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Assessment on Livestock Feed Resources and Utilization Practices in Derashe Special District, Southern-Western Ethiopia: Status, Challenges and Opportunities

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Abstract

Lack of updated information on the livestock feed resource and utilization practice are major challenges to livestock producers and police makers in Ethiopia. Therefore, this study was conducted in Derashe special district with aim of assessing the availability of feed resources and feeding practice, chemical composition of major feeds, and major constraints and opportunities for livestock feed production. The face-to-face household survey involved interviewing of 195 respondents of two Kebeles from the highland, one Kebele from mid land and two kebeles from the lowland agro-ecologies that comprised 78, 39 and 78 respondents respectively were randomly selected and interviewed. The collected data from the qualitative parameters were analyzed using non-parametric methods, while the means of the quantitative parameters were analyzed by One-Way ANOVA by using SPSS, version 16. The results revealed that the dominant feed resource in the area were crop residues (73%), natural pastures (23%) and improved forages (4%). The feed utilization practices in the area were free grazing (12.3%), private grazing (2.56%), cut and carrying system (75.4%) and (9.74%) combination of all feeding practices. The result of chemical composition of major feeds showed that the ash content was ranged from (10-100g/kg, DM), crude protein (24.9-141.9g/kg, DM), NDF (620-816g/kg, DM) and ADF (408-605g/kg, DM). The shortage of land (33.3%), overpopulation (28.2%), drought (26.2%), expansion of cropping-land (6.6%), overgrazing (4.1%) and settlement (1.5%) were major constraints of livestock feed production, while high demand and betterment in price for livestock and livestock products and better marketing access were an opportunities for livestock feed production. Gener-

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ally, results revealed that livestock feed production and utilization practices are crop-residues-pasture-based and old-fashioned. Hence, we recommended that the improvement in feeds and feeding systems through introducing the production of improved suitable forage species, improving quality of crop-residues, introducing pastureland over-sown with suitable legume forages species, conserving feeds when abundant in supply and introduce intensive feeding system.

Introduction

Ethiopia is home for about 60.39 million of cattle, 31.30 million of sheep, 32.74 million of goats, 1.42 million of camels, 56.87 million of chickens, and 2.03 million of horses 9.85 million of donkey and 0.46 million of mules [1]. Despite of this livestock populations, the yields obtained from livestock production is very low and is limited to contribute to the national economy only about 11.48% to the total GDP [2] which is very low as compared to its potential due to inadequate feed supplies and low quality of available feeds[1]. The natural-pasture and crop-residues have been contributing about 56.23% and 30.06% of shares respectively as the main livestock feeds available in the Ethiopia [3] which have been affecting by the different agro-ecologies, the type and accessibility of crop-produced and production-system[4,5]. The common problem with natural pasture and crop residues are marked variation in seasonal-based-feed availability and quality issues, which have been consistently reported as major constraints to livestock production in the developing countries like Ethiopia [6]. This is due to the poor natural-pasture management practices, serious degradation in grazing-areas and the most palatable forage species of natural-pasture have converted and dominated by unpalatable species [7]. The previous study reported from Ethiopia was demonstrated that the quality and quantity of the available livestock feed resources declined drastically during the dry seasons due to frequent drought occurrences and climate change [8]. Similarly, in Derashe district in which this study was conducted, there are lacks of comprehensive information on feed resources availability, nutritional values of major feeds, current status and opportunities for of livestock feed production. Thus, the understanding of the existing feed resources and their nutritional quality of feeds used by livestock will imperative for improving livestock feed production and utilization practices. Therefore, the objectives of the present study were (1) to assess the availability of livestock feed resources and utilization practices (2) to evaluate the chemical composition of major livestock feeds (3) to identify the major constraints and an opportunities for livestock feed production.

Material and methods

Description of the study area

The study was conducted in Derashe special district which is bordered on the South by Konso Zone, on the West by the Alle Special Woreda on the North by the Gamo Zone, on the North-East by Lake Chamo, and on the East by Amaro Special Woreda [9]. The elevation of the district ranges from 1140m to 2640 meters above sea level and lied at 5°39'59.99"N Latitude and 37°19' 60.00" E longitude with the total land with an area of 69,938ha.The climatic condition of the district is characterized as; 38.89% highland, 16.67% mid land and 44.44 % lowland with the mean annual temperatures which ranges between 15.1 and 27.5ºC and whereas, the average annual rain fall ranges from 600 to 1600mm [10]. The common agricultural production system overcome into the study area is mixed crop-livestock production system. The major growing crops in the study area are Maize, Sorghum, Teff and Wheat. The livestock population of the district comprised of 148, 902 cattle, 54, 071 sheep, 94, 722goats, 25, 379 Donkeys, 62 Horses, 139 Mules and 199, 362 Poultry. Livestock production system is characterized by minimal-management-inputs in terms of breeding management, disease control and nutrition and feeding systems which are mainly traditional and subsistence oriented.

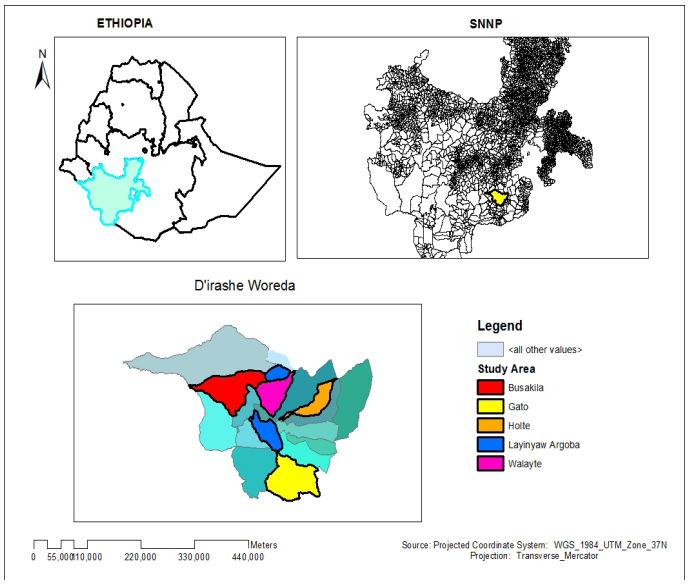

Figure 1: Map of Derashe special district.

Sampling procedure and sample size

Prior to the main sampling attempt, discussion was made with livestock experts of Derashe district to understand the purpose of the study and collaborations during the study. The district has a total of 18 Kebeles (Lower administrative sub-unit) with the three agro-ecologies such as 7 Kebeles in highland, 3 Kebeles in midland and 8 Kebeles in lowland agro-ecologies. From these, 2 Kebeles from the highland, 1 Kebele from mid land and 2 Kebeles from the lowland agro-ecologies were selected by proportional sampling technique based on the livestock holding potentials. About 78, 78 and 39 respondents, respectively from the highland, lowland and midland which was gave a total of 195 (171 Male and 24 Females) were selected and interviewed. The total number of sampling households in each selected Kebeles was determined based on the principle of probability proportional to size'. The total sample size for household interview was determined using probability proportional to size-sampling technique [11].

$$no = \frac{Z^2 * (p)(q)}{d^2}$$

Where, no= desired sample size according to Cochran's (1977) when population greater than 10,000; Z = standard normal deviation (1.96 for 95% confidence level); P = 0.15 (proportion of population to be included in sample i.e. 15%); q= 1-0.15 i.e. (0.85); d = is degree of accuracy desired (0.05), 5% error term.

Data collection methods

Focus Group Discussions (FGDs), Key informant interview, field observations and face-to-face interviews were conducted between January and June 2020 to assess existing potential feed resources and feed availability into the study area. The semi-structured questionnaire used for face-to-face interviews

to collect the primary data on feed resource, feed resource availability, seasonal feed distribution, feed utilization and conservation practices, and feed production constraints, opportunities and feed shortage mitigation strategies. In order to support the data from face-to-face survey, the FGDs were held with groups of farmers who have better experience in livestock and feed production by using check-lists, which was prepared for this purpose. The livestock feed resource, feed resource availability, feed conservation and utilization practices, major livestock feed production constraints and opportunities were important issues that discussed during the focus group discussion. In addition, the key informant interviews were conducted with district livestock experts and Kebele development agents by using check-list used during the FGDs. In order to make result from this study strong and cross check the all ideas raised from face-to-face interviews, FGDs and KII the quick field observation was carried-out by researcher.

Chemical composition of major feeds

Representative samples of major selected feed resource from each Kebeles were collected. From the most dominantly feed resources, which were utilized by livestock such as 3, 4 and 4 feed samples from highland, midland and lowland agro- ecologies respectively were collected. The collected samples were partially dried at 48°C for overnight and bulked per feed- type separately for each agro-ecology. The sampled feeds prepared and transported to Arbaminch University laboratory and, grinded, sealed in plastic air tight bag pending for the further the chemical analysis. All samples of feed in three replicates were analyzed for ash content, Crude Protein (CP), and Ether Extract (EE) according to the procedures of [12]. Neutral Detergent Fiber (NDF) was determined by methods of [13], while Acid Detergent Fiber (ADF) was determined by the methods of [14].

Statistical analysis

The collected data from the face-to-face house hold survey were analyzed by using Statistical Package for Social Sciences (SPSS) version 16. Collected data were described using descriptive statistics (mean, percentage and frequency). The statistical variations for categorical data were tested by means of cross-tabs and significance level was declared at p<0.05 or 0.001. Means of quantitative data between agro-ecologies were compared by employing one-way analysis of variance (One-Way-ANOVA). The statistical model used for analyzing data on feed resources and utilization in this study was:

$$Y_{ij} = \mu + \alpha_i + \Sigma_{ij}$$

Where: y_{ij} = total observation due to i, and j

μ = is overall mean

α_i = location (agro-ecologies)

Σ_{ij} = random error

An index value was calculated as the sum of the weighted number of responses for criterion to provide an overall ranking for qualitative data according to formula of [15].

$$Index = \frac{Rn * C1 + Rn - 1 * C2 ... + R1 * Cn}{\Sigma Rn * C1 + Rn - 1 * C2 ... + R1 * Cn}$$

Where, Rn = Value given for the least ranked level (if the least rank is 3rd, then Rn = 3, Rn-1 = 2, R1 = 1); Cn = Counts of the least ranked level (in the above example, the count of the 3rd rank = Cn, and the count of the 1st rank = C1).

Results and discussion

Demography of households

Demographic characteristics of the respondents are presented in **Table 1**. The result on the sex of studied households indicated that majority of households head (87.7%) were male-headed, while few (12.3%) were female-headed. The result from the present study on the sex of HHs was lower than reported value (91.3%) by [16] from Alaba district of Southern Ethiopia and (95.6%) by [17] from Ilu Aba Bara Zone, Ethiopia. However, the result on sex of HHs was higher than the reported value of (85%) by [18] from the Adami Tullu district. The result on the average ages of respondents in the study area revealed that more (p<0.001) aged of respondents were found in the midland agro-ecology than highland and lowland agro-ecologies, but lowland households had longer experience (p<0.05) in livestock and feed production than households from the highland and midlands agro-ecologies. The overall average age reported by the respondents from the study area was comparable to value (43.2) years reported from Metekel Zone, North-western Ethiopia by [19]. The result on the average family-size was not significantly affected (p<0.001) by three agro-ecologies and overall result from present study was comparable with the findings reported from the Hawassa town (7.1 persons) and Mecha Woreda (7.2) [20]. The educational status of the respondents in the study area was significantly affected (p<0.05) among the three agro-ecologies. Accordingly, about 48.7% of respondents were illiterate, whereas the half percent of respondents (51.3%) were literate. The higher illiteracy level was found in the lowland agro-ecology than rest of two agro-ecologies. The respondents during focus group discussion from the lowland agro-ecology were mentioned that high level of illiteracy level was due to lack awareness on the importance of education and their children have less access to education and thus were made for poor improved forage production and adoption level. Similar to result from the present study, the [21] reported that the low level of education of the households can have an influence on the transfer of agricultural technologies and their participation in development.

Table 1: Demographic characteristics of interviewed households in the Derashe Special district.

Parameters	Agro-ecologies				
	Highland (N=78)	Midland (N=39)	Lowland (N=78)	Overall (N=195)	P- value
Sex of household head (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	
Males	70 (89.7)	37 (94.9)	64 (82)	1717.7)	>0.107
Females	8 (10.3)	2(5.1)	14(18)	24(12.3)	
Marital status (%)					
Single	0(0)	0(0)	1(0.5)	1(0.5)	>0.471

Married	78(100)	39(100)	77(99.5)	194(99.5)	
Educational status (%)					
Illiterate	33(42.3[a])	16(41[b])	46(58.97[c])	95(48.7)	< 0.01
Primary	41(52.6[a])	16(41[b])	28(35.9[c])	85(43.6)	< 0.01
Secondary	3(3.85[a])	6(15.4[b])	2(2.56[a])	11(5.6)	< 0.01
College and above	1(1.28)	1(2.56)	0(0)	2(1)	-
Can read and write	0(0)	0(0)	2(2.56)	2(1)	-
Age of the household (Mean ±SE)	40.15±1.0[c]	47.37±1.589[a]	43.51±1.246[b]	42.93±0.7	< 0.001
Average family size (Mean ±SE)	7.54±1.026	7.49±0.383	6.96±1.263	7.3±0.169	0.268
Farm experience in years (Mean±SD)	20.42±0.95[b]	12.69±0.970[c]	21.95±0.834[a]	19.49±0.6	<0.001

Means with different superscripts (a, b, c) along row are significantly differed at P<0.05 or 0.001), N: Number of Respondent; SE: Standard Error; NS: Non-Significant at P>0.05; %: Percentage; *Significant at P<0.05; **Significant at P<0.01.

Livestock holding and compositions

Livestock species composition in study area is presented in **Table 2**. The result on livestock population declared that there is no significant difference (P>0.05) among the three agro-ecologies for cross breed cattle, sheep, poultry and donkey and but, the more cattle, sheep, poultry and donkey were owned by households who live in lowland agro-ecology. However, the higher (p<0.05) average goat owned by the households in low-land (6.01) agro-ecology than households in highland (3.81) and midland (5.07) agro-ecologies. This is due to capability of goats to resist shortage of feed and other harsh condition than sheep. Farmers keep most of the local breeds of animals with the exception of some crossbred chickens (24%) and only (0.5%) of cattle are cross breed. Almost all of the cattle, sheep, goat and equine reared in the study area were local breeds. Similarly, the study reported by [22] showed that about 98.8% cattle and 100% of small ruminants and equines were local breeds in Jimma Zone. During the focus group discussion and key informant interview, the respondents were reported that now a day the number, herd compositions and size of livestock into study area are decreasing. This is due to the forever increasing in human population as result of the rapid shrinkage in grazing-land by the rapid conversion of grazing-land into cropping-land in order to sustain the food security of their family members. The result on average cattle herd holding per household revealed that higher (p<0.001) cattle number were found in highland agro-ecology than midland agro-ecology, but it was similar (p>0.001) to numbers of cattle found in lowland agro-ecology. This might be there were communal grazing-land at highland and lowland agro-ecologies in local area called Hawassa, which was found around Lake Chamo in lowland agro-ecology. The overall mean TLU of livestock per household in the study area was 3.88, 0.37, 0.1, 0.35, 0.012, 0.03 and 0.04 for cattle, goats, sheep, donkeys, horse, mule and poultry, respectively which was contradicted to the average TLU values of (7.97), (0.74), (0.46) , (0.78) and (0.07) for cattle, sheep, goats, donkeys and poultry, respectively in Meta Robi district reported by [23] and the result of current study was agreed with the findings of [24] which indicated that the average number of livestock in terms of Tropical Livestock Units (TLU) in the three districts; Kersa, Omo Nada and Tiro Afeta of Jimma zone were cattle (4.74), sheep (0.10), goats (0.06), donkey (0.07), horses (0.05) and mule (0.06). Also the result from this study was comparable with previously reported values of cattle (5.35), sheep (0.49), goats (0.03), donkeys (0.22) and poultry (0.02) in Jeldu district by [25]. The result on average (6.3) cattle herd holding per household of this study was much greater than previously reported studies by [26] and [27] for cattle (3.9) in Delbo watershed of Wolayta Zone. The average cattle holding per household were much lower than average cattle holding per households (8.0) reported by [28] for Guduru district in Western-Ethiopia and (7.7) by [29] for Bahirdar Zuria of Northern-Ethiopia. The cattle herd size variation per households in different parts of the country in different areas might be due to the difference in household land holding, variation in human population density and existence of grazing-land.

Table 2: Average livestock holding and composition per household in Derashe special district.

Parameters	Agro ecology				
Livestock	**Highland (N=78)**	**Midland (N=39)**	**Lowland (N=78)**	**Overall (N=195)**	**P-value**
Cattle (Mean± SEM)	6.35 ± 0.75[a]	5.03 ± 0.87[b]	6.29 ± 0.46[a]	6.32 ± 0.57	< 0.004
Local bred	4.05 ±0.266[b]	3.53 ± 0.368[c]	5.29 ± 0.456[a]	4.46 ± 0.23	< 0.001
Cross bred	2.25 ± 0.479	1.5 ± 0.500	1 ± 0.00	1.86 ± 0.34	0.448
Goat (Mean± SEM)	3.81 ±0.355[c]	5.07 ± 0.761[b]	6.01 ± 0.688[a]	5.14 ± 0.392	< 0.051
Sheep (Mean± SEM)	2.83 ± 0.445	3.33 ± 0.882	3.91 ± 0.595	3.53 ± 0.400	0.465
Donkey (Mean± SEM)	1.09 ± 0.048	1 ± 0.00	1.4 ± 0.118	1.23 ± 0.062	0.17
Horse (Mean± SEM)	1± 0.00	0	0	1 ± 0.00	-
Mule (Mean± SEM)	0	0	1±0.00	1 ± 0.00	-
Total chicken (Mean± SEM)	8.98 ±1.459	10.12 ±1.563	10.31±1.03749	8.18 ± 0.804	-
local chicken	4.98 ± 0.705	5.82 ± 0.832	6.76 ± 0.661	5.94 ± 0.433	0.165
Cross breed chicken	4 ± 0.754	4.3 ± 0.731	3.56 ± 0.3749	2.24 ± 0.371	0.18

Means with different superscripts (a, b, c) along row differ significantly (p<0.001 or 0.05), N: Number of Respondent; SEM: Standard Error of Mean; NS: Non-Significant (p>0.05).

Land holding and use pattern of households

The average land holding of households in the study area is presented in **Table 3**. The result revealed that significantly difference ($p<0.05$) in land holding across each agro-ecologies. The result revealed that there were non-significance ($p<0.05$) for land holding for cultivated cropping-land and private grazing-land among the agro-ecologies, but the better private grazing-land was allocated at highland agro-ecology than midland and lowland agro-ecologies. The higher ($p<0.05$) land was allocated for improved forage production in midland agro-ecology than highland and lowland agro-ecologies. This is due to the farmers of midland have better experience in fattening cattle and utilization of technological options. The finding of the average private grazing land (0.14ha) in the current study is higher than the reported value (0.077ha) by [30] for West Hararghe and however, it is less than the reported value (0.42ha) for urban and peri-urban farms of mid rift valley of Ethiopia [31] and the value (0.4ha) by [25] for Jeldu district Western-Shewa area. The private grazing land is mostly found on the roadside of crop land and left the land not conducive for crop cultivation and eroded area of farm land. There was no communal grazing-land in the midland altitude, which is near to the district town, but they left few private grazing-lands on the side of cropping-land. The average cultivated land including fallow land (1.49ha) was less than (2.52ha) reported by [32] for Chire District, Southern Ethiopia and the reported value (1.84ha) by [16] for Alaba District, Southern Ethiopia and higher than reported value (1.14ha) the finding of [33] in Fogera Woreda in South-Gondar, Ethiopia. The higher ($P<0.05$) average land holding (2.03ha) is reported from the lowland agro-ecology than highland (1.94ha) and lowland (1.46 ha) agro-ecologies. The finding on the average land holding (2.17ha) reported from the present study was greater than the national average land holdings value (1.22ha) [34], average land holding vale (1.1ha) reported by [27] for Shashemene-Dilla areas and (0.8ha) value reported by [26] for Boditi, Wolaita Zone. However, it was comparable to reported value (2.28±0.15ha) by [22] for Seka, Mana and Dedo districts of Jimma Zone.

Table 3: Average Land holding and land use pattern of the households (Mean ± SEM) in Derashe Special district.

Parameter	Agro-ecologies				
Landholding (ha)	Highland (Mean ± SE)	Midland (Mean ± SE)	Lowland (Mean ± SE)	Overall (Mean ± SE)	P-value
Backyard	0.21 ± 0.02^{a}	0.05 ± 0.01^{c}	0.07 ± 0.03^{b}	0.13 ± 0.01	<0.001
Cultivated land	1.51 ± 0.13	1.10 ± 0.13	1.66 ± 0.2	1.49 ± 0.09	>0.095
Private grazing-land	0.2 ± 0	0.19 ± 0.12	0.02	0.14 ± 0.10	>0.972
Covered with fodder trees and shrubs	0.20 ± 0^{a}	0.06 ± 0.02^{b}	0	0.07 ± 0.02	<0.056
Covered with forage cultivation	0.02 ± 0.0^{b}	0.05 ± 0.01^{a}	0.03 ± 0.02^{b}	0.04 ± 0.07	<0.021
Closed plantation land	0±0	0.01 ± 0.01	0.32 ± 0.06	0.30 ± 0.05	0.191
Total land holding	1.94 ± 0.15^{b}	1.46 ± 0.4^{c}	2.03 ± 0.3^{a}	2.17 ± 0.29	<0.045

Means with different superscripts (a, b, c) along row are differed at $p<0.05$, N: Number of Respondents; SEM: Standard Error of Mean; NS: Non-Significant Difference at $p>0.05$.

Feed resources and utilization

Feed resources availability

The major feed resources available in the study areas are presented in **Table 4**. According to the respondents, the largest ($p<0.001$) (73%) feed resource for livestock is generated from the crop-residues, but small amount (23%) is contributed from the natural-pasture. However, very few respondents were reported that only about (4%) of the livestock feed come from improved-forage-crops. The higher shares of crop-residues than other feed resources might be shortage of grazing-lands due to gradual turning households into crop production and the absence of alternative feed resources and hence, the increased dependence on crop-residues in the central highlands of Ethiopia [38]. The study reported by [35] showed that crop-residue is contributed the major feed resources for highlands of Ethiopia next to communal-grazing areas which is contradicted result from the present study. But it was similar to what the [36] report, which was demonstrated that crop-residues are major feed resources followed by natural-pasture for highlands of Ethiopia. In general, crop- residues and natural pasture are the major feed resources of the area, which agreed with the report of [4] who reported that the major basal feed resources in the highlands of Ethiopia as natural pasture, crop-residues and stubble grazing.

Table 4: The most dominant feed resources available in the Derashe special district.

Parameter	Agro-ecologies								
	Highland (N=78)		Midland (N=39)		Lowland (N=78)		Overall (N=195)		P-Value
Feed resources (%)	n	%	n	%	n	%	n	%	
Natural Pasture	11	14.1	3	7.7	31	39.7	45	23	<0.001***
Crop-residues	63	72.8	32	80.8	47	82.1	142	73	
Improved forage and pastures	4	5.1	4	5.1	0	0	8	4	

N = Number of Respondent; %: Percentage; NS: Non-Significant at $P>0.05$; ***: Significant at $P<0.001$.

In the study area, about the 32.3% of the respondents also use different types of the non-conventional feeds. The availability of non-conventional feed resources varies across the agro ecologies. It was 46%, 18% and 25.6% in the highland, midland and lowland agro ecologies respectively. During field observation and focus group discussions, the non-conventional feed resources includes; local brewery by-products (Atella/cheka), Banana and Enset leaves, Moringa leaves, chat (Catha edulis) leaves, Terminalia spp and Cordia abyssynica leaves, dashille, and sugarcane tops especially utilized during feed shortage or dry seasons. According to the respondents, cheka atella is frequently used as protein supplements and farmers use it

as substitute to commercial concentrate supplements. Similar feeding practices were experienced during the dry season in the mid-highlands of Ethiopia[37, 38], where farmers feed their cattle with Enset pseudo stem, pseudo stem and leave of Banana, parts of sugar cane and its bagasse, and leaves from different trees. Additionally, farmers used aftermath grazing as one means to sustain their cattle before they started feeding of collected crop-residues. It was practiced after harvesting of (wheat, teff, barely, maize and sorghum) crops. 44.1% of respondents practice grazing of crop-aftermath. Comparably, crop-aftermaths are the major feed source in dry season in South-western Ethiopia [39]. There is highly significant difference ($p<0.05$) across each agro-ecologies and about 52.5%, 15.4% and 50% of respondents respectively in the highland, midland and lowland altitudes practiced grazing of crop-aftermaths. According to survey study the average day of grazing their livestock on the field of crop-aftermath was 13.47±1.4 days and highly significant differences ($p<0.05$) are observed in different agro-ecologies. Mostly there was no trend of giving other feed resources during grazed on crop-aftermath or stubble- grazing. But only about (26.2%) of respondent in the study area provide other feed in addition to stubble-grazing. Generally, there are different crop-residues have utilized by livestock in the study area and accordingly, Teff-straw was dominant crop-residue followed by Maize-stover, Sorghum-stover, Barely straw and wheat straw, respectively in highland area with an index value of (0.3), (0.27), (0.21), (0.12) and (0.08). However, Maize-stover more dominant crop-residues followed Sorghum-stover and Teff-straw in midland agro-ecology with index value of (0.45), (0.3) and (0.25). In lowland agro-ecology, Maize-stover, Sorghum-stover and Teff-straw used as source of crop-residues for livestock with index value of (0.44), (0.32) and (0.28), respectively.

Table 5: The most commonly used of crop-residues type in the Derashe Special District.

Parameter	Agro-ecologies					
	Highland(N=78)		Midland (N=39)		Lowland (N=78)	
crop residues	Index	Rank	Index	Rank	Index	Rank
Maize-Stover	0.27	2nd	0.45	1st	0.44	1st
Sorghum-Stover	0.21	3rd	0.25	3rd	0.32	2nd
Teff-Straw	0.30	1st	0.30	2nd	0.28	3rd
Wheat-Straw	0.08	5th	-	-	-	-
Barley-Straw	0.12	4th	-	-	-	-

*Index= [(5 for rank 1) + (4 for rank 2) + (3 for rank 3) + (2 for rank 4) + (1 for rank 5)] divided by sum of all crop residues mentioned by respondents and N: Sample size in each agro-ecologies.

Seasonal availability of feed resources

The seasonal feed availability in the study area is presented in **Table 6**. The overall HHs indicated that natural pasture, private grazing-land, cultivated-forage and tree legume are more feeds available during the months of May to December and less available to January to April. The crop-residue and crop-aftermath are more available during from the December to Feb and July to August based on the two main cropping seasons prevailed in the study area. In line with this, the study reported by [40] showed that crop-residues and stubble grazing were the major feed resources during the dry seasons in Burie Zuria District, North-western Ethiopia. These feed source availability varied based on difference in altitude, season and feed resources management practices. The reported study by different researchers evidenced that the monthly feed shortage variation among watershed might be attributed by differences in agro-ecologies, feed resource management and landholding size [41,42]. The feed resources availability in the study areas is similar to the feed resources availability in most highlands of Ethiopia [43,44]. Similar to the present finding, the study reported by [45] showed that the principal dry season feed resources available to livestock in Bure district Amhara region include crop-residue, stubble grazing, natural-pasture and hay, while the natural-pasture, crop-residue, hay and stubble grazing were the wet season feeds. The study result on the livestock feed accessibility and type were vary according to seasons of the year, which is consistent with earlier report of [46]. From the present finding, the natural-pasture is major feed resource in wet season, while the crop-residues and stubble grazing were reported to be the major feed resources during the dry seasons. In line to present study, the study reported by [47] revealed that natural- pasture as the major feed sources in wet seasons, while crop-residues and stubble- grazing were major feed source during the dry seasons in Doyogena district, south-western Ethiopia.

Table 6: Seasonal feed availability pattern in year round at Derashe Special District.

Feed sources	Months in year											
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Natural pasture	Xx	Xx	Xx	Xx	X	X	X	X	Xx	Xx	Xx	Xx
Private grazing	Xx	Xx	Xx	Xx	X	X	X	X	Xx	Xx	Xx	Xx
Cultivated forage	Xx	Xx	Xx	Xx	X	X	X	X	Xx	Xx	Xx	Xx
Crop residue	X	X	X	Xx	Xx	Xx	X	X	X	X	Xx	Xx
Aftermath	X	X	Xx	Xx	Xx	Xx	X	X	X	X	Xx	Xx
Tree legumes	Xx	Xx	Xx	Xx	X	X	X	Xx	Xx	Xx	Xx	Xx

Note: X: Feed less available month(s); Xx = Feed sources highly available.

Livestock feed utilization practices

In the study, area livestock feed utilization practices are presented in **Table 7**. The result showed that the majority (75.4%) of respondents were reported that they fed their livestock by cut and carry system by chopping (Figure 2) followed by free-grazing on communal-land (12.3%), combination of cut and carry system, free grazing on communal-land and private-grazing (9.74%) and private grazing (2.56%). The finding of this study was contrary to[25] who reported (94.5%) free-grazing, (4.4%) cut and carry and (1.1%) tethering of feeding systems in Jeldu district.

Table 7: Livestock feeding system in the Derashe special district.

Parameter	Agro ecology								p- value
Livestock feeding systems (%)	Highland (N=78)		Midland (N=39)		Lowland (N=78)		Overall (N=195)		
	n	%	n	%	n	%	n	%	
Free-grazing	10	12.82	-	-	14	17.95	24	12.31	<0.001
Private-grazing	2	2.56	2	5.1	1	1.28	5	2.56	
Zero-grazing	66	84.6	37	94.9	44	56.4	147	75.4	
Combination of above system	-	-	-	-	19	24.4	19	9.74	

N: Number of Sample Size; %: Percentage; NS: Non-Significant at $P>0.05$; *: Significant at $P<0.05$; **: Significant at $P<0.001$.

Grazing-land and its management

The grazing-land and its management in the Derashe special district are presented in **Table 8**. The majority of respondents (63.1%) were not used communal grazing-land, while the remaining portion (36.9) has used communal-grazing-lands. Respondents perceived differently on the status of communal-grazing-lands and majority of respondents (25.6%) reported that no-change occurred in the communal grazing-land, but very few (0.5%) respondents were reported that the increases the status in communal-grazing-land, while about 10.8% reported as communal-grazing-land was decreasing from the time to time due to overgrazing by free-grazing practice. Similarly the study reported by [36] showed that the decline in the size of the grazing-land and degradation through overgrazing and the expansion of arable cropping. Moreover, the study reported by [48] indicated that the reduction of natural-pasture by overgrazed and degraded communal-grazing areas due to recurrent drought in the Bale highlands of Ethiopia. The communal-grazing-land was mostly found in highland altitude (29.5% of respondent) was tree covered and in lowland altitude (61.5% of the respondents) was bush covered and was only 2.6% in midland altitude. In the study area only 21% of respondent own private-grazing land which mostly was utilized by cut and carry system. Private-grazing-land was almost found in midland altitude (81.5%) and less in highland (3.8%) and lowland altitude (7.7%). In the highland and lowland agro-ecologies most of the grazing-land is communally owned. This private grazing-land is mostly found on the sideways of crop-land, on land which not productive for crop-cultivation and eroded areas of farm-land. Similarly, the reported by [49] was demonstrated that communal and private pasture-land; roadside and swampy areas were the sources of natural-pasture in Essera Woreda. The 6.1%, 22.6 % and 29.2 % of respondents in the study area practices the continuous, differed and zero grazing systems, respectively. Similar practices were reported by [26] from Humbo Woreda of Wolaita Zone for dairy cattle feeding systems (free grazing, rotational-grazing and zero-grazing). Overall in the study area, there was poor management of grazing-land, only 6.7% of respondent uses manure application, 9.7% practices weeding, and 19.5% did not apply any management activities to grazing-lands. The current finding is contradicted to the finding reported by [50] which indicated that (14.8%) households apply fertilizer, (51.8%) households apply cattle manure on grazing-lands, and only 22.5% of the respondents manage their pasture-land, while the majority (77.5%) did not manage their pasture-land in central highlands of Ethiopia.

Figure 2: Cut and carrying and chopping of feed practiced by Derashe farmers.

Table 8: Grazing-land and its management practice in Derashe Special District.

Parameter		Agro ecology								P-value
		Highland (N=78)		Midland (N=39)		Lowland (N=78)		Overall (N=195)		
		n	%	n	%	n	%	n	%	
HHs using communal-grazing	Yes	23	29.5	1	2.6	48	61.5	72	36.9	< 0.001
	No	55	70.5	38	97.4	30	38.5	123	63.1	
Status of communal grazing-land										
Decreasing		12	15.4	1	2.6	8	10.2	21	10.8	< 0.001
Increasing		1	1.3	-	-	-	-	1	0.5	
No change		10	12.8	-	-	42	53.8	50	25.6	
Type of communal-grazing										
Open		2	2.6	-	-	6	7.7	8	4.1	< 0.001
Tree covered		19	24.4	1	2.6	3	3.8	23	11.8	
Bush		2	2.6	-	-	34	43.6	36	18.5	
Swampy		-	-	-	-	5	6.4	5	2.6	
Management of grazing										
Fertilizer		-	-	-	-	2	2.6	2	1	< 0.001
Manure		12	15.4	-	-	1	1.3	13	6.7	
Weeding		11	14	1	2.56	7	8.9	19	9.7	
No management		-	-	-	-	38	48.7	38	19.5	

N: Number of Respondents; % = Percentage; ***: Significant at (p<0.01).

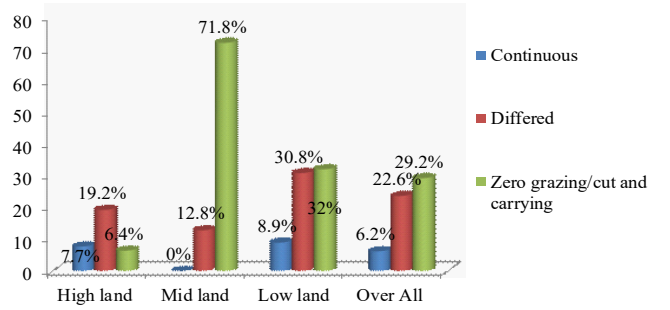

Figure 3: Grazing-types practiced in the Derashe Special district.

Crop-residues storage, treatment and feeding practices

The crop-residues storage, treatment and feeding practices in the study area are presented in **Table 9**. In the study area, almost all (97.4%) respondents stored crop- residues by stacking outside, while very few (1.5%) were baled outside, only 1% of them are stacked under shed and 1% bale under shed. Almost all respondents of three agro-ecologies were reported that they stacked outside the crop-residues, which are similar to report of [21], which showed that 91% of the farmers stored the crop-residues by stacking outdoor near homesteads in Yerer area. The other study reported by [24] showed that only about 7.04% of farmers were stack outside on the field or around homestead without any shedding in Jimma Zone, South-west Ethiopia which is contradicted finding from the present study. This exposes the crop-residues for rain and direct sun-radiation resulting deterioration in quality overtime and feed wastage. Also report of [50] showed that nutritional-quality of crop-residues is highly affected by storage method and storage duration as investigated in Teff and wheat straws. In the study area, majority of respondents (93.3%) were reported that farm-land was the sources of crop-residues and whereas, very few (6.7%) were obtained crop-residues through purchasing from local-market. On the other hand, about 66.7% and 24% respondents were reported that they had started feeding crop-residues soon after collection and one month after collection, respectively, while very few (8.2%) of respondents were provided the crop-residues to livestock after two month of collection. It is apparent that crop-residues is poor in quality and improvements of low quality feed are imperative to improve its' feed intake and digestibility by animal. The majority (52.3%) of respondents in the study area had treated crop-residues by chopping; while about 22% of them were, did not treated crop-residues in order to improve nutrient value of crop-residue. During focus group discussion with respondents, they mentioned that the lack of knowledge how to improve low-quality feed was the main problems in the study area. Similarly, report of [51] indicated that generally low-quality-feed improvement practices are not commonly utilized by the small-holder farmers in Ethiopia due to lack of awareness, skill gap and inputs.

Table 9: Crop residues storage, treatment methods and feeding practices.

Parameter	Agro ecologies								
Storage place (%)	Highland (N=78)		Midland (N=39)		Lowland (N=78)		Overall (N=195)		P-value
	n	%	n	%	n	%	n	%	
Stacked outside	78	100	37	94.87	75	96	190	97.4	0.247
Stacked under shed	-	-	1	2.56	1	1.3	2	1	
Baled outside	-	-	-	-	1	3.8	1	1.5	
Baled under shed	-	-	1	2.5	1	1.3	2	1	
Sources of crop-residues (%)									
Purchased	4	5.13	1	2.56	8	10.26	13	6.66	0.227
Produced on-farm	74	94.87	38	97.4	70	89.7	182	93.33	
Time of feeding (%)									
Soon after collection	75	96	15	38.5	40	51.3	130	66.7	< 0.001
One month after	1	1.3	17	43.5	29	37	47	24	
Two month later	2	2.56	6	15.4	8	10.3	16	8.2	
Over two month	-	-	1	2.56	1	1.3	2	1	
Treatment methods (%)									
Chopped	49	62.8	31	79.5	11	28	91	52.3	< 0.001
Water soaking	6	7.7	6	15.4	5	6.4	17	8.7	
Mixing green fodder	21	27	2	5.1	9	11.5	32	16.4	
No treatment	2	2.56	-	-	41	52.5	43	22	
Other(Atella and salt)	-	-	-	-	11	14.1	11	5.6	

N: Number of Sample Size; %: Percentage; NS: Non-Significant; *** : Significant at P<0.01.

Improved forage production practice

The improved forage production practice in the study area is presented in **Table10**. Above half (56.9%) of respondents of three agro-ecologies were reported that they had grown improved forage on their own land while, remaining portion were not participated in improved forage production. The numbers of households cultivating improved forages are still small. Similarly, the study reported by [7] indicated that forage development is a key to skip for feed shortages and some browse legumes species like Sesbania, Tree lucerne and Pigeon pea and herbaceous legumes likes Alfalfa, Desmodium and Lablab and grasses like Elephant, Desho, Rhodes and Guatemala species which were cultivated in FTC in mid and highland altitudes on backyard, fences and roadside of farm-land of households. The overall respondents were reasoned out that, they involved in cultivation of forages due to get high forage yield and quality-feeds (26%), to control soil run-off (27%) and to fertilize the soil (7%). However, the reasons for not cultivating the improved forages are the shortage of land (34.4%), shortage of forage seed (0.5%), lack of awareness (1.5%) and lack of interest (6.7%). In support to result from the present study, the study reported by [52] demonstrated that there was no-improved-forages cultivation for cattle at small-holders level in Southern Ethiopia due to insufficient land, capacity gap, lack of access to information, poor extension service and lack of inputs (planting materials). The overall the total land allocated for improved forage in the study area was 0.44ha which was less than the result reported by [29] which demonstrated that households allocate about 0.51ha of their land for pasture production in Bahir Dar Zuria and Mecha Woreda. Moreover, the [53] reported that about (93.8%) of dairy farmers' allocated land for improved forages development, with an average area of 0.4ha in Bako, western Ethiopia. The majority (35.9%) of the respondents were reported that they provided improved forage to their livestock though the cut and carry system and whereas, very few (1%) had utilized forage by grazing, while about 20% were practice both grazing and cut-carry system.

Table 10: Status of improved forage production and utilization practices in Derashe district.

Parameter		Agro ecology								P-value
		Highland (N=78)		Midland (N=39)		Lowland (N=78)		Over all (N=195)		
		n	%	n	%	n	%	n	%	
Do you plant improve forage (%)	Yes	35	44.9	33	84.8	43	55.1	111	56.9	<0.00
	No	43	55.1	6	15.4	35	44.9	84	43.1	
Utilization of improved forage										
Grazing		1	1.3	-	-	1	1.3	2	1	<0.001
Cut and carry		34	43.6	29	74.4	7	8.9	70	35.9	
Both		-	-	4	10.3	35	44.8	39	20	
Reason not to produce improve forage										
Shortage of land		28	36	5	12.8	34	43.6	67	34.4	<0.001
Shortage of forage seed		-	-	-	-	1	1.3	1	0.5	
Lack of awareness		2	2.6	1	2.6	-	-	3	1.5	
Not interested		13	16.7	-	-	-	-	13	6.7	
The land allocate for improved forage (Mean ± SE)										
Grass species		0.02±0.09		0.08±0.01		0.03±0.07		0.04±0.06		<0.002
Legume species		-		-		0.21±0.06		0.19±0.06		
Fodder species		-		0.06±0.02		0.23±0.05		0.21±0.01		

N: Number of Respondents; %: Percentage; SEM: Standard Error of Mean; NS: Non-Significant; ***: Significant at P<0.01.

Table 11: Feed preservation practices used by households in the Derashe district.

Parameter		Agro-ecologies								P-value
		Highland (N=78)		Midland (N=39)		Lowland (N=78)		Overall (N=195)		
		n	(%)	n	(%)	n	(%)	n	(%)	
Do you conserve feed as hay	Yes	22	28.2	30	76.9	54	69.2	106	54.9	<0.001
	No	56	71.8	9	23.1	24	31.8	89	45.1	
Time of use conserved feed										
During dry season		17	21.8	22	56.4	37	47.4	76	39.5	<0.001
During wet season		2	2.6	5	12.8	3	3.8	10	5.1	
Any times		3	3.8	3	7.7	14	18	20	10.3	
The reasons not conserve feed (%)										
Inadequacy of forage		41	52.6	6	15.4	17	21.8	64	32.8	<0.001
Labor shortage		15	19.2	3	7.7	7	9	25	12.8	

N: Number of Respondents; %: Percentage; ***: Significant at P<0.01.

Feed preservation practices

The feed conservation and preservation practices used in the study area are presented in **Table 11**. The forage conservation helps to bridge the quantity gap between livestock feed requirements and the production of forage [52]. In the study area about 54.9% of the respondents preserved feeds as hay form, while about 45.1% did not preserved. The respondents of three agro-ecologies were mentioned that lack of practice of feed preservation during the time of surplus production, leads to feed shortage. In support to the result from the present study, the study reported by [22,54] showed that feed shortage is aggravated in Salamago district in South zone and Jimma zone, respectively due to absence of feed-conservation practices. In the study area, there are no silage making practice due to lack of knowledge, lack of proper tools, shortage of land and shortage of forage. The conserved feeds as hay can be utilized during dry season (39.5%), wet season (5.1%) and any times during feed shortage (10.3%).

Livestock feed production constraints and coping up strategies

The frequent climate variability, deterioration in grazing-land, expansion of farming-land and increments in human population are reported by respondents of three agro-ecologies major feed production constraints that have been affecting livestock production system. The causes for these constraints were ranked by respondents as shortage of land (33.3%), overpopulation (28.2%), drought (26.2%), crop expansion (6.6%), overgrazing (4.1%) and settlement (1.5%) in descending order. Agro-ecologically, in highland altitude; drought, crop expansion, overgrazing, shortage of land, settlement and overpopulation respectively in descending order are the causes of feed shortage, in midland altitude; shortage of land, crop expansion, settlement, drought, overgrazing, and overpopulation respectively in descending order are causes of feed shortage and in lowland altitude; overpopulation, land shortage of land, crop expansion, settlement, overgrazing and drought, respectively are the causes of feed shortage in the study area. The shortage of land for fodder production is due to expansion of crop cultivation and farmers allocated more land for crop production than forage production. These observations are agreed with reported finding by [55] which indicated that lack of rainfall, over-grazing, scarcity of land and drought are major causes for shortage feed in dry and wet seasons **Table 12**.

Table 12: Ranks of major causes of feed- shortage in the Derashe district.

Parameter	Agro-ecologies					
	Highland (N=78)		Midland (N=39)		Lowland (N=78)	
Causes of Feed shortage	Index	Rank	Index	Rank	Index	Rank
Drought	0.21	1st	0.18	4th	0.1	6th
Overgrazing	0.18	3rd	0.12	5th	0.14	5th
Crop expansion	0.19	2nd	0.19	2nd	0.17	3rd
Shortage of land	0.17	4th	0.24	1st	0.23	2nd
Settlement	0.12	5th	0.18	3rd	0.13	4th
Overpopulation	0.11	6th	0.08	6th	0.24	1st

*Index = [(6 for rank 1) + (5 for rank 2) + (4 for rank 3) + (3 for rank 4) + (2 for rank 5) + (1for rank 6)] divided by sum of all feed resources mentioned by respondents and N: Number of Respondents Each Agro-Ecology.

Table 13: Consequences of the feed shortage in the Derashe district.

Parameter	Agro-ecologies								
	Highland (N=78)		Midland (N=39)		Lowland (N=78)		Overall (N=195)		p-value
The consequences of feed shortage (%)	n	%	n	%	n	%	n	%	
Weight loss	45	70.5	24	61.5	42	53.8	111	56.9	<0.001
Meat yield reduction	24	30.8	11	28	22	28	57	29.2	
Increase mortality	3	3.8	3	7.7	6	7.7	12	6.2	
Weakness	6	7.7	1	2.6	8	10.3	15	7.7	

N: Number of Respondents; %: Percentage, NS: Non-Significant *** : Significant at P<0.001.

Table 14: Coping Mechanism of feed shortage in the Derashe special district.

Parameter	Agro ecology							
	Highland (N=78)		Midland (N=39)		Lowland (N=78)		Overall (195)	
Coping mechanism to feed shortage	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Feed preservation as hay	0.1543	2nd	0.24908	1st	0.1997	1st	0.1912	1st
Use of improved forage	0.1474	3rd	0.20496	2nd	0.1543	2nd	0.1617	3rd
Purchase feed supplement	0.1236	6th	0.05974	7th	0.0893	7th	0.0973	7th
Forage purchase	0.2013	1st	0.14614	4th	0.1375	5th	0.165	2nd
Destocking	0.1205	7th	0.10386	5th	0.1431	4th	0.1261	5th
Use of browse trees	0.1241	5th	0.16912	3rd	0.1277	6th	0.1346	4th
Travelling long distances	0.1287	4th	0.06716	6th	0.1483	3rd	0.1241	6th

*Index= [(7for rank 1) + (6 for rank 2) + (5 for rank 3) + (4 for rank 4) + (3 for rank 5) + (2 for rank 6) + (1 for rank 7)] divided by sum of respondents and N: Number of respondent.

According to survey study and FGDs the sever months of feed shortage occurrences in highland Jan, Feb, Mar and Apr, in midland; Jan, Feb, Mar and April and in lowland altitude, Jan, Feb and Mar. These sever feed shortage were resulted in weight loss (56.9%), milk yield reduction (29.2%), increase mortality (6.2%) and weakness (7.7%) of animals and highly significant difference ($P < 0.05$) among agro-ecologies. Similar observation was reported by [56] from the highlands and central rift-valley of Ethiopia, which pointed that the weight loss, lower milk yield and mortality were occurred in livestock are an important consequences due to feed shortage. These low availability and quality of feeds especially in the dry seasons tends to affect the productive and reproductive performance of livestock. The finding from present study was similar with finding of [57], which indicated that the feed shortage is prevalent throughout the year in both in dry and wet seasons **Table 13**.

However, the households were alleviated the feed shortage by different measures. Overall the copping-up methods of feed shortages are feed preservation as hay, feed purchase, use of improved forage and browse trees, destocking, travelling long distances and purchase feed supplements. In support to findings from this study, farmers from Umbulo Wacho watershed in southern Ethiopia reported that conserving crop-residues and travelling animals to areas where better feed availability is the main coping-up mechanisms [58]. Also the reported by [45] indicated that five major feed shortage coping-mechanisms as collection and storing of crop-residues (92.16%), preparing of hay from farm boundaries (54.25%), utilizing of browse species (50.93%), utilizing of supplementary feeding either by purchasing or home grown (44.39%) and selling of older and unproductive animals (28%) **Table 14**.

Table 15: Chemical compositions of selected feeds resources in the Derashe special district.

Chemical compositions							
Feed samples		DM%	Ash (g/kg, DM)	CP (g/k, DM)	EE (g/kg, DM)	NDF (g/kg, DM)	ADF (g/kg, DM)
Highland	Natural-pasture	93.9	36.7	85.9	28.9	721	546
	Wheat-straw	91.7	121.7	33.9	23.6	784	556
	Barely-straw	90.2	81.5	43.0	9.3	765	605
Midland	Natural-pasture	94.0	105.9	75.9	16.6	709	515
	Wanza leaf	90.2	80.3	141.9	20.5	770	582
	Sorghum-stover	94.5	101.6	39.9	16.4	735	532
	Teff-straw	90.5	38.1	40.98	21.2	787	458
Lowland	Natural-pasture	94.9	67.4	65.98	18.3	711	456
	Weyibata leaf	91.6	11.5	120.0	7.6	622	527
	Sorghum-stover	90.8	83.7	24.99	35.7	717	537
	Maize-stover	93.7	10.57	46.0	12.2	779	663

DM%: Dry Matter Percentage; CP: Crude Protein; EE: Ether Extract; NDF: Neutral Detergent Fiber; ADF: Acid Detergent Fiber.

Opportunities for feed production

The opportunities for livestock feed production in the study area were high demand for livestock products, high price for livestock and livestock products and better marketing access. The area is also potential of crop-livestock mixed agriculture having large amount of crop-residues production which used as livestock feed sources. The diversified seasons with agro-ecologies are also an important for livestock production and improved feed production.

Chemical composition of major feeds

Chemical compositions of major feed used by livestock in the area are presented in Table 15. The dry matter percentage (DM %) of the natural-pasture for three agro-ecologies ranged from 93.85% to 94.9% which is higher than DM% of indigenous browse leaves and crop-residues. The DM% of crop-residues and natural-pasture from this study are 90% and above, which is similar to study reported by [58] from the North Gonder zone. The higher ash was observed for wheat-straw, while lower is for Teff-stra, whereas the ash content of natural-pasture ranged from 36.7 to 105.9g/kg, DM. The result from the present study for Barely-straw was lower than reported value of ash content of Barely-straw (146.1g/kg, DM) by [59] for different parts of Ethiopian highlands. The higher CP was observed for *Terminalia spp*. (120g/kg, DM) and *Cordia abyssynica (141.9g/kg, DM)* leaves, but lower CP was for crop-residues which ranged from (25g/kg, DM) to (46g/kg, DM) and natural-pasture had higher CP which ranged from (65.9g/kg, DM) to (85.9g/kg, DM) than crop-residues. The CP content of wheat-straw (3.41 % DM) was higher than the reported value of (2.4% DM) by [4] for the central highlands of Ethiopia. The CP content of crop-residues (25-46g/kg, DM) from this finding was lower than the minimum threshold level of CP (75g/kg, DM) required for optimum rumen function and feed intake in ruminant livestock but the CP contents of indigenous browse leaves (120-1419g/kg, DM) was higher than the minimum requirement level and while the CP of natural-pasture (65.9-85.9g/kg, DM) was satisfied the minimum requirement of ruminant animals. The NDF content of all sampled major feeds from the present study ranged from (622g/kg, DM) to (787g/kg, DM). According to classification of [60] the feeds with NDF content less than (450g/kg, DM) categorized as high quality feed, (450g/kg, DM) to (650g/kg, DM) as medium quality feed and those with more than (650g/kg, DM) as low quality feeds. Hence, based on this classification, the feed resources in the study area categorized as low-quality-feed-class and further investigations are required to improve feeding value of feed utilized by the livestock in the study area. Similarly, the [61] reported that feeds that have above (550g/kg, DM) was limited dry matter intake by the ruminant-animals. The ADF contents of the natural-pasture from this result ranges from (456g/kg, DM) to (546g/kg, DM); crop residues from (458g/kg, DM) to (605 g/kg, DM) and browse trees (527g/kg, DM) to (582g/kg, DM). Comparable to ADF values of natural-

pasture was reported by [62] that ranged from [399.7g/kg, DM) to [522g/kg, DM] for the Northern highlands of Ethiopia. Generally, the reported by [63] was categorized roughages with less than 40% ADF as high quality and above 40% as low quality. So, the crop-residues and natural-pastures could be categorized as low-quality-feeds in the study area and should be supplemented with high-quality-feeds. High ADF content in crop-residues is due to all usable nutrients are converted in to grain during grain filling and this make lower digestibility potential of crop-residues[64]. Generally, the nutritive-value of feed is variable depending upon the species and variety of the crops, time of harvest, handling and storage conditions [59]. Moreover, the nutritive value of crop-residues is variable depending upon the species and variety of the crops, time of harvest handling and storage conditions and other factors [65].

Conclusions and recommendation

In the study area, largest feed is contributed from crop-residues, while lower contribution is from improved forages. The improved forge development was not widely practiced and non-conventional feed crop aftermath grazing used to sustain livestock. The maize and sorghum-stovers and teff straw are the most common crop-residues used as animal feed resources in the study area, but wheat and barley-straws are only used as feed source in the highland agro-ecology. The free grazing, cut and carry system, private grazing are important livestock feed utilization practices. The communal-grazing-lands, which used as feed source in the study area, are deteriorated and diminishing from time to time, which causes the feed shortages. Feed was conserved only in the form of hay and there was no silage making practice prevailed at all in the study agro-ecologies. The land shortage, fast population growth, drought, crop expansion and over-grazing were major constraints for livestock feed production, whereas high demand for livestock products, high price for livestock and livestock products, and better marketing access for livestock feed are an important opportunities. The crop-residues and natural-pasture which dominantly used by livestock had low crude protein and high fiber contents, while browse species had high crude protein content. Generally, the majority of livestock feeds used in the study area are poor in crude protein content and hence, farmers should be advised to improved forages species production, introduction of home-made concentrate supplements and feeding practices, conservation and development of forage bank, improve poor quality feeds like crop-resides and establishing strong extension-services on feed resource development for boosting of livestock productive and reproductive performances.

Conflict of interest

We declared that this manuscript is our original work and not published elsewhere and no competing claims among us.

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