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Exploring Livestock Feed Resources, Seasonal Availability, and Strategies for Managing Feed-Related Issues in Burji District, Southern Ethiopia

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Abstract

An assessment was conducted on livestock feed resources, seasonal availability, and strategies for managing feed-related issues in the Burji District of Southern Ethiopia. A total of 134 households involved in livestock production activities were randomly selected for an interview. The results indicated that the majority (74.96%) of interviewed respondents were males, while 25.04% were females. The average number of livestock owned by households in the study area was 11.17 ± 0.29 tropical livestock units (TLU), with cattle predominating at 93.91%. Natural grazing pastures and crop residues were the primary feed sources, though chemical analysis revealed that they are deficient in nutritional quality. The results indicated the feeds contained 4.1-7.5% crude protein (CP) and 63.2-71.5% neutral detergent fiber (NDF). Crop residues and saving natural pasture as hay are the most common coping mechanisms in times of feed shortages. The use of supplementary feeds and crop residue treatments are recommended to address the low crude protein content in primary feeds and to improve the palatability of crop residues.

Keywords: Feeds, Quality, Shortage, Coping strategy.

استكشاف مصادر أعلاف الماشية والتوافر الموسمي واستراتيجيات إدارة المشكلات المتعلقة بالأعلاف في منطقة برجي، جنوب إثيوبيا

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الخلاصة

أُجري تقييمٌ لموارد أعلاف الماشية، والتغيرات الموسمية، واستراتيجيات إدارة تحديات الأعلاف في منطقة برجي بجنوب إثيوبيا. وقد اختير عشوائيًا ما مجموعه 134 أسرة تعمل في تربية الماشية لإجراء المقابلات معها. وأشارت النتائج إلى أن معظم المستجيبين (74.96%) كانوا من الذكور، بينما كانت نسبة الإناث 25.04%. وبلغ متوسط حيازات الماشية لدى الأسر 11.17 ± 0.29 وحدة ماشية استوائية (*TLU*)، معظمها من الماشية بنسبة 93.91%. وكانت مصادر الأعلاف الرئيسية هي المراعي الطبيعية ومخلفات المحاصيل، إلا أن التحليل الكيميائي أظهر أن قيمتها الغذائية منخفضة. وتحتوي هذه الأعلاف على نسبة تتراوح بين 4.1% و7.5% من البروتين الخام (*CP*) و63.2% و71.5% من ألياف المنظفات المحايدة (*NDF*). وخلال فترات نقص الأعلاف، تستخدم الأسر بشكل أساسي مخلفات المحاصيل وتحافظ على المراعي الطبيعية كقش. ولمعالجة انخفاض مستويات البروتين الخام وتحسين مذاق مخلفات المحاصيل، توصي الدراسة باستخدام الأعلاف التكميلية ومعالجات مخلفات المحاصيل.

كلمات مفتاحية: الأعلاف، الجودة، النقص، استراتيجية التكيف.

Introduction

Ethiopia has a large livestock population (7) which constitutes a vital component of the economy of the country. Livestock rearing ensures the availability of food and income to the farming community (14), and in both the rural and urban areas of Ethiopia it is evolving as a significant source (19). However, livestock productivity in the country is generally very low due mainly to poor husbandry, poor feeding (low quality and quantity of feed), and limited extension and veterinary service.

Feed shortages are among the major constraints affecting productivity of livestock and livelihood of the farmers in Ethiopia (10). According to (5), the major feed resources are pastures, crop residues, forage crops, and non-conventional feeds.

Burji district in Southern Ethiopia has a large livestock population and diverse agro–ecological zones suitable for livestock production. The main farming system in the area is a mixed crop-livestock type, where cereal and pulse crops are extensively cultivated and with livestock production forming an important component. However, there is a lack of information on available feed resource and utilization practices in

the district making it crucial to identify available feeds and seasonal variations in their availability as well as to determine the nutritional value of the feed resources. Hence, it was imperative to assess the availability and quality of existing feed resources. This study evaluated the available feed resources for livestock production, assessed their distribution, and analyzed the chemical composition of selected feeds within the study area.

Materials and Methods

Description of the study area: The study was carried out in Burji District, Southern Ethiopia. The district lies between 5°29' 59.99" N latitudes and 37°49' 59.99" E longitudes at altitudes ranging from 801 to 2560 meters above sea level. The district has three agro-ecologies i.e., highland (14%), midland (46%), and lowland (40%). Mean annual average rainfall ranges from 800mm to 1000mm and the mean annual temperature from 15.1 ^{0}C to 27.5 ^{o}C. The livestock population of the district includes 381,936 cattle, 278,967 goats, 37,849 sheep, 874,864 poultry, 22,566 donkeys, 1,287 horses, and 473 mules (3).

Sampling procedures and sample size: The highland, midland, and lowland agro-ecologies in the district have 4, 12, and 10 kebeles, respectively. Six representative kebeles were selected proportional to the agro ecologies and based on the potential in livestock resources. Accordingly, 1, 3, and 2 kebeles were selected from the highland, midland, and lowland agro-ecologies. Households involved in livestock production were identified and listed in each kebele with the help of their administrators, and simple random sampling was used to select the respondent households. The total numbers of respondent households 134 were determined using the (6) formula:

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

Where, Z = standard normal deviation (1.96 at 95% confidence level), P = 0.10 (proportion of population to be included in sample i.e., 10%), q= 1- p i.e., 0.9 and d = degree of accuracy desired 0.05.

Data collection method: Data was collected through structured questionnaires form respondent households. It included household characteristics, land holdings, livestock population, available feed resources, seasonality of feeds, and constraints in livestock production in relation to feed resources.

The index for ranking feed-resources availability for livestock production was calculated as follows: index = sum (3 × number of responses for the first rank + 2 × number of responses for the second rank + 1 × number of responses for the third rank / (3 × total responses for the first rank +2 × total responses for the second rank +1 × total responses for the third rank. Ranks 1 and 3 was deemed the most and least available sources of feed, respectively.

Chemical analysis of sampled feeds: Chemical analysis of the most available feeds in each agro-ecology was conducted at Hawassa University College of Agriculture's Animal Nutrition Laboratory. Samples with high moisture content were partially dried in forced draft oven at 65 °C for 72hrs, and then milled. Feed dry matter (DM), ash, ether extracts (EE) and crude protein (CP), were determined using the procedure of (1). Nitrogen content of the feeds were determined using Kjeldhal procedure. The

CP was computed as N × 6.25. Neutral detergent fiber (NDF) was determined by methods of (28). Acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined by the methods of (27).

Data Analysis: The data were analyzed with the Statistical Package for Social Sciences (SPSS) version 20 using descriptive statistics (mean, percentage, and frequency) and cross-tabulation tests were used to compare qualitative variables. The model used for analyzing data on feed resource and feed quality was: $Y_{ij} = \mu + \alpha_i + \Sigma_{ij,}$ where, *Yij* = total observation, μ = overall mean, α_i = location (agro-ecology) and e_{ij} = random error. For parameters requiring ranking, the index was calculated.

Results and Discussion

Household characteristics of the respondents: Table 1 summarizes the household characteristics of the respondents. The majority of respondents interviewed were male (74.96%) and the rest female (25.04%), similar to the findings by (15) for Moretna Jiru District where the majority of households (97.5%) involved in livestock production were male.

The average mean family size was higher than the 5.1 reported for the Dessie and Kombolcha urban and peri urban area of Ethiopia (21). The literacy rate in this study area was higher than most reported literatures i.e., 69.4% in Damot Gale (22), 59.2% in Lume District of East Shoa (23), and 76.7% in Mirab Abaya district (25). Increasing the educational level of farmer households increases the adoption of new technologies (24).

Table 1: Household characteristics of respondents.

Variables		Agro ecology			Overall	X^2-test	P-value
		Highland (n=22)	Midland (n=67)	Lowland (n-45)			
Household Gender (%)	Male	79.36	75.52	70	74.96	5.92	0.001
	Female	19.64	24.48	30	25.04		
Educational Status (%)	Illiterate	31.82	13.43	22.22	19.4	10.17	0.01
	Elementary school	45.45	62.69	66.66	61.2		
	High school	22.73	20.9	11.11	17.92		
	Higher education	0	2.99	0	1.49		
Family size		7.50 ± 0.4	7.94 ± 0.3	7.64 ± 0.3	7.77 ± 0.1		0.017

n= number of respondents.

Household livestock holdings: The average number of total livestock in study area was 11.17 ± 0.29 TLU with cattle forming the largest group at 93.91% (Table 2). The average number of cows, bulls, heifers, goats, and poultry per household was highest ($p < 0.05$) in the highland agro-ecology area while that for sheep and donkeys was highest ($p<0.05$) in the midland agro-ecology. The mean total livestock holding per household in the study (11.17 + 0.29) was higher than the 6.46 ± 0.41 TLU in Bonke District (8). This might be due to the availability of better grazing lands and feed sources in Burji.

On the other hand, the total mean number of cows (3.29 ± 0.24) and ox (4.78 ± 0.27) per household for this district was higher than cows (2.55 ± 0.50) and ox (2.66 ± 0.02) reported for the Harshin district of Somali Regional State, Ethiopia (13). This could be attributed to the owners securing better advantages from the livestock and its greater role in the agricultural activity of the area. Smallholder households in the highland, midland and lowland agro-ecologies of Baka Dawla district respectively owned 5.25, 3.58 and 4.32 numbers of chickens (11).

Table 2: Household livestock ownership (mean ± SE).

Livestock species		Livestock structure in agro-ecology (TLU)			Overall mean	P - value
		Highland	Midland	Lowland		
Cattle	Cow	4.18 ± 0.35^{a}	2.63 ± 0.16^{b}	3.06 ± 0.22^{b}	3.03 ± 0.13	0.005
	Ox	5.05 ± 0.29^{a}	5.39 ± 0.25^{a}	3.91 ± 0.27^{b}	4.84 ± 0.17	0.004
	Bull	1.20 ± 0.13^{a}	1.11 ± 0.78^{b}	1.17 ± 0.97^{b}	1.15 ± 0.05	0.038
	Heifers	1.05 ± 0.98^{a}	0.63 ± 0.6^{b}	0.84 ± 0.08^{b}	0.77 ± 0.05	0.003
	Calves	0.44 ± 0.39^{a}	0.31 ± 0.25^{b}	0.4 ± 0.04^{a}	0.36 ± 0.02	0.045
Sheep		0.12 ± 0.41^{b}	0.21 ± 0.25^{a}	0.16 ± 0.03^{b}	0.18 ± 0.02	0.040
Goats		0.59 ± 0.80^{a}	0.46 ± 0.53^{b}	0.27 ± 0.04^{b}	0.42 ± 0.03	0.003
Donkeys		0.59 ± 0.85^{b}	0.79 ± 0.60^{a}	0.42 ± 0.05^{b}	0.63 ± 0.04	0.001
Poultry		0.6 ± 0.10^{a}	0.05 ± 0.01^{b}	0.03 ± 0.01^{b}	0.04 ± 0.04	0.041
Total livestock TLU		12.81 ± 0.59	11.31 ± 0.39	10.16 ± 0.53	11.17 ± 0.29	0.050

Means with similar superscript within a row are not significantly different; TLU= tropical livestock unit;
SE = standard error.

Household landholding and use pattern: Table 3 presents the average landholding and usage patterns for the study area. Total landholding and portion of land used for crop production per household head are seen to be significantly higher ($p < 0.05$) in the midland agro-ecology, followed by the highland and lowland areas. Homestead lands were higher ($p < 0.05$) in the lowland agro-ecology category than in the other two types while those allocated for forage production was significantly higher ($p<0.05$) in the lowland category. The mean total land holding per household was similar to that reported by (5) of 2.05 ± 0.09 hectares in the Jimma and Ilu Aba Bora zones.

Table 3: Average land holding and use patterns of the households (Mean± SE).

Land allocation pattern (ha)	Agro-ecology			Overall mean	P – value
	Highland	Midland	Lowland		
Homestead/backyard	0.13 ± 0.02^{c}	0.16 ± 0.01^{b}	0.22 ± 0.02^{a}	0.17 ± 0.01	0.000
Land for crop production	1.78 ± 0.18^{b}	2.22 ± 0.10^{a}	1.10 ± 0.12^{c}	1.70 ± 0.08	0.002
Land for forages	0.06 ± 0.03^{c}	0.10 ± 0.02^{b}	0.18 ± 0.02^{a}	0.11 ± 0.02	0.004
Grazing land	0.17 ± 0.03	0.15 ± 0.02	0.12 ± 0.02	0.15 ± 0.02	0.024
Forest land	0.14 ± 0.03	0.07 ± 0.02	0.13 ± 0.02	0.11 ± 0.01	0.013
Total	2.27 ± 0.19^{b}	2.70 ± 0.11^{a}	1.75 ± 0.13^{c}	2.24 ± 0.09	0.001

a, b, c means with different superscript within a row are significantly different; SE = standard error; ha = hectare.

(23) documented an average size of 2.23 ± 0.10 hectares in the Lume District of the East Shoa Zone, while it was smaller at 0.68 ± 0.09 hectares in the Haramaya District, Eastern Ethiopia (18).

Major feed resources: The major available feeds in the study area as ranked by respondents within agro-ecology are presented in Table 4. (13) reported natural pastures as the major feed resource followed by crop residues for the Harshin district of Somali Regional State, similar to the Gilgel Gibe Catchments of Jimma Zone, Southwestern Ethiopia as noted by (20). (4) reported crop residues, natural pasture, and stubble grazing as the major feed resource for Burie Zuria District, North Western Ethiopia.

Table 4: Available feed resources across agro-ecologies.

Variables	Agro-ecology					
	Highland		Midland		Lowland	
	Index	Rank	Index	Rank	Index	Rank
Natural pastures	0.42	1	0.30	1	0.32	1
Crop residues	0.33	2	0.29	2	0.28	2
Hay	0.12	3	0.13	4	0.16	3
Browsing trees	0.07	5	0.12	5	0.10	5
Improved forage	0.06	4	0.16	3	0.15	4

Seasonal availability of feed resources: Seasonal availability of feed in the study area is presented in Table 5. As shown, crop residues ranked first in the dry season followed by the natural pasture; while in the wet season it was the reverse. (17) revealed crop residues ranked first during the dry season for Chire District, Southern Ethiopia. Similarly, (5) reported that crop residues were the first ranked feeds in the dry season followed by natural pasture in South Western Ethiopia.

Table 5: Available feed resources in dry and wet seasons.

	Ranking by Respondents			
	Dry Season		Wet season	
Feed Types	Index	Rank	Index	Rank
Natural pasture	0.23	2	0.28	1
Crop residues	0.25	1	0.21	2
Browsing trees	0.14	3	0.13	4
Stubble grazing	0.11	4	0.12	5
Improved forage	0.10	5	0.15	3

Feed shortage coping strategies: The coping mechanisms for livestock feed shortages are outlined in Table 6. Most respondents in the study area reported experiencing feed shortages. The use of crop residues, hay making from natural pasture, and traveling long distances in search of feed were the major coping strategies in the area.

Table 6: Feed shortage coping strategies in the study area.

Variables		Agro-ecology			Overall (N=134)
		Highland (n=22)	Midland (n=67)	Lowland (n=45)	
Do you face feed shortages?	Yes	89.9	92.9	93.3	92.03
	No	10.1	7.1	6.7	7.97
Coping Mechanisms	Store/save crop residues	68.2	61.2	66.7	65.4
	Making hay from pasture	22.7	34.3	33.3	30.1
	Traveling long distances to search for feed	9.1	4.5	0	4.5

N=total number of respondents; n= respondents in the different agro-ecologies.

Contrary to this study, (22) reported that 55% of respondents in Damote Gale District of Wolaita Zone, Southern Ethiopia coped by purchasing feed to overcome shortages. (8) noted that about 41% of respondents relied on crop residues to withstand feed shortages in the Bonke district of Gamo Gofa Zone.

Chemical composition of selected feed stuffs: Chemical analysis results of major feed resources in Table 7 show that the dry matter (DM) constituted 90% and above of all the feed samples analyzed.

Table 7: Chemical composition of selected feed within the agro-ecologies.

Agro-ecology	Feed type	Chemical composition (%)						
		DM	Ash	CP	NDF	ADF	ADL	EE
Highland	Natural pasture (hay)	91	8.6	5.0	63.5	32.6	8	1.7
	Barley straw	92.5	9.6	4.6	71.7	40	8.5	2.2
Midland	Natural pasture (hay)	91.2	13	5.1	65.5	34.8	8.6	1.9
	Teff straw	95.3	8.9	5.4	64.5	32.7	6.2	1.9
	Haricot bean straw	90.3	9.5	7.5	55.4	38	14.7	2.1
Lowland	Natural pasture (hay)	92.3	11.8	5.3	63.2	34	8.9	2.2
	Teff straw	94.6	7.3	5.2	68	33.4	4.6	1.9

DM = dry matter, CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent lignin, and EE = ether extract.

In this study, the dry matter content of natural pasture (hay) in the lowland agro-ecology was higher than for the midland and highland areas, while in the midlands ash content was higher. Form-sampled crop residues teff straw in the midland had high dry matter content followed by lowland teff straw. The CP content of teff straw was higher in the midland than in the lowland agro-ecology. Generally, the nutritional value of the grasses evaluated in this study was low due mainly to poor pasture management, land fragmentation and degradation, overgrazing, overstocking, soil types.

The nutritional values of natural pasture obtained in this study are consistent with (17) who noted that CP and DM contents of 5.3% and 92% for Southern Ethiopia. The CP content of natural pasture in this study is in line with the 5.4% value reported by (23) for the Lume District of the East Shoa Zone. (17) reported 92.4%, 4.5%, and 40.5% respectively for DM, CP, and ADF in natural pasture for the Chire District,

Southern Ethiopia. Alternatively, a higher value of CP content (7.49%) for natural pasture was reported by (4).

Conclusions

The study results indicate that natural pasture and crop residues were the major feed sources in the area, and that their availability depended on the seasons of the year. The nutritional quality of theses feeds were especially low as indicated by the chemical analysis. Supplementary feeding and treatment of crop residues are recommended to compensate for the poor protein content of the major feeds and to enhance crop residue palatability. Farmers in the area should be given awareness training on improved forage production and conservation. Also recommended for the area are adaptability trials for the introduction of climate resilient forage.

Supplementary Materials:

No Supplementary Materials.

Author Contributions:

Author 1: Methodology, investigation, writing—original draft preparation; Author 2: Analysis, writing—review and editing. Both authors have read and agreed to the published version of the manuscript.

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Data available upon request.

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The authors declare no conflict of interest.

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