



Research Article

Volume 7 Issue 4 - June 2017

DOI: 10.19080/ARTOAJ.2017.07.555720

Agri Res & Tech: Open Access J

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Assessment of Availability and Nutritive Values of Feed Resources and their Contribution to Livestock Nutrient Requirements in Chire District, Southern Ethiopia



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Submission: February 02, 2017; **Published:** June 15, 2017

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Abstract

Availability and nutritive values of feed resources and their nutrient contribution to livestock was assessed in Chire district by measuring the amount and chemical composition of feed resources and estimating balance between available and required amounts of nutrients by livestock. For the survey, agro-ecology, kebeles and households (HHs) of the district were selected using purposive multi-stage random sampling procedures. A survey was conducted on 120 HHs and data were collected using group discussion, structured questionnaire and personal observations. Major feed samples were collected from each kebele and their chemical composition and in vitro dry matter digestibility (IVDMD) were determined. On average 13.23tons of feed dry matter (DM) per annum was produced per HH from the major feed resources. The average estimated annual livestock DM requirement for maintenance was 15.78tons with a deficit of 2.55tons. The available feed DM satisfies 87.22% and 79.44% of maintenance DM requirements of livestock in dega (>2300masl) and woyine dega (1500-2300masl), respectively, which indicates that feed shortage was more aggravated at dega than woyine dega. Banana leaf, enset leaf and Elephant grass had reasonably high CP content than the rest of the feedstuffs. The highest percentage of IVDMD was observed in banana leaf (69.74%) followed by elephant grass (64.26%), and enset leaf (61.44%) at woyine dega. Lowest IVDMD was observed in teff straw (45.08%) and bamboo leaf (45.85%). Ways of improving IVDMD of the available feed resources and supplementary feeds that can alleviate the feed shortage must be given priority.

Keywords: Feed availability; Chemical composition; Feed balance; Dega; Woyine dega

Introduction

Ethiopia is believed to have the largest livestock population in Africa. According to CSA (2014/15), Ethiopia owns 56.71million cattle, 29,332,382 sheep, 29,112,936 goat, 2,033115 horses, 7,428037 donkeys, 400,329 mules, 1,164106 camels, 56,886,719 poultry.

The livestock sector has been and is still contributing considerable portion to the economy of the country. The sector contributes 15 to 17% of GDP, 35 to 49% of agricultural GDP, and 37 to 87% of the household incomes [1]. Scholars Benin et al. 2003; Jabbar et al. 2007; Negassa et al, 2011; Solomon et al. [2]; ILRI [1] stated that Ethiopia has huge cattle population, diversified agro-ecological zones and farming systems but the current level of production and productivity, at either the macro or micro level is below its potential.

The availability of feed resources and the nutritional quality of the available feeds are the most important factors that determine the productivity of livestock [3]. Feed shortages and nutrient

deficiencies become more acute in the dry season in both the highlands and lowlands.

For optimum livestock productivity, the available feed resource should match with the number of animals in a given area. However, there is scanty of information regarding the assessment of feed resources in the Chire district. In the Chire district, past efforts paid less attention for efficient utilization of local feed resources and mainly focused on exotic forages development. Alternative strategies for feed development that take into account the utilization of local resources that are already adapted to local environment, need to be explored before they are lost forever.

This study was conducted to assess the amount and chemical composition of livestock feed resources and estimate balance between availability and requirement in Chire district. The result of this study helped in identifying the existing feed resources, utilization practices and ways and means of improving these practices. It has helped in defining prospects for future interventions

in developing livestock feeding systems to enhance productivity and viable integration of the crop and livestock sectors.

Materials and Methods

The study was conducted in Chire district, Sidama zone of the Southern Nations, Nationalities and Peoples' Regional State (SNNPRS). The district is located at 207 km away from Hawassa to the south. The land area of the district is estimated to be 39300ha, and bordered with Nansabo district Oromia Region to the west and to the south, Bensa district to the north and Aroressa district to the east. According to MOA (2000) classification of agro-climatic zones, the district can be divided into three climatic zones, namely highland areas (Dega) >2,300 m.a.s.l, which accounts six keble's (37.5%) of the total land, mid-altitude (Woyine Dega) 1500-2300 m.a.s.l which accounts nine kebeles (56.25%) of the total land and lowland areas (Kolla) <1500 m.a.s.l, which accounts one keble' (6.25%) of the total land areas of the District. The elevation of the Chire districts varies from 1400-3000 m.a.s.l. The mean annual rainfall of District ranges between 900-1500mm while the average annual temperature of the area ranges from 15 °C to 27 °C.

Chire district is characterized by mixed crop-livestock farming system. The livestock population of the area was estimated to be 120464 cattle, 11842 goats, 52793 sheep, 7108 donkeys, 9139 horses, 4063 mule and 59698 chickens (District Agriculture and Rural Development Office 2015). Cereals (maize, barley and teff), haricot bean, enset and coffee are the major crops produced in the area.

Selection of chire district

Two agro-ecology zones of dega and woyine dega were purposively selected based on livestock population. Kebeles were selected based on proportion of kebeles existing in each altitude zone and randomly from each altitude zones. Households were selected randomly from each kebele.

Feed sample preparation

Representative samples of available feed resources were collected during the data collection. Sample site were grouped for grazing site using 0.5m x 0.5m quadrants placed randomly. Crop residues were sampled purposely from crop fields. Leaves of different plants were sampled during the dry season, a critical time when these plants serve as the alternative feed source. Thereafter, sub-samples were taken after thorough mixing for laboratory analysis. Feed samples were air-dried under shed before being transported to the laboratory, then dried at 65 °C for 72h, and ground in Willey mill to pass through 1mm sieve and allowed to equilibrate at room temperature for 24h. The samples were then put in plastic bags and sealed for further chemical analysis.

Estimation of annual feed resources production and livestock feed requirements

The quantity of feed dry matter (DM) obtained from crop residues per HH were estimated from grain yield to crop residue ratio using conversion factors suggested by different researchers. The multiplier used for teff, barley and wheat straw was 1.5per

unit weight of grain yield while the factors for maize and haricot bean were 2.0 and 1.2, respectively FAO 1987. The dry matter (DM) output of private grazing pasture, crop aftermath, and enset and banana leaves were estimated using multiplier 3, 0.5 and 8 tons DM/ha/year, respectively (FAO 1987, MOA 2001). The daily DM requirement for maintenance of one TLU was estimated to be 2.5% of the body weight (ILCA, 1991) which is $250 \times 2.5\% = 6.25\text{kg DM daily}$ or 2.28 t DM per year.

Chemical Analysis

Dry matter (DM) and total nitrogen (N) contents of feed samples were determined following standard method of [4]. Crude protein (CP) was calculated as $N \times 6.25$. Ash was determined by complete burning of the feed samples in a muffle furnace at 500 °C overnight, according to the procedure of AOAC [4]. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were analyzed using the detergent extraction method [5].

In vitro dry matter digestibility

In vitro dry matter digestibility was determined by the method of Tilley & Terry [6] as modified by Van Soest & Robertson [5]. Rumen fluid was collected from sheep by means of esophageal tube.

Statistical analysis

The statistical analysis was carried out using a statistical package for social science (SPSS version 16). Data analysis involved the use of appropriate descriptive statics and frequencies. Means were separated using Tukey test and were considered significant at $P < 0.05$.

Result and Discussion

Land holding and land use pattern

Table 1: Average land use patterns and holding size (ha, Mean±SE) per household in dega and (N=60) and woyine dega zone (N=60).

Land Holding	Dega Zone (N=60)	Woyine Dega Zone (N=60)	Overall (N=120)
Cultivated land			
Own	2.4±0.12	2.38±0.12	2.39±0.16
Rented	0.19±0.05	0.75±0.03	0.13±0.03
Total	2.6±0.10	2.45±0.12	2.52±0.15
Grazing land			
Own	0.69±0.06a	0.31±0.07b	0.504±0.04
Rented	0.8±0.03a	0.05±0.02b	0.068±0.19
Total	0.78±0.06a	0.35±0.07b	0.57±0.53
Total own	3.09±0.28	2.99±0.26	2.99±0.27
Total rented	0.99±0.08	0.13±0.04	0.56±0.60
Overall total	4.08±0.36	3.12±0.30	3.62±0.15

Means with different superscript letters within a row between zones are significantly different ($P < 0.05$) N: Number of Respondents; SE: Standard Error

Landholding and land use pattern of respondents in the study district is summarized in Table 1. The overall average household land holding size of the Chire district was 2.99 ha and about 0.56ha was total rented land Chire district. Out of total land owned per

household in dega zone was 2.6ha and woyine dega zone was 2.45ha of land was allocated for crop cultivation and 0.78ha in dega and 0.35ha in woyine dega zone was allocated for private grazing.

($P < 0.05$) N=number of respondents, SE=standard error

Livestock holding and composition

Tropical livestock unit of the district was 5.6 per household with dega having (6.3) more ($p < 0.05$) than that (4.9) of woyine dega. Cattle were most important livestock species in both agro-ecologies (Table 2). Mean cattle holding size was much lower than that reported (11TLU) for Adami Tullu Jiddo Kombolcha District (Duressa, 2007), (8.7TLU) for Sinana, (11.5TLU) for Dinsha (Solomon, 2004) and (11TLU) for Badewacho and Sodd Zuria districts (Netsanet, 2006). The smaller TLU per HH in the Chire district could be attributed to shrinkage of grazing land.

Table 2: Livestock holding and composition and feed sources per household in dega and woyine dega kebeles of Chire district (TLU).

Livestock Species	Dega (N=60)	Woyine Dega (N=60)	Overall Mean
Cattle	Tropical livestock unit		
Bull	1.03	0.68	0.86
Ox	0.24	0.13	0.19
Heifer	1.34	1.13	1.24
Cow	2.58	2.34	2.46
Sheep	0.35	0.08	0.21
Goat	-	0.05	0.03
Donkey	-	0.06	0.03
Horse	0.6	0.02	0.31
Mule	0.02	0.09	0.06
Chicken	0.13	0.3	0.22
Feed resources	%		
Natural pasture	50	35	
Crop residues	21.6	0.1	
Crop root	13.3	43.3	
Crop after math	13.3	6.7	
Hay	-	1.7	
Supplements	1.6	3.3	

TLU: Tropical Livestock Unit; N: Number of Respondents

Feed resources availability

Feed problem is one of major factors that hinders the production and productivities of livestock in the Chire district. Natural pasture and root crops (enset and banana leaf) were ranked 1st and are primary source of feed to livestock in both agro-ecological zones of the Chire district (Table 2). In general crop residues and natural pasture are the major feed resources of the dega kebeles which agree with Tolera et al. [7], Alemayehu (2004) who reported natural pasture and crop residues to be the major feed resources for highlands of Ethiopia

Improved for age development practice and their utilization

This study indicated that there was less experience in growing improved forage. Majority of respondents mentioned that they do not cultivate improved forage (Table 3) at dega and woyine dega respectively. Admasu [8] has also reported that forage development is a key to skip feed shortages if practiced but it is at an infant stage in terms of usage. Proportion of farmers producing improved forage was only minimal at dega but slightly better at woyine dega. Moreover, reasonable population of respondents conserves feed to overcome seasonal feed shortage problem in dega than woyine dega.

Table 3: Levels of improved forage development and utilization practices.

Respondent Experience	Dega Zone (N=60)		Woyine Dega Zone (N=60)	
	No	Yes	No	Yes
Cultivate improved forage (%)	93.3	6.7	81.7	18.3
Conserve feed (%)	58.3	41.7	71.7	28.3
Treat crop residues (%)	75	25	65	35
Reasons for not producing improved forage	N (%)			Rank
Lack of awareness	64(53.3)			1
Lack of seed	28(23.4)			2
Shortage land	16(13)			3
Availability of other feed sources	12(10.3)			4

Estimation of available feed resources

Table 4: Estimated annual feed dry matter obtained per household farm from different feed resources.

Sources of Feed	Feed Production (T DM/HH)			
	Dega (N=60)	Woyine dega (N=60)	Average (DM)	%
Maize stover	-	2.5	1.25	29.48
Teff straw	0.02 ^b	0.75 ^a	0.39	9.19
Wheat straw	1.5	-	0.75	17.68
Barely straw	2.55	-	1.27	29.95
Haricot bean straw	-	0.35	0.18	4.24
Bean	0.55	0.25	0.25	9.19
Total crop residues	4.62 ^a	3.85 ^b	4.24	100
Utilizable crop residues	4.16 ^a	3.47 ^b	3.84	29.02
Aftermath	2.00 ^a	0.70 ^b	1.35	10.2
Private grazing	4.50 ^a	1.05 ^b	2.76	20.86
Fallow land	0.5	0.35	0.43	3.25
Forest/ woody land	0.25	0.4	0.31	2.34
Enset and banana leaf	4.08 ^b	5 ^a	4.54	34.31
Total DM available	15.49 ^a	10.97 ^b	13.23	100

The dry matter obtained from different feed resources is presented in Table 4. The average utilizable dry matter output obtained per household from private grazing land was higher for dega than woyine dega. The overall average utilizable dry matter output produced annually from crop residues per household was lower than that (6.7 tons DM) reported by Solomon et al. [2] in

the Bale high land. The differences in varieties and types of crops; quality and quantity of fertilizers used; plant protection measures which may also lead to differences in vegetative growth and yield [9]. More than half of the residue DM was contributed by maize stover and barley straw.

Estimation of feed supply and feed requirement

According to Table 5 the average annual utilizable feed dry matter in dega zone required for maintenance was higher than the actual DM production which could not completely support it. Similar negative feed balances were also reported by Admasu [8] and Wondatir [10] in Wolayita Sodo, Alaba District and central Rift Valley of Ethiopia.

Table 5: Estimated annual utilizable feed DM supply, DM requirement and feed balance per household.

Parameters	Agro-Ecology		
	Dega	Woyine dega	Average
Annual feed DM supply (t)	15.49	10.97	13.23
Requirement for maintenance (t DM/year)	17.76	13.81	15.78
Balance of requirement (t)	-2.27	-2.84	-2.55
(%)	-12.88	-20.56	-16.66

DM: Dry Matter; t: tone

Seasonality of feed resources availability

The type, quality and quantity of available feed resource are influenced by season. Commonly available feed resources at different times of the year are presented in (Table 6). Natural pastures, thinning and green maize stover, weeds and different browse species are used during most part of the year.

Table 6: Season of the year when different feeds are available in the Chire district.

Feed Type Resources	Sept.-Nov.	Dec.-Apr.	May-Aug.
Natural pasture			
Dry maize Stover			
Green maize stover			
Teff straw			
Barely straw			
Crop after math			
Cut-and-carry grass			
Enset leaves and other parts			
Browses and weeds			

Note: The shaded area shows the months during which the given feed resources are available for animal feeding.

Chemical composition and nutritive value of feeds

Chemical composition and nutritive values of major feed resources are shown in Table 7. The high fiber and low crude protein contents of the different feed resources could be related to varietal differences, location or climate, fertility of the land, stage of maturity at harvest, morphological fraction fed, method of harvesting and transporting, length and condition of storage (Archimade et al 2002). The relatively high CP content of enset leaf is in line with

the values (17%) reported by Adugna [11] at southern Ethiopia, which makes it a favorable feed resource in ruminant feeding. High CP combined with low NDF and ADF contents are indicators of good forage quality (Aregheore, 2007). The highest digestibility coefficient was observed in banana leaf followed by elephant grass and enset leaf at woyine dega. Lower IVDMD values were observed in teff straw and in bamboo leaf which is likely associated with their higher lignin content compared to the other feed resources. IVDMD of enset leaf at both agro-ecologies was almost similar and higher than earlier report (69.2%) of Adugna [12].

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 [13-28].

Table 7: Chemical composition (%) and in vitro dry matter degradability of major feed resources in Chire district.

Feed type	Lab DM		% of DM				
	Agro-Ecology	(%)	Ash	CP	NDF	ADF	IVDMD
Natural pasture	Dega	90	4.5	7.5	69.49	33.12	56.52
Natural pasture	Woyine dega	91.5	6	6.25	67.51	31.18	59.42
Elephant grass	Woyine dega	89.5	7.5	16.09	67.11	34.02	64.26
Enset leaf	Dega	94	9.5	12.21	56.36	25	60.79
Enset leaf	Woyine dega	91	8	14.93	57.23	26.59	61.44
Banana leaf	Woyine dega	88	7.5	13.62	55.44	25.19	69.74
Sugar cane leaf	Woyine dega	85	8.5	6.37	74.01	39.39	50.45
Bamboo leaf	Dega	92	7	10.96	69.52	31.58	45.85
Maize stover	Woyine dega	93	8	5.67	72.55	26.62	59.42
Teff straw	Woyine dega	91	3	5.56	77.5	39.39	45.08
Barley straw	Dega	92.4	4.2	4.1	76	42	52.1

Abbreviations: DM: Dry Matter; Cp: Crude Protein; NDF: Neutral Detergent Acid, ADF: Acid Detergent Fiber; ADL: Acid Detergent Lignin, IVOMD: *In vitro* Organic Matter Digestibility

Conclusion and Recommendation

From this study it can be concluded that the major feed resources available in Chire district were natural pasture, different parts of enset and banana and crop residues. Available feed resources do not meet nutrient requirements to get optimum benefits from the livestock sector. Introducing improved forages and conservation of exiting forage/natural pasture in the form of hay at the end of rainy season might be part of the solution.

Acknowledgement

The authors acknowledge the Chire district Bureau of Agriculture for giving the chance to pursue this study.

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DOI: [10.19080/ARTOAJ.2017.07.555720](https://doi.org/10.19080/ARTOAJ.2017.07.555720)

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