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Beef Cattle Production System and Evaluating Nutrient Composition of Selected Browse Species in Kercha District West Guji Zone Southern Ethiopia

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ABSTRACT:

The study was conducted to assess the beef cattle production system; available feed resources and to evaluate the nutrient composition of selected browse species in Kercha district West Guji Zone Southern Ethiopia. A total of 120 households were selected purposively for the survey study. Both primary and secondary data were collected and analyzed using SAS software. The 80% of farmers in the study area kept their beef cattle under an extensive production system and the beef cattle production opportunity in the study area was high demand for beef cattle, feed and water availability, and accessibility of roads. The production constraints in the study area were feed shortage, knowledge of beef cattle husbandry, lack of initial capital, and disease occurrence. The major feed resources in the Kercha district were natural pasture, crop residues, browse trees, and kitchen left over. From the identified feeds, four major and highly utilized browse trees (Millettia ferruginea, Vernonia amygdalina, Triumfetta tomentosa, and Dombeya torrida), which were nominated by the respondents from the study area, were selected and subjected to chemical analysis, to determine the DM, Ash, CP, NDF, ADF, ADL and EE. The Millettia ferruginea has 92.7%DM, 17.4% Ash, 50.3%NDF, 24.76%ADF, 9.05%ADL, 23.85%CP and 7.11%EE, Vernonia amygdalina has 95.7%DM, 14.39%Ash, 35.31%NDF, 18.45% ADF, 8.63%ADL, 17.82% CP% and 10.25%EE, Triumfetta tomentosa has 89.7%DM, 10.19%Ash, 34.67% NDF%, 21.43%ADF, 9.01%ADL, 12.85%CP and 7.25%EE and Dombeya torrida has 90% DM, 13% Ash, 33.54%NDF, 17.23%ADF, 5.92%ADL, 14.49%CP and 6.6%EE. To improve the performance of beef cattle production, especially under an extensive traditional production system, there is a need to supply adequate feed in terms of quality and quantity which could promote the frequency of fattening and an appropriate marketing system needs to be developed so that the farmers can be benefited from their business.

Keywords: *Beef cattle, feed resource, browse tree, beef cattle production, fattening System*

1. INTRODUCTION

Ethiopia has the largest livestock population in Africa with 60.39 million cattle (CSA, 2018), and is endowed with different agroecological zone which is suitable for livestock production. Thus, the livestock subsector has an enormous contribution to Ethiopia's national economy. It contributes about 16.5% of the national Gross Domestic Product (GDP) and 35.6% of the agricultural GDP (Metaferia *et al.* 2011). Cattle contribute about 80% of the livestock product. Ethiopia produces about 1 million tons of beef per year, valued at USD 5.1 billion, (FAO, 2019). On the other hand, the farmers and pastoral communities in Ethiopia are largely dependent on livestock for their livelihood, where livestock have diverse functions in various farming system and serves as a source of food, traction, manure, raw materials, investment, cash income, foreign exchange earnings and social and cultural identity (Belete *et al.*, 2010). Beef cattle are one of the agricultural sectors in Ethiopia from which the country earn foreign currency, through live animals and meat products exports, while most of the rural populations are engaged to fulfill their daily needs and economic gaps (Harko Halala, 2015).

In Ethiopia, meat consumption was about 8kg per capita per year (Sebisbe, 2008) of which about 4.3 kg comes from beef. The low level of meat consumption in Ethiopia is due to the low level of meat production, which in turn was due to the low productivity of the livestock subsector. Like, most tropical and sub-tropical countries, there are deep-rooted production constraints negatively affecting beef cattle sectors in Ethiopia (Solomon, *et.al* 2010; Boufennara, *et.al* 2012). Thus, these technical and institutional challenges include; feed shortage, diseases and parasites, drought, shortage of grazing land, market access, veterinary services, extension services, and other infrastructure (Firew. 2007). The tree species are important sources of protein, energy, and minerals, and utilization and domestication should target both the leguminous and non-leguminous types (Abayneh and Getu, 2018) and browse trees (like Millettia ferruginea, Vernonia amygdalina, Triumfetta tomentosa and Dombeya torrida) can bridge the gap of feed shortage. The need to increase livestock production from the existing livestock resources requires actions under the production system. Upon examining the livestock feed resources and feed balance at the smallholder farmer level, Kassa *et.al. (*2003) suggested the possible use of livestock feed balance as a potential indicator to assess the sustainability of the farms.

Therefore, a comprehensive study on the beef cattle production system, available feed resources, production constraints, and opportunities is a primary step to work on and resolve the bottlenecks in the sector and thereby enhancing the livelihoods of smallholder beef cattle farmers and increasing its contributions to the national economy. Regard, the detailed studies on the beef cattle production system and available feed sources for beef cattle production in the study area were so far limited. Therefore, the present study was initiated to generate baseline information on the beef cattle production system, and available feed resources, and evaluates the chemical composition of selected browse species in the Kercha district of West Guji zone, Oromia Regional State.

2. MATERIAL AND METHOD

2.1. Description of the Districts

This study was conducted in the Kercha district of West Guji zone of Oromia Regional State Southern Ethiopia. Kercha district is located at a distance of 461 km from Addis Ababa, the capital city of Ethiopia, and 38 km east of Bule Hora the capital city of West Guji Zone. Geographically, it lies between 38021' E to 39054' E latitude and 5027' N to 5051'N longitude. The district is bordered by Birbisa Kojowa district in the east, Bule Hora district in the west, Hambala Wamana district in the north, Malka Soda District in the south and Gedeb district of Gedeo Zone in the Northwest. And district the total land area of the district is 55090.366 ha. (Kercha land administration office, 2019).

2.1.1. Climatic Characteristics

Kercha district is characterized by three types of climatic zones such as highland (dega) 4.3%, mid-highland (woyinadega) 94% and lowland (kola) 1.7%. The annual temperature of the district is ranged from 15^{o}c to 25^{o}c. The annual rainfall range from 930mm to 1500mm and has two types of rainy season, Summer "Ganna", which starts in early March up to July, and spring "Hageeya", which starts in early September and extended up to late November (Kecha district Agricultural and Natural Resource Office, 2019).

2.1.2. Demographic Characteristics of the District

The total human population of Kercha district is estimated at 136,157 males and 136,435 total of 272,592. The livelihood of the district population is primarily based on cultivation followed by animal production (CSA, 2017). The district livestock population is estimated at 40224 cattle, 28164 sheep, 12937 goats, 11642 horses, 1934 Mule, 18514 Donkey, and 31033 Chickens (Kecha District Livestock and Fishery Resource Development Office, 2019).

2.2 Methods of Sampling and Data collection

Data collected were employed by using purposive sampling techniques based on beef cattle ownership thus, a total of 120 respondents were selected. Both primary and secondary data were employed and the primary data were obtained by using structured and semi-structured questionnaires through interviews of beef cattle fatteners. secondary information was gathered from online from different published literature and Kercha district livestock and fishery resource development office, Kercha district agricultural and natural resource office and land administration office.

To select representative peasant associations (PAs), the discussions were held with District Livestock Experts and Development Agents (DAs), thus four PAs were identified from three agroecology. After discussion of one (1) PAs Lemi Kercha from highland, two(2) PAs such as Banko Michicha and Hebo Molicha from mid-highland and one(1) Pas, the Galesa Soke from lowland, a total of four (4) PAs were selected from 23 rural PAs, based on the potential of beef cattle production, and availability of feed resources. Then, 30(thirty) respondents were selected from each PAs using a simple random sampling technique where a total of 120 respondents were selected from all PAs. Therefore, the information on the beef cattle production system and available feed were collected.

2.2.1. Identification of feed samples

Group discussions (FGD) with key informants were held at selected sampling areas and selected farmers in each PAs. While identifying and selecting feed resources; parameters such as palatability and preference by the animal, and availability in wet and dry seasons have been used. After the identification process, the participants listed out the major feed resource in the area depending on their knowledge, particularly feed resources as potential feed for beef cattle was recorded. And four feed resources from browse species (namely Millettia ferruginea, Vernonia amygdalina, Dombeya torrida and Ttrumfetta tomentosa were selected for evaluation of their chemical compositions.

Selected feed resource samples were collected freshly and weighed by using electronic balance and partially dried under the shed and grounded using hammer mill and labeled and further chemical analyzed.

2.2.2. Chemical composition of selected feed sample

After the feed was dried, it was taken to Dilla University nutrition laboratories to grind and analyzed for DM (dry matter), ash, and EE (Ether Extract) content. And the other nutritional composition like NDF (neutral detergent fiber), ADF (acid detergent fiber), ADL (acid detergent lignin) and CP (crude protein) were analyzed at Hawasa University nutrition laboratory.

The DM content of feed samples was determined by an oven at 65°C for 48h until constant weight before chemical analysis. Sub-samples from partially dried sample feeds were taken and ignited in a muffle furnace at 550°C for 6 h to determine the ash contents of each feed and the EE content was determined by using Soxhlet apparatus method. The Nitrogen content of the feed was determined using kjeldhal procedure (AOAC, 2000). The CP was computed as N*6.25. The neutral detergent fiber (NDF), acid detergent lignin (ADL) and acid detergent fiber (ADF) was analyzed according to Van Soest *et al.,* (1991).

2.3. Data analysis

The descriptive statistical analysis was done for qualitative survey data using SPSS software, 2011 version 20.0, while the effect of browse feed types and agro-ecology on the chemical composition of feed were analyzed using SAS software (SAS, 2001). And the results were summarized and presented using a table, percentage, mean, standard error and frequencies. The mean significant difference was computed by using $p<0.05$ and the homogeneity of the data was checked using the Fisher least significant difference (LSD). Then, the data collected from laboratory analysis were analyzed using the following statistical model. The statistical model used was:

$Y_{ijk} = \mu + \alpha_i + \beta_{ij} + (\alpha * \beta)_{ij} + e_{ijk}$

Where: Yijk = feed available in different agro-ecology

μ = Overall mean

$(\alpha*\beta)$ ij = interaction effect of i^{th} agro-ecology and j^{th} feed types

α_i = the effect of i^{th} agro-ecology

e_{ijk} = Random error

β_{ij} = the effect of j^{th} feed types

3. RESULTS AND DISCUSSION

3.1. Household Characteristics of the Study Districts

The mean age of the respondents ranged from 41-50 years with a minimum age of 20 and maximum age of 65. Of one hundred twenty (120) respondents 85% were males and the rest 15% were females. Overall, an average of male-headed HHs of 85% in the current study was higher than the result (83.6%) made by Dirsha, (2018) in the Gurage zone, southern Ethiopia.

The educational status, the highest proportions, 54.2% of the respondent were illiterate, 26.6 % were primary (1-4 grade), 16.7% were junior (5-8 grade), and the remaining 2.5% were completed secondary school. The study is also in line with Amistu *et.al.* (2016) who reports the majority of farmers who respond to fattening were illiterate in Lemmo Woreda Hadiya Zone in southern Ethiopia.

The 97.5% source of income of respondents in the study area was livestock and crop production and the rest 2.5% are Livestock production only this study was similar to that of the report of Addisu *et.al*, (2016) where the major source of income in North Gonder Zone of Ethiopia was crop and livestock production.

Table 1: Socio-economic characteristics of the households

Variable		Highland		Mid highland		Low land		Total	
		N	%	N	%	N	%	N	%
Sex	Male	26	86.6	50	83.3	26	86.6	102	85
	Female	4	13.4	10	16.7	4	13.4	18	15
	Total	30	100	60	100	30	100	120	100
Age	20-30	2	6.7	4	6.6	1	3.3	7	5.8
	31-40	9	30	17	28.3	9	30	35	29.2
	41-50	13	43.3	25	41.6	13	43.4	51	42.5
	51-60	6	20	14	23.4	6	20	26	21.7
	61 age and above	-	-	-	-	1	3.3	1	0.8
	Total	30	100	60	100	30	100	120	100
Education Status	Illiterate	17	56.6	29	467	19	63.3	65	54.2
	1-4 grade	8	26.7	16	26.7	8	26.7	32	26.6
	5-8 grade	4	13.4	13	21.6	3	10	20	16.7
	9-12 grade	1	3.3	2	3.33	-	-	3	2.5
	Total	30	100	60	100	30	100	120	100
Source of income	Livestock production only	-	-	-	-	3	10	3	2.5
	Crop and livestock production	30	100	60	100	27	90	117	97.5
	Total	30	100	60	100	30	100	120	100

N=Number of respondents,

3.2. Cattle Production System in the Study Area

The majority of the respondents (80%) kept their cattle under extensive production systems, while the remaining, 14.2% and 5.8% practiced semi-intensive and intensive production systems respectively. Farmers practiced the intensive production system only during the finishing of beef cattle in the study area. This shows that most of the producers kept beef cattle under an extensive production system in the study area, which affected beef cattle production since, under an extensive production system; animals graze in the field without any supplementary feed and are kept in the simply constructed fence, that were exposed them to several adverse environmental factors. This finding was similar to the reports, Tsedeke, (2007) and Feleke *et.al.* (2015), where about 66.25% of the farmers kept their animals under an extensive production system, followed by a semi-intensive production system (30%), and

farmers kept their animal in the intensive production system (3.7%) in Shashogo Woreda, Hadiya zone.

Table 2: Beef cattle production system in the Study Area

Production system	Highland		Mid-highland		Low land		Total	
	N	%	N	%	N	%	N	%
Intensive production system	3	10	4	6.6	-	-	7	5.8
Semi-intensive production	6	20	9	15	2	6.67	17	14.2
Extensive production	21	70	40	66.6	28	93.6	96	80
Total	30	100	60	100	30	100	120	100

N=Number of respondents

3.3 Purposes for Cattle Fattening

The major purpose or reasons for cattle fattening of sampled respondents were to obtain better selling prices (93.3%) for the existing aged animals, while, 5% and 1.7% were to enable their ox to plow well strongly and for better meat for home consumption respectively. This result is similar to Yidnekachew *et.al* (2016) that was reported the market-oriented beef cattle fattening system under farmer management conditions in the south Omo zone of SNNPR.

Table 3: Purpose of beef cattle fattening in the study area

Purpose of beef cattle fattening	Highland		Mid-highland		Low land		Total	
	N	%	N	%	N	%	N	%
Getting better prices	27	90	55	91.6	30	100	112	93.3
Enable their ox to plow well strongly	2	6.6	4	6.7	-	-	6	5
Better meat for home consumption	1	33.4	1	1.7	-	-	2	1.7
Total	30	100	60	100	30	100	120	100

N=Number of respondents

4.4. Cattle Grazing Management

Overall, of interviewed households, 83.2% were herd cattle alone, 11.5% were herd cattle, small ruminants, and equines together, while 5.3% mixed with small ruminants (Table 4). The tendency of keeping cattle with small ruminants was low which might be associated with their feeding behavior. In wet seasons of the year when the major feed source was communal grazing, 33.6% of the households exercises free grazing and tethering; while 29.2%, 22.6 and 10.6% practiced free grazing, tethering, and cut and carry systems for feeding their animals, respectively. In dry seasons, the majority

of the households used both free grazing and tethering their animals (46%) while, 31.9% of households used free grazing, 13.3% of households used tethering methods and only 8.8% of them used to cut and carry system. These findings disagree with Amistu *et.al.* (2016), who report that 36.6% of farmers feed their beef cattle by using cut and carry system (48.33%), only grazing (36.6%) and both grazing and cut-carry systems(15%) in Lemmo Woreda, Hadiya zone.

Table 4: Grazing management of cattle in the study area

Ways of grazing	**Fattening systems**					
	Extensive system N=96		Semi-intensive N=17		Overall N=113	
	N	%	N	%	N	%
Cattle alone	79	82.3	15	88.3	94	83.2
Mixed with small ruminants	6	6.25	-	-	6	5.3
Cattle, small ruminants, and equines together	11	11.45	2	11.8	13	11.5
Grazing during the dry season						
Free grazing	31	32.3	5	29.4	36	31.9
Tethered grazing	12	12.5	3	17.7	15	13.3
Cut and carry	5	5.2	5	29.4	10	8.8
Free grazing and tethering	48	50	4	23.5	52	46
Grazing during the wet season						
Free grazing	31	32.3	2	11.8	33	29.2
Tethered grazing	27	28.1	3	17.6	30	26.6
Cut and carry	2	2.1	10	58.8	12	10.6
Free grazing and tethering	36	37.5	2	11.7	38	33.6

N=Number of respondents,

3.5. Methods to Decide Finishing Period, Duration of Fattening and Age of Beef Cattle for Fattening

The duration of fattening, majority of the respondents fattens their animals in 2-3 months (80%) while, about 15% of respondent fatten their animal within 3.5 months and 5% of respondent fatten within 4 months and above. The present finding was in line with the finding of Amanuel et.al (2019), who indicated that about 90% of farmers were fattening their cattle in three months in Gimbi District of the West Wollega zone.

Overall, the decision of beef cattle finishing period in the study areas were based on live body weight change (gain) (73.33%), anticipated current and future prices (20%), and calculating feeding length (10%). The present study was in line with Shewangzaw (2016) reported that the ending of the cattle

finishing period was decided by considering the live weight change of fattening cattle with visual observation based on their feed intake (68%) and by anticipating the current and future price (28%). The age at which beef cattle fattening and finishing started fattening after 7 years old (57.5%), 29% and 22% of respondents started fattening after 6 years and 8 years old respectively. This report was similar to Shewangzaw (2016) who reported that the fatteners in North Gonder set their cattle for fattening after 6 to 7 years old.

Table 5: The duration of fattening, age of beef cattle for fattening and Decision of end of fattening

Variable	Duration of beef cattle finishing	N	%
Duration of fattening	2-3 months	96	80
	3.5 months	18	15
	4 months	6	5
Age of beef cattle for fattening	6-6.99 year	29	24.2
	7-7.99 year	69	57.5
	8 and above	22	18.3
The decision to end fattening	Calculated feeding length	12	10
	Live weight change	88	73.33
	Anticipated current and future prices	20	16.67

N = number of respondents

3.6. Beef Cattle Production Opportunity in Study Area

The beef cattle production opportunity in the study area were market demand (35.8%), comfortable environment (good climate) (33.4%) included weather conditions like rainfall, temperature, and humidity, and the market demand showed consumers demand was high. Some opportunities were also including feed during the wet season and water availability (15.8%), accessibility of roads for beef cattle transport farm to market (7.5%), and professional support (7.5%) in order of their importance. There is much water for forage development by irrigation. The other opportunity the growth of the population also increases the demand for meat and local breeds that withstand harsh climates and poor-quality feed. This finding was in line with Amistu *et.al* (2016) who indicates the beef cattle production opportunity was market demand, comfortable environment, feed, and water availability and road access.

Table 6: Beef cattle production opportunity

Beef cattle production opportunity	Highland		Mid highland		Low land		Overall	
	N=30	%	N=60	%	N=30	%	N=120	%
Market demand	11	36.7	21	35	11	36.6	43	35.8
Comfortable environments	10	33.3	21	35	9	30	40	33.4
Feed and water availability	5	16.7	9	15	5	16.7	19	15.8
Road access	2	6.6	4	6.7	3	10	9	7.5
Professional support	2	6.7	5	8.3	2	6.7	9	7.5
Total	30	100	60	100	30	100	120	100

N=Number of respondents,

3.7. Beef Cattle Production Constraint of Study Area

The main beef cattle production constraint in the study area were the knowledge gap on beef cattle husbandry and management (18.3%), feed shortage (32.5%) i.e. there was a lack of improved forage seed, lack of proper conservation of feed when they are in an excess amount related with the supply fluctuation in the study area; lack of preservation of surplus feed in the wet season and feed quality was poor, lack of initial capital (10.8%), disease occurrence (14.2%), insufficient land (12.5%) and lack of awareness (11.7%). In high land, mid-highland, and low land areas, the major problem of beef cattle production were feed shortage and poor management problems but the share of percentage was relatively varied for all agroecologies. Scarcity of land was the problem of mid-highland areas for grazing land, which was shifted for cash crop production and selection problem of beef cattle. The present study is in line with the findings of Addisu (2016), who reported the critical constraints of beef cattle production in the north Gonder Amhara Regional States were lack of initial capital, shortage of feed and water, insufficient land, the occurrence of disease and lack of awareness.

Feed shortage was a critical issue reported by the majority of the households during the group discussion in the area. According to the perceptions of participants, the introduction of extension services on storage and efficient utilization of crop residues, establishment and management practices of improved forages, and providing technology interventions to improve the existing grazing lands were some of the recommendations of the participants to alleviate livestock feed shortage. The current was in agreement with similarly Tesfaye (2016), who reported that feed shortage was a critical issue in the Lume district of east Shoa zone Ethiopia, and Shapiro, (2016) one of the challenges of cattle fattening was feed shortage and poor quality.

Table 7: Beef cattle production constraint

Beef cattle production constraint	Highland		Mid highland		Low land		Overall	
	N=30	%	N=60	%	N=30	%	N	%
Feed shortage	7	23.4	18	30	14	46.7	39	32.5
lack of good management	6	20	12	20	4	13.3	22	18.3
Lack of initial capital	4	13.3	6	10	3	10	13	10.8
Disease occurrence	5	16.7	9	15	3	10	17	14.2
Insufficient land	4	13.3	9	15	2	6.7	15	12.5
Lack of awareness	4	13.3	6	10	4	13.3	14	11.7
Total	30	100	60	100	30	100	120	100

N = Number of respondents

3.8. Feed Resources Used for Fattening Cattle in Kercha District

Feed resources identified from the study districts are presented in table 10. In the Kercha district, the major feed resources and supplementary feeds were identified by the interviewed cattle fatteners based on availability, abundance, and palatability to the animal (selectivity to beef cattle) and were ranked. These identified feed resources were grass, brows tree, crop residue and kitchen left over.

Crop residues were the main feeds available during feed shortage. Moreover, feed shortage was reported during the dry season (January to the last of February). A few animals were foraging from a limited communal, roadside and private grazing area during the wet season, since in the main crop season all crop fields were covered with crop plantations in mid-highland and highland. Relatively feed is in good supply from June to October, when weeds are grown in the crop field. Animals graze freely on the crop fields once the crops were harvested during November, December, January and February. Farmers preserve crop residues for the dry season.

According to focus group discussions, the size of land used for grazing has decreased from time to time. This was mainly due to the allocation of land for crop production. In most production systems where cattle are fattened traditionally, they are commonly based on locally available feed resources. Enset residue was a major feed supplemented for fattening animals during the finishing of beef cattle and it is regarded as a good roughage feed source for the mid-highland and highland study area. This finding is similar to Dirsha (2018), where feed shortage was the first major constraint affecting livestock production and productivity in the Gurage zone, southern Ethiopia.

Table 8: Common feed resource of beef cattle in Kercha district

Types of feed					
Local name		Common name/Botanical name	Palatability (rank 1-4)	Availability of season	
				Wet	Dry
Grass	Benidha(Oro.)	Cynodon dactylon Bermuda grass	1	✓	✓
	Mujja(Oro.)	Snowdenia polystachya (Fresen.) Pilg	1	✓	X
	Maget(Am.)	Trifolium spp.	2	✓	✓
	Senbelet(Am.)	Hyperhennia spp., Cymbopogon spp	1	✓	✓
	Gicha(Am.)	Cyperus rotundus	2	✓	✓
	Sutaa.(Oro)	Pennisetum shimprai	3	✓	✓
	Dogoo(Oro.)	Bamboo grass Pennisetum mezianum	3	✓	✓
	Margaa dasho(Oro)	Chloris gayana /Massaba/	1	✓	X
	Qaqabatto(Oro.)	Desmodium intortum	3	✓	✓
	Marga Arbaa(Oro.)	Elephant grass, Pennisetum purpureum	1	✓	✓
Browse Species	Sesbania(Oro)	Sesbania sesban	1	✓	✓
	Dargu(Oro)	Achyranthes aspera	3	✓	X
	Dhangaggoo(Oro)	Rumex nepalensis Spreng, Polygonaceae	2	✓	X
	Dhadhaatuu(Oro.)	Millettia ferruginea	1	✓	✓
	Ebicha(Oro.)	Vernonia amygdalina, Bitter leaf (Eng.)	1	✓	✓
	Danigola(Oro.)	Triumfetta tomentosa bojer.	1	✓	✓
	Daannisa(Oro.)	Donbeya torrida	1	✓	✓
	Garbii(Oro.)	Acacia albida Del.	3	✓	✓
	Waacuu(Oro.)	Acacia essay, Acacia seyal	2	✓	✓
	Mi'eessaa(Oro)	Euclea shimperi	3	✓	✓
	Biqqaa(Oro.)	Combretum molle	3	✓	✓
	Leemaa(Oro)	Arundinaria alpine	4	✓	✓
	Qobbo(Oro.)	Ricinus communis L.	4	✓	✓
	Dhittacha(Oro)	Sapindaceae Dodonaea angustifolia L.F.	4	✓	
	Harruu (Oro.)	Ficus ovata Vahl	4	✓	✓
	Worqoo (Oro.)	Dracaena plant	1	✓	✓
	Ejersa (Oro.)	Olea africana, O. hochstetteri	3	✓	✓
Crop residues	Boqqollo Maize straw)	Zea mays. Corn	1	X	✓
	Xaaffii (Teff straw)	Eragrostis tef	1	X	✓
	Sindee (Wheat straw)	Triticum aestivum	1	X	✓
	Garbuu (Barley straw)	Hordeum vulgare L.barley	1	X	✓
	Worqichaa(Oro)	Ensete ventricosum (Welw.)Cheesman	1		✓

Baaqela(Oro.)	Bean straw	2	X	✓
Atara(Oro.)	Pea straw	2	X	✓

Rank 1 very highly palatable, Rank 3: highly palatable, Rank 3: palatable and Rank 4: less palatable to beef cattle

3.9. Nutrient Composition of Selected Browse Species

3.9.1. Dry Matter (DM)

The DM content of Millettia ferruginea in highland, mid-highland, and low land was 91.5%, 92.5%, and 94% respectively, Vernonia amygdalina in highland, mid-highland, and lowland was 94%, 96%, 97%, Triumfetta tomentosa Bojer in highland, mid highland and lowland was 89.5, 90, and 89.5 respectively and Dombeya torrida in highland, mid highland and lowland was 86.5%, 91.5%, 92% respectively (Table 9). The dry matter content of all evaluated feed resources was higher in lowland than in highland and mid-highland areas due to high temperature. The effect of different agroecologies had a significantly different effect at ($p<0.05$) on the DM composition of the above-evaluated browse species. The DM content for all evaluated feed was greater than 89.5% and ranged from 89.5% to 97% which agree with the result reported by Belachew *et.al.* (2013) and in line with that reported by Dirsha Demam, (2018) for the DM content of the feeds in highland and mid highland agro-ecologies was above 90% and in line with the result reported for Vernonia amygdalina by Usunobun U. and Okolie P. Ngozi (2016) who indicated the mean dry mater content was 90.6% in Benin City, Edo state of Nigeria Africa.

3.9.2. Ash

The ash content of the evaluated browse tree species in the study area ranged from 8.05% to 14.8%. The mean ash content of Millettia ferruginea, Vernonia amygdalina, Triumfetta tomentosa, and Dombeya torrida was 8.66%, 13.7%, 9.98%, and 12.8% respectively. Vernonia amygdalina had the highest ash content (13.71%) in low land, followed by Dombeya torrida (13%) in highland and the least Ash content (7.6%) was recorded from Millettia ferruginea in highland (table 9). The variation observed could be due to variation in agroecology of the study areas that correspond with Dirsha (2018), the variation observed could be due to variation in agroecology of the Gurage zone. This report also was in line with Solomon Melaku *et.al.* (2010), who reports the average ash content of different browse species ranged between 8.7% and 16.8% in Northern Ethiopia.

4.9.3 Neutral Detergent Fiber (NDF)

The average NDF content of the browse tree in the current study was 40.01%. The NDF content of Millettia ferruginea, Vernonia amygdalina, Triumfetta tomentosa Bojer, and Dombeya torrida were

50.3%, 35.31%, 34.67%, and 39.79% respectively. The NDF content of the evaluated browse tree ranged between 31.32%-53.9% NDF. The Millettia ferruginea had significantly higher ($p<0.05$) NDF contents than Vernonia amygdalina, Dombeya torrida, and the lowest NDF content was found in Triumfetta tomentosa (table 9). This range was similar to Belete Shenkute *et.al.* (2012), who reported the NDF result ranged between 30.4 to 78.5% of the most browse species in the mid-Rift Valley of Ethiopia, and Similar values ranging from 45 to 65% reported by the Dirsha *et.al.* (2018). Singh and Oosting (1992) pointed out that less than 45% NDF content for roughage feeds could be classified as high quality while the feeds containing more than 55% NDF limit dry matter intake and are considered low-quality feeds (Van Soest, 1982).

3.12.4. Acid Detergent Fibre (ADF)

The average ADF content of the browse tree was 21.1% and ranged between 17.23 to 24.76%. The mean ADF content of Millettia ferruginea was 25.21%, 27.95%, and 29.11, in highland, mid-highland, and low land respectively, the average ADF content of Vernonia amygdalina was 18.45%, and 19.05%, 19%, 17.29% in highland, mid highland and lowland respectively, Triumfetta tomentosa was 21.43%, and 22.21%, 21.27%, 20.83% in highland, mid highland and lowland respectively and that of Dombeya torrida was 17.23% and 17.28%, 17.68%, 16.73%, in highland, mid highland and lowland respectively. Variation in ADF content could be attributed to significant deference at ($p<0.05$) in different agroecology and feed type. The ADF values of Millettia ferruginea leaf meal presented in this study were similar to the result of 24.32% indicated by Sandip, *et.al.* (2013) for Milletia ferruginia ADF content was 24.32% in Gedio Zone SNNPRs.

4.9.5 Acid Detergent Lignin (ADL)

The average ADL content of the evaluated browse tree was 8.15% which was 9.05 for Millettia ferruginea, Vernonia amygdalina 8.63%, Triumfetta tomentosa Bojer 9.01%, and Dombeya torrida had 5.92%. In general, the average ADL content of the evaluated browse tree ranged between 5.07-11.9% in the study area. The highest ADL content was found in Millettia ferruginea and the lowest was Dombeya torrida. The present study similar to the report of Amsalu(2017) who reports the ADL content of browses tree varied from 4.01-9.66% and Berhanu *et.al* (2014) the ADL content of browses tree are varied from 0.8-9.66%. But this report was higher than the reports of Andualem *et.al.* (2015), who indicate the ADL content of Cayshiyaa browse tree, ranges from 4.66-5.66% (Table 9).

4.9.6. Crude protein (CP)

The CP content of the evaluated browse tree varied widely, ranging from 12.85-23.85% with an average of 17.25%. The CP content of Millettia ferruginea was 23.85%, Vernonia amygdalina was 17.82%, Triumfetta tomentosa was 12.85% and Dombeya torrida was 14.49%. The highest CP content was found in Millettia ferruginea and the lowest was Triumfetta tomentosa Bojer. Variation in the nutrient content of browse species may be because of soil fertility differences and the inherent ability of the plant to accumulate nutrients from the soil. This indicates the selected browse plants analyzed in this study may be well used as a protein supplement to low-quality feeds such as crop residues due to a higher level of crude protein of all the browse plant species for the animal. Sandip, (2013) the CP content of the Millettia ferruginea leaves (23.58%) was lower than the results obtained by Wondewsen, (2009) from Sesbania sesban browse tree.

This range of current results of CP value was in line with Mohammed's (2009) reports in Chifra district of Afar regional state, Ethiopia for Grewia tembensis (22%). However, the CP content result of the present study is within the range reported by Dicko and Sikena (1992) reported for different browse species (6-23% CP). Also, in line with Deribe, (2013), reports the browse species had CP content that varied from 12.2% to 25.1%, but in Afar rangeland and Borana rangeland, it ranged from 13.8% to 28.7%, and the majority containing the above 15% in DM basis (table 9).

4.3.7. Ether Extract (EE)

The mean EE content of the studied major brows tree in the study area was 7.8% which ranged from 6.6-10.2% i.e. the average EE content of Millettia ferruginea was 7.11%, Vernonia amygdalina 10.2%, Triumfetta tomentosa Bojer 7.25% and Dombeya torrida 6.6%. The Vernonia amygdalina had the highest EE content 11.4% in the lowland, followed by Triumfetta tomentosa 8.95% in the mid-highland (table 9). The variations observed in EE contents of brows trees could be associated with environmental factors of rainfall, soil character and temperature. The present study was in line with Getnet (2015), who report the EE content of Chamaecytisus palmensis plant ranged between 5.7%-24.6%. This result disagreed with that of the report of Amsalu, *et.al* (2017) which was the Millettia ferruginea (3.49 %) and Vernonia amygadalina (2.86%) in the mid-Rift Valley of Ethiopia.

Table 9: Mean comparison of chemical compositions (M±SE) of some browse species in the Kercha district

Ag	FT	DM	Ash	NDF	ADF	ADL	CP	EE
High land	DT	86.5±0.7^{a}	13±1^{a}	44.4±0.17^{a}	17.2±0.19^{a}	5.067±0.09^{c}	14.08±0.15^{c}	5.2±0.6^{a}
	MF	91.5±0.7^{b}	7.6±0.5^{b}	34.9±0.37^{bb}	25.1±0.1^{b}	5.76±0.04^{b}	21.14±0.12^{a}	7.09±1.6^{a}
	TF	89.5±0.7^{c}	9.75±0.05^{b}	34.8±0.36^{b}	22.2±0.2^{c}	11.08±0.1^{a}	11.87±0.01^{d}	5.03±0.58^{a}
	VA	94±0^{d}	13.5±0.3^{a}	34.04±0.33^{b}	19.04±0.2^{d}	5.75±0.06^{b}	16.64±0.17^{b}	8.51±2.18^{a}
	Mean± SE	90.3±2.9	10.96±0.93	37.06±1.6	20.9±1.13	6.91±0.9	16.08±1.27	6.46±0.76
	P value	0.0011	0.0054	<.0001	<.0001	<.0001	<.0001	0.3640
Mid highland	DT	88.5±0.7^{a}	12.95±0.05^{a}	53.9±0.3^{a}	17.6±0.24^{a}	7.27±0.07^{b}	15.2±0.16^{c}	9.27±2.6^{a}
	MF	92.5±0.7^{b}	8.05±0.55^{c}	36.4±0.16^{b}	27.9±0.3^{c}	9.4±0.39^{a}	26.3±0.13^{a}	6.46±4.28^{a}
	TF	90.5±0.7b^{c}	9.95±0.25^{b}	33.4±0.19^{c}	21.2±0.16^{c}	9.14±0.05^{a}	12.6±0.07^{d}	8.95±2.28^{a}
	VA	96±1.4^{c}	12.85±0.55^{a}	53.9±0.3^{d}	18.9±0.06^{d}	9.02±0.04^{a}	17.46±0.09^{b}	11.45±0.12^{a}
	Mean± SE	91.8±3.0	10.95±0.79	44.4±3.6	21.4±1.49	8.7±0.32	17.9±1.94	9.04±1.24
	P-value	0.0054	0.0027	<.0001	<.0001	0.0058	<.0001	0.6783
Lowland	DT	92±1.4^{a}	12.45±0.15^{ba}	52.5±0.27^{a}	52.5±0.27^{a}	5.42±0.038^{d}	5.45±1.14^{b}	5.45±1.14^{b}
	MF	94±0^{b}	10.35±0.25^{b}	35.70±58^{b}	35.70±58b	11.95±0.06^{a}	7.97±0.5^{ba}	7.97±0.5^{ba}
	TF	91.5±0.7b^{c}	10.25±0.15^{b}	34.525±4^{c}	34.525±4^{c}	6.75±0.07^{c}	7.77±0.08b^{a}	7.77±0.08b^{a}
	VA	97±0.7^{c}	14.8±1.4^{a}	31.3±0.17^{d}	31.3±0.17^{d}	11.14±0.04^{b}	10.8±2.07^{a}	10.8±2.07^{a}
	Mean± SE	93.6±2.4	11.9±0.75	38.5±3.1	38.5±3.1	8.8±1.05	8.02±0.86	8.02±0.86
	P-value	0.0101	0.0303	<.0001	<.0001	<.0001	0.1362	0.1362

Ag= Agro ecology FT= feed type in different agro ecology, DT= *Dombeya torrida,* MF= *Millettia ferruginea* TF= *Triumfetta tomentosa Bojer,* VA= *Vernonia amygdalina* DM = Dry mater, NDF =Neutral detergent fiber, ADL= Acid detergent lignin, CP= crud protein, EE= Ether extract, $^{a-d}$ Different superscript letters within a column indicate a significant difference (p.0.05) between studied parameters of plant, M± SE= mean plus/minus standard error

5. CONCLUSION

From the report of the current study, it is concluded that the study results indicate that 80% of the households kept their cattle under an extensive production system which will impact the production of beef cattle and the primary purpose of keeping cattle was for income generation, followed for milk and saving. The major purpose or reason for cattle fattening of beef producers was to fatten their cattle to get better prices for existing aged animals when it was sold. The main production constraints of beef cattle fatteners were feed shortage, lack of governmental feed processing factories, absence of market information, lack of credit and improved cattle fattening technologies, lack of good management, lack of initial capital, disease occurrence, insufficient land and lack of awareness on beef production. The identified feed source for beef cattle in the study area was natural grasses (pasture),

browse trees, crop residues and kitchen left over. Enset was a major feed supplemented for fattening animals during finishing beef cattle.

The chemical composition evaluation of major feeds collected from all agro-ecology showed that the crude protein (CP) content of browse species Millettia ferruginea (23.85%), Vernonia amygdalina (17.82%), Triumfetta tomentosa (12.85%) and Dombeya torrida was 14.49% which had higher CP contents than the minimum level of 7% CP required for optimum rumen microbial function. The dry matter content of all evaluated feed resources was higher in lowland than in highland and mid-highland areas due to temperatures of different agroecologies. The effect of different agroecology had a significant effect ($p<0.05$) on the DM, Ash, NDF, ADF, ADL, CP, and EE contents of evaluated browse species.

6. RECOMMENDATION

On the bases of the above findings of this study, the following recommendations are forwarded;

- Introduction of extension service on storage and efficient utilization of crop residues, establishment and management practices of improved forages, and providing technology interventions to improve the existing grazing lands were some of the recommendations to alleviate livestock feed shortage.

- Extension policies and strategies on fattening practices, feed improvement strategies, credit service, training, and extension service (advice on beef selection, feeding, and health care) and further research on production performance of fattening cattle and carcass quality related to feeding in West Guji Kercha district should be conducted.

- Expanding improved forage species to overcome the scarcity of feed which will be encountered during dry seasons. There should be a forage promotion program to expand improved forage availability.

- All evaluated browses species (*Millettia ferruginea, Vernonia amygdalina, Dombeya torrida (J.F. Gmel.) and Trumfetta tomentosa*) have the potential to substitute the low-quality feed and these species are best in their nutritional values in all agroecology as well as a dry and wet season. Especially *Millettia ferruginea* has high CP content. So, the community must conserve them and manage them and appropriately feed their animals at any time.

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