reasonable benefit from their farming activities. This can be accomplished by increasing feed output under sustainable farming systems and preparing a better mix of nutrients for livestock from these sources, as well as increasing feed utilization efficiency by utilizing available feed resources (Alemayehu, 2002). As a consequence, the value of livestock in general and cattle in particular, can be increased. Understanding the current status of feed production, distribution, and utilization is important for identifying and designing effective feed supply and livestock productivity interventions (Tolera et al., 2014). Furthermore, knowing the available feed resource is important for effective feed utilization, which is essential for effective animal production and food security (Makkar and Ankers, 2014). It's difficult to handle the feed resource if users don't know when it'll be available. Apart from feed availability, understanding the nutritional content of feed is important, as good feed promotes cattle production and provides a higher-quality product. This showed that feed resource availability and nutritional quality are the most critical factors determining livestock productivity (Tesfay, 2010).

However, comprehensively resolving these gaps is required in order to conduct major analysis and steps for various cattle production and feed development initiatives. As a result, this study was planned to look into cattle production practices and assess the nutritional value of the area's major feed resources. As a result, the findings of this study are expected to have significant implications for persons or organizations working in this field, as well as policy makers Furthermore, the outcome can contribute to the area's knowledge base and act as a springboard for future research and policy development efforts. Therefore, this study was conducted to assess cattle production practice and evaluate the nutritional value of major available feed resources in Adadle district of Shabele Zone, Somali Regional State, Ethiopia.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted at Adadle district belong to Shabele zone of the Somali regional state, it covers a total area of 8,665.2 Square Km and borderers with Godey, Ber'ano, Elkari, Hargele, Kalafo and Barey districts from Northern, North Western, Western, Eastern and South Western direction respectively and with Somalia country in the south direction. Adadle is 17 km far away from the Zonal Capital Godey towards the South direction. The district is located at a distance of 1243 km south east of Addis Ababa, at an elevation of 300-500 meter above sea level. The minimum and maximum mean annual temperature was 280C -380C, respectively. The rainfall pattern was bimodal type. The mean annual rainfall of the area ranges from 150 to 300 mm which is not sufficient for rain feed production (AWLCRDO, 2013). According to (CSA, 2013), an estimated total human population of Adadle district were 99, 063 of whom 56,027 were men and 43,036 were women. The livestock population of the district is estimated to be 206,400. These include 40,200 cattle, 100,400 sheep, 63,600 goats, 1,400 camels and 800 equines (BoFED, 2013). The district has 15 kebelles (8 pastoralists and 7 agro-pastoralists) and the dominate livestock production system in the district was pastoralism. Major food crops grown in the district areas are maize and sorghum (AWLCRDO, 2013).

2.2. Study Design and Sampling Procedure

The study consisted of two components: a survey and a laboratory experiment. The survey aimed to gather detailed information on cattle production practices and the available feed resources. The laboratory experiment, conducted as the second part, focused on analyzing the nutritional composition of the primary feed resources identified and ranked by respondents in the survey. This study was a cross-sectional investigation to collect relevant information on cattle production practices and available feed resources. The study area was stratified into pastoral and agro-pastoral production systems. Each production system was further stratified into rural kebeles (RKs) (RKs, the lowest administration unit in Ethiopia). A total of six rural kebeles (3 from pastoral and 3 from agro-pastoral systems) were selected based on cattle population/herd size. Then the list of cattle producer households in each selected rural kebeles were collected from their respective administrations. Eventually, twenty-five cattle producer households from each rural kebeles were selected randomly. Thus, the total number of cattle producer households selected to study cattle production practices in the district were 150 (2 production systems * 3 rural kebeles * 25 households).

2.3. Data Collection

The data was collected through questionnaires with sample households, interviews with key informants and through focus group discussions. One focus group discussion was held in each study kebele with about ten members. Moreover, field observations were made to enrich the data about feeding, watering, housing, healthcare of the cattle, utilization of feed resources and management of communal grazing land, feed conservation systems and feed resource situation of the households. For the evaluation of the nutritive value of major available feed resources in the study area were identified and ranked by the respondents accordingly their preference by cattle. The feed samples were kept under shade until collection for the day was completed. After then, samples were dried until the field work was completed. All sub-samples harvested from the same grazing lands were thoroughly mixed to make one composite sample of one kilo gram. The samples were dried by air to prevent spoilage before being placed in the laboratory oven. Feeds obtained from grasses their specimens were collected, pressed and labeled and dried the dried samples then were transported to the Haramaya University central laboratory for the analysis. Moreover, identification of different grasses was undertaken following the guide provided in the Flora of Ethiopia (Hedberg and Edwards, 1989; 1995) and the Flora of Tropical East Africa (Cufodontis, 1953-1972). The samples were dried in an oven for 72 hours at $60°C$ and ground in a Willy mill to pass through 1 mm sieve for chemical composition analysis.

2.4. Feed sample collection and preparation

Selections of feed types were done based on information obtained during group discussions regarding their relative abundance in the district and their consumption by grazing of cattle. While identifying the available feed resources, first 5 commonly used feeds in the study area were identified from selected RK, and then feed for laboratory analysis were sampled from each identified feed in according to the preference rank given by the respondents. Natural pasture from each grazing land was harvested randomly from 10 quadrates (with size of 1x1 m^2) at stubble height (5cm). Natural pasture (grasses), species were identified by the respondents during survey part accordingly to their preference by cattle Moreover, Grasses species were sampled as described by (Tarawali et al., 1995), the feed samples were collected in dry season (November to May) while in wet season from (August to October).

2.5. Chemical Analysis of Feed Samples

Chrysopogon plumulosus, Pennisetum thunbergii, Cynodon dactylon, Brachiaria cornata and Grass S.p.p were analyzed for chemical composition. Dry matter content was determined by oven drying the samples at 105oC for 24 hours. Total Nitrogen (N) was determined by the Kjeldahl method (Aoac, 2005). Crude protein (CP) was calculated as N x 6.25. Ash was determined by complete burning of the feed samples in a muffle furnace at 500oC for 5 hrs. According to the procedure of AOAC (2005) Neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL), were analyzed using the detergent extraction method (Van Soest et al., 1991).

2.6. Data Analysis

The data was used questionnaire survey and field observations were analyzed using Statistical Package for Social Science software (SPSS, Ver.21). Chi-square test was employed to examine the difference in cattle production practices among the categorical variables. The General Linear Model (GLM) procedure of SAS (2009) was used to analyze data on chemical composition of major feed resources. Mean comparison was made using Turkey test, adjustment, and the differences were considered significant at P<0.05. The following model was used for the analysis of chemical composition of major feed resources.

$$Y_{ij} = \mu + Si + e_{ij} \quad (1)$$

Where,Y_{ij}= observations; μ = overall mean; Si = the effect of i^{th} the season; and e_{ij} = random error

3. Results and Discussion

Demographic Characteristics of the Households Most households in both pastoral (84%) and agro-pastoral (82%) production systems were male-headed (Table 1). The average age of respondents across both systems was 33.4 years. A large proportion of respondents were illiterate, with 50.7% in pastoral and 50.7% in agro-pastoral systems. Additionally, the majority were engaged in livestock production, with 73.3% in pastoral and 14.7% in agro-pastoral systems. This finding aligns with Kula et al. (2016), who stated that livestock rearing serves as the main source of income and means of livelihood.

3.1. Purpose of keeping cattle

Numerous purposes, such as generating cash, producing milk and meat, and serving social and cultural roles, led to the keeping of cattle in the study area (Table 2). In all locations, the primary goal of keeping cattle was milk production, which was followed by the production of meat, social and cultural factors, and income. Regarding milk production, sale/income, social and cultural values, and meat production, there was no difference (P>0.05) between the production systems.

3.2. Milk Production and Associated Constraints

Table 3 presents the average milk yield and the primary constraints to milk production in the study area for both pastoral and agro-pastoral production systems. The average milk yield across both systems was relatively similar, with pastoral systems producing 3.13 ± 1.0 liters and agro-pastoral systems yielding 3.16 ± 1.03 liters, resulting in an overall average of 3.14 ± 1.01 liters.

Several challenges were identified, with significant variations between the two systems. Feed shortages were a major constraint, reported by 41.3% of respondents in pastoral systems compared to 33.3% in agro-pastoral systems, showing a significant difference (P < 0.0001). Livestock diseases were reported as a constraint by 25.3% of respondents in agro-pastoral areas and 14.7% in pastoral areas, also showing a significant difference (P < 0.0001). Inadequate veterinary services were a significant issue in pastoral systems, affecting 24.0% of respondents, compared to only 9.3% in agro-pastoral systems. Additionally, water shortage was a notable concern in pastoral systems, reported by 28.0% of respondents, while only 5.3% of agro-pastoral respondents indicated it as a constraint.

3.3. Water Source and Watering Management

The analysis of water sources and management practices across pastoral and agro-pastoral communities reveals significant differences in various aspects. During the wet season, springs are the primary water resource for pastoralists (58.7%), while agro-pastoralists rely heavily on rivers (77.4%), indicating a stark contrast in water source preferences (P < 0.0001). In the dry season, both groups primarily access water from rivers, but pastoralists also

Table 1: Sex, age, educational level and sources of income of household heads in the study area

Variables	Pastoral		Agro- pastoral		Overall	*P value*
Sex of the respondents	**N= (75)**	**%**	**N= (75)**	**%**	**N= (150)**	
Male	63	84.0	62	82.7	83.35	<0.8
Female	12	16.0	13	17.3	16.65	
Age (years)						
30	15	20.0^{b}	45	60.0^{a}	40	<0.0001
30-45	45	60.0^{a}	5	6.7^{b}	33.5	
46-60	10	13.3^{b}	15	20.0^{a}	16.65	
60	5	6.7^{b}	10	13.3^{a}	10	
Educational status						
Illiterate	38	50.7	38	50.7	50.7	<0.8
Primary grades	24	32.0	26	34.7	33.35	
Junior grades	13	17.3	11	14.7	16	
Major sources of income						
Livestock production	55	73.3^{a}	11	14.7^{b}	44	<0.0001
Crop production	0	0	30	40.0	20	
Both	0	0	32	42.7	21.35	
Business	15	20.0^{a}	2	2.7^{b}	11.35	
Remittance	5	6.7	0	0	3.35	

Means followed by different superscript letters in the same columns are significantly different at (P<0.05), N= number of respondents

Table 2: Purpose of keeping cattle in the study area

Variables	Pastoral		Agro- pastoral		Overall	*P value*
Purpose of keeping cattle	**N= (75)**	**%**	**N= (75)**	**%**	**N= (150)**	
Milk Production	30	40.0	30	40.0	40	< 0.8
Sale (income)	20	26.7	16	21.3	24	
Social cultural values	16	21.3	20	26.7	24	
Meat	9	12.0	9	12.0	12	

Table 3: Milk yield and major constraints of milk production in the study area

Parameters	Pastoral		Agro- pastoral		Overall	*P value*
	N = (75)	%	N = (75)	%	N = (150)	
Milk yield (Mean±SD)	3.13±1.0		3.16±1.03		3.14±1.01	
Constraints of milk production						
Feed shortages	31	41.3[a]	25	33.3[b]	37.3	<0.0001
Livestock diseases	11	14.7 [b]	19	25.3 [a]	20	
In adequate veterinary services	7	24.0 [a]	18	9.3 [b]	16.65	
High feed cost	5	6.7	9	12.0	9.35	
Water shortage	21	28.0 [a]	4	5.3 [b]	16.65	

Means followed by different superscript letters in the same columns are significantly different at (P<0.05), N= number of respondents SD= standard division

utilize birkas and walls, highlighting their dependence on alternative sources (P < 0.0001).

Watering frequency further underscores these differences. In the wet season, agro-pastoralists experience unrestricted access to water, while pastoralists primarily water once daily, reflecting a more constrained water availability (P < 0.0001). In the dry season, a significant portion of agro-pastoralists water their livestock daily (44.0%), compared to a smaller fraction of pastoralists (25.3%) who rely on less frequent watering (P < 0.0001) (Table 4).

Distance to watering points reveals that a majority of pastoralists (76.0%) have watering points within 1-5 km during the wet season, whereas agro-pastoralists (58.7%) face a more challenging situation, with many having to travel further (P < 0.0001). In the dry season, both groups show a similar trend, but agro-pastoralists are notably more affected by longer distances to watering points.

Major water problems identified include water shortages, distance to watering points, labor shortages, and water purity issues. While both groups face challenges, water purity is particularly concerning for agro-pastoralists, with 46.7% reporting issues, compared to only 12.0% of pastoralists (P < 0.0001). This indicates a significant disparity in water quality perceptions between the two communities. Overall, the findings underscore the critical importance of water source management and access in both pastoral and agro-pastoral settings, with implications for livestock health and community resilience in the face of environmental changes.

3.4. Cattle Housing Practices

The analysis of cattle housing practices in the study area reveals noteworthy distinctions between pastoral and agro-pastoral communities. Both groups predominantly use kraals without roofing for cattle housing, indicating a shared preference for this traditional structure (100%). However, there are significant differences in where cattle are kept at night. A considerable majority of agro-pastoralists (100%) house their cattle in separate structures, while only 82.7% of pastoralists do so, suggesting a more integrated approach to livestock management in agro-pastoral settings (P < 0.0001). Moreover, both groups exhibit a lack of regular cleaning practices, with all respondents indicating that they do not clean cattle housing regularly. This raises concerns about animal health and hygiene, as inadequate sanitation could lead to increased disease transmission and other health issues among livestock. Overall, while both pastoral and agro-pastoral communities share similar housing types and poor cleaning practices, the significant difference in nighttime housing reveals a divergence in management strategies that could impact livestock welfare and productivity. These findings highlight the need for improved sanitation practices and considerations for housing management in both communities to enhance livestock health and overall productivity (Table 5).

3.5. Animal Health Care Practices

Health care practices of cattle in the study the area is illustrated in (Table 6). The most common cattle diseases in the study area were Anthrax, Lumb Skin Disease (LSD) and Foot and Mouth Diseases (FMD). The three main cattle diseases in pastoral production were, in order, foot and mouth disease (64%), lumb skin disease (LSD) (18.7%) and anthrax (17.3%). Between the two production systems, there was no apparent difference in the prevalence of common cattle diseases (P>0.05). The diseases seen in this investigation are consistent with Belete's findings (2006).

The majority of responders treated their cattle for disease using traditional methods, while the rest used modern techniques. Between each production system, there was no statistically significant difference in the methods used to treat cattle disease (P>0.05). The distance to the closest veterinarian varied (P<0.05) depending upon the production system. The level of pastoral production was higher among farmers who were located within one kilometer of their homes than in agro pastoral production.

Farmers within 1 to 5 kilometers provided more agro-pastoral than pastoral products, respectively. Hence According to the MoARD report from 2008, which revealed that those vaccines and medications needed for the handling of livestock are typically provided on a heavily subsidized basis by the Veterinary Department of the Regional Agricultural Bureaus, disease prevention and control measures have been implemented by regional and local government bodies the majority of the time. The economics of livestock production are also adversely affected by the presence of diseases because these conditions not only damage livestock but also their owners mentally (Tulu et al., 2018).

Table 4: Water source and watering management

Variables	Pastoral		Agro- pastoral		Overall	*P value*
Major water resources	**N = (75)**	%	**N = (75)**	%	**N = (150)**	<0.0001
Wet season						
Spring	44	58.7[a]	17	22.6[b]	40.65	
Well	15	20.0	-	-	10	
Birka	16	21.3	-	-	10.65	
River	-	-	58	77.4	38.7	
Dry season						
River	-	-	75	100	50	
Birka	29	38.7	-	-	19.35	
Walls	46	61.3	-	-	30.65	<0.0001
Watering frequency in wet season						
Freely available	35	46.7[b]	75	100[a]	73.35	
Once a day	40	53.3	-	-	26.65	<0.0001
Watering frequency in dry season						
Freely available	-	-	42	56.0	28	
Once a day	19	25.3[b]	33	44.0[a]	34.65	
Once in two days	56	74.7	-	-	37.35	<0.0001
Distance to watering point in wet season						
1Km	5	6.7[b]	44	58.7[a]	32.7	
1-5 Km	57	76.0[a]	15	20.0[b]	48	
5-10 Km	13	17.3	16	21.3	19.3	<0.0001
Distance to watering point in dry season						
1-5 Km	34	45.3[b]	59	78.7[a]	62	
5-10 Km	41	54.7[a]	16	21.3[b]	38	<0.0001
Major water Problems						
shortage of water supply	30	40.0	-	-	20	
Distance to watering points	20	26.7	23	30.7	28.7	
Labour shortage to fetch	16	21.3	17	22.7	22	
Water						
Water purity	9	12.0[b]	35	46.7[a]	29.35	<0.0001

Means followed by different superscript letters in the same column are significantly different at (P<0.05), N= number of respondents

Table 5: Cattle housing practices in the study area

Variables	Pastoral		Agro- pastoral		Overall	*P value*
Cattle housing type	**N= (75)**	%	**N= (75)**	%	**N= (150)**	
Kraal without roofing	75	100	75	100	100	
Where do you keep cattle at night						
In a separate house	62	82.7[b]	75	100[a]	91.35	<0.0001
In our residence compound	13	17.3	-	-	8.65	
Do you clean cattle house regularly						
No	75	100	75	100	100	
Yes	-	-	-	-	-	

Means followed by different superscript letters in the same row are significantly different at (P<0.05), N= number of respondents

3.6. Cattle Production Constraints

As presented in Table 7, drought, water shortage, feed shortage, disease occurrences, parasites, veterinary services as the main constraints of cattle production. However, in pastoral areas, inadequate veterinary services (13.3%), diseases and parasites (60%) and water shortages (20%) were all considered serious constraints of cattle production. The production systems had different cattle production constraints (P< 0.05). It is confirmed that a severe lack of feed could be a significant barrier to cattle productivity (Duguma et al., 2012). The study found that farmers emphasized the lack of feed, despite the fact that feed is the main factor affecting cattle production. They also underlined the need for improving feeding practices as a necessary first step in any improvement program. Feed shortages (40.0 %), diseases and parasites (26.7 %), a lack of veterinary services (21.3 %), and water shortages (12 %) were rated first, second, third, and fourth, respectively, as productivity constraints for agro-pastoralists. Water provision was essential for farmers whose cattle lived far from permanent rivers, especially during dry times. In both production systems, a seasonal shortage of cattle feed was cited as one of the major issues with cattle production in the study area, particularly during the dry season, which was consistent with the findings of (Kechero et al., 2013).

3.7. Feed Resources and Feeding System

Key informants shared their opinions in focus groups about how the seasons and farming practices affected the availability of feed resources. The main sources of feed for

Table 6: Health care practices of cattle in the study area

Variables	Pastoral		Agro- pastoral		Overall	*P value*
Do you have diseases problems	**N = (75)**	%	**N = (75)**	%	**N = (150)**	<0.001
Yes	75	100[a]	67	89.3[b]	94.65	
No	-	-	8	10.7	5.35	
Common diseases of cattle						
Foot Mouth disease (FMD)	48	64.0	45	60.0	62	
Lumb skin disease (LSD)	14	18.7	17	22.7	20.7	<0.8
Anthrax	13	17.3	13	17.3	17.3	
Measures taken to treat or prevent the disease						
Modern	13	17.3	17	22.7	20	
Traditional	62	82.7	58	77.3	80	<0.4
Distance to nearest veterinary						
1 km	67	89.3[a]	33	44[b]	66.6	
1-5 km	8	10.7[b]	42	56[a]	33.3	<0.0001

Means followed by different superscript letters in the same column are significantly different at (P<0.05), N= number of respondents

feeding cattle in various seasons were natural pastures and crop residues (Table 8). In comparison to the production system, natural pasture varied (P < 0.05). Poor management has resulted in very poor-quality natural pasture that cannot provide animals with the nutrients they need, especially during the dry season, according to reports by (Malede and Takele, 2014) and (Gizaw et al., 2017). Between the two production systems, there were significant differences in crop residues (P< 0.05). The difference between the two production systems could be linked to how crop residues are used and conserved in practice. Sorghum stover (16%) and maize stover (8%), two crop residues, respectively, held the largest proportion and were the most often utilized by HHs to feed their livestock, primarily cattle in the agro-pastoral area, which covered about (24%) of the total area. The findings corroborated the findings of (Tolera et al., 2014), who stated that crop residue and natural pasture were the main sources of cattle feed in Ethiopia's highlands.

Crop residues are the second most important source of cattle feed in the district's dry season after natural pasture. There was a significant difference in how crop residues were used between the two production systems (P <0.05). Because there was a severe lack of cattle feed during the dry season, the biggest proportion of crop residues (13.3%) was used for feeding. When compared to natural pastures in both production methods, the district's usage of crop residues as cattle feed resources was considerably (P< 0.05) lower. These studies discovered that crop residues are utilized in local housing projects in addition to serving as a source of cattle fodder. There were differences in the utilization of crop residues for feeding between the two production systems (P < 0.05). The availability of crop residues and utilization techniques in the study area may account for this variation. The primary source of cattle feed during the dry season, second only to natural pasture, is crop residues. Prior reports of comparable observations can be found in (Reed and Goe, 1989; Solomon, 2004).

The respondents in both locations reported that their cattle typically graze alone. Cattle that are grazed alone or in combination with small ruminants make up 82.7% and 17.3% of pastoral productivity, respectively. Grazed cattle were used alone in 89.3% of agro-pastoral production and in mixtures with small ruminants in 10.7% of cases. During the dry season and the planting season, they also mentioned that there was a feed shortage in the area. In line with the findings of (Kechero et al., 2013), there is a constant lack of feed throughout the year, including during the dry and wet seasons (2013).

3.8. Feed utilization and conservation practices

3.8.1. Types of feed conservation and major problems in feed conservation

The respondents indicated that the majority of households in both locations did not practice feed conservation (Table 9). In pastoral areas, natural pasture hay made up the only type of feed that was conserved (10.7%); others (89.3%) were not. The production system differences in feed conservation types were significant (P<0.05). In both pastoral and agro-pastoral production, farmers who did not practice feed conservation were more prevalent. Lack of awareness was the greatest barrier to implementing feed conservation. Despite the fact that ignorance dominates the whole study area, Issues found in this study concur with (Zewdie, 2010).

The three main feed conservation strategies used in agro-pastoral production were natural pasture hay (26.7%), crop residues (21.3%), and improved forage hay (12%). Natural pasture and crop residues do not satisfy the nutritional needs of animals, especially in the dry season, because of their poor quality and poor management (Malede and Takele, 2014). Natural pasture hay produced using different production methods differed significantly (P< 0.05). The availability of these feed resources is insufficient in the study area, and improved forage production and conservation are not widely implemented. Sisay agreed with the uncommon practice of using improved forage. Crop residues typically rank as the second-most crucial feed resource that may be preserved and used to feed cattle in agro-pastoral farming. Crop residue should be collected, handled, processed, and stored under ideal conditions if it is to be used as livestock feed in general and specifically as cattle feed. Although natural pasture and crop residues are produced in small proportions, farmers' lack of knowledge has in part hindered their effective utilization for feeding cattle.

The need to keep crop residues in a separate place was genuine for some farmers. Crop residue availability is strongly linked with farming practices, crop production, and cultivation intensity. The majority of those who were interviewed confirmed that farmers in the study area were

Table 7: Cattle production constraints in the study area as identified by the respondents

Constraints	Pastoral		Rank	Agro- pastoral		Rank	Overall	*P value*
	N = (75)	%		N =(75)	%		N = (150)	
Feed shortage	45	60.0	1st	30	40.0	1st	50	
Water shortages	15	20.0	2nd	9	12.0	4th	16	<0.004
Diseases and parasites	10	13.3	3rd	20	26.7	2nd	20	
Inadequate of veterinary services	5	6.7	4th	16	21.3	3rd	14	

Means followed by different superscript letters in the same row are significantly different at (P<0.05), N= number of respondents it simply percentage how can compare percentage in a descriptive statical analysis? Please rewrite

Table 8: Major cattle feed resources in the study area

Major feed resources in the study area	Pastoral		Agro- pastoral		Overall	*P value*
	N= (75)	%	N= (75)	%	N= (150)	
Natural pasture	73	97.4[a]	57	76[b]	86.7	
Crop residue	2	2.6[b]	18	24[a]	13.3	<0.0001
Major crop residue						
Maize stover	2	2.6[b]	6	8a	5.3	
Sorghum stover	-	-	12	16	8	
Do not use/not available	73	97.4[a]	57	76[b]	86.7	<0.0001
Utilization practice of crop residues						
Construction of local houses	-	-	8	10.7	5.3	
For feed	2	2.6[b]	10	13.3[a]	8	
Do not use crop residue	73	97.4[a]	57	76[b]	86.7	<0.0001
How cattle graze						
Cattle alone	62	82.7	67	89.3	86	
Mixed with small ruminants	13	17.3	8	10.7	14	<0.2
Cattle grazing in dry season						
Free grazing	75	100	75	100	100	
Cattle grazing in wet season						
Free grazing	75	100	75	100	100	
Is there is feed shortage or constraint for your cattle?						
Yes	75	100	75	100	100	
Season of feed shortage						
Dry season	75	100	75	100	100	

Means followed by different superscript letters in the same row are significantly different at (P<0.05), N= number of respondents

not cultivating forage for their cattle in a better way. From the time of the farm visit (field observation) and based on respondents, the primary issues affecting feed utilization and conservation practices for feeding cattle were, respectively, a lack of seed, a lack of awareness and knowledge, and a labor shortage.

The main obstacles to utilizing feed and practicing conservation in pastoral areas were scarcity of seed (64.0%), illiteracy and a lack of knowledge (18.7%), and labor shortage (17.3%). The difference in lack of seed between the two production systems was not statistically significant (P>0.05). Lack of awareness and understanding varied across the production system (P< 0.05). In both places, each respondent stated that "the communal grazing land's condition was getting worse." According to the survey's results, which are shown in (Table 9), overgrazing is the main cause of the deteriorating grazing land conditions in the study area, which are then led on by changes in the species composition, a decline in biomass production, and weed infestation. There was a significant difference in species composition between the two production systems (P<0.05).

3.9. Strategies to cope up during feed scarcity

Although there was a lack of feed in both production systems, the responders offered various coping mechanisms (Table 10). Traveling long distances to find feed (64%) was the most common way to deal with a lack of feed in a pastoral area, followed by purchasing feed (18.7%) and storing feed when it was available (17.3%). However, the production systems' strategies to overcome feed scarcity varied (P< 0.05). This shows that moving animals to places with greater feed availability is the primary strategy used in pastoral production to deal with critical feed shortages, while in agro-pastoral farming, crop cultivation (32 %) is the primary method. The results also showed that no respondents engaged in pastoral production practiced feed conservation in the form of hay as a defense mechanism against feed scarcity. This may have been due to a lack of awareness brought on by inadequate linkages and extension services in the study area additionally, there was no difference in the production system's purchasing of feed and storing feed during times of available surplus (P > 0.05). Those that used hay as natural pasture made up a small proportion of the respondents. This demonstrates that the hay was not well prepared and even well trained in time. During the fieldwork, this was confirmed. In general, the studies showed that there is no strong connection between the low level of extension services provided to farmers and the area's habit of making hay for a short period of time, which is consistent with Sisay's assessment (2006).

Table 9: Types of feed conservation and major problems in feed conservation in the study area

Types of feed conservation	Pastoral		Agro- pastoral		Overall	*P value*
	N= (75)	%	N= (75)	%	N= (150)	
Do not conserve	67	89.3[a]	30	40.0[b]	64.65	<0.0001
Natural pasture hay	8	10.7[b]	20	26.7[a]	37.4	
Crop residue	-	-	16	21.3	10.65	
Improved forage hay	-	-	9	12.0	6	
Do you conserve feed?						
Yes	8	10.7[b]	45	60.0[a]	35.35	<0.0001
No	67	89.3[a]	30	40.0[b]	64.65	
If not Why?						
Shortage of seed	48	64.0	45	60	62	<0.03
Lack of awareness & knowledge	14	18.7[b]	25	33.3[a]	26	
Labor shortage	13	17.3[a]	5	6.7[b]	12	
Status of communal grazing land						
Decreasing	75	100	75	100	100	
Reason of decreasing communal grazing land						
Over grazing	50	66.7	50	66.7	66.7	<0.001
Reduction in species composition	16	21.3[a]	7	9.3[b]	15.3	
Reduction in biomass production	9	12.0	10	13.3	12.65	
Infestation with weeds	-	-	8	10.7	5.35	

Means followed by different superscript letters in the same row are significantly different at (P<0.05), N= number of respondents

Table 10: Strategies to cope up during feed scarcity

Strategies to cope up during feed scarcity	Pastoral		Agro- pastoral		Overall	*P value*
	N= (75)	%	N= (75)	%	N= (150)	
Traveling long distance for searching feed	48	64.0[a]	12	16[b]	40	<0.0001
Purchasing feed	14	18.7	14	18.7	18.7	
Storing the feed during available the surplus in the area	13	17.3	13	17.3	17.3	
Crop cultivation	-	-	24	32.0	16	
Hay making	-	-	12	16	8	

Means followed by different superscript letters in the same row are significantly different at (P<0.05), N= number of respondents

3.10. Chemical Composition and Nutritive Values of Major Feeds

The chemical composition of the five kinds of natural pasture grass that are most frequently observed in the study area is presented in (Table 11). Crude protein (CP), ash, acid detergent lignin (ADL), and acid detergent fiber (ADF) were significantly different across seasons in pastoral production, while dry matter and neutral detergent fiber (NDF) were not significantly different. The average DM content of several feeds used in pastoral production during the wet season ranged from (89.21%) to (90.98%), while during the dry season, it ranged from (91.01%) to (91.79 %). These findings contradict those of (Sisay, 2006), who said that natural pastures in the northern Gondar Zone had DM content ranging from 92.9 to 94.1 %. However, the current DM content of native grasses is higher than the findings of (Gashu et al., 2017; Tonamo et al., 2015), who reported DM values ranging from 35.17%) to 44.97%, respectively. Because grasses have low nutritional content and are less compostable, animals consume less of their feed and use it less efficiently, which lowers their performance **(Wolde et al., 2014)**. But the CP concentration was lower than the necessary % CP level for animals in the tropics (Kearl, 1982; Van Soest et al., 1991; Mlay et al., 2006). The average ash content of grass species used in pastoral production ranged from 7.42 to 17.36 % in the wet season and from 4.54 to 21.36 % in the dry season. In the wet season, neutral detergent fiber (NDF) was distributed between 68.14% and 83.58 %, and between 71.81% and 86.73 % in the dry season. Due to the adverse association between voluntary feed intake and NDF content, the higher NDF level may serve as a constraint on feed intake (Ensminger et al., 1990).

The levels of acid detergent fiber (ADF) derived from grasses in this study were substantially different between seasons in pastoral production (P<0.05). The ADF contents of grass species in the two seasons were, respectively, (42.91%) to (49.53%) and (45.27%) to (58.77%). During the wet season, the average ADL content of grass species ranged from 15.32% to 27.31%, and during the dry season, it ranged from 12.38 % to 31.90 %. In agro-pastoral production. DM, crude protein (CP), ash, acid detergent lignin (ADL), acid detergent fiber (ADF), and neutral detergent fiber (NDF) did not vary significantly (P > 0.05) between seasons. In the wet season, the average DM content of the grass species studied ranged from 88.02% to 91.18 %, while in the dry season, it ranged from 90.01 % to 91.30 %. In agro pastoral production for the wet season, the ash content of the various grass types varied from 5.28 % to 16.6 %. These findings are consistent with those of (Keba et al., 2013), who stated that the ash content of natural grass ranged from (12.5 %– 16.7 %).

In the wet season, the NDF concentration of grass species ranged from 68.59 % to 85.41 %, whereas in the dry season, it ranged from 69.30 % to 84 %. The ADL and

Table 11: Chemical composition of major feed resources in wet and dry season

Pastoral production							
Sample	**Season**	**DM**	**Ash**	**NDF**	**ADF**	**ADL**	**CP**
Chrysopogon plumulosus	Wet	89.21	8.31	83.58	49.53^{b}	23.33^{b}	5.42^{a}
	Dry	91.79	5.21	84.96	56.74^{a}	31.90^{a}	2.48^{b}
Pennisetum thunbergii	Wet	90.88	11.07^{a}	82.89	46.75^{b}	26.39	5.45
	Dry	91.55	6.56^{b}	84.96	58.77^{a}	28.11	4.45
Cynodon dactylon	Wet	90.98	12.19	81.15	46.74	27.31^{a}	5.98^{a}
	Dry	91.01	10.50	84.07	45.27	19.69^{b}	2.83^{b}
Brachiaria cornata	Wet	90.94	17.36^{b}	68.14	43.00^{b}	16.36	6.03^{a}
	Dry	91.62	21.36^{a}	71.81	55.55^{a}	16.97	3.14^{b}
Grass S.p.p	Wet	90.75	7.42^{a}	83.20	42.91^{b}	15.32	4.35
	Dry	91.49	4.54^{b}	86.73	53.98^{a}	12.38	2.47
Agro pastoral production							
Chrysopogon plumulosus	Wet	88.02	8.42	83.69	51.06	24.20	5.78
	Dry	90.01	6.10	84.00	50.33	28.16	3.23
Pennisetum thunbergii	Wet	90.07	10.96	83.01	49.03	27.41	4.95
	Dry	90.60	7.53	81.05	50.01	27.04	4.12
Cynodon dactylon	Wet	91.18	11.04	82.32	46.95	26.83	4.77
	Dry	90.21	10.32	83.00	45.13	25.35	3.41
Brachiaria cornata	Wet	91.12	16.6	68.59	45.36	16.11	5.82
	Dry	90.12	19.44	69.30	44.00	17.00	5.86
Grass S.p.p	Wet	90.93	5.28	85.41	46.20	15.07	4.84
	Dry	91.30	6.15	83.62	47.50	14.63	3.95

ADF contents of all major feed resources utilized in agro-pastoral production ranged from (15.07 %) to (27.41%) in the wet season and from (14.63 %) to (28.16 %) and (45.36 %) to (51.06 %) in the dry season, respectively. The CP contents of the grass species varied from (4.77 % to 5.82 %) during the wet season and from (3.23 % to 5.86 %) during the dry season. The earlier analysis of Ethiopian dry forages and roughages revealed a CP content of less than 9%, suggesting that the microbiological need is difficult to meet without the addition of protein-rich diets (Bediye et al., 2001). Thus, among the evaluated grass species, Brachiaria cornata (6.03%) and Cynodon dactylon (5.98%) had the highest crude protein (CP) levels. The species with the highest CP and lowest NDF was Brachiaria cornata. The wet season had higher CP contents than the dry season did for all grass types. Grass S.p.p. had the lowest CP, Ash, and highest NDF contents overall.

4. Conclusion and Recommendations

The study highlights several critical insights regarding livestock management, particularly for cattle, in the pastoral and agro-pastoral areas examined. Cattle remain the dominant species raised, with feed primarily sourced from hay, crop residues, and natural pasture. Notably, maize and sorghum stovers are the most utilized feeds, although the overall use of crop residues and conservation methods is inadequate. This limitation is largely attributed to labor shortages, a lack of awareness, and seed availability, preventing households from producing improved forages effectively. While natural pasture and crop residues offer potential feed resources, their utilization is hampered by insufficient knowledge among farmers. The dry season poses a significant challenge due to a shortage of feed resources, contrasting with the relative abundance during the wet season. Additionally, livestock face serious health threats from diseases, parasites, and inadequate veterinary services. Nutritionally, the study found that most cattle feed resources exhibited poor chemical composition, particularly in the dry season, with crude protein levels below the minimum requirement for tropical animals. Among the grass species, Brachiaria cornata and Cynodon dactylon showed the highest crude protein content, though still insufficient for optimal livestock health. To improve cattle production practices, there is an urgent need for awareness-raising initiatives and extension services targeting disease management, feed shortages, and water scarcity. Furthermore, further research is recommended to explore the implications of suboptimal husbandry practices on goat production and to analyze the mineral content of various grass species for enhanced nutrition. Overall, addressing these challenges through education and improved husbandry practices is vital for the sustainability and productivity of livestock farming in the region.

Acknowledgment

We extend our sincere gratitude to the data collectors and everyone involved in the successful completion of this manuscript, especially the pastoralists who dedicated their time to interviewing and sharing their knowledge and experience, as their contributions were invaluable.

Conflict of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Abera, J. (2018). Assessment of resilience of dairy farming in bishoftu and asella areas, oromia regional state, ethiopia. Master's thesis, Addis Ababa University, Ethiopia.

Alemayehu, M. (2002). Forage production in ethiopia: A case study with implications for livestock production. ethiopian society of animal production (esap), addis ababa, ethiopia. *P*, 106.

Alemayehu, M. (2005). Feed resources base of ethiopia: Status and opportunities for integrated development. In *Proceedings of the 12th Annual*

Conference of the Ethiopian Society of Animal Production (ESAP), Ethiopia.pp. 377 386. Addis Ababa.

Aoac, O. (2005). Method 973.48nitrogen (total) in water: Kjeldahl method'. In of Analysis of AOA, O. M., editor, *Dr. George W Latimer, Jr.* INTERNATIONAL, 22nd Edition (New York, 2023; online edn, AOAC Publications.

AWLCRDO (2013). Report on maize production in ethiopia.

Bediye, S., Assefa, G., Tedla, A., and Fekadu, D. (2001). Present status and future direction of feed resources and nutrition research targeted for wheat-based crop livestock production system in ethiopia. In Wall, P. C., editor, *Wheat and weed*. Proceedings of two stakeholder workshop on improving the productivity of crop-livestock system in Ethiopia.

BoFED (2013). (bureau of finance and economic development) and japan international cooperation agency. Manual for Planning, Budgeting, Monitoring and Evaluation and Information Management, Oromia, Finfine/Addis Ababa, Ethiopia.

CSA (2013). Statistical abstract. *120*.

CSA (2017a). *Agricultural Sample Survey*, volume Volume II. Report on livestock and livestock Characteristics.

CSA (2017b). *Federal democratic republic of Ethiopia central statistical agency, agricultural sample survey, report on livestock and livestock holding characteristics*. Central Statistical Agency, Addis Ababa, Ethiopia.

CSA (2018). The federal democratic republic of ethiopia central statistical agency agricultural sample survey. report on area and production of crops. statistical bulletin no 586. addis abeba, ethiopia. *Report On Area and Production of Major Crops (Private peasant holdings, Meher season)*.

CSA (2020). Agricultural sample survey. report on livestock and livestock characteristics. *Statistical Bulletin*, II:9–11.

Deribe, G. (2015). Evaluation of major feed resources in crop-livestock mixed farming systems, southern ethiopia: Indigenous knowledge versus laboratory analysis results. *Journal of Agricultural and Rural Develpment. Tropical-Subtropical*, 116(2):157–166.

Deribe Gemiyo, D. G., Hassen, A., Tsedeke Kocho, T. K., Tekleyohannes Birhanu, T. B., Zekarias Bassa, Z. B., and Addisu Jimma, A. J. (2013). Chemical composition and digestibility of major feed resources in mixed farming system of southern ethiopia. *World Applied Sciences Journal*, 26:267–275.

Duguma, B., Tegegne, A., and Hegde, B. (2012). Smallholder livestock production system in dandi district, oromia regional state, central ethiopia. *Read and write*, 20:25–26.

Endale, Y. (2015). *Assessment of feed resources and determination of mineral status of livestock feed in Meta Robi District, West Shewa Zone, Oromia regional state, Ethiopia. An MSc Thesis, Ambo University*. Ambo, Ethiopia.

Ensminger, M. E., Oldfield, J. E., and Heinemann, W. W. (1990). Feeds and nutrition. *Clovis*.

FAO (2018). *Africa sustainable Livestock production systems spotlight Cattle sectors in Ethiopia*. Food and Agriculture Organization, Rome, Italy.

Gashu, G., Tegene, N., and Aster, A. (2017). Assessment of availability and nutritive values of feed resources and their contribution to livestock nutrient requirements in chire district, southern ethiopia. agricul. *Res. Technol.*, 7(4):555–720.

Gelayenew, B., Nurfeta, A., Assefa, G., and Asebe, G. (2016). Assessment of livestock feed resources in the farming systems of mixed and shifting cultivation, gambella regional state, south western ethiopia. *Global Journal of Science Frontier Research*, 16(5):11–20.

Gizaw, B., Tsegay, Z., Tefera, G., Aynalem, E., Wassie, M., and Abatneh, E. (2017). Phosphate solubilizing fungi isolated and characterized from teff rhizosphere soil collected from north showa zone, ethiopia. *African Journal of Microbiology Research*, 11(17):687–696.

Haile, A. et al. (2011). *Breeding strategy to improve Ethiopian Boran cattle for meat and milk production*, volume 26. ILRI (aka ILCA and ILRAD).

Kearl, L. (1982). Nutrient requirements of ruminants in developing countries. international feedstuffs institute, utah agricultural experiment station, utah state university, logan, utah, usa.

Keba, H. T., Madakadze, I., Angassa, A., and Hassen, A. (2013). Nutritive value of grasses in semi-arid rangelands of ethiopia: Local experience based herbage preference evaluation versus laboratory analysis. *Asian-Australasian Journal of Animal Sciences*, 26(3):366.

Kebede, G., Assefa, G., Feyissa, F., and Mengistu, A. (2016). A review on some management and improvement practices of natural pasture in the mid and high altitude areas of ethiopia. *International Journal of Livestock Research*, 6(5):1–14.

Kechero, Y., Tolemariam, T., and Haile, A. (2013). Characteristics and determinants of livestock production in jimma zone / southwestern ethiopia. *African Journal of Basic Applied Sciences*, 5(2):69–81.

Makkar, H. P. and Ankers, P. (2014). A need for generating sound quantitative data at national levels for feed-efficient animal production. *Animal Production Science*, 54, . 1071/AN14377:1569–1574.

Malede, B. and Takele, A. (2014). Livestock feed resources assessment, constraints and improvement strategies in ethiopia. *Middle-East Journal of Scientific Research*, 21(4):616–622.

Melaku, T. (2011). Oxenization versus tractorization: Options and constraints for ethiopian framing system. *Int. J. Sustainab. Agric.*, 3(1):11–20.

Melese, G., Berhan, T., and Mengistu, U. (2014). Effect of supplementation with non-conventional feeds on feed intake and body weight change of washera sheep fed urea treated finger millet straw. *Greener Journal of Agricultural Science*, 4(2):067–074.

Mlay, P. S., Pereka, A., Chikula Phiri, E., Balthazary, S., Igusti, J., Hvelplund, T., Riis Weisbjerg, M., and Madsen, J. (2006). Feed value of selected tropical grasses, legumes and concentrates. *Veterinarski arhiv*, 76(1):53–63.

Reed, J. D. and Goe, M. R. (1989). Estimating the nutritive value of cereal crop residues: implications for developing feeding standards for draught animals. *ILCA Bulletin*, 34(6).

Sefa, S. (2017). Estimation of feeds and fodders for livestock population of ethiopia and mitigation of feed shortage. *Journal of Natural Science and Research*, 7(11):45–49.

Sisay, A. (2006). Livestock production systems and available feed resources in different agro- ecologies of north gonder zone, ethiopia. Master's thesis, Haramaya University Dire Dawa, Ethiopia.

Solomon, B. (2004). Assessment of livestock production systems and feed resource base in siannas dish woreda of bale highlands, southeast oromia. Master's thesis, Alemaya University, Dire Adwa, Ethiopia.

Tarawali, S., Tarawali, G., Larbi, A., and Hanson, J. (1995). International livestock research institute nairobi, kenya july 1995.

Tesfay, Y. (2010). Feed resource availability in tigra region. *Northern Ethiopia for production of export quality meat and livestock*.

Tolera, A., Feyissa, F., Geleti, D., Duressa, D., Kebede, D., Gurmessa, S., Keba, W., and Duncan, A. J. (2014). *Assessment of livestock feed production and utilization systems and analysis of feed value chain in Diga district, Ethiopia*. International Livestock Research Institute.

Tonamo, A., Berhan, T., Gebeyehu, G., and Ermias, B. (2015). Characterization of cattle husbandry practices in essera district, dawuro zone, and southern ethiopia. *Afr. J. Agric. Res.*, 10(34):3421–3435.

Tulu, D., Deresa, B., Begna, F., and Gojam, A. (2018). Review of common causes of abortion in dairy cattle in ethiopia. *Journal of Veterinary Medicine and Animal Health*, 10(1):1–13.

Ulfina, G., Zelalem, B., Jemal, D., Gemeda, D., Chala, M., Jiregna, D., Diriba, G., Lemma, G., Workneh, A., and Adam, D. (2005). Survey of cattle production and marketing practices in danno district, western ethiopia, using pra tools. *PRA Report*.

Van Soest, P. v., Robertson, J. B., and Lewis, B. A. (1991). Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *Journal of dairy science*, 74(10):3583–3597.

Zewdie, W. (2010). Livestock production systems in relation with feed availability in the highlands and central rift valley of ethiopia. Master's thesis, An presented to Haramaya University.