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Livestock Feed, Feed Balance and Chemical Composition of Major Livestock Feeds in South Ari District South-Western Ethiopia

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Abstract

The lack of adequate information on livestock feed basis, feed balance, and quality parameters of major feeds is a critical livestock production constraint in the South Ari district. This study was conducted to identify the livestock feed basis, feed balance, and quality parameters of major feeds. Two Kebeles from the South Ari district were selected based on the local experience in livestock feed production and potential availability of diversified livestock feeds. One focus group discussion (FGD) per Kebele, which comprised 25 livestock keepers, was established with the aid of Kebele experts and local administrative bodies. The respondents were asked about the major livestock feed bases, livestock feed categories, and purpose of feeding values. After conducting FGDs, all FGDs members collected samples of major livestock feed that were listed during the FGDs and the samples were quantified for quality parameters. The results from the present study elucidated that there were 20 herbaceous and 16 browse forage species identified as livestock feeds. The estimated total dry matter required for livestock species per year was 857, 307 tons and produced was 115, 857.6 tons per year. The feed balance calculation showed that total deficits of 789, 427.9 tons of dry matter per year. The ash and crude protein contents of herbaceous species ranged from 38.6-315g kg^{-1}, DM to 44.3-224.5g kg^{-1}, DM, respectively, while they ranged from 97-330g kg^{-1}, DM to 104-222 g kg^{-1}, DM for browse species. Based on results from this study it was suggested that the primary emphasis is need to be improving the livestock feed basis through introducing productive improved forage species, improving poor quality-feeds and enhancing the utilization of indigenous forage species as protein supplements.

Keywords: Livestock; Feed basis; Feed balance; Quality parameters

Introduction

Ethiopia has about 70 million cattle, 42.9 million sheep, 52.5 million goats, 8.1 million camels, 2.15 million horses, 10.8 million donkeys, 0.38 million mules, and 57 million chickens [1]. Livestock have contributed tremendously to generating immediate cash income, food (meat, milk, and eggs), fulfilling cultural obligations, and providing about 68 million tons of organic fertilizer and almost 617 million days of animal traction in Ethiopia [2-4]. Despite this tremendous role for rural communities, the yields obtained from livestock production in Ethiopia are generally very low as compared to other countries in Africa [2, 3, and 5]. The low livestock productivity is happening because the livestock feeding system is based on low-quality feed from natural-pasture (56.2%) and crop-residues (35%) and the year-round feed supply from this feed-base is inadequate to meet the requirements of animals [1, 4, 6]. Similarly, in the study area, the livestock production system follows the fashion of a low-input/low-output system, and the feeding system is based on natural pasture and crop residue. The adequate information on livestock feed sources, feed balance, and chemical compositions of major feeds are critical-lacked in the study area. This is due to smallholder farmers' lack of understanding of the feed source, feed quality, and amount of feed needed for their livestock [7]. Understanding the livestock feed availability, feed balance, and quality of feeds adds credibility to smallholder-farmers' how and what will be provided to their livestock for maximized benefits from the livestock [3, 4]. Moreover, assessing the livestock feed balance, which is defined as the balance between availability of feed produced and demand of livestock, is used as a potential indicator to assess sustainability and profitability of livestock production [8, 9]. Moreover in the study area, livestock keepers have developed indigenous knowledge on how and for what purpose they use the indigenous forage species for livestock. Therefore, understanding their indigenous knowledge gives a clue to conglomerate it with scientific knowledge to generate recommendation for further utilization of indigenous forage in livestock diet. Likewise, the understanding of the indigenous forage species' quality parameters is quite indispensable for the designing of the long-term utilization of species which will be targeted to properly balance their uses in livestock nutrition. Therefore, this study was aimed at (1) assessing the major livestock feed resources; (2) calculating livestock feed balance; and (3) evaluating the chemical composition of major livestock feeds.

Materials and Method

Description of the study area

The assessment study on livestock feed source, feed balance and quality parameters of major livestock feeds was conducted at Seda and Shapi Kebeles (lowest administrative sub-unit) of South Ari district based on the diversity of feeds and better experiences of livestock keepers on feed production. South Ari district is among the ten districts in the south Omo, which located between latitude of 5°44'0"N latitude and 36°16'0"E and 36°40'0"E longitude direction. The altitude of district ranges between 1400-3418m above sea level and bordered on the south by Bena-Tsemay, on the west by the Mago-River, on the north by the Basketo and North Ari, on the north-east by the Gamo-Gofa and on the east by Malle district [10]. The district is predominantly Dega (37%),

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Woyina-Dega (60%) and Wirch (3%) with annual temperature and rainfall which averaging 20oC and 900mm, respectively [10]. The rain-fed-mixed crop-livestock production system is dominant production system in the study district primarily to meet the subsistence food requirements of the smallholder-farmers. The major cereal crops such as maize, sorghum, barley, wheat, finger millet, from pulses haricot bean, faba bean, field pea, ground nut and cash crops such as coffee, kororima and chat are major food-feed-crops have been growing in study area [10, 11]. Moreover, the cattle, sheep, goats, poultry and equines are major livestock species have reared in the study area [12].

Data collection methods

The focus group discussions (FGDs), on-farm field observations and sample collection had used to enrich the primary data on livestock feed source, feed balance and quality parameters of major indigenous forage species used as livestock feed.

Focus Group Discussions (FGDs)

The FGDs were conducted in Seda and Shapi kebekes of South Ari district based on the better local experiences of livestock keepers and availability of diversified livestock feeds. One focus group discussion (FGDs) per Kebele, which had comprised 25 smallholder- livestock keepers, was selected with aid of Kebele development experts and local administrative bodies. The disscants were asked about the major feeds utilized by livestock (cattle, sheep, goats), livestock feed categories (herbaceous and browse) and purpose of feeding values (milk and meat improvement and diseases control).

On-farm field observations

The most experienced livestock keepers from the each FGDs member were voted by the FGD participants, for the purpose of collecting and identifying samples of the major indigenous forage species which have utilized by livestock species (cattle, sheep and goats). The experienced-livestock keepers were collected major indigenous forage species from the communal grazing area and organised in to grasses, herbaceous and browse species. The all selected indigenous species were photographed using smart phone and coded with local names. The collected indigenous forage species were scientifically identified by using Ethiopia Flora identification Book [13], while for those which were difficult to easily identify their scientific names were identified by using the plant net software.

Source of secondary data

Secondary data on livestock number and total areas covered with grazing land and cropping was sourced from the South Ari Agricultural Office to calculate livestock feed balance.

Estimation of feed supply

The figures obtained from agricultural office were used to estimate the quantity of feed produced per year for livestock species based on each land-use-category system. The annual dry matter production from the each grazing-land-category was calculated by recommendation of [14], while the feed production from crop-residues was estimated using conversion factors developed by [15].

Estimation of dry matter demands

Livestock species reported from the study area was aggregated into tropical livestock units (TLUs) by considering the annual average livestock species numbers by using species-specific TLU conversion factors of 0.7 for cattle, 0.1 for sheep and goats, 0.5 for donkeys and 0.8 for horses and mule [16-18]. The estimation of dry-matter-demand of livestock species was calculated based on the expected daily dry matter intake suggested for the standard TLU of 250kg at 2.5% of the body weight, which is equivalent to 6.25kg/day for tropical condition.

Livestock feed balance

The livestock feed balance in the study area was determined as the difference between the total annual feed produced from different land-use-category and the total annual feed demands for different livestock species.

Sample processing and laboratory analysis

The samples of selected indigenous forage species in three replicates per plant were processed by handpicking and air-dried at room temperature in livestock feed and nutrition laboratory of Jinak Agricultural Research Center. The different quality parameters of selected indigenous forage samples were analyzed at Debre Birhan Agricultural Research Center. Accordingly, the dry matter percentage (DM %), crude protein (CP) and ash content were analyzed according to the methods of [19]. The neutral detergent fiber (NDF) vale was calculated according to the procedure of [20], while the acid detergent fiber (ADF) value was analyzed by the method described by [21].

Results and Discussion

Major herbaceous livestock feeds

The major herbaceous indigenous forage species utilized as livestock feed in the South Ari district is listed in Table 1. The livestock keepers were reported about 20 different herbaceous forage species (grasses and legumes) utilized by different livestock species. The respondents were categorized each of the listed forage species based on the feeding purpose to livestock. The *Stenotaphrum secudatum, Cyperus bulbosus, Armoracia rusticana, Galinsoga quadriradiata, Symphytum officinale, Cleome rutidosperma, Ipomoea aquatica Forssk, Alliaria petiolata and Digitaria sanguinalis* were reported as meat and milk enhancers, whereas *Cynodon dactylon (L.), Mentha suavelens, Arthraxon hispidus and Commenlina erecta* were used to fatten cattle, sheep and goats. The *Armoracia rusticana, Alliaria petiolata and Geranium endressii* reported as forages species that used to treat animals that infected by the Antrax, whereas forage like *Sison amomum (L.)* is used to treat calf exhibited diarrhea mixed with blood.

Major browse forages for livestock

The major indigenous browse forage species used as livestock feeds in study district are listed in Table 2. The respondents were identified about 16 different indigenous browse forage species that have been utilising by livestock for the purposes of livestock feeding. They categorized as meat and milk enhancer (*Perilla frutescens, Gliricidia sepium, Microsorum punctatum, Vriesae splendens, Ficus sur Forssk, Ficus nymphaeifolia, Mill Commelina virgicinica (L.), Ficus carica, Cajanus cajan, Cassava, Argemone mexicana L. and Stachytarpheta cayennensis*), disease controlling immunity enhancer (*Hydrangea macrophylla*), meat, milk and immunity enhancer (*Actinodia deliciosa, Reynoutri sachalinensi and Cochlistema odoratissimum lem.*). They were reported that, they were supplemented their livestock like goats, sheep and cattle with either leaves or pods of browse species, to boost growth rates, weight gains and milk production due to these plants are highly palatable by animals and have higher crude protein contents as compared to grass species. Similarly, the smaller-holders farmers from Western and Eastern-Africa were supplemented West-African-dwarf sheep and small-East-African goats with different browse leaves

Table 1: The list of major herbaceous forage species used as livestock feed and their purpose of feeding by small-holder-livestock keepers in South Ari district.

Local name (Aregna)	Scientific name	Family	Purpose of feeding			Remark
			Meat	Milk	Disease control	
Gilima	Arthraxon hispidus	Poaceae	**			XXX
Gilima-Kasimis	Commenlina erecta (L.)	Poaceae	**			XXX
Ganta	Commelina diffusa Burm.f.	Commelinaceae	**	**		XXX
Serda	Cynodon dactylon (L.)	Poaceae	**			XXX
Donkey	Mentha suavelens	Lamiaceae	**			XV
Bucha	Stenotaphrum secudatum	Poaceae	**	**		XXX
Tsetsi	Cyperus bulbosus	Poaceae	**	**		XXX
Tsokorsi	Armoracia rusticana	Brassicaceae	**	**	**(Anthrax)	XXX
Abayile	Galinsoga quadriradiata	Compositae	**	**		XXX
Achinti	Symphytum officinale	Boraginaceae	**	**	**	XXX
Kaya	Geranium endressii	Geraniaceae			**(Anthrax)	XXXX
Dia	Cleome rutidosperma	Cleomaceae	**	**		XX
Topi	Sison amomum (L.)	Apiaece			**(trt. calf)	X
Sakita	Ipomoea aquatica Forssk	Conovolvulacea	**	**		XXX
Singa	Phleum pretense L.	Poaceae	**	**		XXX
Lushi	Tilia platyphyllos scop	Malvaceae				XXX
Ayikenton	Veronica persica poir	Plantaginaceae				XXX
Besita	Alliaria petiolata	Brassicaceae	**	**	**(Aba senga)	XXX
Zersi	Digitaria sanguinalis	Poaceae	**	**		X
Turina	Indigofera spicata spira	Malvaceae	**	**		XXX

Key note: X= cattle; XX = Cattle and sheep; XXX= Utilized by cattle, goats, sheep; XXXX = equines; XV = cattle and equines

Table 2: The list of major browse species used as livestock feed and their purpose of feeding in South Ari district.

Local Name	Scientific Name	Family	Purpose of feeding			Remarks
			Meat	Milk	Diseases control	
Gara	Hydrangea macrophylla	Hydrangeaceae	**		**	XXX
Kulitibi	Perilla frutescens	Leguminosae	**	**		VII
Chubisha	Stachytarpheta cayennensis	Verbenaceae	**	**		
Lagi	Actinodia deliciosa	Deliciosae	**	**	**	XXX
Doblish	Reynoutri sachalinensi	Polygonaceae	**	**	**(trt Pneumonia)	XXX
Zagi	Gliricidia sepium	Leguminosae	**	**		XXX (dry season)
Wusha	Cochlistema odoratissimum lem.	Odoratissimum	**	**	**(Ectoparasites)	X
Washa	Microsorum punctatum	Polygonaceae	**	**		XXX (dry seasons)
Wachi	Vriesae splendens	Splendens	**	**		XXX
Sema	Ficus sur Forssk	Forssk	**	**		XXX (pods, seeds)
Wala	Ficus nymphaeifolia Mill	Phaeifolia	**	**		XX (dry seasons)
Asha	Commelina virgicinica (L.)	Commelinaceae	**	**		XXX
Tseka	Ficus carica		**	**		XXX
Sharing	Cajanus cajan	Leguminosae	**	**		XXX
Fakalis	Cassava	Leguminosae	**	**		XXX (dry season)
Kuma	Argemone mexicana L.	Mexicana (L.)	**	**		VIII

Key note: X= cattle; XX = consumed by cattle and sheep; XXX= consumed by cattle, goats, sheep; XXXX = consumed by Equines; XV = Cattle and Equines; VII= consumed by goat and sheep; VIII = Consumed by livestock species

and pods to improve growth rate and weight gain performances [22-24]. Also, [25] reported that farmers from the central Tanzania were supplemented goats with *Ecborium spp, Tamarindus indica, Acacia tortilis and Delonix elata* to improve intake and promoting growth performances in goats which is concord to the practices reported from present study. Similarly, farmers of Mieso district from Ethiopia reported that they were supplemented milking cow with leaves of *Grewia ferruginea* to get higher milk yields due to the plant has high crude protein content which is responsible to stimulate more milk yield than control one [26]. The other important benefit of using the browse species to livestock in the study area is as source of medicine for treating several diseases and parasites. Also farmers were reported very few indigenous forage species such as *Hydrangea macrophylla, Actinodia deliciosa and Reynoutri sachalinensis* were used to control diseases like Pneumonia in goats, sheep and cattle. The other important browse species reported by respondents in study area is Cochlistema odoratissimum lem, which is used to treat different *Ectoparasites* that leads itching of skin in goats, sheep and cattle. Similar to result from the present study, [27] reported that goat keepers from the South Africa were used the browse plants such as *Aloe ferox, Acokanthera oppositifolia and Elephantorrhiza elephantine* to control diseases and parasites in goats. The similar study was also reported by [26], which demonstrated that the Ethiopian farmers were used the leaves of browse species such as Grewia species to cure wounds in animal and human. The [28] also reported that the aqueous and organic leaves extracts of *C. hereroense* used to fight free-living nematode in animals and [29] and [30] reported that browse species (Fabaceae family) are used to treat various livestock diseases caused by internal and external parasites.

Quality parameters of herbaceous species

The quality parameters of major indigenous herbaceous forage species utilized by livestock species in the study district are presented in Table 3. The herbaceous species' ash and CP contents ranged from 38.6-315g kg^{-1}, DM and 44.3-224.5g kg^{-1}, DM, respectively. *Stenotaphrum secudatum* had higher ash, while *Digitaria sangunalis* had lowest ash content. The *Tilia platyphyllos scop* had a higher CP, while Cynodon dactylon (L.) had a lowest CP, and CP values varied from 44.3g kg^{-1} to 224.5g kg^{-1}, DM. The *Commelinaceae* had higher NDF and ADF contents, while *Tilia platyphyllos scop* had lowest NDF and ADF contents. The NDF values ranged from 444-680g kg^{-1}, DM and the ADF values ranged from 227.9-574.5g kg^{-1}, DM. The CP is essential for the development of muscles and tissues, hormones, enzymes, and hemoglobin [31, 32]. Thus, the CP levels obtained in this study (84.4 g/kg–224.5 g/kg, DM) except for *Commelinaceae, Digitaria sanguinalis, and Commelina erecta L.* species were higher than the required CP levels (70-80 g/kg^{-1}, DM) for normal microbial digestion [33-35]. Furthermore, the CP levels obtained from this study for all herbaceous species except *Stenotaphrum secudatum, Symphytum officinale and Cleome rutidosperma* were higher than the minimum CP levels required for proper growth (113 g/kg, DM). In addition, [36] categorized livestock feed sources into three categories based on CP content, as low-quality feeds (CP < 40 g/kg^{-1}, DM), medium-quality feeds (CP = 50-100 g/kg^{-1}, DM) and high-quality feeds (CP> 100 g/kg^{-1}, DM). Accordingly, *Cynodon dactylon, Commelinaceae, Digitaria sanguinalis, Stenotaphrum secudatum, Digitaria sangunali, and Commelina erecta L* were classified as feeds of medium quality, and the rest of species were categorized as high-quality-feeds that have the potential to be used as protein supplements to the ruminant animals.

Chemical composition of indigenous browse forage species

The chemical composition of indigenous browse forage species utilized by different livestock species in the study district is presented in Table 4. The ash and CP contents of browse species ranged between 97-330g kg^{-1}, DM and 104-222 g kg^{-1}, DM. The *Gliricidia sepium* had higher ash content of 330 g kg^{-1}, DM, while *Argemone mexicana* L had lowest ash content of 97g kg^{-1}, DM. The *Manihot esculenta* had a higher CP content of 222 g kg^{-1}, DM, while *Microsorum punctatum* had a lowest CP of 104 g kg^{-1}, DM. The *Ficus sur* Forssk had higher NDF content of 655 g kg^{-1}, DM, while *Ficus carica* had lowest ND content of 344 g kg^{-1}, DM. The NDF values ranged from 344-655g kg^{-1}, DM and the ADF values ranged from 231-553g kg^{-1}, DM. The CP is essential for the development of muscles and tissues, hormones, enzymes, and hemoglobin [31, 32]. Thus, the CP levels obtained in this study (104 g/kg-222 g/kg, DM) were higher than the minimum required CP levels (70-80 g/kg^{-1}, DM) for normal microbial digestion [33-35] and were characterized as high-quality feeds (CP > 100 g/kg^{-1}, DM) with the potential to be used as protein supplements to ruminant animals.

Annual dry matter produced for livestock

The total estimated annual dry matter yields produced from different land-use-systems and major crops in the South Ari district is presented in Table 5. The highest dry matter yields for livestock from the different land-use systems came from the private-grazing-lands (50,160 tons/year), while the lowest dry matter yield came from the fallow-land (1,800 tons/year). In the study area, the higher dry matter produced from the private grazing land than from communal land is due to the fact that the study area is crop-dominated and has a large area of privately-owned land with higher productivity(ton/ha) as compared to communal-grazing-land. The studies reported by [7] and [37] from Salamago and Maalee districts of South Omo indicated that the higher annual dry matter yield (1502, 156.8 tons/year) and (312, 876 tons/year) were produced from open communal-grazing-land, respectively, than from private grazing-land, which was in agreement with the result from this study. The higher dry matter yields come from maize-stover, followed by sorghum-stover and wheat straw, whereas the lowest dry matter yields come from groundnut and sunflower. Similarly, the studies reported by [7] and [37] from Salamago and Maalee districts of South Omo indicated that the highest annual dry matter yield (1770.80 tons/year) and (15,681 tons/year) were produced from maize-stover and the lowest was obtained from sunflower seed.

Table 3: Quality parameters (g kg-1, DM) of indigenous herbaceous forage species in South Ari.

Local Name	Scientific Name	DM	Ash	CP	NDF	ADF
Gilima	*Commelinaceae*	900	105.3	59	685	574.5
Zersi	*Digitaria sanguinalis*	900	55	55.3	650	460
Wusha	*Cochlistema odoratissimum*	930	107.5	164.9	550	451
Ganta	*Commelina diffusa Burm f.*	940	308.5	194.1	555.6	446.8
Serdo	*Cynodon dactylon (L.)*	900	65	44.3	650	446.7
Donkey	*Mentha suavelens*	940	180.9	108.3	645	479.6
Bucha	*Stenotaphrum secudatum*	950	315.7	84.8	550	436
Tsetse	*Cyperus bulbosus*	940	159.5	153.7	654	531.9
Tsokorsi	*Armoracia rusticana*	940	74.5	132.1	500	361.7
Abayila	*Galinsoga quadriradiata*	940	266	174.5	546.3	468.1
Achenti	*Symphytum officinale*	930	96.8	121.3	656.7	566
Kaya	*Geranium endressii*	910	103.4	133.2	550	389
Dia	*Cleome rutidosperma*	900	98.8	123.3	503.4	355.5
Topi	*Sison amomum L.*	940	74.5	182.3	444	340.4
Sakita	*Ipomoea aquatica Forssk*	940	202.1	146.8	522	425.5
Singa	*Phleum pretense L.*	900	38.6	53.2	625	456
Lushi	*Tilia platyphyllos scop*	950	136.8	224.5	387	297.9
Ayikenton	*Veronica persica poir*	930	258.1	142.6	593.6	489.4
Besita	*Alliaria petiolata*	930	129	175.3	650	419.8
Gilima-kasimis	*Commelina erecta L.*	950	105.3	59	685	574.5

Key note: CP = Crude Protein; NDF = Neutral Detergent Fiber; ADF = Acid Detergent Fiber

Table 4: Quality parameters (g kg^{-1}, DM) of major browse species as livestock feed in South Ari.

Local name	Scientific Name	Family	quality parameters				
			DM	Ash	CP	NDF	AD
Gara	*Hydrangea macrophylla*	*Hydrangeaceae*	950	142	190	600	480
Kulitibi	*Perilla frutescens*	*Leguminosae*	930	140	206	500	407
Chubisha	*Stachytarphetacayennensis*	*Verbenaceae*	940	106	157	437	340
Lagi	*Actinodia deliciosa*	*Deliciosae*	950	136	164	500	404
Doblish	*Reynoutri sachalinensis*	*Polygonaceae*	930	161	131	566	453
Zagi	*Gliricidia sepium*	*Leguminosae*	910	330	145	594	489
Wusha	*Cochlistemaodoratissimum*	*Odoratissimum*	930	107	165	655	450
Washa	*Microsorum punctatum*	*Polygonaceae*	940	159	104	601	468
Wachi	*Vriesae splendens*	*Splendens*	950	105	171	499	404
Sema	*Ficus sur Forssk*	*Forssk*	940	234	202	655	532
Wala	*Ficus nymphaeifolia Mill*	*Phaeifolia*	950	157	149	455	362
Asha	*Commelina virgicinica (L.)*	*Commelinaceae*	940	117	128	491	383
Tseka	*Ficus carica*		940	202	173	344	231
Sharing	*Cajanus cajan*	*Leguminosae*	920	126	167	562	359
Fakalis	*Manihot esculenta*	*Asparagaceae*	900	112	222	489	333
Kuma	*Argemone mexicana L.*	*Mexicana (L.)*	900	97	118	622	510

Key note: CP = Crude Protein; NDF = Neutral Detergent Fiber; ADF = Acid Detergent Fiber

Table 5: The total estimated annual dry matter yields from different land-use-system and major crops in South Ari district.

Land -use-system	Amount land covered (ha)	Productivity/ha	TDMY (tons/ year)
Private-grazing land	16,720	3	50, 160
Communal grazing land	4, 200	2	8,400
Road side grazing land	1428	1.8	2, 570.4
Fallow land	1,200	1.5	1, 800
Forest/woody land	8,500	0.7	5, 950
Sub-total	-	-	68, 880
Major crops			
Maize	17, 665	2	35,330
Sorghum	1, 240.50	2.5	3,101
Wheat	2,008	1.5	3,012
Barely	1, 033	1.5	1, 549.5
Teff	648	1.2	777.6
Haricot bean	700	1.2	840
Bean	446	1.2	669
Ground net	300	1.2	360
Field pea	719	1.2	862.8
Sunflower	30	1.2	36
False banana Leaves and stem	55	8	440
Sub-total	-	-	46, 977.90
TDMY/t/year			115, 857.6

Feed balance

According to 2021 report of South Ari office of agriculture, the district had about 512, 772 cattle, 104, 216 sheep, 62, 229 goats, 21, 661 horses and 13, 300 mules, which were equivalent to 358, 940.39, 10,421.60, 6, 222.9, 2,166.1 and 1330 TLU (Table 6). These livestock species needs total of annual dry matter per year was about 857, 307 tons (Table 6). The feed balance calculation in the study district revealed that total deficits of 789, 427.9 tons of dry matter yields per year which indicated that livestock species that have reared in the study area have more nutritional suffered by low supply of feed. Moreover, overall livestock dry matter demands for maintenance and dry matter yields that supplied is generally found to be negative which indicated that feeds produced from different grazing-types and crop residues for

Table 6: Annual dry matter required by livestock species and feed balance in South Ari district in 2021.

Livestock species	Livestock species	CF	Livestock species in TLU	DMY required (tons/day)	TDM required (tons/year)
Cattle	512, 772	0.7	358, 940.39	2.28	818, 384
Sheep	104, 216	0.1	10,421.60	2.28	23, 761
Goat	62, 229	0.1	6, 222.9	2.28	14, 188
Horse	21, 661	0.5	10, 830.5	2.28	24, 693.5
Mule	13, 300	0.8	10, 640	2.28	24, 259
Total DMY required					905, 285.54
TDMY					115, 857.6
Feed balance					-789, 27.90

TDMY = Total Dry Matter Yield, CF = Conversion Factor

livestock species in the study district was even not enough to satisfy the maintenance demands of feed. In support to result from the present study, the study reported by [7] and [37] from Salamago and Maale districts were demonstrated that estimated feed balance for livestock was negative. Likewise, the other study reported by [3] demonstrated that availability of feed and nutrients (ME and CP) showed the feed deficiency in Ethiopia by 9% as DM and 45 and 42% of ME and CP deficiencies, respectively.

Conclusion

This study was conducted to identify the livestock feed basis, feed balance, and quality parameters of major feeds. Two Kebeles from the South Ari district were selected based on the local experience in livestock feed production and potential availability of diversified livestock feeds. One Focus Group Discussion (FGD) per Kebele, which comprised 25 livestock keepers, was established with the aid of Kebele experts and local administrative bodies. The disscants were asked about the major livestock feed bases, livestock feed categories, and purpose of feeding values. After conducting FGDs, all FGDs members collected samples of major livestock feed that were listed during the FGDs and the samples were quantified for quality parameters. The results from the present study elucidated that there were 20 herbaceous and 16 browse forage species identified as livestock feeds. The estimated total dry matter required for livestock species per year was 857, 307 tons and

produced was 115, 857.6 tons per year. The feed balance calculation showed that total deficits of 789, 427.9 tons of dry matter per year. The ash and crude protein contents of herbaceous species ranged from 38.6-315g kg^{-1}, DM to 44.3-224.5g kg^{-1}, DM, respectively, while they ranged from 97-330g kg^{-1}, DM to 104-222 g kg^{-1}, DM for browse species. Based on results from this study it was suggested that the primary emphasis is need to be improving the livestock feed basis through introducing productive improved forage species, improving poor quality-feeds and enhancing the utilization of indigenous forage species as protein supplements.

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