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Research Article

Seasonal Availability of Major Feed Resources, Constraints of Ruminant Production and their Coping Mechanisms in Different Agro ecologies of Tigray, Northern Ethiopia

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ABSTRACT

The study was conducted to assess the seasonal availability of feed resources, major constraints of ruminant production and their copping mechanism in different agro ecologies. The study was undertaken using structured questionnaire and focus group discussions. Three districts were selected based on representativeness of agro-ecologies and a total of 270 respondents were interviewed to generate the data. Statistical Package for Social Sciences software was used for data analysis. In the highland (95%) and midland (98%) involve in both crop and livestock production system. In highland crop residues (98.9%) were found the major feed source in dry season which is followed by leaf of indigenous browse species (95.6%), hay (90%) and crop aftermath (82.2%) whereas in wet season majority of the respondents (95.6%) use weeds as a major source of feed which is highly supported by tinned cereal crops. Similarly, in midland hay (100%) was found the major feed source during the dry season which is followed by crop residue (97.8%), leaf of indigenous browse species (91.1%) and crop after math (86.6%) while in wet season majority of the respondents (100%) use weeds followed by indigenous browse species. Cultivation of improved forage was not practiced in majority of the study area. Major livestock constraints were shortage of feed, shortage of water, drought, decrease in grazing land, lack of improved breed and animal healthcare problem. The coping mechanisms for these challenges were purchasing feed, cut and feeding foliage of browse species and destocking. Development of improved forages and efficient utilization of browse species that can be integrated with the dominant farming system needs attention.

Key words: Agro ecology, Crop residue, Feed Resource, Ruminant, Season

INTRODUCTION

In Ethiopia, feed shortage, both in terms of quantity and quality, is among the prominent setbacks of the livestock sector resulting in a low contribution of the sector to the national GDP, regardless of the large population of livestock species owned by the country. Feed scarcity is indicated as a major factor responsible for the lower reproductive and growth performance of animals, especially during the dry season (Berhanu *et al*., 2009).The dry season is characterized by inadequate grazing resources as a result of which animals are not able to meet even their maintenance requirements and lose a substantial amount of their weight. In the last couple of decades, the use of communal grazing lands, private pastures and forest areas as feed resources has declined while the use of crop residues and purchased feed has generally increased (Benin *et al.*, 2003). This is because of the increased crop farming lands; excessive grazing that caused soil compaction which in turn resulted in reduced plant species diversity and percentage cover of the herbaceous and woody vegetation (Tessema *et al*., 2011). On the other hand, regardless of the increased utilization of agro-industrial by-products as animal feed, these are not available, affordable or feasible for most of the smallholder farmers in Ethiopia (Benin *et al.*, 2004; Yayeneshet *et al*., 2016).

Livestock production is the most important field of agriculture in Eastern zones of Tigray which is characterized by mixed crop livestock farming system.

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The farmers in these zones rear animals for different purposes like providing draught power, milk, meat, manure and sources of cash. However, there is a shortage of feed and feeding management which resulted to low disease resistance ability and low productivity of animals. Therefore, in order to design an appropriate intervention options, it is important to generate more baseline information. The objectives of this study were to spot out the seasonal availability of feed resources, the major constraints of ruminant production and their coping mechanisms in different agro ecologies of the study area.

MATERIALS AND METHODS

Description of the study area

The study area is located in the eastern part of Tigray regional state, Northern Ethiopia. This zone covers about 6050 km^2 area. The selected study areas vary with biophysical conditions, including agro-ecological zoning, elevation, rainfall pattern and amount, temperature, land use and soil types. Most of the districts are categorized as Highland or Dry *Dega*, followed by Midland or Dry *Weina Dega*. The elevation of the selected districts ranges from 1883 to 3298 masl. Annual rainfall is variable within a range of 420-689mm. Temperature ranges from 12 to 24°C. Most of the lands are cultivated with some patchy grazing bottomlands and hilly sites. The major soil type of the study area includes Lithic Leptosols followed by Haplic Lixisols (mainly around TsaesieTsaeda emba) and Vertic Cambisols (around Kilte Awlaelo) (Gebremedhin and Dawit, 2013).

Selection of the study site and sampling methods

A purposive sampling technique was used in selecting the three districts with the intention of covering those districts having potential of livestock population, agro ecology and farming systems. From each district, three rural kebeles (RKs) were purposively selected for questionnaire survey. From the selected RKs, 30 farmers were purposively selected based on their experience in livestock rearing. A total of 270 farmers (180 from highland agro ecology and 90 from midland) were interviewed and two focus group discussions were also held in both agro ecologies.

Statistical analysis

The Statistical Package for Social Sciences (SPSS) software (version 16.0) computer programs was used for data analysis. The analysis included descriptive statistics (means, frequencies and percentages). Indices (weighted averages) were developed to obtain the aggregate ranking of the major feed resources utilized in the study area.

RESULTS

Farming activities and livestock production system

The major farming activity was reported to be mixed farming system. Respondents in the highland (95%) and midland (98%) involve in both crop and livestock production system. Despite their involvement in mixed farming, few percentages of highland respondents give priority to livestock as their most important activity. Similarly, the midland respondent reported crop production to consist the larger share of family income. Many grain crops mainly cereals and pulses, are grown in both agro-ecologies. The main crops grown in the areas differ in terms of area coverage and distribution between the two agro-ecologies. In highland the respondents give priority to production of wheat, barley, lentil, faba bean, chick pea and field pea while the important crops in the midland includes wheat, *teff*, barley and field pea (Table1).

Availability of major feed resources

The results of the survey indicated that the major feed resources available in both agro ecologies during wet and dry seasons were natural pasture, crop residues (wheat, barley and *teff* straws), concentrate (wheat bran and local brewery by products) and indigenous browse species (IBS). Most of the farmers in highland and midland reported the main feed resources to be crop residue and indigenous browse species. During the dry season crop residues, indigenous browse species and hay are the dominant resources in both agro-ecologies. Whereas, weeds which are highly supported by tinned cereal crops, herbaceous legumes and indigenous browse species (IBS) from the major feed resources in the wet season (Table 3).

The contribution of the major feed resources to the overall feed supply for ruminants varied. From the ranking of the available feed resources by the local farmers, weeds, crop residue, indigenous browse species and natural pasture stood first to fourth in the highlands during wet season. During the dry season in both agro-ecologies, crop residue was the first in its contribution followed by indigenous browse species, hay and crop aftermath. In midland, weeds were the first in its contribution during wet season followed by crop residue, indigenous browse species and natural pasture (Table 4).

Table 1: Major crops grown at highland and midland of Eastern zone of Tigray

Major crops	Agro ecology						
	Highland (n=180)				Midland (n=90)		
	Districts		Frequency	%	District	Frequency	%
	AT	GA			KA		
Wheat	90	88	178	98.9	90	90	100
Barley	88	90	178	98.9	84	84	93.3
Teff	24	2	26	14.4	86	86	95.6
Field Pea	22	30	52	28.9	48	48	53.3
Chick Pea	62	6	68	37.8	-	-	-
Lentil	10	72	82	45.6	12	12	13.3
Faba Bean	2	70	72	40.0	-	-	-

AT= Atsbi Wemberta; GA= Ganta Afeshum; KA= Kelte Awlaelo; - = Not reported.

Table 2: Farming and production systems in Eastern Zone of Tigray

Production system	Highland		Midland	
	Frequency	Percent	Frequency	Percent
Livestock	4	2.2	1	1.1
Crop	6	3.3	1	1.1
Mixed	170	94.5	88	97.8
Total (n)	180	100	90	100

Constraints of ruminant production and coping mechanisms

The survey result showed that feed shortage was the major constraint to livestock production in both highland and midland of the study area. In highland feed shortage is the first constraint to livestock production followed by water shortage, drought and decreasing grazing lands. Similarly in midland feed shortage was the major challenge followed by drought, water scarcity and decrease in grazing lands (Table 5). Confirming the feed shortage as a major livestock production constraint, most of the farmers interviewed in both agro-ecologies reported that the above mentioned feed resources are not enough to maintain the livestock population of the area for the whole year. The most critical time of feed shortage was reported to be the period from February to June.

During the critical period of feed shortage, farmers in both highland and midland use different strategies to cope with the feed shortage. Accordingly, purchasing feed (Hay or straw) from other areas, cut and feeding of indigenous browse species and destocking by selling during feed scares were among the major strategies employed (Table 6). Nevertheless, Industrial by products such as wheat bran, Nuge seed cake and cotton seed cake were not available at large and purchasing ability of the majority of the farmers are low in both agro ecology and their contribution to

Table 3: Percent of respondent farmers on utilization of the different feed resources during the two major seasons in Eastern zone of Tigray

Feed Resources	Agro ecology							
	Highland				Midland			
	Wet season		Dry season		Wet season		Dry season	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Crop residue	150	83.3	178	98.9	68	75.6	88	97.8
Natural pasture	72	40.0	48	26.7	30	33.3	36	40.0
Improved forage	22	12.2	34	18.9	2	2.20	12	13.3
Crop after math	2	1.10	148	82.2	2	2.20	78	86.6
Hay	38	21.1	162	90.0	20	22.2	90	100
Industrial by product	68	37.7	116	64.4	14	15.5	30	33.3
Weed	178	98.9	-	-	90	100	-	-
IBS	158	87.7	172	95.6	70	77.8	82	91.1

Wet season: The main rainy season in the study area from late June to Early September; Dry season: from October to late May; IBS =Indigenous browse species, Highland (n=180); Midland (n=90).

Table 4: Seasonal availability and ranking of major feed resources during wet and dry seasons of different agro ecologies

Agro ecology	Feed resource	Wet season							Dry season						
		Rank					Index	Over all rank	Rank					Index	Over all rank
		1st	2nd	3rd	4th	5th			1st	2nd	3rd	4th	5th		
Highland	Crop residue	10	28	72	44	26	0.25	2	32	64	70	12	2	0.34	1
	Natural pasture	4	8	24	44	100	0.11	4	0	0	6	52	122	0.05	6
	Improved forage	0	0	4	18	158	0.02	7	0	0	0	36	144	0.03	7
	Crop after math	0	0	0	0	180	0.00	8	0	0	22	126	32	0.12	4
	Hay	0	0	8	30	142	0.04	6	0	18	54	90	18	0.18	3
	Industrial by product	0	0	6	64	110	0.06	5	0	0	8	100	72	0.08	5
	Weed	18	50	88	24	0	0.34	1	0	0	0	0	0	0.00	8
	IBS	2	2	62	92	22	0.18	3	4	4	88	74	10	0.20	2
Total		34	88	264	320	734	-	-	38	86	248	490	400	-	-
Midland	Crop residue	0	18	40	10	22	0.30	2	4	24	58	2	2	0.33	1
	Natural pasture	0	2	8	20	60	0.08	4	0	0	0	36	54	0.06	5
	Improved forage	0	0	0	0	90	0.00	7	0	0	0	12	78	0.02	7
	Crop after math	0	0	0	0	90	0.00	8	0	0	2	72	16	0.12	4
	Hay	0	2	4	12	72	0.05	5	0	4	38	48	0	0.22	2
	Industrial by product	0	0	0	12	78	0.02	6	0	0	0	32	58	0.05	6
	Weed	2	6	66	16	0	0.35	1	0	0	0	0	0	0.00	8
	IBS	2	0	26	42	20	0.20	3	0	0	42	42	6	0.20	3
Total		4	28	144	114	430	-	-	4	28	140	244	214	-	-

Index = sum of (8 x number of respondents ranked first + 7 x number of respondents ranked second + 6 x number of respondents ranked third + 5 x number of respondents ranked fourth + 4x number of respondents ranked fifth +3x number of respondents ranked six+ 2x number of respondents ranked seventh + 1x number of respondents ranked seventh) for each divided by sum of (8 x total number of household ranked first + 7 x total number of household ranked second + 6x total number of household ranked third + 5 x total number of household ranked fourth + 4 x total number of household ranked fifth+3 x total number of household ranked six +2 x total number of household ranked seventh +1 x total number of household ranked eighth).

Table 5: Major livestock production constraints as ranked by respondent farmers in different agro ecologies

Agro ecology	Constraints	Rank						Index	Over all Rank
		1st	2nd	3rd	4th	5th	6th		
Highland	Feed shortage	130	36	8	2	0	0	0.21	1
	Disease	4	10	18	12	10	0	0.07	5
	Drought	12	36	30	22	12	0	0.16	3
	Water shortage	32	46	24	6	8	4	0.19	2
	Poor management	0	2	0	10	4	10	0.02	6
	Low productive breed	0	16	14	18	8	6	0.07	5
	Decrease grazing land	4	26	46	22	18	2	0.15	4
Total		182	172	140	92	60	22	-	
Midland	Feed shortage	54	32	4	0	0	0	0.35	1
	Disease	0	8	6	4	2	0	0.05	6
	Drought	18	10	24	12	0	0	0.21	2
	Water shortage	10	24	16	6	0	0	0.19	3
	Poor management	2	0	2	2	8	0	0.05	6
	Low productive breed	4	2	2	16	2	0	0.07	5
	Decrease grazing land	0	10	16	8	4	0	0.10	4
Total		88	86	70	48	16	0	-	

Index= sum of (7 x number of respondents ranked first + 6 x number of respondents ranked second + 5 x number of respondents ranked third + 4 x number of respondents ranked fourth + 3x number of respondents ranked fifth + 2x number of respondents ranked sixth + 1x number of respondents ranked seventh) divided by sum of (7 x total responses for 1st rank+ 6 x total responses for 2nd rank + 5 x total responses for 3rd rank + 4 x total responses for 4th rank+3 x total responses for 5 thrank+2 x total responses for 6th rank+1x total responses for 7th rank). Highland (n=180); Midland (n=90).

Table 6: Coping mechanisms for the constraints of ruminant production in different agro ecologies

Copping mechanism	Highland		Midland	
	Frequency	Percent	Frequency	Percent
Purchase feed	60	33.3	35	38.8
Destocking by selling	100	55.5	40	44.4
Browse feeding	20	11.1	15	16.6
Total (n)	180	100	90	100

Table 7: Reasons of feed shortage as respond by the respondents in different agro ecologies

Reasons	Highland (n=180)		Midland (n=90)	
	Frequency	Percent	Frequency	Percent
Shortage of land	130	72.3	50	55.6
Shortage of water	30	16.7	31	34.4
Luck of proper feed management	20	11.0	9	10.0

livestock feed as a copping strategy were small. The consequences of feed shortage for ruminant production in all study areas include weight loss, lower milk yield, morbidity and mortality, absence of heat and decrease energy of ox for plowing.

Reasons of the feed shortage

Regarding the reasons for feed shortage more than half of the respondents (72.3%, 55.6%) in highland and midland respectively reported that shortage of land both for crop and natural pasture was the main reason in the study area whereas, shortage of water (16.7%, 34.4%), poor feed management (9%, 10%) in highland and midland respectively reported as other reasons of feed shortage (Table 7).

DISCUSSION

Major feed resource availability

This study identified locally available feed resources for ruminant production in relation to season and agro ecology. Several studies revealed that the feed resources identified by the current study play significant roles within the Tigray region and beyond (Yayeneshet, 2010; Yayeneshet *et al*., 2016; Berihu *et al.,* 2014; Getachew *et al*., 2014).The present study recognized natural pasture, crop residues and industrial by products as the most commonly used feed resources in different area of Tigray. Previous studies (Mergia*et al*., 2014;Chalsissa*et al*., 2014; Zewdie and Yoseph, 2014; Adugna*et al*., 2014; Takele *et al*., 2014a; Takele*et al*., 2014b; Derebe, 2015; Zewdie, 2015; Endale *et al*., 2016 and Duguma and Janssens, 2016) also identified these feed resource as important in different parts of Ethiopia. The finding of the current study revealed that the contribution of the available feed resources for ruminants were different during wet and dry seasons and agro-ecology. This difference in their contribution could be attributed to the availability of the feed resources at different seasons due to rainfall distribution of the specific area. A variation in contribution of feed resources for different agro-ecologies in this study was in agreement with previous report (Ahmed *et al*., 2010).

Constraints of ruminant production and their coping mechanisms

In the mid-land and highland agro-ecologies of the study areas, farmers pinpointed feed shortage, drought, water scarcity and a decrease in grazing lands as the major challenges. The coping mechanisms for these challenges were purchasing feed, cut and feeding of indigenous browse species and destocking. The major livestock production constraints and copping strategies identified by the current study were in agreement with the previous reports (Dawit *et al*., 2013; Berihu *et al.,* 2014;Takele *et al*., 2014a;Mergia *et al*., 2014 and Andualem *et al*., 2015;Zewdie, 2015; Duguma and Janssens, 2016).These authors reported that during the critical feed shortage, the strategies to alleviate the major constraint were buying crop residues, sending animals with their herders to areas where forage or rain availability had been reported, and destocking some animals from the flock by selling. This implies the need to strengthen traditional copping strategies of farmers.

Conclusion and recommendation

Weeds which is supported by tinned cereal crops like maize and some other leguminous fodder, crop residue and browse species and natural pasture constitutes the main source of animal feed with maximum availability during wet season. In the case of dry season, the crop residue overcomes and remains the main feed option with the naturally occurring shrubs and tree fodders at the time of critical scarcity period between February to June. Crop residues are abundantly available at the beginning of the dry season following the harvest of cereal and pulse crops. However, the abundant crop residues right after harvest is used immediately and finished before the next crop harvesting season, feed wastage on the farm due to lack of proper conservation and storage. Forage cultivation is rarely practiced in irrigation practiced areas. Industrial by products were not available at large and purchasing ability of the majority of the farmers are low in both agro ecologies and their contribution to livestock feed as a copping strategy were small. Therefore it is recommended that

- Improved and indigenous forage varieties that can adapt to the existing farming system of the area especially those drought resistant forage varieties and productive under intercropping condition with cereal crops should need to be evaluated and on farm demonstrated.
- Continuous market oriented forage seed multiplication and distribution of nationally released or certified different forage varieties which are suitable to the study area should be done for efficient utilization of land resource and increasing availability of feed.
- Capacity building and demonstration of the different feeds and feed conservation options, improvement of the feed value of crop residues, cultivation of improved and indigenous forages in different forage development strategies needs a special focus.

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