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Feed Resources Available and Evaluation of Their Nutritional Qualities in Lalo Kile District of Kellem Wollega Zone, Western Ethiopia

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Abstract: This study was conducted to assess the livestock feed resources and nutritional qualities in Lalo kile district of Kellem Wollega zone, western Ethiopia in terms of quantity proportion and quality and evaluate the efficiently utilization of available feed resources. Stratified random and purposive sampling techniques were used to select the kebeles and target households. The district was stratified into two agro ecologies, mid and low altitude areas. A total 127 households, 66 from three mid altitude and 61 from three low altitude Kebeles were selected for interview. Structured questionnaire, secondary data sources and field observations were employed to generate the qualitative data; while laboratory chemical analysis was used to get the quantitative data. The surveyed data were analyzed using GLM ANOVA procedures for social sciences (SPSS, version 20). The result of the study indicated that natural pastures (36%), crop residues (34.49%), fodder trees and shrubs (15.60%), stubble crops (8.13%), non-conventional feed (4.46%) and others were the proportion of major available feeds resources with varied in agro ecologies. The average annual dry matter production from natural pasture, crop residues, fodder trees and shrubs, stubble crops, non-conventional feed and improved forages were 4.30±0.11, 4.03±0.11, 1.83±0.01, 0.96±0.03, 0.52±0.04 and 0.16±0.03 tons/household/year, respectively. About 51 different indigenous shrubs and fodder tree species were identified (25 species of shrubs and 26 species of trees) edible by livestock in the study area. In the dry season most of available feed resources were of poor nutritional values with significant differences in agro ecologies ($p<0.05$) due low crude protein and high cell wall fiber components (ADF and NDF) hence their digestibility is low in natural pastures feeds and crop residues and strategic supplementation of protein and energy rich feeds fodder trees like Rhoicissus tridentata, Cucumis ficifolius, Combertum paniculatum, Acanthus polystachius should be provided.

Key words: Feeds · Feed Proportion · Chemical Composition and Nutritive Values of Feeds · Lalo Kile

INTRODUCTION

Ethiopia holds a substantial potential of livestock population with diversified agro ecologies, currently estimated at about 56.71 million cattle, 29.33 million sheep, 29.11 million goats, 2.03 million horses, 7.43 million donkeys, 0.4 million mules, 1.16 million camels, 56.87 million poultry and 5.89 million beehives [1]. Livestock rearing is practiced in almost all parts of the country across all agro-ecological set up. However, the productivity of the livestock resources and the benefits obtained from the sector does not proportionate with the high livestock population due to various constraints [2]. Among these constraints issues related to feed are the most severe ones. The limited feed supply and poor qualities of the available feeds are the major constraints for optimal livestock productivity in tropical and sub-tropical countries [3].

The progressive decline of average farm sizes in response to rising human populations, encroachment of cropping land onto erstwhile grazing areas and onto less fertile and more easily erodible lands and expansion of degraded lands, which can no longer support either annual crops and pastures that contributes to shortage of feed resources [4].

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In this respect, Lalo kile district is not exceptional and the same trend was observed due to prioritizing better lands for cultivation results to compete grazing lands. To this effect, comprehensive survey of the types, quantity, quality, availability, alternative uses and relative costs of the different feed resources are important to characterize the feed resources and to facilitate the decision making process in livestock feed resource development under small holder conditions.

The information on nutritional characterization of locally available feed resources at country level is inadequate and where the available values are variably documented [5]. The great diversity and nutritional characterization of feeds in the study district in particular have not yet been investigated. Therefore, the main purpose of this study was to generate base-line information on characterization of available livestock feed resources in terms feed quantity and nutritional qualities and evaluate the efficiently utilization of available feed resources in study area.

MATERIALS AND METHODS

Description of the Study Area: The study was carried out in Lalo kile district of Kellem Wollega zone, Western Ethiopia, which is located at distance of 510km west of Addis Ababa, the capital city of Ethiopia. The district is situated at 8°43' 36"- 9°3' 31"N of latitude and 35°12'52"-35°26'54"E longitude. The altitude ranges between 1430-1780m.a.s.l.The mean annual rainfall ranges from 1000 to 1500mm per annual. The minimum and maximum daily temperatures of the area are 15°C and 31°C respectively.

Sampling Procedure and Methods of Data Collection: For this study, stratified random and purposive sampling techniques were used to select the kebeles and households, respectively. The district is stratified in to two agro-ecological zones, mid altitude from 1500-2000m.a.s.l.and low altitude from less than 1500 m.a.s.l. Totally 127 representative sample farmers were selected by using the reduced formula according to Yamane [6].

$$n_1 = \frac{n_o}{1+\frac{n_o}{N}} = \frac{13_8}{1+\frac{1_1 38}{1_1 650}} = 127$$

Feed Quantity Assessment: The quantity of dry matter production obtainable from natural pastures was estimated by conversion factors of 3.0 t /ha for private grazing land, 1.8 t/ha for fallow land, 2.0t/ha for communal grazing, 0.50 t/ha for stubble crops, 8t/ha for improved forages and 1.2t/ha for wood, bush and shrubs. The quantity of dry matter (DM) output from major crop residues by conversion of grain yields to fibrous multipliers of 1.5 for wheat, barley, oats and wheat, 1.2 for field pea, faba bean and linseed, 2.0 for finger millet, 0.3 for sugar cane, sweet potato and other root & tubers, 4 for noug and linseed, 0.25 for vegetables waste and 8 for banana [7].

Feed Sampling and Preparation: The sample feeds were collected during dry season from January to March and wet season in late July to August to conduct the chemical composition and nutritive values of feed resources based on agro ecology. While identifying

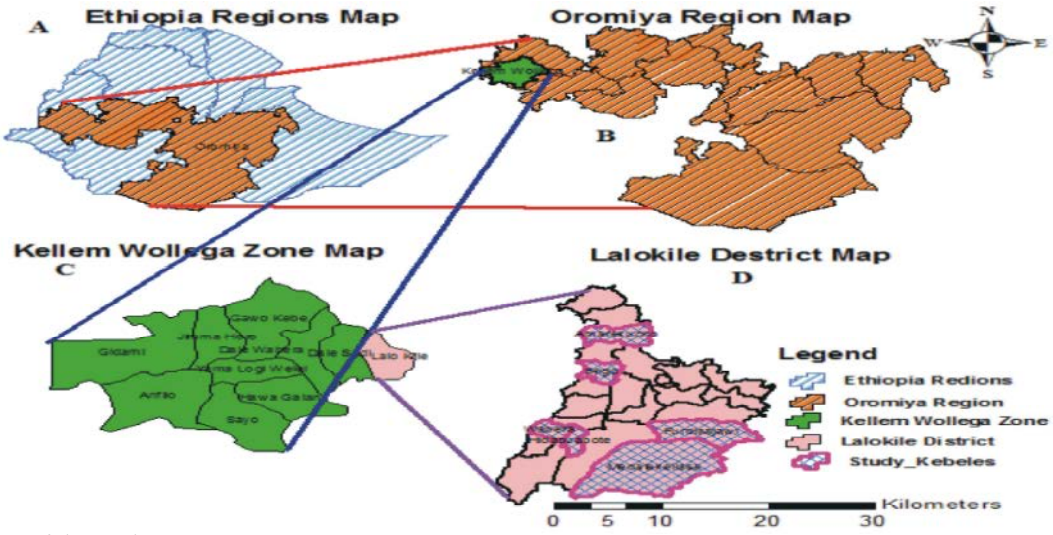

Fig. 1: Map of the study area

the available feed resources, the households were requested to rank the major resources based on their palatability, dominance and ability to maintain greenness for chemical analysis.

Chemical Analysis of Sample Feed: The various samples of feed resources collected were processed and subjected to proximate analyzed. The dry matter, total ash, crude protein, crude fiber, crude fat and acid-detergent fiber were determined according to AOAC [8]. Neutral-detergent fiber determination was following according to Van soest *et al*. [9] procedures. The NDF was analyzed without a heat stable amylase where as ADF result was expressed without residual ash. Metabolizable energy content of each feed resources for tropical forages and concentrates was estimated by multiple regression model and summative equation developed by Abate and Meyer [10].

$$ME\ (MJ/kg\ DM) = 5.34 - 0.1365CF + 0.6926NFE - 0.0152NFE^2 + 0.0001NFE^3$$

where
NFE = %DM - (%EE + %CP + %CF + %Ash) according to McDonald *et al.*[11].

The Digestible Crude Protein (DCP) of feed resources was estimated according to the equation developed by FAO [12].

$$DCP\ (g/kg) = 0.929 \times CP\ (g) - 3.52$$

Statistical Analysis: The GLM ANOVA model was used to analyze the quantitative data and least significant difference at $p<0.05$ level tests were used. When the F-test showed significant differences, LSD was used to separate the individual means. A feed samples were analyzed using the following statistical model as: $Y_{ijk} = \mu + \alpha_i + \beta_{ij} + e_{ijk}$; Where: Y_{ijk} = Quantity and quality of feed, μ = Overall mean, α_i = the effect of i^{th} agro-ecology (i=1-2), β_{ij} = the effect of j^{th} study season (j=1-2), eijk= random error.

RESULTS AND DISCUSSION

Livestock Feed Resources Available during Dry and Wet Season in the Study Area: The major feed resources available during varied seasons are presented in Table 1. The principal dry season a feed resource available in the study area was crop-residue (34.49%). Whereas in the wet season, natural pastures (36.0%) were the principal feed resources available in study area. Tesfaye [13] reported the major feed are natural pasture (55.7%) and crop residues (20.7%) in dry and in wet season natural pasture is sole feed resources in Metema district of north Gondar.

Quantity of Dry matter Production from Natural Pasture: Natural pasture is one of the major livestock feed resources in wet season providing 51.6% of the feed resources in the study district with a wide range of grasses, legumes and other herbaceous.

Table 1: The proportion of feed resources available in wet and dry season of the study area

	Agro ecologies						
	Overall mean (%)		Mid altitude (%)		Low altitude (%)		
Feed resources (%)	Wet	Dry	Wet	Dry	Wet	Dry	Total
Natural pasture(grazing)	36.39	4.00	29.11	1.25	32.75	3.25	36.00
*Private grazing	16.22	3.65	4.02	2.25	10.12	2.95	13.07
*Communal grazing	6.84	-	16.12	-	11.48	-	11.48
*Fallow grazing land	9.94	-	7.34	-	8.64	-	8.64
*Roadside feed resources	3.39	0.35	1.63	0.25	2.51	0.30	2.81
Fodder trees & shrubs	4.15	8.25	3.00	15.80	3.58	12.02	15.60
Improved forage	0.83	0.83	0.33	0.65	0.58	0.74	1.32
Crop residues	2.50	40.67	1.24	40.84	1.87	40.75	42.62
*Crop residues	-	35.14	-	33.84	-	34.49	34.49
*Stubble crops	2.50	5.53	1.24	7.0	1.87	6.26	8.13

Table 2: The mean annual dry matter production from natural pasture (Tons per household)

	Mid altitude (N=66)	Low altitude (N=61)	Mean (N=127)	
Grazing area	Mean±SE	Mean±SE	Mean±SE	*p-value*
Private grazing land	2.5±0.04	0.70±0.05	1.6±0.03	< .002
Communal grazing land	0.86±0.02	1.80±0.07	1.33±0.04	< .001
Fallow land	1.25±0.02	0.82±0.05	1.03±0.03	< .001
Roadside	0.47±0.01	0.21±0.02	0.34±0.01	< .037
Total	5.08±0.09	3.53±0.17	4.30±0.11	< .001

N=Number of respondents, SE=standard error

Table 3: Dry matters from crop residues and stubble crops per household and its utilization (Tons)

	Midland (N=66)		Lowland (N=61)		Over all (N=127)		
Variable	Mean±SE	%	Mean±SE	%	Mean±SE	%	*p-value*
Maize	0.91±0.03	19.12	1.11±0.07	26.49	1.01±0.05	22.54	<.001
Sorghum	0.81±0.04	17.02	1.03±0.04	24.58	0.92±0.04	20.54	<.001
Finger millet	0.88±0.03	18.49	1.25±0.04	29.83	1.06±0.40	23.66	<.001
Teff	0.55±0.02	11.55	-	-	0.28±0.01	6.25	<.001
Wheat	0.33±0.02	6.93	-	-	0.17±0.01	3.79	<.004
Noug	0.69±0.06	14.50	0.22±0.05	5.25	0.46±0.05	10.27	<.001
Haricot bean	0.12±0.01	2.52	0.26±0.03	6.21	0.19±0.02	4.24	<.001
Barley	0.12±0.02	2.52	-	-	0.06±0.01	1.34	<.086
Sweet potato	0.06±0.00	1.26	0.13±0.00	3.10	0.09±0.00	2.01	<.078
Vegetable	0.05±0.00	1.05	0.03±0.00	0.72	0.04±0.00	0.89	<.049
Soybean	0.15±0.01	3.15	-	-	0.08±0.01	1.79	<.008
Over all	4.76±0.10	100.0	4.19±0.19	100.0	4.48±0.12	100.00	<.001
Utilizable (90%)	4.28±0.01	90.00	3.77±0.19	90.00	4.03±0.11	90.00	<.001
Stubble crops	1.01±0.03	-	0.92±0.05	-	0.96±0.03	-	<.001

N=Number of householder; SE = Standard error

Table 4: List of major shrubs and trees species identified as important to livestock feeds in Lalo kile district

Scientific name	Vernacular Name (Afan Oromo)	% of respondents (n)	Edible parts	Livestock species	Type of fodders
Rhoicissus tridentata	Laaluu	87.80%(58)	Leaf, twigs	Calf, sheep, goats	shrubs
Acanthus polystachius Delile	Sokorru	81.80%(104)	Leaf, twigs	Goats &sheep	shrubs
Teclea nobilis	Gurshane	62.30%(38)	Leaf, twigs	Cattle, sheep & goats	shrubs
Combertum paniculatum	Baggee	65.30%(83)	Leaf	Cattle, goats	shrubs
Myrsine africana L.	Qacama dima	68.80%(42)	Lea f	Cattle sheep and goats	shrubs
Zehneria scara	Hidda reffa	63.90%(39)	Root	Cattle	shrubs
Sapium ellipticum	Bosoqa	93.30%(118)	Leaf, twigs	Cattle, sheep & goats	tree
Ficussur Fossk	Harbu	82.30%(104)	Leaf, pods	Cattle & goats	tree
Bersama abyssinica	Lolchisa	68.50%(87)	Wood ash	Cattle	tree
Schefflera abyssinica	Afarfattu	66.40%(84)	Wood ash	Cattle	tree
Combretum collinum	Dhandhamsa	66.00%(40)	Leaf	Cattle, sheep, goats	tree
Ficusovate	Dambijabbi	90.00%(59)	Leaf, twigs	Cattle, sheep & goats	tree
Mcraceae (Family name)	Madalle	78.30%(48)	Leaf, twigs	Cattle, sheep &goats	tree
Ficusthonningii Blume	Dambii	69.10%(87)	Leaf	Cattle, sheep &goats	tree
Albizia gumifera	Ambabeessa	73.40%(93)	Steam	Cattle, sheep &goats	tree
Vernonai amygadalina	Ebicha	82.50%(54)	Leaf, twigs	Cattle sheep & goats	tree
Rubusapetalus Poir	Goraa	78.00 %(51)	Leaf	Cattle, sheep & goats	tree

Dry Matter Production from Crop Residues and Stubble Grazing: In dry season Crop residues are dominant feed sources in the district. The mean annual DM production from crop residues was 4.76±0.01 and 4.19±0.19tons per household in mid and low altitude area, respectively. The result was less than Dawit *et al*. [14] who reported 10.9±1.1 and 8.5±0.5 TDM per household in Adami Tullu Jiddo Kombolcha district, respectively.

Fodder Trees and Shrubs: The lists of common shrubs and fodder trees identified in dry season were presented in Table 4. The quantity of dry matter production of fodder shrubs and trees from sampled household was estimated 1.56±0.01 ton/hh and 2.10±0.02 ton/hh in mid and low altitudes in study area, respectively.

Improved Forage Feed Resources: The use of improved forages as livestock feed resources was not well adopted by farmers in both agro ecologies of the study area. The proportion of improved forages available was 1.66% in mid and 0.98% low altitude with overall 1.32% of proportion of feed in the study district. Only few farmers in both agro ecologies of the study area had grown *Sesbania sesban, Leucaena leucocephala, Vernonai amygadalina* and *Rubus apetalus* at the back yard both for the purpose of coffee shade and livestock feeds and *Pennisetum purpureum, chloris gayana, Avena saliva, lablab purpureas* at the small plot of land used it as livestock feed. Cultivated forage and pasture crops are mainly important as cut and carry sources of feed and as a supplement to crop residues and natural pastures [15].

Table 5: Chemical composition and nutritive values of major grasses and legumes in study area

	Chemical composition (% DM)									Nutritive values	
Feedstuff	DM (%)	OM	Ash	EE	CP	CF	NDF	ADF	NFE	DCP	ME
Mid altitude area											
Pennisetum clandustinum	90.20^{b}	90.00^{c}	10.00^{a}	2.20^{bc}	13.30^{a}	44.20^{c}	58.50^{bc}	47.40^{c}	18.40^{c}	10.70^{a}	7.30^{d}
Cymbopogon citrates DC.	90.80^{ba}	94.00^{ba}	6.00^{b}	1.30^{d}	9.60^{c}	50.30^{a}	58.40^{bc}	51.53^{b}	23.60^{b}	5.40^{c}	7.80^{c}
Snowdine polystarch	90.70^{ba}	94.50^{a}	5.50^{c}	2.00^{bc}	11.60^{b}	47.00^{b}	59.50^{b}	50.07^{b}	23.60^{b}	8.20^{b}	8.30^{b}
Musa paradisiacal	91.70^{a}	90.20^{c}	9.80^{a}	2.40^{a}	11.40^{b}	40.10^{d}	64.20^{a}	53.20^{a}	27.00^{a}	8.00^{b}	9.40^{a}
CV	1.35	0.27	3.23	9.39	1.54	2.57	1.22	2.38	9.83	2.17	6.68
p-value	<.042	<.0001	<.0001	<.0037	<.0001	<.0006	<.0002	<.0046	<.0050	<.0001	<.042
Low altitude area											
Pennisetum clandustinum	90.80^{b}	91.20^{c}	8.80^{b}	1.60^{b}	12.00^{b}	50.10^{b}	65.70^{b}	54.40^{c}	16.20^{c}	9.50^{b}	6.20^{c}
Cymbopogon citrates DC.	90.30^{b}	92.80^{b}	7.20^{c}	0.80^{c}	8.60^{c}	56.50^{a}	67.50^{b}	56.13^{b}	17.30^{b}	4.40^{d}	5.60^{d}
Snowdine polystarch	90.60^{b}	93.90^{a}	6.10^{d}	1.50^{b}	10.40^{c}	51.70^{b}	63.30^{c}	50.47^{d}	19.90^{a}	7.10^{c}	6.80^{b}
Musa paradisiacal	92.00^{a}	89.60^{d}	10.40^{a}	2.80^{a}	13.10^{a}	44.70^{c}	70.10^{a}	59.60^{a}	19.00^{ba}	10.50^{a}	7.60^{a}
CV	0.37	0.42	4.78	4.45	1.89	2.27	1.47	1.79	7.67	1.87	6.72
p-value	<.0095	<.0001	<.0001	<.0008	<.0001	<.0001	<.0008	<.0002	<.0052	<.0001	<.0180

Note: DM=Dry matter; OM =Organic Matter; CP = Crude Protein; NDF=Neutral Detergent Fiber; ADF= Acid Detergent Fiber;
NFE= Nitrogen Free Extract DCP=Digestible Crude Protein (g/kg DM); ME= Metabolizable Energy (MJ/ kg DM),
Means with the same letter are not significantly different.

Chemical Composition and Nutritive Values of Feeds Resources: One of the basic needs in the planning and utilization of pastures and achieving optimum performance of livestock is determining the nutritional needs of livestock in terms of energy, protein, minerals and vitamins. This is only possible when the quality of pastures forage plants for each region in terms of chemical composition is known.

The nutritional values of feed samples from natural pastures are presented in Table 5. The crude protein contents of forage grasses and legumes were moderate in nutritional qualities in the study area. Similarly, NDF contents of key grasses and legumes in wet season was significantly different ($p<0.01$) between the two agro ecologies of the study area. The present result of NDF contents of grasses and legumes was similar within the ranges of Deribe *et al*. [16] in southern Ethiopia. The ADF contents of the major grasses and legumes feed also categorized as low roughages which greater 47.40% with significant different between species and agro ecologies ($p<0.01$) in study area. The present result was agreement with in the ranges of Fekede *et al*. [17] result at tropical highland of Ethiopia.

The crude protein (CP) content of crop residues varied from 3.95% in wheat straw to 9.19% in nug chuff mid altitude area and 3.94% of sorghum to 6.72% of haricot bean crop residues in low altitude area. The CP content of feeds sampled was similar with Deribe *et al.* [16] reports ranges from 2.01-8.97% at southern Ethiopia. Except nug chuff, all crop residues evaluated had lower CP contents than the minimum level of 7% CP required for optimum rumen microbial function in study area.

The neutral detergent fiber (NDF) content of all crop residues was above 65% except noug chuff (57.53%) in the both agro ecologies of the study area. Solomon *et al*. [18] reported that all crop residues had higher than (> 70%) NDF contents with similar study in Sinana sub district of Bale highland. All crop residues in this study were categorized as low quality roughages and their high cell wall content can be a limiting factor to feed intake.

The ADF content of all crop residues was above 50% in both agro ecologies of the study area (Table 6). All crop residues could be categorized as low quality roughages in the study district. The energy contents and digestible crude protein of crop residues was significantly different ($p<0.01$) between both agro ecologies. The energy content of crop residues ranged from 8.77 MJ (nug chuff) to 9.50MJ (Maize stover) in mid altitude and 8.99MJ (Sorghum) to 11.13MJ (Haricot bean) straw in low altitude area of the study district. The energy contents for crop residues in this study were within the range reported by Seyoum and Fekede [19] in West shewa zone of Ethiopia. Differences might be due to differences in soil fertility and crop variety used. The digestible CP contents of crop residues varies from 0.15g (Wheat straw) to 5.02 g (Nug chuff) in mid altitude and 0.14g (Sorghum) to 2.32g (Haricot bean) in low altitude area. The result was disagreement with Zewdie [20] who reported the lowest energy content crop residues was 6.48MJ of wheat straw to 7.89MJ barley straw and the DCP contents 24.85g of oats straw to 59.04g of haricot bean at central rift valley of Ethiopia. The present result of the energy and protein content of crop residue were lower than the reported thresholds due to climatic difference and post harvest handling of the crop residues in the study area.

Table 6: Chemical composition and nutritive values of major crop residues in the study area

	Chemical composition (% DM)									Nutritive values	
Feedstuff	DM (%)	OM	Ash	EE	CP	CF	NDF	ADF	NFE	DCP (g/kgDM)	ME(MJ/kg DM)
Mid altitude											
Teff straw	92.47^{cb}	95.60^{b}	4.40^{c}	1.20^{cbd}	4.43^{c}	53.46^{b}	68.60^{a}	57.80^{b}	35.55^{a}	0.65^{c}	8.89^{bc}
Finger millet	91.53^{cbd}	91.83^{c}	8.17^{b}	1.10^{d}	4.09^{d}	52.76^{c}	67.40^{ba}	55.47^{c}	31.00^{c}	0.28^{d}	8.80^{dc}
Wheat straw	92.67^{b}	94.00^{d}	6.00^{c}	1.27^{cb}	3.95^{d}	57.76^{a}	70.07^{a}	60.40^{a}	33.41^{b}	0.15^{c}	8.72^{dc}
Maize stover	90.23^{d}	94.87^{c}	5.13^{d}	1.17^{cd}	4.47^{c}	47.89^{c}	65.47^{b}	55.07^{c}	35.03^{ba}	0.67^{c}	9.42^{a}
Sorghum stover	91.30^{cd}	97.13^{a}	2.87^{f}	1.33^{b}	5.98^{b}	51.80^{dc}	65.60^{b}	54.33^{c}	35.54^{a}	2.04^{b}	9.08^{ba}
Noug chuff	94.63^{a}	89.83^{f}	10.17^{a}	3.53^{a}	9.19^{a}	51.90^{d}	57.53^{c}	49.80^{d}	25.90^{d}	5.02^{a}	8.62^{d}
CV	0.80	0.23	3.57	4.97	1.88	1.10	2.29	1.64	3.31	2.92	1.38
p-value	<.0012	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	< .0001	<.0013
Low altitude											
Finger millet	90.77^{b}	94.90^{b}	5.10^{b}	1.73^{b}	4.81^{b}	62.04^{a}	68.53^{cb}	54.33^{c}	37.12^{a}	0.95^{b}	9.48^{b}
Sorghum stover	92.33^{a}	95.13^{b}	4.87^{b}	1.53^{cb}	3.94^{c}	57.53^{b}	67.33^{c}	56.27^{b}	34.72^{b}	0.14^{c}	8.76^{b}
Maize stover	91.87^{ba}	95.67^{a}	4.33^{c}	1.40^{c}	4.04^{c}	56.04^{c}	69.93^{b}	57.47^{b}	36.16^{a}	0.31^{c}	8.95^{b}
Haricot bean	92.38^{a}	93.94^{c}	6.06^{a}	2.30^{a}	6.72^{a}	49.20^{d}	73.02^{a}	62.30^{a}	28.20^{c}	2.32^{a}	11.13^{a}
CV	0.72	0.21	3.96	6.25	6.19	0.65	1.02	1.22	2.22	14.58	5.81
p-value	<.16	<.0007	<.0007	<.0006	<.0003	<.0001	<.0007	<.0001	<.0001	<.0001	<.018

Note: DM=Dry matter; OM =Organic Matter; CP = Crude Protein; NDF=Neutral Detergent Fiber; ADF= Acid Detergent Fiber;

NFE= Nitrogen Free Extract DCP=Digestible Crude Protein; ME= Metabolizable Energy, Means with the same letter are not significantly different.

In general crop residues, mainly cereal crops (Aftermaths being collected and stored), are used as major feeds for ruminant livestock, particularly during the dry season. However, the fact that straws and stover are high in structural components and their associated fiber contents, their utilization for animals is limited due to their poor quality. Adugna and Said [21] reported that the CP content of crop residues ranges between 3.3 to 13.3% on DM basis, which agrees with this study.

Feeding leaves and twigs of indigenous trees for livestock, particularly during the dry season is common practice in both the studied altitudes of study district. There were great variations in chemical composition within and among the browse species studied (Table 7). The dry matter contents of shrubs and fodder trees are above 88.63% in mid and 90.87% in low altitude of the study district. The result was relatively similar with the result of Abebe *et al.* [22] who reported the dry matter contents of multipurpose fodder trees was within range of 89.4-93.1% in Lay-Armachuho and Sidama district of the Ethiopian. Fodder trees and shrubs had CP content ranging from 8.90% (*Zehneria scara)* root to 17.80% (*Rhoicissus tridentata*) leaves in mid and 6.27% (*Schefflera abyssinica)* to13.57% (*Acanthus polystachius*) in low altitude of the study district. The present study of CP contents for shrubs and fodder trees was comparable within range of Belete *et al.* [23] report the CP contents of tree and shrubs ranging from 8.9% to 20.9%. The high CP content of browse species makes them a potential source protein supplement for feeds of poor quality roughages and forages.

The lowest NDF content observed for *Cucumisfici folius* A. Rich (40.60%) and the highest was for *Rhoicissus tridentata* (51.93%) in mid and *Acanthus polystachius* (45.87%) was the lowest and *Schefflera abyssinica* (59.20%) was the highest observed in low altitude of the study area. The NDF values for the current feeds analysis are comparable with that reported by Takele *et al.* [24] at the districts of Wolayta zone, southern Ethiopia. Similarly, the ADF content varied from 26.93% (*Cucumisfici folius* A. Rich) to 44.27% (*Rhoicissus tridentata*) in mid altitude and 38.60% (*Acanthus polystachius*) to 52.67% (*Schefflera abyssinica*)in low altitude area. The high ADF content in shrubs and fodder trees associated with lower digestibility since digestibility of feed. The highest and lowest ME content was found in *Rhoicissus tridentata* (11.39 MJ) and *Alb*izia *gumifera* (7.88MJ) in mid and *Acanthus polystachius*(11.34 MJ) and *Bersama abyssinica*(8.66MJ) in low altitude of study area. The ME values of current study was greater than the reports of Diriba *et al*. [16] in Sub humid areas of Western Ethiopia. The digestibility CP contents of shrubs and fodder trees were vary from *Zehneria scara* (4.75g) to *Rhoicissus tridentata* (13.11g) mid and *Schefflera abyssinica* (2.31g) to *Acanthus polystachius* (9.09g) in low altitude of the study area. These browse trees and other protein-rich feeds are potential sources of crude protein which can facilitate the growth of rumen microbes that play a significant role in digestion of feeds in ruminant animals [25]. The low contents of nutritive of fodder trees are normally characterized by low digestibility and low energy values results reduce livestock performances.

Table 7: Chemical composition and nutritive values of fodder trees and shrubs in mid altitude area

	Chemical composition (% DM)									Nutritive values	
Feedstuff	DM (%)	OM	Ash	EE	CP	CF	NDF	ADF	NFE	DCP (g/kg DM)	ME (MJ/kg DM)
Mid altitude area											
Rhoicissus tridentate	90.43^{dc}	91.00^{bc}	9.00^{b}	1.77^{d}	17.80^{a}	28.16^{c}	51.93^{a}	44.27^{a}	33.49^{c}	13.11^{a}	11.39^{a}
Cucumisfici folius A.	88.63^{e}	90.93^{bc}	9.07^{b}	1.20^{e}	14.44^{b}	35.07^{b}	40.60^{d}	26.93^{e}	28.57^{e}	9.90^{b}	10.26^{d}
Albizia gumifera	89.97^{d}	91.20^{b}	8.80^{eb}	2.00^{c}	9.34^{d}	47.27^{a}	50.20^{b}	37.07^{d}	22.32^{f}	5.25^{d}	7.88^{e}
Combertum paniculatum	91.53^{a}	95.25^{a}	4.75^{d}	3.80^{a}	13.72^{c}	29.09^{c}	51.27^{a}	43.20^{b}	39.78^{a}	9.31^{c}	11.16^{b}
Zehneria scara	91.00^{bac}	89.83^{d}	10.17^{a}	2.70^{b}	8.90^{e}	34.02^{b}	47.20^{c}	41.27^{c}	35.06^{b}	4.75^{e}	10.60^{c}
CV	0.59	0.27	3.04	3.94	1.07	1.16	2.46	2.81	1.57	0.52	0.71
p-value	<.0037	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Low altitude area											
Acanthus polystachius	90.87^{dc}	91.63^{c}	8.37^{a}	4.00^{a}	13.57^{a}	28.38^{b}	45.87^{d}	38.60^{d}	37.04^{a}	9.09^{a}	11.34^{a}
Schefflera abyssinica	91.10^{c}	97.00^{b}	3.00^{b}	1.27^{b}	6.27^{d}	48.00^{a}	59.20^{a}	52.67^{a}	32.23^{c}	2.31^{d}	8.67^{b}
Bersama abyssinica	92.27^{b}	96.80^{b}	3.20^{b}	1.30^{b}	7.34^{b}	48.11^{a}	58.07^{ba}	48.60^{b}	32.44^{c}	3.32^{b}	8.66^{b}
Teclea nobilis	93.07^{a}	97.40^{a}	2.60^{c}	1.07^{c}	7.05^{c}	47.89^{a}	52.87^{c}	42.60^{c}	34.93^{b}	3.05^{c}	8.71^{b}
CV	0.27	0.21	4.61	3.41	0.57	1.62	1.85	1.94	1.97	0.94	1.05
p-value	<.0004	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

DM=Dry matter; OM=Organic Matter; CP = Crude Protein; NDF=Neutral Detergent Fiber; ADF= Acid Detergent Fiber; NFE=Nitrogen Free Extract, DCP=Digestible Crude Protein; ME=Metabolizable Energy, Means with the same letter are not significantly different.

CONCLUSION

This study shows that natural pasture, crop residues, fodder trees and shrubs, Stubble crops, non-conventional feed and improved forage in very limited are the major feed resources available with different proportion in the study area. However, poor in nutritional qualities due to low crude protein and high cell wall fiber components (ADF and NDF) hence their digestibility is low in natural pastures feeds and crop residues. Moreover, these feed resources showed CP contents below the critical level (7 %) required for optimum rumen function and feed intake. On the other hand, indigenous browses feeds contain low NDF and high CP values with better digestibility and that suggests their potential suitability for strategic supplementation, particularly during the dry season. Thus strategic supplementation of protein and energy rich feeds must be taught to farmers in the area such as *Rhoicissus tridentata, Cucumisfici folius* A.*, Combertum paniculatum*, Acanthus polystachius and others. Fibrous feeds, like crop residues, with low digestibility constitute the major proportion of feeds under smallholder farmers in study area. Therefore, to improve the digestibility applying alkali or urea, improving harvesting time and storage should be improved.

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REFERENCES

1. CSA (Central Statistical Agency), 2015. Agricultural Sample Survey 2015, Volume II Report on Livestock and Livestock Characteristics (Private and Peasant Holdings) Statistical Bulletin 578. Addis Ababa.
2. Asfaw, N., R. Shahidur and G. Birhanu, 2011. Livestock Production and Marketing. Development Strategy and Governance Division, International Food Policy Research Institute Ethiopia Strategy Support Program II, Ethiopia. ESSP II Working Paper, pp: 26.
3. Boufennara, S., S. Lopez, H. Bousseboua, R. Bodas and L. Bouazza, 2012. Chemical composition and digestibility of some browse plant species collected from Algerian arid rangelands. Spanish Journal of Agricultural Research, 10(1): 88-98.
4. Alemayehu Mengistu, 2005. Feed resource base of Ethiopia: limitation and opportunities for integrated development. pp: 250-259. In Participatory Innovation and Research: Lesson for Livestock Development. Proceeding of the 12th Annual Conference of Ethiopian Society of Animal Production (ESAP), Volume II Technical papers. 12-14 August, Addis Ababa, Ethiopia.
5. Zinash, S. and B. Seyoum, 1998. The Composition of Ethiopian Feed stuffs, Research Report no.6.Institute of Agricultural Research (IAR), Addis Ababa, Ethiopia, pp: 28-33.
6. Yamane, Taro, 1967. Statistics: An introductory Analysis, 2nd Ed., New York: Harper and row.

7. FAO (Food and Agricultural Organizations of the United Nations), 1987. Master Land Use Plan, Ethiopian Rangeland/Livestock Consultancy Report Prepared for the Government of the Peoples Democratic Republic of Ethiopia. Food and Agricultural Organization of the United Nations. Technical Report.AG/ETH/82/020/FAO, Rome, pp: 94.
8. AOAC, 1995. Association of Official Analytical Chemists: Official Methods of Analysis of AOAC International (16thed.). Virginia, USA.
9. Van Soest, P.J., J.B. Robertson and B.A. Lewis,1991. Methods for dietary fiber. Neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition. Journal of Dairy Science, 74: 3583-3597.
10. Abate A.L. and M. Meyer, 1997. Prediction of the useful energy in tropical feeds from proximate composition and in vivo derived energetic contents 1. Metabolizable the energy. Small Ruminant Res., 25(1): 51-59.
11. McDonald, P., R.A. Edwards, J.F.D. Greenhalgh, C.A. Morgan, L.A. Sinclair and R.G. Wilkinson, 2010. Animal Nutrition. 7th ed. Prentice Hall, London, pp: 300.
12. FAO (Food and Agriculture Organization of the United Nations), 1986. Ethiopian highland reclamation study. Final report. Vol. 1, FAO, Rome.
13. Tesfaye Desalew, 2008. Assessment of feed resources and rangeland Condition in Metema district of north Gondar zone, Ethiopia. MSc Thesis submitted to the department of Animal sciences, school of graduate studies Haramaya University, pp: 161.
14. Dawit, A., N. Ajebu and B. Sandip, 2013. Assessment of feed resource availability and livestock production constraints in selected Kebeles of AdamiTulluJiddoKombolcha District, Ethiopia. African Journal of Agricultural research, 8(29): 4067-4073.
15. Adugna, T., 2008. Feed resources and feeding management. Ethiopia Sanitary &Phytosanitary Standards and Livestock & Meat Marketing Program (SPS-LMM). Texas Agricultural Experiment Station (TAES)/Texas A & M University. September 2008, Addis Ababa.
16. Deribe, G., H. Abubeker, K. Tsedeke, B. Tekleyohannes, B. Zekarias and J. Addisu, 2013. Chemical Composition and Digestibility of Major Feed Resources in Mixed Farming System of Southern Ethiopia. IDOSI Publications, World Applied Sciences Journal, 26(2): 267-275.
17. Fekede, F., S.H. Prasad, A. Getnet, B. Seyoum, K. Getu, K. Aemiro and K. Gezahegne, 2014. Dynamics in nutritional characteristics of natural pasture hay as affected by harvesting stage, storage method and storage duration in cooler tropical highlands. African Journal of Agricultural Research, 9(43): 3233-3244.
18. Solomon, M., T. Aregawi and N. Lisanework, 2010. Chemical composition, in vitro dry matter digestibility and in sacco degradability of selected browse species used as animal feeds under semi-arid conditions in Northern Ethiopia, Agro forest Syst., 80: 173-184.
19. Seyoum, B. and F. Fekede, 2008. The status of animal feeds and nutrition in the West Shewa Zone of Oromia, Ethiopia. Holetta Agricultural Research Center, EIAR.
20. Zewdie, W., 2010. Livestock production systems in relation with feed availability in the Highlands and Central Rift valley of Ethiopia. A M.Sc. thesis submitted to the School of Animal and Range Sciences, School of Graduate studies Haramaya University, pp: 160.
21. Adugna, T. and A.N. Said, 1994. Assessment of feed resources in WolaytaSodo, Ethiopian. Journal of Agricultural Science, 14: 69-87.
22. Abebe, M., S.J. Oosting, S. Fernandez-Rivera and A.J. Van derijpp, 2008. Multipurpose fodder trees in the Ethiopian highlands: Farmers' preference and relationship of indigenous knowledge of feed value with laboratory indicators. Article in Agricultural Systems, 96: 184-194.
23. Belete, S.H., H. Abubeker, A. Tadese, A. Nura and E. Abule, 2012. Identification and Nutritive Value of Potential Fodder Trees and Shrubs in the Mid Rift Valley of Ethiopia. The Journal of Animal & Plant Sciences, 22(4): 1126-1132.
24. Takele Geta, Lisanework Nigatu and Getachew Animut, 2014. Evaluation of Potential Yield and Chemical Composition of Selected Indigenous Multi-Purpose Fodder Trees in Three Districts ofWolayta Zone, Southern Ethiopia. World Applied Sciences Journal, 31(3): 399-405.
25. Ammar, H., S. Lopez, O. Bochi, R. Garcia and M.J. Ranilla, 2000. Composition and in-vitro digestibility of leaves and stems of grasses and legumes harvested from permanent mountain meadows at different maturity stages. Journal of Animal and Feed Sciences, 8: 599-610.