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Assessment of major dairy cattle feed resource availability and their chemical composition in Soro district of Hadiya zone, Southern Ethiopia

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Abstract**—** *In Ethiopia, the livestock industry is a vital and central part of the agricultural sector. Livestock farming is important for the supply of meat and milk; it also serves as a source of additional income both for smallholder farmers and livestock owners. This study was conducted to assess the available dairy cattle feed resources and analyze their chemical composition in Soro district, Hadiya zone of Southern Ethiopia. Single-visit-multiple-subjects formal survey technique was used to collect data with the use of pre-tested, structured questionnaires translated into the local language (Hadiyagna). From each of the nine kebeles, twenty households were randomly selected so that 180 households were involved in the study to collect the data. The data collected from individual farmers have been entered into Microsoft Excel (2010) spreadsheet. The major feed resources assessed in the study areas were natural pasture (76.7%), crop residues (63.3%), concentrate (37.8%), improved forages (30%), and others (enset waste, weed and browse trees). From the above feeds grass, wheat straw, teff straw, barley straw, wheat bran, Enset leaf, and Enset stem were collected for chemical analysis. The highest dry matter (95%) was recorded from grass and the lowest (89%) from wheat bran. The highest crude protein of (14.65%) was recorded from wheat bran and the lowest (6.05%) from teff straw. The higher fiber contents of 82.34% and 80.27% were recorded from wheat straw and teff straw, respectively. Hence, the major feed resources were natural pasture and crop residues that are of low quality with high fiber content, which may result in reduced livestock productivity and disease resistance. Therefore, feed shortage, water scarcity, disease, and low productivity of animals were assessed to be the major livestock production constraints.*

Keywords**— Dairy cattle; Feed resources; Livestock; Chemical composition.**

I. INTRODUCTION

The livestock sector plays a significant role in the livelihood security of dairy farmers in the country. The rural economy mainly depends on agriculture and the allied sector, where animal husbandry and dairy development play an important role in supplementing the income of rural households, particularly, the landless, small, and marginal farmers (Thakkar et al. 2021). Ethiopia has a large livestock population and diverse agro-ecological zones suitable for livestock production and growing diverse types of food and fodder crops (Demissie, 2017). However, livestock production has mostly been subsistence-oriented and characterized by very low reproductive and productive performance. Ethiopia is believed to have the largest livestock population in Africa (Solomon et al. 2003; Helina and Schmidt, 2012). An estimate indicates that the country is home to about 54 million cattle, 25.5 million sheep, and 24.06 million goats

(Solomon, 2004). Of the total cattle population, 98.95% are local breeds and the remaining are hybrid and exotic breeds. 99.8% of the sheep and nearly all goat population of the country are local breeds (Samson and Frehiwot et al. 2014).

Currently, the livestock subsector supports and sustains livelihoods for 80% of the rural population. Despite the high livestock population and existing favorable environmental conditions, the current livestock output of the country is little (Samson and Frehiwot, 2014). This is associated with several complex and inter-related factors such as inadequate feed and nutrition, widespread diseases, the poor genetic potential of local breeds, market problems, marketing, and infrastructure (Friat and Haben, 2020). The large livestock population, the suitable climate for improved, high-yielding animal breeds, and the relatively disease-free environment for livestock make Ethiopia have a significant potential for dairy development (Abebe et al. 2008). Under the smallholder livestock production system, animals are dependent on a variety of feed resources which vary both in quantity and quality (Dawit et al. 2013). For optimum livestock productivity, the available feed resource should match the number of animals in a given area (Gashu et al. 2017). The availability of feed resources in Ethiopia depends on the mode and intensity of crop production as well as population pressure and interacts with rainfall amount and distribution

pattern, and season of the year (Mohamed-Saleem and Abate, 1995). Again, the availability of feed resources of the country has diversified based on agro-ecologies and farming systems, which vary from one locality to the other.

In Ethiopia, the human and animal populations are very much affected by nutritional problems, primarily due to a lack of food of high nutritional value (Gebrekidan et al. 2012). To solve this problem and to ameliorate the nutritional status of the population, measures should be taken to improve animal production to ensure a better supply of animal protein of high nutritive value. In this regard, milk is among livestock products whose demand continues to increase and plays a very important role in feeding the rural and urban population of Ethiopia. However, the quality and quantity of milk production deteriorate due to biological causes including poor nutrition, the low genetic potential of the animals, and the prevalence of diseases (Atyabi et al. 2006; Mesele et al. 2012). It is the most important factor in affecting either positively or negatively the potential of the animal. It is well established that poor nutrition and feed shortages are the root causes of the poor performance of livestock in Ethiopia (Tolera et al. 2007).

Livestock feed resources are classified as natural pasture, crop residue, improved pasture, and forage, agro-industrial by-products, and other by-products like food and vegetable refusal, of which the first two contribute the largest feed type (Alemayehu and Sisay, 2003; Bizelew et al. 2016 and Sefa, 2017). Animals depend mainly on natural pastures for their feed requirements. Natural pastures that provide more than 90% of the livestock feed are generally very poorly managed (Bikila and Tigist, 2016). In the mixed farming mid-altitude areas, better soils are used for cropping and the main permanent natural pasturelands are found on the upper slopes of hills and seasonally waterlogged areas (Tadesse and Solomon, 2014). Due to poor management and overstocking, natural pastures are highly overgrazed resulting in severe land degradation, loss of valuable species, and dominance by unpalatable species (Alemu, 1998).

Ethiopia is known for cereal crop production and the resulting crop residues could be used as a potential feed source for feeding dairy cattle to improve milk production. Though the country is estimated to have a huge supply of crop residues, there may be mishandling and a lack of awareness about crop-residue improvement (Adinew et al. 2020). Thus, the utilization efficiency of the residues is low. Besides, there may be a lack of proper selection of feeds for dairy cows for improving milk production, lack of market information about supplementary feeds, and also poor management of feeding systems which may lower the performance of cows. Hence, the producers may not get reasonable benefits from their dairy activity unless appropriate improvement strategies have to be introduced. Inadequate information about livestock feed resources and milk yield of both crossbreed and indigenous dairy cattle are the main problems in the Soro district. There is a problem with designing appropriate livestock feeding strategies to feed crossbreed and indigenous dairy cattle. Therefore, documenting the livestock feed resource and evaluating their chemical composition is crucial to designing appropriate interventions to enhance the productivity of both breeds of dairy cows in the area. Feed resource assessment in the area helps to design feeding alternatives during the worse season of the year to mitigate the dairy cows' feed shortage in the area. Therefore, this study aimed to assess the major available dairy cattle feed resources and evaluate their chemical composition in the Soro district of Hadiya Zone, Southern Regional State.

II. MATERIALS AND METHODS

The study was conducted at Soro district which was located in the Hadiya Zone of SNNP Regional State of Ethiopia. The district is approximately located between 10°17'-10°45'n latitude and 37°00'-37°10E' longitude. Hosanna and Gimbichu, the town of the district located in the south of Addis Ababa at a distance of 260 km, respectively. The mean annual T° of the Soro district is 17.27 C° and with elevations ranging from 501-2500 m.a.s.l. In the study areas, the annual rainfall pattern starts from June - September which receives 1001-1400 mm. The plain topography combined with the availability of optimum climatic and fertile soil conditions makes the district suitable for mixed crop-livestock production (HZARDO, 2013).

Study Design

A cross-sectional study design was employed to assess dairy animal feed resources. The cross-sectional study design was used and a cross-sectional visit of the study area was made for close observation of the overall livestock population and the available feed resource estimation. Focused Group Discussions (FGD) were held with elders, key informants, development agents, and district administrative officers working on the study areas to collect secondary data. Additional information on the potential Kebeles, livestock population and distribution, and locally available major livestock feed resources were obtained from the Soro Woreda Office of Agriculture and Rural Development and the locally developed organizational structure of the Kebeles (lowest administrative unit).

Sampling Technique: Soro district was selected purposively to collect the data about the available feed resources. There were three agro-ecological Zones in the Soro district (*Kolla*, *Dega*, and *Woynadega*). There were 20 Kebeles in "*Kolla",* 24 Kebeles in "*Woynadega*" and 5 Kebeles in "*Dega*". From these, 4 Kebeles from "*Kolla*", 4 Kebeles from "*Woyna Dega",* and 1 Kebele from "*Dega*" were purposively selected. From each of the 9 Kebeles, 20 households were randomly selected so that a total of 180 households were involved in the study to collect the primary data.

Representative samples of feed resources (pasture, crop residues, agro-industrial by-products, and locally available other feeds, etc.) which were commonly used in feeding domestic dairy cattle were collected from each selected Kebeles. In the beginning, the feed samples from grazing sites were taken from quadrats placed and demarked across diagonal line transects in the grazed area, and divided with systematically sampling procedures into 5 subsamples (top, bottom, middle, right and left positions) and 5 quadrats (0.5m x 0.5m) was harvested from each of the 5 subsamples. The grass in the quadrats was completely cut at ground level by sickle (manually). Finally, the samples of the same feed were mixed thoroughly and 1/3 of it was taken to Hawassa University, animal nutrition laboratory for further analysis.

III. METHODS OF DATA COLLECTION

Questionnaire survey: Single-visit-multiple-subjects formal survey technique was used to collect data with the use of pre-tested, structured questionnaires translated into the local language (Hadiyagna). The primary data collected included the general household characteristics of the respondents, landholding, and land use system, livestock herd size, and composition, the constraint of livestock, and the purpose of keeping livestock and livestock feed resources locally available feed resources (pasture and forage crops, crop residues, industrial by-products, and non-conventional feed resources) and feeding system. Secondary data was collected from the district and zonal offices targeting the feed resources available in the area, and the constraint of livestock.

A cross-sectional visit of the study area was made for close observation of the overall dairy cattle feed resource. Focused Group Discussions (FGD) were held by key informants, development agents, and district administrative officers working in the study areas to collect the data. Focus group discussions were held at each Kebele with 7 key informants selected from the study area, the researcher facilitated and guided the discussions, and the issues for discussion were livestock production system and utilization of grazing areas. Additional information was collected from the Soro district Office of Agriculture and Rural Development and the locally developed organizational structure of the Kebeles (lowest administrative unit).

Sample preparation and Chemical analysis: After completion of the survey, the dominant feeds were selected, air-dried, and taken to Hawassa University Animal Nutrition Laboratory and dried in an oven at 60^0C for 72 hours. Then all dried samples were ground separately to pass through a 1mm sieve of the Willey mill. The ground samples were kept in airtight plastic bags awaiting analysis. The determination of dry matter (DM), ash, and nitrogen (N) were done according to AOAC (1995). Crude protein (CP) was calculated as N * 6.25. Ash was determined by burning the sample at 550 to 600°C in a muffle furnace for 3 hours. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were analyzed according to VanSoest et al. (1991) using ANKOM ®200-fiber analyzer (ANKOM Technology Corp., Fairport, NY, USA).

Statistical analysis: The data collected from individual farmers have been entered in Statistical Package for Social Science (SPSS version 13). Leven's test was used to check the homogeneity of variances in the data analysis. Descriptive statistics (mean, standard deviation, frequency, percentages, table) were employed to summarize data on household characteristics; available feed resources, and feeding systems.

IV. RESULTS AND DISCUSSION

Analysis of dairy cows owner Household characteristics

Dairy cow owner household characteristics: The demographic information of respondents was presented in Table 1 below. The status of respondents in the selected Kebeles was 78.3% head, 16.1% wife, 3.3% son, and 1.1% daughter (Table 1). In Table 1 results revealed that the majority (80%) of the respondents were male. This result is in line with the *Azage* et al. (2003) finding report that most households were male-headed. The study further indicated that 41.7% of the respondents were illiterate. Moreover, the proportion of respondents who are capable of reading and writing only was 30% whereas 37.2% of the respondents attended formal education (1-8 grades). Regarding marital status, 96.1% of respondents were married and 3.9% were unmarried. The dominant farming system in the study area is a mixed crop-livestock type. Furthermore, farming was the major occupation in the district that was 79.4% and the rest 20.6% of the respondents were having additional jobs.

Table 1: Demographic information of respondents.

HH Status		Kolla	Weynadega	Dega	Total	%
Respondent status	Head	67	62	12	141	78.3
	Wife	5	17	7	29	16.1
	Son	4	2	1	7	3.8
	Daughter	1	1	1	3	1.6
Sex	Male	64	66	14	144	80
	Female	15	15	6	36	20
Educational level	Non formal	34	33	8	75	41.6
	Primary	32	22	9	63	35
	Secondary	8	12	1	21	11.6
	Adult literacy	5	10	2	17	9.4
Marital status	Married	76	79	18	173	96.1
	Unmarried	3	2	2	7	3.9
Major occupation	Farmer	72	53	18	143	79.4
	Trader	2	10	0	12	6.6
	Farmer & trader	5	16	2	23	12.7
	Retained	0	1	1	2	1.1

Landholdings and land-use systems in the study area: The land is among the most significant resources required for the effective application of any agricultural farming activities. The results indicated the average landholding per household for the four land-use types (annual crop, forest tree, grazing land, and perennial crop) in the district were 0.296±0.231, 0.141±0.024, 0.062±0.015, and 0.127±0.020, respectively, while the land used for Orchards and fallow was undefined (Table 2). Moreover, table 2 also showed that more land was used for annual crops and forest trees. Thus, the average landholding in the study area (0.63±0.058 ha) was lower than that reported for neighboring districts (0.69±0.02 ha) of Damot Gale (Fikre, 2009), and Dale districts (1.77ha) of the Sidama zone (Endashaw, 2007). This might be due to differences in the population density of the areas and differences in the farming system.

Table 2: Average land-use patterns and holding size (ha).

Land-use type	Highland	Midland	Lowland	Average
Annual crop	0.260±0.036	0.191±0.017	0.438±0.042	0.296±0.031
Forest trees	0.163±0.036	0.161±0.023	0.101±0.015	0.141±0.024
Grazing land	0.036 ±0.017	0.092±0.016	0.058 ±0.012	0.062±0.015
Orchards	_	_	_	_
Perennial crop	0.093±0.022	0.171±0.017	0.117±0.022	0.127±0.020
Fallow	_	_	_	_
Total landholding	0.55±0.01	0.62±0.073	0.714±0.091	0.63±0.058

Key. *Ha=hectare, SD=standard deviation*

Livestock herd size and composition: According to the survey results, most farmers kept more than one species of domestic animals. Results of this study indicated that in cattle livestock species, cows and oxen were the larger herd size and composition among the other types while bulls were the lowest classes in the entire three agro-ecological zones (Table 3). Additionally, in the case of sheep livestock species, ewes and lambs were the largest herd size in "*Kolla"* agro-ecological zone while Ewes were presented largely in *Woynadega* and *Dega* agro-ecological zones (Table 3). Furthermore, of the goat species, Does were the largest herd size than that of kids and bucks. Besides this, poultry was the largest herd size of all of the livestock populations in the study area. Generally, the present study showed that the possession of the farmers was higher for poultry than larger ruminants. This result agrees with the findings reported by Abdi et al. (2013); Estefanos et al. (2014); Bikila and Tigist, (2016). The sheep, goats, and poultry were the means of risk aversion in case of natural disaster or any incidence of disease outbreak, some farmers preferred to keep sheep and goats because they were easy to manage and accommodate in a smaller area than large ruminants.

Table 3: Livestock herd size and composition in the study areas.

Species	Types	Kolla Mean±SE	Weynadega Mean±SE	Dega Mean±SE	Total mean±SE	P<0.05
Cattle	Cow	2.73±0.22	2.69±0.16	2.30±0.25	2.57±0.21	0.57
	Oxen	2.24±0.12	1.54±0.10	2.00±0.12	1.92±0.11	0.00
	Bull	0.21±0.05	0.24±0.05	0.45±0.11	0.30±0.07	0.12
	Heifer	1.16±0.14	0.41±0.08	0.45±0.18	0.67±0.13	0.00
	Steers	1.04±0.16	0.54±0.09	0.45±0.13	0.67±0.12	0.01
	Calves	1.45±0.10	1.44±0.08	1.37±0.14	1.42±0.11	0.91
Sheep	Lamb	0.57±0.15	0.73±0.09	1.65±0.15	0.98±0.13	0.00
	Ewes	0.67±0.10	1.11±0.13	1.55±0.19	1.11±0.14	0.00
	Ram	0.29±0.08	0.54±0.07	1.15±0.13	0.66±0.09	0.00
Goat	Does	0.95±0.15	0.78±0.11	0.65±0.18	0.79±0.14	0.49
	Kids	0.69±0.12	0.48±0.07	0.40±0.11	0.52±0.10	0.18
	Bucks	0.29±0.06	0.38±0.06	0.30±0.10	0.32±0.07	0.55
Equine	Donkey	0.88±0.08	0.89±0.08	0.30±0.10	0.69±0.08	0.00
	Mule	0.21±0.04	0.33±0.05	0.15±0.08	0.23±0.05	0.11
	Horse	0.05±0.04	0.07±0.04	0.10±0.07	0.07±0.05	0.84
Poultry	Poultry	7.05±0.39	6.39±0.25	5.60±0.57	6.34±0.40	0.09

Key: SE=Standard error.

Constraints of livestock production: The results indicate that feed shortage is the major constraint identified by most of the respondents. The results of this study showed feed shortage (62.8%) followed by disease (25.5%), low productivity (10%), and water shortage (1.1%) in all three agro-ecological zones (Table 4). The primary constraint of dairy cattle production in the study area was feed shortages followed by a frequent outbreak of major livestock diseases. Feed shortage in the study area might be associated with cropland expansion that results in a shortage of grazing lands. The observations are in agreement with that of Dawit et al. (2013) farmers indicated that increment in cropland at the expense of grazing land, shortage of land for forage production, renting, and allocation of open grazing lands around Lake Zeway for investors have resulted in a decrease grazing land. Moreover, in the three agro-ecological zones the major feed shortage was observed in Dega agro-ecological zone, which was about 70% and next was recorded in *Kolla* (66.25%) while the lowest (57.5 %) was in Woynadega (Table 4). The result is in agreement with that of Keftasa (1996) and Dawit et al. (2013) they also indicated that the shifting of grazing land into crop cultivation has dwindled the potential of the livestock in the area and put immense pressure on the existing land. Furthermore, the results indicated that the most prevalent diseases reported in the three study areas included were: blackleg, foot and mouth disease (FMD), anthrax, and fascioliasis. The interaction of these constraints affects the overall production in the study area. These results are similar to Mulu, 2009; Duguma et al. 2012 and Kaassahun et al. 2015; Ashenafi and Melaku, (2020) reported that the major constraints of livestock production are feed shortage and animals health problems are closely linked to the kind of environment in which the herd is kept and the management methods used in the production system.

Table 4: Constraints of dairy cattle production as identified by respondents.

Constraints	Kolla	Weynadega	Dega	Percentage
Feed shortage	53	46	14	62.8
Disease	22	21	3	25.5
Low productivity	3	13	2	10
Water scarcity	1	1	0	1.1
Others	0	0	0	0

Purposes of keeping livestock: According to the respondents, farmers kept cattle for many purposes in the study area. The major purposes were milk (41 %), draft power (22.2%) meat (11.1 %), saving (8.3%), income generation (5.5%) and manure (5.5%) (Table 5). These results agreed with the results reported by Abera (2012) the majority of the respondent keeps cattle mainly for milk, meat, and saving which is comparable with current the study, and farmers use cattle manure as a source of fertilizer. However, no one kept the cattle for hide and skin. For these purposes, major attention was given to draft power because most of the farmers have at least one pair of oxen to plough the land. However, the main reasons for raising small ruminants were meat production, saving, income generation, and manure production with higher priority given to income generation which was about (61.1%) followed by meat production (28.9%) while the others were 1.66 %, 6.11 % and 2.22 % for saving, hide and skin and manure production respectively. Among the different reasons outlined in table-5, the farmers used equine and cattle (oxen) for draft power. Cows were the only source of milk production whereas milk from small ruminants was not consumed in the area because of cultural taboo.

Table 5: Purpose of keeping livestock in the study district.

Livestock	Purpose of livestock keeping						
	Meat	Milk	Draft power	Income	Saving	Hide & Skin	Manure
Cattle	20(11.1)	75(41)	40(22.2)	10(5.5)	15(8.3)	_	10(5.5)
Small ruminant	52(28.9)	_	_	110(61.1)	3(1.7)	11(6.1)	4(2.2)
Equine	_	_	167(92.8)	_	_	_	13(7.2)

Major feed resources for dairy cattle: According to the result of respondents, grazing natural pasture and crop residues was ranked as the first and second most important feed resource in the study area. In Table 6 results revealed that the respondents ranked enset as the third most important feed resource in the study area mostly in highland and midland areas. Moreover, improved forage and industrial by-products were obtained from the by-product of wheat milling which is wheat bran widely used in urban areas and ranked fourth and fifth. The result of this study was in agreement with that of Miresa and Demeke (2020) and Gebretsadik, (2019). Results in Table 6 revealed that the major available feed resources in the study area were natural pasture, enset, crop residues, hay, an industrial by-product, and forage crop aftermath. The results indicated that the major feed resources were natural pasture (76.6%), crop residues (63.3%), Wheat straw (17.8%), teff straw (51.1%), barley straw (11.7%), sorghums (4.4%), maize Stover (15%) and concentrate (37.8%), wheat bran and noug seed cake, improved forages (30%) and others (enset waste, weed and browse trees) (Table 6). However, crop residues, natural pasture, and aftermath grazing were the major feed resources for the dry season. Crop residues from cereals such as wheat, teff, and barely were common in the study area. Teff straw, maize stover, and sorghum stover were available in large mass in the low land area which was *"Kolla"* agro-ecological zone, whereas wheat straw, barley straw, teff straw, grass, and enset were largely presented in midland areas (*Woyna dega*) while wheat straw, barley straw, and grass were common in high land area (*Dega*).

In the study area most of the time the farmers were used enset in the dry and wet seasons. Enset was a widely cultivated crop in mid (sub-humid) and highland districts of the area, which was used for both human and livestock food. An enset part (leaf and pseudostem) was usually fed to livestock during the dry season. Enset root was fed for fattening oxen and sheep, and to heal sick animals. The importance of enset for livestock feed has been reported previously Adugna, (1990); Amsalu et al. (2008), and Deribe et al. (2013). In the highlands, the natural pasture, crop residues (wheat straw and barley straw), and weed were the major sources of feed. This statement agreed with reports presented by Alemayehu and Sisay, (2003); Bilatu et al. (2018).

Table 6: The major available feed resources as ranked by farmers.

Feed resource	Ranked (Number of responses)					
	Rank1	Rank2	Rank3	Rank4	Rank5	(Rank) mean index
Natural pasture	60	66	30	31	33	0.277(1)
Crop residue	54	42	29	18	23	0.216(2)
Industrial by-product	30	7	50	20	30	0.147(5)
Improved pasture	12	50	35	35	42	0.176(4)
Enset	24	15	36	76	52	0.182(3)
Total	180	180	180	180	180	1.00

Index = [(5 × number of responses for 1^{st} rank + 4 × number of responses for 2^{nd} rank + 3 × number of responses for 3^{rd} rank + 2 × number of responses for 4^{th} rank +1 × number of responses for 5^{th} rank)] divided by (5 × total responses for 1^{st} rank + 4 × total responses for 2^{nd} rank + 3 × total responses for 3^{rd} rank + 2× total responses for 4^{th} rank + 5×total responses for 5^{th} rank).

Feed resources during dry and wet seasons: As presented in Table 7, during the dry season, (85.6%) of the respondents have used crop residues as the number one feed resource followed by hay (82.2 %) and industrial by-product (65%). The results revealed that the majority of the respondents indicated that crop residues from wheat straw, teff straw, maize stover, barley straw, bean, and peas residues were important feed sources, especially during the dry season when the availability of pasture was low (Table 7). The present study was in agreement with the reports of Berihu et al. (2014). According to the data obtained from the respondents in the study area, in the wet season, the respondents used natural pasture (88.9%), fodder trees (75%), and improved forages (71.7%) (Table 7). This result is similar to Tesfaye's (2007) reported that the wet season feed resources were natural pasture followed by fodder trees and improved forages.

Table 7: Dry and wet season feeds in the study district.

Feed type	Dry season		Wet season	
	Frequency	Percentage	Frequency	Percentage
Natural pasture	45	25	160	88.9
Crop residues	154	85.6	32	17.8
Hay	148	82.2	26	14.4
Fodder tree	20	11.1	135	75
Industrial by-product	117	65	63	35
Improved forages	51	28.3	129	71.7

Feeding system: Livestock owners were followed different feeding systems for efficient utilization of the available feeds. In the study district 67.8%, 18.9%, and 13.3% of the respondents were fed their animals with feeding systems of grazing and stall-feeding, only grazing and only stall-feeding respectively (Table 8). In Table 8 results revealed that the more practiced feeding system was grazing and stalls feeding systems. More farmers only used grazing to feed their cattle in lowland areas. This was due to the availability of grazing land in lowland areas which was better than the midland areas while cut and carrying (only stall-feeding) feeding systems were more in the midland and highland area. Furthermore, the responses given by the respondents during the survey time, in lowland areas, many farmers have practiced a group feeding system and in that feeding system, all age categories of animals were fed together so that it was difficult for younger animals to satisfy their daily dry matter requirement as some of the animals can consume more than others and fight each other. Most of the time in high land areas farmers practiced let to graze, cut and carry, and tethering.

Table 8: Percentage and frequency of feed resources and feeding systems.

Feeding system	Frequency	Percentages
Grazing & stall feeding	122	67.8
Only grazing	34	18.9
Only stall feeding	24	13.3

Communal and Private grazing land availability: In the study area, the farmer used both communal and private grazing lands. Farmers in kebeles mostly use private grazing land because the communal grazing land was changed to crop cultivation and decreased from time to time and this indicated that the quantity of livestock feed obtained from this source was also decreased. Results indicated that respondents responded that allocation of communal grazing lands for landless youths and expansion of croplands were the major reasons for decreasing the size of communal grazing land in their respective areas. This result is similar to Wocat, (2012) reported that communal grazing areas were increasingly being converted into cropland due to rapid population growth.

Chemical composition of major feeds in the study area: The chemical composition of the top seven major feedstuffs in the study area were shown in (Table 9) below. The content of dry matter (DM) was relatively high (95%) in grass feedstuff compared with the others while the lowest value of DM was recorded in wheat bran. In general, the DM compositions for all feedstuffs analyzed in this study were relatively high. According to the result obtained in this study, the crude protein (CP) of the wheat bran and enset leaf was high. Moreover, the crude protein (CP) of the wheat straw, teff straw, barley straw, grass, and enset stem were comparable. The crude protein (CP) content (6.48 %) of the grass recorded in this study was slightly lower than the value (9.6%) reported by Solomon (2004). Furthermore, the results of this study indicated that the CP content of wheat bran, wheat straw, teff straw, barley straw, grass, enset leaf, and enset stem was: 14.65, 6.65, 6.05, 6.06, 6.48, 13.75, and 6.74, respectively (Table 9). Similarly, Lonsdale (1989) reported the crude protein CP (14.65%) content of wheat bran. However, compared to the study, the reports of Asnakew and Simret, (2005); Fentie and Solomon, (2007) on the CP content of wheat bran were (19.55, 20.10, and 23.08 %) respectively higher. Similar to this finding Solomon et al. (2021) reported. The differences between the results might be due to the

variation in the raw material, methods of chopping or milling, and the extended storage of the samples.

The results of the current study indicated that the NDF content of all crop residues was above 40%. Similarly, Singh and Oosting, (1992) reported that roughage feeds with NDF content of less than 45% are categorized as high quality, 45 to 65% as medium quality, and those with more than 65% as low-quality roughages. In this study, the contents of NDF were more than 65%, so all crop residues might be categorized as low-quality roughages that may reduce animal performance. Table 9 result also revealed that the contents of NDF for the feedstuffs of Enset leaf, Enset stem, and grass were 57.27, 61.97, and 64.64 respectively. So, these results might be considered medium-quality feeds according to the statements of (Singh and Oosting, 1992; Usman et al. 2018). Whereas, wheat bran was categorized under high-quality feed which was below 45 %. The NDF value of wheat bran in the present study was lower than earlier reported values (55.50, 44, 44.13, 44.97, 43.83, 44.94, and 39.16%) by Hirut (2008), Simret (2005), Mulat (2006), Fentie and Solomon, (2007), Abebe and Jemberu (2008), respectively.

Likewise, the ADF content of wheat bran in this study was lower than in earlier reports (12.70, 12.47, 12.36% 12.39, and 12.45%) by Solomon et al. (2004), Simret (2005), Asnakew (2005), Fentie and Solomon, (2007), and Jemberu, (2008), respectively. However, the ADF content was higher than those reported by Giri et al. (2000) and Tesfay (2007) (9.49% and 9.46%, respectively). According to the results of the present study, the lignin content of grass, wheat bran, and enset steam were comparable. Based on the lignin content, the different crop residues could be categorized as low-quality roughages. Furthermore, the results indicated that the lignin content was high for all crop residues except teff straw, which is beyond the maximum level of lignin (7%), which limits DM intake. The ADL of grass was lower than 7%, which was medium quality roughages, and feed staff. The ether extract (EE) contents of these feeds (grass, wheat straw, teff straw, barley straw, wheat bran, enset leaf, and enset stem) were 2.22, 0.38, 1.33, 2.70, 3.18, 6.56, and 1.34, respectively (Table 9).

Table 9: Chemical composition of major feeds in the study area.

Feeds	**Chemical composition**							
	% of Nutrient composition (in DM base)							
	DM	OM	AS H	EE	CP	NDF	ADF	ADL
Wheat straw	93.2	91.48	8.52	0.38	6.65	82.34	47.76	7.26
Teff straw	93	92.79	7.21	1.33	6.05	80.27	40.59	4.85
Enset leaf	94.5	68.48	31.52	6.56	13.75	57.27	22.44	4.72
Barley straw	94.7	88.82	11.18	2.70	6.06	79.97	48.97	7.62
Grass	95	85.47	14.53	2.22	6.48	64.64	32.61	3.80
Wheat bran (supplement)	89.4	95.55	4.45	3.18	14.65	40.82	10.85	3.27
Enset stem	94.6	88.49	11.51	1.34	6.74	61.97	41.82	3.61

Key: *ADF=acid detergent fiber; ADL=acid detergent lignin CF=crude fiber, CP= crude protein, EE=ether extract, DM= dry matter, NDF=neutral detergent fiber.*

V. CONCLUSION

According to the survey, the major available feed resources for dairy cattle in the study area were natural pasture, crop residues, concentrate, improved forages, and others (enset waste, weed and browse trees). Crop residues, natural pasture, and aftermath grazing were the major feed resources for the dry season and with high fiber content and low digestibility, which could decrease livestock productivity and disease resistance. The reason for the feed shortage in the study area is an expansion of cropland. Therefore, the size of grazing land decreases from time to time which leads to a shortage of feed resources in the study area. To increase livestock productivity, the primary focus needs to be on improving the existing feed resources through management, utilization practices, and applying improvement practices such as treatment of crop residues, and improving the existing management system of grazing land. Thus, training and extension advice is urgently required in handling crop residues, feeding, healthcare, and market information to improve the performance of dairy cattle in the study areas. Finally, awareness should be given to farmers on how to conserve forage and hay to overcome feed shortages during the dry season.

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AUTHOR'S CONTRIBUTION

DB: Conceived and designed the study; Data collected and analyzed and wrote the paper. TW: Received the draft; make scientific comments and revised it; wrote the paper and discussed the interpretation. And he handled the whole process from journal selection up to publication. Additionally, he covered the manuscript payment cost.

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