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STUDY OF LIVESTOCK FEED RESOURCES AND NUTRITIONAL VALUES OF MAJOR LIVESTOCK FEEDS IN DOYOGENA DISTRICT, SOUTHERN ETHIOPIA

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. Author FT contributed with manuscript structuring, data analysis and the final draft. Author TL supervised the collecting of samples and participated with data analysis. Authors NB, ZK, MG, MS, SC, AE and DD were responsible for supervising field activities and editing the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The main barrier to livestock production in Ethiopia is an insufficient supply of feed, both in terms of quantity and quality. This study was conducted in the Doyogena district of the Kembata-Tembaro zone of Southern Ethiopia with the objectives of determining the availability and nutritive value of major livestock feeds; conserving and utilizing available feed resources. The utilization practices of different feeds was assessed with a self-structured questionnaires. Chemical composition of major feed resources was estimated in animal nutrition lab of Hawassa University. Natural pasture and crop leftovers are key feed resources in the area and cultivated forages were only lately introduced, with limited adoption due to agricultural land scarcity. Their use for livestock feed had been hindered by economic, inadequate handling and processing problems. The involvement of the government for improving the financial capabilities of farmers with improved technologies related to feeding crop residues and natural pastures were suggested as an important strategy. Chemical analysis on major feed resources indicated that there were significant ($p<0.05$) difference among the feed types in CP and NDF content. The CP varied from 5.37% to 79.24% in woynadega while in kola it ranged from 4.54% to 79.41%. In the woynadega agroecology, the NDF content ranged from 44.17% to 79.24%, whereas in kola, it ranged from 44.13 % to 79.41 %. ADF and lignin contents were also significantly different ($P<0.05$). The ADF and lignin contents ranged from 12.86% to 48.91%and 3.57% to 9.70% respectively in woynadega, in kola agroecology ranged from 12.74% to 50.04% and 3.52% to 10.49% respectively. There were significant differences in

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IVDMD (p<0.05%) also, and it ranged from 47.30% to 79.78% in woynadega agro-ecology and in kola it ranged from 59.98% to 79.67%. As a result, farmers must learn how to use and process locally available feeds in order to improve local animal production performance.

Keywords: Available feeds; chemical composition livestock; digestibility; production.

1. INTRODUCTION

Livestock is essential components of African farming systems, and they are increasingly being seen as vital routes out of poverty for rural people [1], (FAO, 2010). The main barrier to livestock production in Ethiopia is an insufficient supply of feed, both in terms of quantity and quality [2]. Feed scarcity has been identified as a contributing cause to animals' poor reproductive and growth performance, particularly during the dry season [3]. In both the highlands and lowlands of Ethiopia, feed shortages are particularly severe during the dry season [4]. Farm animal-fed resources and systems differ by location. Landholdings, socioeconomic level, and livestock and product marketing all influence feeding patterns. Lack of adequate feed resources as the main constraint to animal production is more pronounced in the mixed crop-livestock-dominated highlands as well as in the mid-altitude areas of the country, where most of the cultivated areas are located. The use of crop residues as livestock feed may increase in the future for several reasons. As the world population continues to grow, the capacity to produce food will be stressed. Tolera et al. [5] reported that crop residues contribute to about 50% of the total feed supply in Ethiopia.

Crop residues are potentially rich sources of energy as about 80 percent of their DM consists of polysaccharides, but usually underutilized because of their low digestibility, which limits feed intake [6]. This is because animals thrive predominantly on high-fiber feeds (straw, Stover's and native pasture hay) which are deficient in nutrients (nitrogen, sulfur, minerals, phosphorous etc.) essential for microbial fermentation. In livestock production, one of the most important factors determining profitability is to achieve optimal level of feeding [7-9]. As a result, during the dry season, herders face their greatest challenge. Establishing grass/legume pastures on the farm to produce extra feed will alleviate their situation. Hence, this study was planned to help in improving livestock feed management and advising farmers on how to conserve feeds for the dry season as the best option for their livestock, as well as identifying available livestock feed resources and major constraints in the study area by encouraging farmers to plant improved livestock forage around their homestead/back yard.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The study was carried out in the Doyogena woreda of the Kembata Tambaro Zone in Southern Ethiopia. This district is located in 171 kilometers south of Hawassa, the seat of the SNNP region, and 258 kilometers south of Addis Ababa. The altitude varies from 1900 to 2800 meters above sea level, with 70% highland and 30 % mid-altitude agro-ecological conditions. The average temperature is 10°C to 16°C, and the average rainfall is 1200 mm to 1600 mm (DOFED, 2006). The community undertakes animal husbandry and crop cultivation as part of its farming system (mixed farming system).

2.2 Method of Data Collection and Sources of Data

The study included two parts namely: Survey part and laboratory part. The survey focused on list and types of feed resources, their utilization and conservation methods and constraints of livestock production. For this, five kebeles were selected purposely based on production potential, accessibility and agro-ecology. Three kebeles from kola and two kebeles from woynadega were selected. A total of 120 farmers (Twenty-four farmers from each kebeles) were selected randomly.

2.3 Household Survey

Information like feed resource type, feeding practice, and feed conservation methods was collected using a semi-structured questionnaire by the researcher. The questionnaires were pre-tested and re-adjusted before the actual data collection started.

2.4 Feed Sample Preparation and Chemical Analysis

Dry matter, crude protein, NDF, ADF, and *in-vitro* determination for existing livestock feed resources like natural pastures, improved forages, crop by-products in the study area were conducted at the Hawassa university animal nutrition laboratory using the proximate approach [10] and [11]. Feed samples were collected from households randomly from each kebeles of the study area. The samples were dried in

an oven at 60°C for 48 hours. The samples were ground to pass through a one-millimeter sieve and allowed to equilibrate at room temperature for 24 hours. The ground samples were kept in airtight containers pending analysis for chemical composition like DM, total nitrogen (N) and ash by procedure of AOAC [10]. Crude protein (CP) was calculated as N x 6.25. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined by the methods of Van Soest et al. [11]. Ash corrected NDF was determined by overnight burning of the NDF in a Furnace at 550°C.

In-vitro dry matter digestibility (IVDMD) was determined by the Tilley and Terry method as modified by Van Soest and Robertson (1991). Dried samples were incubated in 1256 ml Erlenmeyer flasks containing rumen fluid medium mixture for 48 hours in a water bath maintained at 39℃.The rumen fluid was obtained from rumen of sheep by means of esophageal tube. The rumen fluid was kept in a thermos container to maintain the body temperature of the animal (38 to 39^{o}C).

2.5 Statistical Analysis

Statistical Package for Social Science (SPSS) version 16 was used to analyze the survey data and descriptive statistics (mean, percentage, standard error, and frequency) were used to describe qualitative data. The laboratory data was analyzed using SAS version 9.0 GLM model.

3. RESULTS AND DISCUSSION

3.1 Livestock Herd Size and Composition

The average size of cattle herd was 4.64±1.32 while that of chicken and donkey was 2.16±0.19 and 0.37±0.64, respectively. There was also a significant ($P<0.05$) differences between livestock species. Livestock ownership per household as Tropical Livestock Unit (TLU) was higher in the kola (5.04) than in the woynadega (3.63 TLU) agro-ecology.

3.2 Main Source of Income in the Area

The main source of income of respondents was crop sale followed by livestock sale. Among crops income from chat and coffee were most important in both agro ecology, whereas enset and vegetables in woynadega and maize and haricot bean in kola also useful cash crops. The off-farm activity is less important to generate income.

3.3 Purpose of Livestock Keeping

The purpose of cattle keeping was for milk in both agro ecology followed by meat, manure, income, saving and skins/hides in woynadega while in kola milk followed by meat, income, manure, saving and skins/hides.

The main feed yield in the area during wet season was natural pasture and crop residues in both agro ecology (woynadega and kola), followed by Aftermath, fodder tree, Industrial byproducts in woynadega while Natural pasture, Crop residue, fodder tree, industrial byproducts and Aftermath in kola (Table 4). In dry season major feed resources in both agro ecology were natural pasture followed by crop residue, fodder tree, industrial byproducts and aftermath. In general, crop-residues and natural pasture are the major feed resources of the area which agree with the report of (Tolera et al. [5]) and in line with the findings of Seyoum et al. [12] who reported that the major basal feed resources for livestock in the highlands of Ethiopia are natural pasture, crop residues and stubble grazing.

3.4 Method of Storing Feed Resources

About 70.8% and 86.1% of respondents from woynadega and kola agro-ecology, respectively store their feed stacked outside while a few (29.2% and 13.9%) respondents said that they store feed stacked under the shade (Fig. 1).

3.5 The Type of Feed that They Stored

Majority of the farmers (62.5%) from both agro-ecology did not save their feed in large quantities for the dry season, while 37.5 % from both agro ecology did store crop leftovers in small quantities (Table 5).

3.6 Time of Starting Feeding Stored Feed

Out of total, 58.4% from woynadega and about 69.5% from kola agro ecology, the time of starting feeding stored feed was soon after collection and in small amount during feed shortage and during dry season 25% & 23.6%, 16.7% & 6.9 from woynadega and kola (Table 6). Similarly, Alemayehu (2003) reported that livestock feeding calendar varies depending on availability of the feed resources in the different months of the year.

Table 1. Average number of livestock species owned per household in the district

Animal category	Woynadega		Kola		Average
	Mean±SE	TLU	Mean±SE	TLU	Mean±SE
Cattle	4.19±1.35[a]	3.25	5.10±2.17[a]	4.11	4.64±1.32
Sheep	0.64±0.13[c]	0.06	1.28±0.13[bc]	0.07	0.96±0.13
Goat	0.40±0.11[c]	0.03	0.72±0.11[c]	0.18	0.56±0.11
Chicken	1.56±0.19[b]	0.03	2.76±0.19[b]	0.03	2.16±0.19
Donkey	0.52±0.79[c]	0.05	0.22±0.49[d]	0.72	0.37±0.64
Total		3.42		5.04	

N=number of respondents; [abc] means with different superscript in the same column are significantly different (P<0.05); SE= standard error, TLU=Tropical Livestock Unit

Table 2. Source of income in the area

Source of income	Woynadega		Kola	
	Rank	Index	Rank	Index
Livestock sale	2	0.36	2	0.36
Crop sale	1	0.46	1	0.43
Off-farm activities	3	0.18	3	0.21

Index = Sum of (3×number of HHs ranked 1st) + (2 × number of HHs ranked 2nd) + (1×number of HHs ranked 3rd) for particular income source divided by sum of (number of HHs ranked 1st) + (number of HHs ranked 2nd) + (number of HHs ranked 3rd) for all income source

Table 3. Purpose of livestock keeping

Purpose of keeping animals	Woynadega agro ecology				Kola agro ecology			
	Cattle	Small ruminants	Equine	Poultry	Cattle	Small ruminants	Equine	Poultry
Milk	1st	5th	–	–	1st	2nd	–	–
Meat	2nd	3rd	–	3rd	2nd	1st	–	2nd
Manure	3rd	4th	3rd	4th	4th	3rd	2nd	3rd
Income	4th	1st	1st	1st	3rd	5th	4th	4th
Saving	5th	2nd	2nd	2nd	5th	5th	3rd	1st
Skins/hides	6th	6th	–	–	7th	6th	–	–
Draft power	7th	–	4th	–	6th	–	1st	–

Index = Sum of (7×number of HHs ranked 1st) + (6 × number of HHs ranked 2nd) + (5×number of HHs ranked 3rd) (4×number of HHs ranked 4th) (3×number of HHs ranked 5th) (2×number of HHs ranked 6th) (1×number of HHs ranked 7th)divided by sum of (number of HHs ranked 1st) + (number of HHs ranked 2nd) + (number of HHs ranked 3rd) + (number of HHs ranked 4th) + (number of HHs ranked 5th) + (number of HHs ranked 6th) + (number of HHs ranked 7th) for all livestock types

Table 4. Major feed resources in the study area

Feed type	During wet season				During dry season			
	Woynadega		Kola		Woynadega		Kola	
	Rank	Index	Rank	Index	Rank	Index	Rank	Index
Natural pasture	1	0.26	1	0.25	1	0.22	1	0.24
Crop residue	2	0.20	2	0.20	2	0.21	2	0.23
Fodder tree	4	0.17	3	0.19	3	0.20	3	0.19
Industrial by products	5	0.16	4	0.18	4	0.19	4	0.18
Aftermath	3	0.18	5	0.17	5	0.18	5	0.17

Index = Sum of (5×number of HHs ranked 1st) + (4 × number of HHs ranked 2nd) + (3×number of HHs ranked 3rd) + (2×number of HHs ranked 4th) + (1×number of HHs ranked 5th) for particular feed source divided by sum of (number of HHs ranked 1st) + (number of HHs ranked 2nd) + (number of HHs ranked 3rd) + (number of HHs ranked 4th) + (number of HHs ranked 5th) for all feed source

Table 5. The type of feed conserved

Type of feed	Woynadega		Kola	
	N	Percent	N	Percent
Crop residue	30	62.5	45	62.5
Natural pasture	18	37.5	27	37.5
Total	48	100	72	100

N= number of respondents

Type of utilization that was employed in the area was direct grazing in woynadega (58.3%) and kola (88.9%), respectively, followed by cut and carry system (Table 7).

3.7 Prioritized Animals While Grazing

Farmers used to give priority to lactating cow, followed by heifers, small ruminants, bulls, and drought oxen in woynadega while in kola lactating cow is followed by heifers, drought oxen, small ruminants, and bulls, the reason behind this was feed shortage in the area.

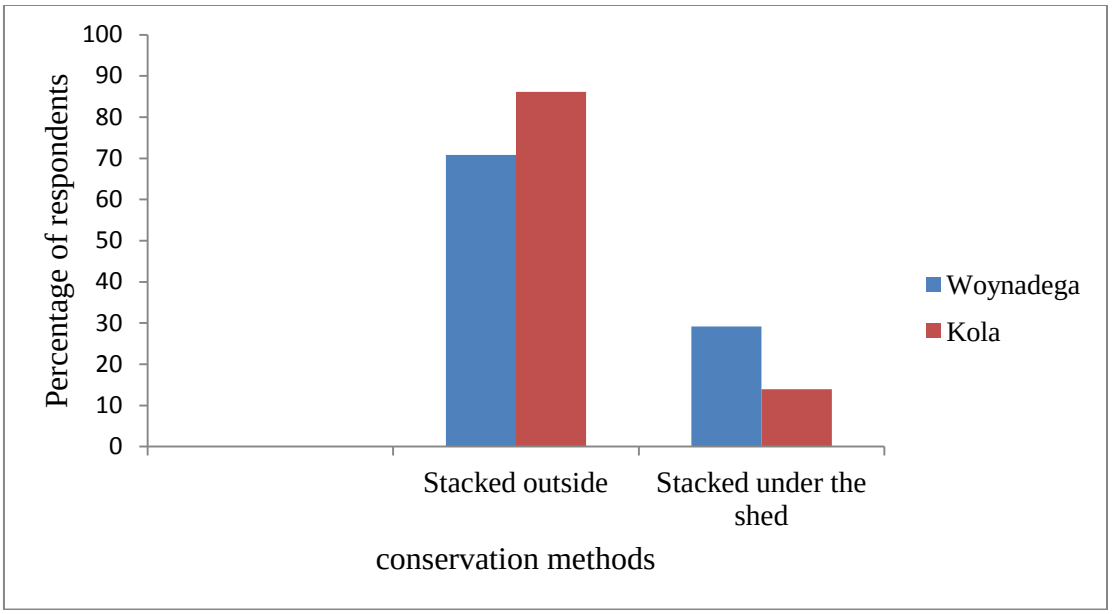

Fig. 1. Way of storing feed in the area

Table 6. Time of feeding stored feeds

Time of starting feed	Woynadega		Kola	
	N	Percent	N	Percent
Soon after collection	28	58.4	50	69.5
During dry season	20	41.7	22	30.5
Total	48	100	72	100

N= number of respondents

Table 7. Type of utilization of feed

System	Woynadega		Kola	
	N	Percent	N	Percent
Direct grazing	28	58.3	64	88.9
Cut and carry	20	41.7	8	11.1
Total	48	100	72	100

N= number of respondents

Table 8. Animals were given priority during grazing

Type of animals	Woynadega		Kola	
	Rank	Index	Index	Rank
Lactating cow	1	0.26	0.30	1
Heifers	2	0.25	0.24	2
Bulls	4	0.16	0.12	5
Drought oxen	5	0.15	0.18	3
Small ruminants	3	0.18	0.16	4

Index = Sum of (5×number of HHs ranked 1st) + (4 × number of HHs ranked 2nd) + (3×number of HHs ranked 3rd) + (2×number of HHs ranked 4th) + (1×number of HHs ranked 5th) for particular animal type divided by sum of (number of HHs ranked 1st) + (number of HHs ranked 2nd) + (number of HHs ranked 3rd) + (number of HHs ranked 4th) + (number of HHs ranked 5th) for all animal type

3.8 Sources of Water and Watering Practice

The main source of water (Table 9) for livestock was river in both agro-ecology (woynadega and kola) and watering frequency in the woreda was once per day in dry season and freely available in wet season.

3.9 Average Distance Travelled by Livestock to Get Water

According to the survey result the average distance travelled by livestock in the area was 2.59±0.37 in dry season and 1.59±0.79 in wet season accordingly. There was significant difference (P<0.0.5) because of other options like rain in addition to river.

The frequency of watering for livestock during wet season freely available was (62.5%) in woynadega and (55.6%) in kola and twice a day next (22.9%) in woynadega and (37.5%) in kola. Almost all of the respondents got insufficient and unclean drinking water for their livestock. The respondents provided water for their livestock once per day. This finding is disagreeing with the Teshager et.al. (2013) which reported that majority (90.6%) of the respondents water their cattle twice a day.

3.10 Measures Taken to Alleviate Feed Shortage

The measures taken to alleviate feed shortage was purchasing concentrate that was wheat bran (50% & 76.4%) in both agroecology (woynadega and kola) in the dry season and was followed by feed conservation (45.8% & 20.8%) and purchase of forage (4.2 & 2.8%) in both agroecology while in the wet season it was purchase concentrate or wheat bran (81.2%) in woynadega followed by feed conservation (18.8%) and purchase of forage while in kola agroecology purchase of concentrate that available in the market, wheat bran (90.3%) was the main and followed by feed conservation (8.3) and purchase of forage (1.4%).

Feed availability was seasonal, with a shortage from December to March and a critical shortage from April to May. However, feed was relatively good in supply from June to September. The farmers preserve crop residues for the dry season; however, the way of conservation was not appropriate and there was also limited experience in treatment and processing methods for improving the nutritional quality of crop residue.

Table 9. Sources of water for livestock

Sources of water	During wet season				During dry season			
	Woynadega		Kola		Woynadega		Kola	
	N	%	N	%	N	%	N	%
River	29	60.4	46	63.9	44	91.7	71	98.6
Pond	3	6.2	1	1.4	1	2.1	1	1.4
Spring water	15	31.2	24	33.3	2	4	-	-
Pipe water	1	2.1	1	1.4	1	2	-	-
Total	48	100	72	100	48	100	72	100

Table 10. Average distance (Mean± SE) for livestock in kilometer

Season	Woynadega	Kola	Average
Dry season	2.50±0.07[a]	2.67±0.66[a]	2.59±0.37
Wet season	1.46±0.84[b]	1.71±0.73[b]	1.59±0.79
Total	1.98±0.46	2.19±0.69	4.17±1.15

SE= standard error; [ab]means with different supper subscript letters in the same column are significantly different (P<0.05)

Table 11. Frequency of watering for livestock

Situation	During wet season				During dry season			
	Woynadega		Kola		Woynadega		Kola	
	N	%	N	%	N	%	N	%
Freely available	30	62.5	40	55.6	1	2.1	_	_
Once a day	7	14.6	5	6.9	42	87.5	72	100
Twice a day	11	22.9	27	37.5	5	10.4	_	_
Total	48	100	72	100	48	100	72	100

N= number of respondents; %=percentage

Table 12. Attempts to mitigate the feed shortage

Measures taken	During wet season				During dry season			
	Woynadega		Kola		Woynadega		Kola	
	N	%	N	%	N	%	N	%
Feed conservation	39	81.2	65	90.3	24	50	55	76.4
Purchase concentrate	9	18.8	6	8.3	22	45.8	15	20.8
Purchase of forage	_	_	1	1.4	2	4.2	2	2.8
Total	48	100	72	100	48	100	72	100

N= number of respondents

Table 13. Major livestock feed resources, availability, and feeding calendar in the study area

Feed source and its availability	Months of a year											
Feed sources	Ja	Fe	M	Ap	Ma	Ju	Ju	A	S	Oc	No	De
Natural pasture					X	x	x	X	x	x	x	x
Crop residue	x	x	x	x								
Improved forage						x	x	x	x	x		
Agro industrial by products	x	x	x	x								
Aftermath	x	x	x									
Feed adequacy					x	x	x	x	x	x	x	X
Feed scarcity	x	x	x									X

3.11 Constraints of Livestock Production

Feed shortage was reported in the dry as well as wet season; however, the shortage was severe during the dry season. About 47.9% of respondents from woynadega and about 52.8% of respondents from kola said that the main constraints of livestock production was feed shortage. Health problem, water scarcity, low productivity, predator and scarcity of labor were the second, third; fourth, fifth and sixth constraints, respectively. Although crop residues are the major feed resources in the study area, their use for livestock feed has been hindered by many problems such as economic problems and inadequate know-how in handling and processing these resources.

3.12 Chemical Composition Analysis of Major Livestock Feeds

There was a significant ($p<0.05$) difference among the feed types in ash content in woynadega agro-ecology. The highest ash contents were for sugar cane leaf (13.55%) and maize stover (13.12%) whereas; the lowest was for teff straw (4.65%). The ash content varied from 4.65 %(teff straw) to 13.55 % (sugar cane leaf).

In the case of kola agroecology there was also significant ($p<0.05$) difference among the feed types in ash content. The highest ash content was for elephant grass (14.95%) whereas the lowest were haricot bean (2.85%) and teff straw (3.64%). The ash content varied from 2.85% (haricot bean) to elephant grass (14.95%) in kola agro ecology.

There was significant ($p<0.05$) difference among the feed types in crude protein (CP) content in Woynadega agro ecology. The highest CP content was wheat bran (18.51%) whereas; the lowest were desho grass (5.37%) and teff straw (5.51%). The range of CP content varied from desho grass (5.37%) to wheat bran (18.51%) which can be a moderate protein source. In the kola agro ecology there was also significant ($p<0.05$) difference among the feed types in CP content. The highest CP content was wheat bran (18.16%) whereas, the lowest was desho grass (4.54%). The range of CP content varied from desho grass (4.54%) to wheat bran (18.16%).

There was significant ($p<0.05$) difference among the feed types in NDF content in the woynadega agro ecology. The highest NDF content was teff straw (79.24%) whereas, the lowest NDF content was wheat bran (44.17%). The NDF content varied from wheat bran (44.17%) to teff straw (79.24%).

In the kola agro ecology there was also significant ($p<0.05$) difference among the feed types in NDF content. The highest NDF content was teff straw (79.41%) whereas, the lowest NDF content where wheat bran (44.13%) and enset leaf (54.99%). The NDF content varied from wheat bran (44.13%) to teff straw (79.41%).

Table 14. Constraints of livestock production as identified by respondents

Constraints	Woynadega(N=48)	Kola(N=72)
	Percentage	Percentage
Shortage of feed	47.9	52.8
Health problem	33.3	6.9
Water scarcity	12.5	27.8
Low productivity	4.2	8.3
Predator	2.1	1.4
Scarcity of labor	_	2.8
Total	100	100

In the woynadega agro-ecological, there was a significant ($p<0.05$) difference in ADF content among the feed types. Haricot bean straw had the highest ADF content (48.91 percent), while Enset leaf (29.20 percent) and wheat bran had the lowest (12.86 %). Wheat bran (12.86 percent ADF) to haricot bean (12.86 percent ADF) (48.91%). In the kola agroecology, there was also a significant ($p<0.05$) difference among the feed types in ADF content. The highest ADF contents were haricot bean straw (50.04%) and desho grass (49.94%) whereas, the lowest ADF contents were banana leaf (28.29%) and wheat bran(12.74%).The ADF content range from wheat bran(12.74%) to haricot bean straw (50.04%).

There was significant ($p<0.05$) difference among the feed types in ADL content in woynadega agro ecology. The highest ADL concentration was reported in haricot bean (9.35 %) and banana leaf (9.70 %), whereas wheat bran had the lowest ADL content (3.57 %).The ADL content varied from wheat bran (3.57%) to banana leaf (9.70%). In the kola agro ecology there was also significant ($p<0.05$) difference among the feed types in ADL content. The highest ADL content was haricot bean (10.49%) whereas; the lowest ADL contents were wheat bran (3.52%) and maize Stover (4.17%). The ADL content varied from wheat bran (3.52%) to haricot bean (10.49%).

There was significant ($p<0.05$) difference among the feed types in IVDMD content in the woynadega agro ecology. The highest IVDMD content was wheat bran (79.78%) whereas; the lowest IVDMD content was teff straw (47.30%). The IVDMD content varied from teff straw (47.30%) to wheat bran (79.78%). In the kola agro ecology there was also significant ($p<0.05$) difference among the feed types in IVDMD content. The highest IVDMD contents were wheat bran (79.67%) and banana leaf (79.46%) whereas, the lowest IVDMD content was natural grass (59.98%). The IVDMD content varied from natural grass (59.98%) to wheat bran (79.67%).

All the major feed stuffs except desho grass (5.37%) and teff straw (5.51t in woynadega and desho grass (4.54%) in kola, had high CP content than the minimum level of 7% required for optimum rumen microbial function [13]. Roughage feeds with NDF content of less than 45% area categorized as high quality, 45% to 65% as medium quality and those with more than 65% as low quality roughages [14]. According to the laboratory data in woynadega agro ecology wheat bran in both agro ecologies categorized in high quality (44.17% and 44.13%) respectively. Enset leaf (58.40%), banana leaf (57.25%), haricot bean (61.31%), sugar cane leaf (63.77%) was categorized in medium quality and the rest were low quality forages while in the kola agro ecology except banana leaf (54.98%) and enset leaf (54.99%) the rest were low quality forages. Similarly, Kellems and Church [15] categorized roughages with less than 40% ADF as high quality and above 40% as low quality.

According to the lab data in woynadega agro-ecology except teff straw (40.92%) and haricot bean straw (48.91%) the rest were high quality while in kola agro-ecology except haricot bean straw (50.04%) and desho grass (49.94%) the rest were high quality. The lignin content was near to and above the maximum level of 7% which limits DM intake except elephant grass (4.37%), sugar cane leaf (4.41%) and enset leaf (5.84%) in woynadega, while in kola except desho grass (3.83%), maize Stover (4.17%) and teff straw (5.20%), the rest were near and above the minimum level of 7% limits DMI. Lignin completely indigestible and forms lignin cellulose/hemicelluloses, complexes [15] due to physical encrustation of the plant fiber and reduces its availability to microbial enzymes [16]. Higher NDF content and increased lignifications of the fiber reduce digestibility [17].

Table 15. Chemical composition of feed in the two agro-ecological zones of the study area

Agro-ecology	Feed type	Chemical composition (%DM)					IVDMD (%DM)
		Ash	CP	NDF	ADF	ADL	
Woynadega	Teff straw	4.65^{f}	5.51^{g}	79.24^{a}	40.92^{b}	6.49^{b}	47.30^{f}
	Maize Stover	13.12^{a}	8.95^{de}	66.90^{e}	30.81^{g}	6.77^{b}	67.32^{bc}
	Haricot bean straw	9.49^{bc}	9.55^{d}	61.31^{g}	48.91^{a}	9.35^{a}	71.57^{a}
	Natural grass	8.04^{de}	7.79^{f}	67.75^{d}	35.20^{e}	6.63^{b}	61.92^{d}
	Desho grass	4.78^{f}	5.37^{g}	76.31^{b}	39.59^{c}	4.37^{d}	52.92^{e}
	Elephant grass	10.63^{b}	11.85^{c}	69.88^{c}	35.96^{d}	6.78^{b}	69.98^{ab}
	Sugar cane leaf	13.55^{a}	8.38e^{f}	63.77^{f}	33.46^{f}	4.41^{d}	65.52^{cd}
	Banana leaf	9.09^{cd}	14.37^{b}	57.25^{i}	29.86^{h}	9.70^{a}	62.90^{d}
	Enset leaf	7.23^{e}	17.08^{a}	58.40^{h}	29.20^{h}	5.84^{c}	61.93^{d}
	Wheat bran	5.40^{ef}	18.51^{a}	44.17^{j}	12.86^{i}	3.57^{e}	79.78^{a}
	SE	0.38	0.24	0.23	0.21	0.13	1.04
Kola	Teff straw	3.64^{g}	7.74^{ef}	79.41^{a}	39.98^{b}	5.20^{d}	50.90^{g}
	Maize Stover	13.23^{b}	8.35^{ef}	59.42^{f}	28.50^{e}	4.17^{e}	76.99^{b}
	Haricot bean straw	2.85^{g}	7.33^{f}	73.91^{c}	50.04^{a}	10.49^{a}	61.82^{e}
	Natural grass	7.41^{e}	15.26^{b}	70.21^{d}	39.02^{c}	6.98^{c}	59.98^{f}
	Desho grass	5.80^{f}	4.54^{g}	76.85^{b}	49.94^{a}	3.83^{e}	62.91^{d}
	Elephant grass	14.95^{a}	10.87^{d}	70.42^{d}	38.51^{d}	6.91^{c}	65.20^{c}
	Sugar cane leaf	10.62^{c}	9.67^{de}	69.68^{e}	38.52^{d}	6.68^{c}	77.50^{b}
	Banana leaf	8.10^{de}	13.01^{c}	54.98^{g}	28.29^{e}	8.40^{b}	79.46^{a}
	Enset leaf	8.84^{d}	17.90^{a}	54.99^{g}	28.49^{e}	8.29^{b}	79.07^{a}
	Wheat bran	5.41^{f}	18.16^{a}	44.13^{h}	12.74^{f}	3.52^{f}	79.67^{a}
	SE	0.36	0.40	0.10	0.12	0.15	0.17

^{abc}Means with different superscript in the same column are significantly different (P<0.05); DM= dry matter; %= percentage; CP= crude protein; NDF=neutral detergent fiber; ADF= acid detergent fiber; ADL= acid detergent lignin; IVDMD= in vitro dry matter digestibility; SE= standard error

4. CONCLUSSION AND RECOMMENDATION

Livestock productivity is often low across the country due to a variety of issues including poor genetic makeup, poor nutrition, and poor veterinary care, and development-oriented extension activities pay very little attention to livestock production. Although natural pasture and crop residues were produced in the study area, their full and efficient utilization for animal feeding was limited, partly due to economic issues and partly due to farmers' lack of knowledge about how to handle and process the residues to get the most out of them.

In both agro ecologies, natural pasture and crop residues were the most widely used feed resources. Despite the fact that natural pasture provided a substantial amount of feed for society, the contribution and productivity of this feed resource has been declining from time to time due to crop expansion at the expense of grazing land.

Much more needs to be done in terms of balancing the nutrient supply with the nutrient needs of the livestock population in order for livestock to achieve good value to their owners. This can be accomplished by reducing the size of the household herd and replacing less productive animals with fewer, more productive animals. Farmers must be trained on how to use and process locally available feeds in order to improve the performance of their animals.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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