Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.6, No.9, 2016

Constraints and Opportunities on Production and Utilization of Improved Forages in East Gojjam Zone, Amhara Region, Ethiopia: In the Case of Enebsie Sar Midr District

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Abstract
The study was conducted with the objectives of identifying the major constraints and opportunities in the production and utilization of improved forages in East Gojjam Zone, Amhara Region, Ethiopia (in case of Enebsie Sar Midr District). Data were collected from sampled respondents using single-visit-multiple-subject-formal survey with semi-structured questionnaires. A total of 180 households (HHs); of which 30 HHs in each of the six randomly selected kebeles were selected randomly. Key informants were also used for the purpose of explanation and verification in the study. Descriptive statistics, correlation analysis, one-way ANOVA and least significance difference were carried out using SPSS version 16. The average livestock holding per household in the district was 2.90 tropical livestock unit (TLU) and the existing feed supply cannot satisfy even the maintenance DM requirement of livestock in the three agro-ecologies. *Sesbania sesban* (Sesbania), *Vicia dasycarp*a (vetch), *Chamaecytisus palmensis* (tree lucerne), *Avena sativa* (oats), and *Pennisetum purpureum* (elephant grass) are developed mainly with the purpose of soil and water conservation (34.55%) and feed (30.63%). Land shortage (31.14%), free grazing (30.58%), input shortage (23.99%), poor extension service (7.76%), attitude (3.50%) and skill gap (3.04) of the farmers were limiting factors for the production and utilization of improved forages. The increasing demands of animal products, the existence of marginal lands, decreasing of free grazing in the district and the need to intensify agriculture and the attention given to the livestock sector at regional and national levels can be opportunities. Livestock is highly constrained from getting year round feed supply and the major feed resources are characterized by poor quality. Improved forages can be important intervention to the limited quantity and quality of feeds because of having limited access of other feed resources like agro-industrial by products and concentrate feeds in and around the study area. Research (on-farm evaluation) on palatability, productivity, adaptability of different improved forages with participation of farmers might be very important. Moreover, forage seed/seedling production at farmers' level/farmers cooperatives, community based implementation of free grazing policy and research and extension on the use of available marginal lands efficiently can be development interventions for the technology in the study area.
Keywords: constraints, feed resources, household, improved forage crops, opportunities, tropical livestock unit

1. Introduction

The Ethiopian Central Statistical Agency (ECSA) (2011) indicated that the country is one of the richest country in the livestock inventory in Africa and the livestock sector contributes 16–20% of the total gross domestic product (GDP) and 30–35% of the total agricultural GDP (Halderman, 2004; Aklilu, 2002). The sector creates livelihood for 65% of the rural population (EEA, 2005). However, compared to the potential the contribution of the sector to the country's economy is still disproportionately low due to shortage of feed in terms of quality and quantity as one of the major constraints (Gebremedhin *et al.*, 2006; Legesse *et al.*, 2008). However, different reports showed some variation on the contribution of different feed resources, the major feed resources of the country include natural grazing land (58.67%), crop residues (29.19%), hay (7.35%), industrial by products (0.81%, improved forages (0.25%) while other sources contribute 3.71% (ECSA, 2011).

Apart from the provision of protein-rich fodder to livestock, improved forage legumes can improve the productivity of pasture by increasing the amount of nitrogen available for uptake by associated grasses and potential for sustainable development (Giller, 2001; Mapiye *et al.,* 2006). In addition to improving the quality and quantity of feed supply, improved forage crops are very important to improve soil fertility, soil and water conservation activities and natural rehabilitation of the degraded areas in the district. However, the contribution of improved forages is insignificant, which is only 0.25% of the country (ECSA, 2011) and 0.26% of Amhara National regional State (ANRS) (ECSA, 2007) of the feed resources. Since Enbsie Sar Midr is one of the remote districts of the region, agro-industrial processing plant and formulated ration are not accessible in the area. Producing and utilizing improved forage crops can be more easily accessible with relatively low price compared to concentrates. However, the contribution of improved forage crops are very much limited in the study area, some improved forage crops like sesbania (*Sesbania sesban)*, vetch *(Vicia dasycarpa),* oats (*Avena sativa*), tree lucerne (*Chamaecytisus palmensis*) and elephant (napier) grass (*Pennisetum purpureum*) are disseminated.

Moreover, multipurpose forage crops which are planted on soil conservation structures have not been managed well and not properly used as a source of animal feed.

Shortage of farm land, undulated topography, natural hazards and absence of diversification in production are serious problems in the district. Since the livelihood of people depends on agriculture, integrating and diversifying with livestock and crop production are very important to minimize the risk; which makes the agriculture system more sustainable. However, feed shortage is the first limiting factor in the area for diversification (Mertule Mariam ATVET College, 2007 unpublished). Even though the production and utilization of improved forage crops in the district are too low, the existence of enclosure areas and marginal lands in the district may increase and feasible for the production and utilization of improved forages; especially the multipurpose improved forages. In addition, the decreasing rate of natural pasture, poor quality of the available crop residues, and absence of other alternative feed resources like agro-industrial by products showed that the different concerned bodies should focus on improved forages for decreasing the feed shortage interms of quality and quantity. Even though some development organizations suggest the constraints of improved forage production in the region and in the nation, lack of research supported information in the farmers' context about the technology is a problem. To that end, assessing the existing production situation and identifying the constraints and opportunities at the ground should be the first step. Therefore, the objectives of this study are to identify the major constraints and opportunities in the production and utilization of improved forage crops and to evaluate farmers' attitude on the production and utilization of improved forage crops.

2. Materials and Methods

2.1 Description of the Study Area

The study was conducted in Enebsie Sar Midr district, East Gojjam Zone of ANRS. The district town (Mertule Mariam) is located at 10^0 52' North latitude and 38^0 17' East longitudes.

According to *Woreda* agriculture office (WAO) (2011), the district comprises 20% plain land, 30% hilly (mountainous) topography while valley and undulating area make up 5% and 45%, respectively. The district is categorized in to low altitude, mid altitude and high altitude which has an average annual rainfall of 1053 mm and temperature of 23.63 ^{O}C (WFEDO, 2011). However, the rainfall pattern in the area is inconsistent and inadequate particularly for long season crops; there is a chance of getting little shower rain between February and April besides to the main rainfall pattern.

The livelihood of the community in the district is heavily dependent on crop and livestock production and the farmers in the area practice mixed farming system. Moreover, according to the WAO (2010), the livestock population of the district was estimated to be cattle (72,854), sheep (31,124), goats (51,723), equines (15,962), and poultry (31,221) (Woreda finance and economic development office, 2011).

2.2 Methodology of the Study

Single-visit-multiple-subject-formal survey method (International Livestock Centre for Africa (ILCA), 1990) from the formal method and key informant interview and direct observations from the informal methods of appraisal were used. Open and close ended questionnaires were prepared. The questionnaire and record sheets were pre-tested on a pilot survey and on the basis of information obtained; the questionnaire and record sheets were modified and developed for the formal interview. Preference and pair wise ranking were also applied to prioritize most of the information.

2.2.1 Sampling techniques and sample size

The sampling frame was based on the administrative structure of the district (the largest unit) and rural *Kebeles* (smallest unit) as separate layer. For this study, stratified sampling technique was used to classify the district based on agro-ecology because of their distinct in crop production, livestock production and land use systems. Hence the district was classified in to three categories: low altitude, mid altitude and high altitude. One *Kebele* from low altitude, three *Kebeles* from mid altitude and two *Kebeles* from high altitude agro-ecology; totally six representatives rural *Kebele*s were selected randomly from 33 administrative rural *Kebele*s of the district. In each selected *Kebele* 30 households were selected randomly for purpose of this study.

2.2.2. Data sources and methods of data collection

In this study, both primary and secondary sources of data were used. The secondary data like livestock population, demographic structure, altitude, rainfall, topography, and temperature were taken from different governmental organizations, NGOs and DAs of the sampled *Kebeles* as necessary. The primary data on some social, institutional, economic, production and utilization variables related to improved forage crops were collected from sampled respondents and key informants.

2.2.3. Data management and statistical analysis

The collected data were analyzed by SPSS (SPSS version 15, 2006). Land holding and land use pattern, livestock holding, available feed resources and feeding systems was described using descriptive statistics. Frequency analysis and index analysis was used to analyze the ranked data and one-way ANOVA was used for

analyzing the significance of different means. LSD was used for comparison of different means and correlation analysis was done to test the relationship between different variables.

3. Results and Discussion

3.1 Land Holding and Land Use Pattern

Table 1. Private land holding (ha) and land use type per household in the study district

Land use type	Agro-ecology				
	High altitude	Mid altitude	Low altitude	Average	
	N = 60	N = 90	N= 30	N = 180	
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	%
Crop land	0.75 ± 0.04[a]	1.07 ± 0.04[b]	1.06 ± 0.09[b]	0.96 ± 0.03	96
Forest/Plantation	0.01 ± 0.004[a]	0.02 ± 0.01[a]	0.03 ± 0.01[a]	0.02 ± 0.004	2
Private grazing	0.03 ± 0.01[a]	0.01 ± 003[b]	0.00[c]	0.01 ± 0.003	1
Improved forage	0.002 ± 0.001[a]	0.02 ± 0.01[a]	0.001 ± 0.001[a]	0.01 ± 0.004	1
Total land	**0.78 ± 0.04[a]**	**1.12 ± 0.04[b]**	**1.09 ± 0.10[b]**	**1.00 ± 0.03**	**100**

abc = mean values with different superscript within the row are significantly different ($p<0.05$)
SE= standard error; N= number of respondents

The average land holding per household in Enebsie Sar Midir district is 1.00 ha; which included crop land, private grazing land, forest/plantation land and land allocated to improved forage production (Table 1). Households in the mid altitude and low altitude agro-ecological zones had better total private land holding than households of high altitude agro-ecology of the study district ($p<0.05$). This might be due to the existence of high human population in the high altitude and majority of the area in high altitude agro-ecology is more undulated and mountainous which is unsuitable for agricultural activities (Agri-service Ethiopia, 2004). The result is comparable with the regional average, which was 1.10 ha per household (Bayeh and Tenaw, 2006) however; it is too small as compared to other research results in mid altitude and high altitude areas of Ethiopia. The report of ECSA (1998) shows that land holding of smallholder farmers were small and fragmented and at national level about 60% of the households have less than 2 ha/household; which is better from the current study. This might be due to majority of the land in the district is not suitable for cultivation (73.56%) due to undulated topography which results very high human population in the district per available cultivated land.

According to the survey done by Amhara national regional state Bureau of agriculture (2006), 85% of the farmers have private pasture land which accounted for 24% of their land holding. The land allocated to grazing and improved forage production in the study area is too small as compared to different results in the country. The indicated smaller correlation coefficients of improved forage production with different parameters *i.e.* total private land holding, total arable land and private grazing land in Table 1 might be due to the limited level of production and severe land shortage in which farmers give higher priority to food crops than improved forage production. This agreed with the report of Tilahun *et al.* (2005) that most Ethiopian highland farmers have higher priority to crop than animal production.

Table 2. Land allocated to major crops including rented land per household (ha)

Main crops	Agro-ecology			Total	
	High altitude	Mid altitude	Low altitude		
	N = 60	N = 90	N = 30	N = 180	%
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	
Teff	0.23 ± 0.03[a]	0.45 ± 0.03[b]	0.25 ± 0.03[a]	0.34 ± 0.02	31.78
Wheat	0.39 ± 0.04[a]	0.38 ± 0.02[a]	0.05 ± 0.02[b]	0.33 ± 0.02	30.84
Barley	0.10 ± 0.03[b]	0.04 ± 0.01[a]	0.01 ± 0.01[a]	0.04 ± 0.01	3.74
Maize	0.00[a]	0.00[a]	0.04 ± 0.02[b]	0.01 ± 0.003	0.93
Sorghum	0.00[a]	0.02 ± 0.01[a]	0.32 ± 0.05[b]	0.06 ± 0.01	5.60
Cereals	0.63 ± 0.04[a]	0.89 ± 0.05[b]	0.76 ± 0.06[ab]	0.78 ± 0.03	72.90
Grass pea	0.01 ± 0.01[a]	0.13 ± 0.03[b]	0.01 ± 0.01[a]	0.07 ± 0.01	6.54
Chickpea	0.00[a]	0.06 ± 0.01[b]	0.01 ± 0.01[a]	0.03 ± 0.01	2.8
Faba bean	0.11 ± 0.02[a]	0.12 ± 0.02[a]	0.00[b]	0.09 ± 0.01	8.41
Field pea	0.06 ± 0.02[a]	0.05 ± 0.01[a]	0.02 ± 0.01[b]	0.05 ± 0.01	4.67
Haricot bean	0.00[a]	0.01 ± 00[a]	0.29 ± 0.05[b]	0.05 ± 0.01	4.67
Pulses	0.18 ± 0.02[a]	0.36 ± 0.04[b]	0.32 ± 0.05[b]	0.29 ± 0.02	27.10
Total	**0.81 ± 0.05[a]**	**1.24 ± 0.07[b]**	**1.08 ± 0.09[b]**	**1.07 ± 0.05**	**100.00**

ab = mean values with different superscript within the row are significantly different($p<0.05$)
SE = standard error; N= number of respondents

The average land holding per household in Enebsie Sar Midir district is 1.00 ha; which included crop land, private grazing land, forest/plantation land and land allocated to improved forage production (Table 2). Households in the mid altitude and low altitude agro-ecological zones had better total private land holding than households of high altitude agro-ecology of the study district ($p<0.05$). This might be due to the existence of high human population in the high altitude and majority of the area in high altitude agro-ecology is more undulated and mountainous which is unsuitable for agricultural activities (Agri-service Ethiopia, 2004). The result is comparable with the regional average, which was 1.10 ha per household (Bayeh and Tenaw, 2006) however; it is too small as compared to other research results in mid altitude and high altitude areas of Ethiopia. The report of ECSA (1998) shows that land holding of smallholder farmers were small and fragmented and at national level about 60% of the households have less than 2 ha/household; which is better from the current study. This might be due to majority of the land in the district is not suitable for cultivation (73.56%) due to undulated topography which results very high human population has been concentrated in cultivated land of the district.

3.2 Livestock Holding and their Utility

Table 3. Average livestock holding (TLU/HH) in Enbsie Sar Midr district

Type of livestock	Agro-ecology				
	High altitude	Mid altitude	Low altitude	Total	
	N=60	N=90	N=30	N=180	
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	%
Cattle	1.80 ± 0.12^{a}	2.65 ± 0.15^{b}	3.00 ± 0.25^{b}	2.48 ± 0.10	85.52
Sheep	0.14 ± 0.02^{a}	0.13 ± 0.02^{a}	0.07 ± 0.03^{b}	0.12 ± 0.01	4.14
Goat	0.05 ± 0.01^{a}	0.07 ± 0.02^{a}	0.32 ± 0.07^{b}	0.10 ± 0.02	3.45
Equine	0.21 ± 0.03^{a}	0.18 ± 0.02^{a}	0.20 ± 0.06^{a}	0.20 ± 0.02	6.90
Total	$\mathbf{2.20 \pm 0.15^{a}}$	$\mathbf{3.03 \pm 0.17^{b}}$	$\mathbf{3.59 \pm 0.36^{c}}$	$\mathbf{2.90 \pm 0.12}$	

abc = mean values with different superscript within the row are significantly different ($p<0.05$)
SE = standard error; N= number of respondents; TLU conversion factor; oxen = 1.1, young bull = 0.6, cows = 0.8, heifers = 0.5, calves (less than or equal to 1 year) = 0.2, sheep and goat = 0.09, donkey = 0.36, horse and mule = 0.8

As can be seen in Table 3, an average overall livestock holding per household in the study was 2.90 TLU. This figure is lower than 5.31 TLU/household (Shitahun, 2009) and 5.03 TLU/household (Fisseha *et al.*, 2010) in Bure district; which is one of the districts in the region. This might be due to sever land shortage, absence of other alternative feed resources like industrial by products and the topographic features of the district (undulated, mountainous, and very degraded) which are not suitable for agriculture which aggravates feed shortage that in turn can hinder livestock production in the study area. Average total livestock holdings per household in low altitude, high altitude and mid altitude areas were significantly different ($p<0.05$) of which low altitude is the highest while high altitude showed the least livestock holding. As expected the average holding per household of sheep in the high altitude is significantly higher than low altitude while average holding of goat per household in the low altitude is higher than the other agro-ecologies of the district ($p<0.05$). However, there is no significant difference ($p>0.05$) between high altitude and mid altitude in average holding of sheep and goat per household. Low altitude agro-ecology has better mean livestock holding per household than the other two agro-ecologies in the district while in the high altitude agro-ecology livestock holding per household is the least (Table 3). This may be due to existence of better communal grazing land in the low altitude and better cropland availability than high altitude which can supply higher proportion of livestock feed in the form of crop residues and stubble grazing.

When the livestock proportion is calculated in terms of TLU per HH, cattle were the dominant livestock species which accounted for 85.52% followed by 6.90% equine, 4.14% sheep and 3.45% goat. The proportion of cattle in the district is in agreement with the report of Shitahun (2009) in Bure district; which was 82.67% of the livestock found in the area. The current study is in line with the report of Getachew and Abate (1993) that in the mixed farming systems of the high altitude and mid altitudes of Ethiopia cattle were the most important livestock species for cultivation, threshing and manure purpose.

Table 4. The Correlations of improved forage land with other parameters included in the study (Pearson Correlation).

Parameters	Total land (ha)	Arable land (ha)	Grazing land (ha)	Improved forage land (ha)	Livestock number (TLU)	Crop residue (DM)
Total land(ha)	1.00					
Arable land(ha)	0.948(**)	1.00				
Grazing land(ha)	0.096	-0.023	1.00			
Improved forage land(ha)	0.259(**)	0.229(**)	0.07	1.00		
Livestock Number (TLU)	0.385(**)	0.296(**)	0.149(*)	0.093	1.00	
Crop residue (DM)	0.484(**)	0.458(**)	-0.047	0.05	0.472(**)	1.00
N	180	180	180	180	180	180

** Correlation is significant at 0.01 level (2-tailed); * Correlation is significant at 0.05 level (2-tailed).
N = number of respondents

The total livestock holding had positive correlation coefficients of 0.39, 0.30, 0.15 and 0.47 with total private land holding, total arable land, private grazing land and total crop residues produced, respectively (Table 4). There is difference in degree of correlation coefficients with the report of Shitahun (2009) in Bure district of which total livestock holding had correlation coefficients of 0.77, 0.72 0.64, and 0.34 with total crop land, crop-residue production, private land holding and private grazing land holding, respectively. However, positive correlation coefficients had been observed in both studies. The smaller correlation coefficients of livestock holding with different land use type in the current study might be due to the existing smaller land holding of the farmers. Besides, improved forage production had correlation coefficients of 0.26, 0.23 and 0.07 with the total private land holding, total arable land and private grazing land, respectively. However, the total livestock and improved forage production correlation coefficients are too small which might be due to the very limited level of production of improved forage crops in the study area.

3.3. Feed resources in study area

Table 5. The different feed resources and their rank in the study area

	Rank and number of respondents									
Feed resources	1st	2nd	3rd	4th	5th	6th	7th	Weight	Index	Rank
Crop residue and aftermath	140	35	11	2	1	0	0	1256	0.5118	1
Communal grazing land	80	25	1	3	0	1	0	729	0.2971	2
Other local feeds	0	2	6	14	20	10	5	183	0.0746	3
Hay	0	3	14	5	8	9	5	155	0.0632	4
Improved forage	0	5	6	9	9	3	2	131	0.0534	5
Industrial by product	0	0	0	0	0	0	0	0	0.0000	6
Concentrate feeds	0	0	0	0	0	0	0	0	0.0000	7
Total	220	70	38	33	38	23	12	2454	1.0000	

Index = Sum [(number of respondents of the 1st rank X 7) + (number of respondents of the 2nd rank X 6) + (number of respondents of the 3rd rank X 5) + (number of respondents of the 4th rank X 4) + (number of respondents of the 5th rank X 3) + (number of respondents of the 6th rank X 2) + (number of respondents of the 7th rank X 1)]/Total weight

The main feed resources to livestock in the district are crop residues, natural pasture (communal grazing land, shrub lands and private grazing), and aftermath from crop lands, hay, improved forage crops with their decreasing order of feed contribution. Previous studies conducted by Seyoum *et al*. (2001) and Alemayehu (2004) indicated that the major basal feed resources in high altitude parts of Ethiopia were natural pasture, crop residues and stubble grazing, but their contribution to the total feed resource base varied from area to area based on cropping intensity. Ahmed *et al.* (2010) in the central highlands of Ethiopia also showed that over 50% of the feed to animals came from natural pasture. Similarly, a study conducted by Firew and Getnet (2010) in ANRS showed that the major feed resources in the region includes natural pasture, crop residues, industrial by products, hay, improved forage (too small), and "unconventional" feed resources like lupine (*Gibto), Atela* and *Birint* which are by products of home brewed beverages. According to the respondent rank, among the feed resources, crop residues takes the largest share (the first rank) in the current study while natural pasture was the major feed resource in the other studies. Therefore, this showed that livestock in the current study is highly dependent on

crop residues. This is because majority of the farmers' land (96%) in the study district is cultivated for crop production. Moreover, small amount of natural pasture in the form of communal grazing and shrub lands are also available. This indicates that improved forage production should be incorporated in the different land use and management system of the farmers to improve the feed quality and decrease the feed shortage.

3.4. The feed resources and their seasonal availability in the study area

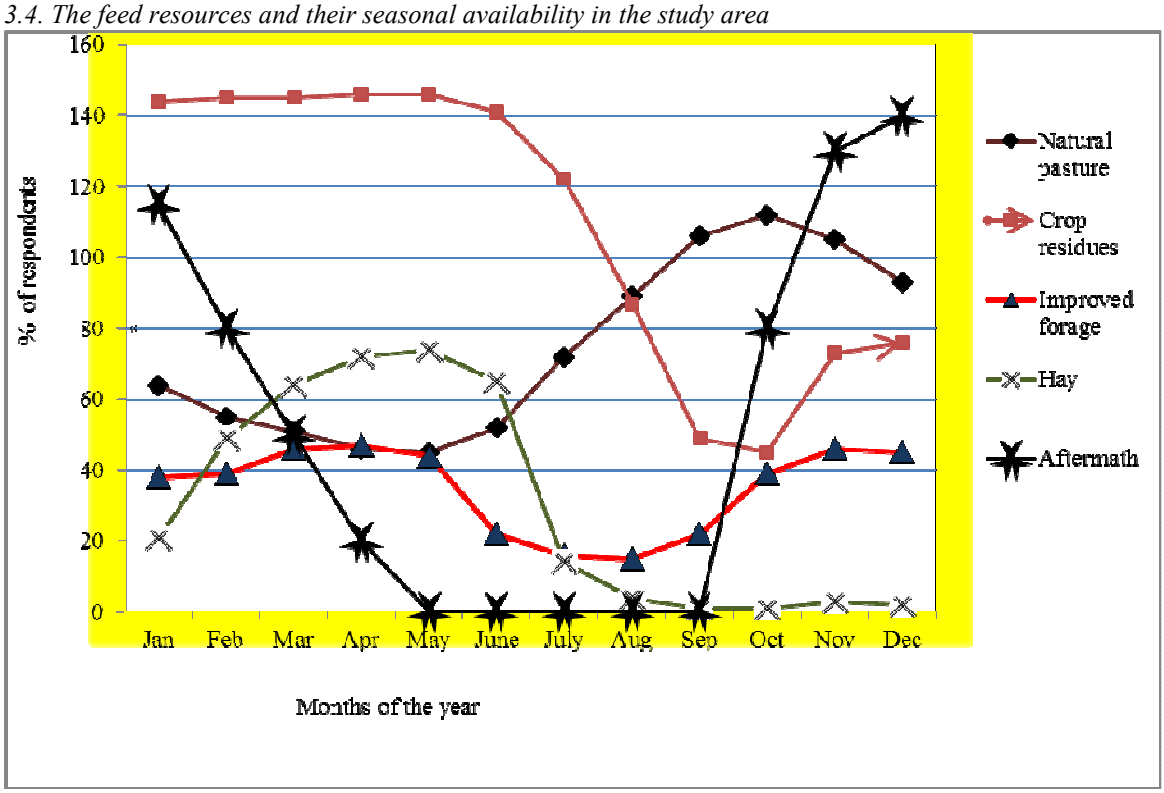

Figure 1. Feeding calendar and seasonal availability of the feed resources

The type, quality and quantity of available feeds in the study area appeared to be strongly influenced by season of the yea which is supported by findings of Sisay (2006); the annual distribution of livestock feed lacked consistency for several years because of variations in rainfall, time of harvesting and production levels of crops. In the current study, starting from October to May, animals utilize stubble grazing and other farmers also used stubble grazing after the owners' livestock have grazed much of the available feed. However, crop residues are utilized all over the year with different contributions; there is high availability from November to May. The same practice was reported in the central highlands of Ethiopia that livestock graze on seasonal fallow lands and permanent pasture during cropping season and on croplands after harvest is common (Ahmed, 2006). When these feed resources are finished, the animals are offered from collected and stored crop residues twice or three times per day. As it is indicated in Figure 1, crop residues are the major feed resources and feeding of new crop residues and crop stubbles start in October when pulse crops (faba bean, field pea) start to be harvested. Even though feeding of crop residues is practiced throughout the year, its contribution is decreasing from June to October because of decreasing availability. The current study is in agreement with Sisay (2006) who reported that crop residues were the main sources of feed during the dry period when pasture ceases to provide reasonable quantity of feed. Crop stubbles are also used with varied quantity and quality depending on the crop type and crop calendar of the farmers *i.e.* more accessible from October to May and reaches to maximum in December and January since most crops are harvested.

Natural pasture grazing, which encompasses communal grazing lands, shrub lands and private grazing lands, is also practiced in the feeding calendar and its availability is relatively good from July to December. Communal grazing and shrub lands are utilized year round without restriction in all altitude zones and becomes a major source of feed for livestock until crop harvest. A similar trend was also reported by Alemayehu (2004) and Ahmed (2006). However, its availability and productivity is decreasing from time to time because of the crop land expansion and poor management resulting uncontrolled free grazing and weed encroachment (Woreda finance and economic development office, 2011). Similarly, ECSA (2003) indicated that the contribution of natural pasture which covers 30% of the total area of the Amhara regional state was believed to be declining with about 47% supply.

Hay is also provided from March to June especially to oxen during the period when high draught power

is needed however, there is a difference depending on the quantity of hay harvested, the number of animals kept and the agro-ecology. This is in agreement with Ahmed (2006) who reported the same practice in Basona Worana district of North Shoa.

Even though the contribution is too small, improved forage crops are also available and supplemented to animals in the study district. March and April (after little shower rain) and October, November and December (after the main rain) are months of the year in which improved forage crops are more available and utilized by the farmers in the study area. The result agreed with the report of Alemu (1990); as under rain fed conditions perennials can be given two harvests during the time of normal rains and three to four cuts during years of more than average rainfall. Similarly, Alemayehu (2003) indicated that livestock feeding calendar varied depending on the availability of feed resources over season. According to this study; feeding calendar is an essential livestock management practice to use the available feed resources efficiently and to supply livestock with the required quantity and quality of feed and to overcome the feed shortage.

Table 6. The severity of feed shortage over seasons of the year in the study district

Season of the year (%)	Agro-ecology			
	High altitude N=60	Mid altitude N=90	Low altitude N=30	Over all N=180
Wet season	86.67	68.89	0.00	63.33
Dry season	13.33	28.89	100.00	35.56
All round the year	0.00	2.22	0.00	1.11

N= number of respondents

Apparently there is feed shortage throughout the year in the district, the availability of different feed resources varied over different seasons of the year. Therefore, the quality and quantity of feed resources are not the same throughout the year in different agro- ecologies of the study district. In the high altitude and mid altitude areas, the severity of feed shortage is high during the wet season when the main feed resource (crop residues) become depleted and stubble grazing is not available since the majority of the land is covered with food crops. In the low altitude areas, however, the shortage is more sever in the dry season because better feed can be available from communal grazing and shrub lands in the wet season. In addition, the feed resources from their cropping system are not well managed and utilized which might be aggravated by unsuitable agro-ecological features in the dry season (Table 6). Overall in the study area higher feed shortage is observed in the wet season than dry season because most farmers are highly dependent on the crop residues and stubble grazing which are depleted in the wet season. However, Asaminew (2007) in Bahir Dar Zuria and Mecha district reported that major feed problem exists in the dry season than wet season. This might be due to the difference in the availability of the main feed resources between the study areas in different seasons of the year.

3.5. Coping mechanisms of the feed shortage

Table 7. The coping mechanisms of farmers to the feed shortage

Coping mechanisms	Rank and number of respondents							Weight	Index	Rank
	1st	2nd	3rd	4th	5th	6th	7th			
Storage of crop residues	149	16	6	2	1	0	1	1182	0.2671	1
Buying roughage feed	13	45	47	20	39	2	1	798	0.1803	2
Hay storage	6	50	23	38	7	8	0	646	0.146	3
Use browse trees	2	20	37	47	18	18	9	606	0.1369	4
Use improved forages	6	36	27	16	22	14	13	564	0.1275	5
Traveling long distance	0	8	10	22	16	36	1	400	0.0904	6
Selling livestock	0	1	18	10	8	14	41	229	0.0518	7
Total	176	176	168	155	111	92	66	4425	1	

Index = Sum [(number of respondents of the 1st rank X 7) + (number of respondents of the 2nd rank X 6) + (number of respondents of the 3rd rank X 5) + (number of respondents of the 4th rank X 4) + (number of respondents of the 5th rank X 3) + (number of respondents of the 6th rank X 2) + (number of respondents of the 7th rank X 1)]/Total weight

Farmers in the study area took one or more coping mechanisms for solving the feed shortage. Even though collection and storing of crop residues is one of their main coping mechanisms, developing and utilizing of improved forage crops are also used as a coping mechanism in study district (Table 7). Besides, if all the coping mechanisms did not solve their problem, farmers are selling their older and unproductive animals, in order of importance, during the feed shortage season (5.18%). A total of 92 respondents used this as a coping mechanism with different ranks. This mechanism is more practiced in the low altitude than the other two agro-ecologies of the district which might be due to the absence of other alternative feed resources when drought occurs. The major coping strategies are in line with the coping mechanisms reported by Shitahun (2009) in Bure

district. Similarly, Asaminew (2007) reported that conservation in the form of hay, storage of crop residues and use of improved forage crops were some of the coping mechanisms developed by the communities to overcome the seasonal shortage of feed; which had in agreement with the current study.

3.6. Feed management and feeding systems

Table 8. Respondents' reason for decreasing size and/or productivity per area of communal grazing land and shrub lands

	Rank and number of respondents						
Factors	1st	2nd	3rd	4th	Weight	Index	Rank
Crop expansion	80	53	4	3	490	0.3579	1
Decreasing soil fertility	28	31	57	21	340	0.2484	2
Weed encroachment	2	31	33	36	203	0.1483	4
Over grazing	40	26	33	32	336	0.2454	3
Total	**150**	**141**	**127**	**92**	**1369**	**1**	

Index = Sum [(number of respondents of the 1st rank X 4) + (number of respondents of the 2nd rank X 3) + (number of respondents of the 3rd rank X 2) + (number of respondents of the 4th rank X 1)]/Total weight

Seasonality in feed supply and poor quality of available feeds may be aggravated due to lack of good feed management and appropriate feeding system. The respondents indicated that the productivity per area of shrub land and communal grazing land are decreasing due to decreasing of soil fertility, overstocking/high grazing pressure and weed encroachment (Table 8). This showed that not only the decreasing size of grazing land is a problem but also, lack of grazing land management (continuous free grazing, weed encroachment, overstocking/high grazing pressure with the sense of communal property) could be the cause for the decreasing productivity per area of communal grazing and shrub lands. As cited by Ahmed (2006), the result of the current study agreed with the theory of Pluhar *et al.* (1987), which states that the effects of heavy grazing generally reduces productivity and increases soil erosion. Similarly, Walter *et al*. (1990) and Amsalu (2000) reported that high grazing pressure caused a loss of ground cover and decrease the feed produced in the available area.

Although expansion of crop land areas in the district resulted in an increase of crop residues, it is characterized by low quality. As recommended by Van Soest (1988) as cited by Shitahun (2009), their use should be with proper treatment methods and with supplementation. This needs consideration because without feed supplement and/or proper treatment method, crop residues result in slow growth, poor fertility and high calf mortality. Even though collection and storage of crop residues were common in the study area, improving utilization efficiency of cereal crop residues through different treatment mechanisms and feed supplementation were not yet practiced and crop residues were not utilized efficiently. Therefore, roughages especially crop residues given to animals in the study area have low digestibility and low protein content in most parts of the year. According to Ahmed (2006), farmers faced different kinds of problems in improving the nutritional quality of crop residues like lack of knowhow, lack of finance and inaccessibility of concentrate supplementation. Smith (1993) listed chopping, grinding and ensiling with urea as the most appropriate methods of improving the feed value of crop residues at the smallholder level. However, because of one or more of the problems indicated above, none of these methods have been properly applied in the current study district.

According to Yihalem (2004), there is also nutritional quality problem due to delaying in harvesting of the feed resources. This could promote lignifications which increase stem to leaf ratio as a result of leaf shattering and reduction with legume to grass proportion due to early maturing of the legume component. In this regard, most farmers in the study area have not enough awareness about the nutrient losses during feed management. Therefore, observations on harvesting system, storage condition and provision of feed to animals during data collection pertaining to the feeding and feed management systems indicated that the available feed resources have poor nutritional quality which results in insufficient nutrients for the animals. This agreed with Firew and Getnet (2010) report in which feed management, utilization and conservation problems were observed in their different study districts of ANRS.

Table 9. Respondents' rank to common feeding practices in Enbsie Sar Midir district

Feeding system	Rank and number of respondents						
	1st	2nd	3rd	4th	Weight	Index	Ranks
Free grazing	79	49	25	5	518	0.3565	1
Stall feeding of crop residues	29	67	53	11	434	0.2987	2
Green feed with cut and carry	46	38	41	20	400	0.2753	3
Rotational grazing	4	8	20	21	101	0.0695	4
Total	158	162	139	57	1453	1	

Index = Sum [(number of respondents of the 1st rank X 4) + (number of respondents of the 2nd rank X 3) + (number of respondents of the 3rd rank X 2) + (number of respondents of the 4th rank X 1)]/Total weight

According to the respondents rank shown in Table 9, free grazing is the major feeding practice (35.60%) of farmers in the district. However, respondents explained that due to the continuing shrinkage of grazing land from time to time, they become more dependent on crop residues and they practiced stall feeding of crop residues (29.87%). Besides, in the wet season feeding of green feed mainly natural grasses through cut and carry (27.53%) and very low level of rotational grazing (6.95%) are practiced in the study district. Cut and carry feeding system is practiced based on the feed resources available in protected (enclosure) areas, soil conservation structures and feed resources/weeds found between/in the crop lands. Even though the practice of stall feeding is a very good trend and promising to bring farmers in to better production system, yet farmers who undertake this activity have very few numbers of cattle and mainly depend on the crop residues. However, the level of feeding practice differs from area to area.

3.7. Practices of Improved Forage Production in Enbsie Sar Midir District

3.7.1. Types and purpose of improved forage production

Table 10. Number of respondents involved in developing different improved forage crops

Species	N	%
Sesbania sesban (Sesbania)	97	61.39
*Vicia dasycarp*a (Vetch)	37	23.42
Chamaecytisus palmensis (Tree lucerne)	13	8.23
Avena sativa (Oats)	10	6.33
Pennisetum purpureum (Elephant grass)	2	1.26

N= number of respondents developing the species without considering the level of production

Although the level of production and contribution of improved forage crops are very limited in the study district, the production of some types of improved forage crops such as *Sesbania sesban* (sesbania*), Vicia dasycarpa* (vetch), *Chamaecytisus palmensis* (tree lucerne/tagasaste), from the leguminous improved forage species and *Avena sativa* (oats*)* and *Pennisetum purpureum* (elephant grass*)* from the grass species are disseminated and practiced in the district (Table 10). These improved forage crops are similar which are commonly disseminated in different areas of the region (Bureau of agriculture, 2002; Firew and Getnet, 2010) however; production of elephant grass is not well practiced. This might be poor awareness level of the farmers; they did not consider the biomass produced from the production and the advantage in soil and water conservation activities, especially in gullies. In addition to the above improved forage species, according to *Woreda* agricultural office livestock extension experts, recently; *Phalaris aquatic* (phalaris grass*), Desmodium introtum (*desmodium), *Vigna unguiculata (*cowpea) and *Cajanus cajan (*pigeon pea*)* were introduced to the district. However, because of the shortage of input and the time needed to show the advantage and the productivity of these species to the farmers; their dissemination rates were very much limited in the study area. According to, Alemayehu and Alan (1988) reported that due to different reasons, production, utilization and adoption rates of improved forage production technologies were very poor in most parts of Ethiopia. According to the above authors, this is not simply because of poor and ineffective extension services only, but also because of a wide range of constraints including land shortage, free grazing, input shortage, increased labor and capital requirements, poor soil moisture and poor involvements of farmers in the dissemination and production. Of the above constraints, land shortage, free grazing, input shortage (seeds/seedlings) and poor involvements of farmers in the dissemination and production of improved forage species holds true in study district.

3.7.2. Farmers preference of improved forages as animal feed

Table 11. Respondents' preference as animal feed and their rank in area coverage of improved forage crops

Improved forage crops	Rank and number of respondents					Weight	Index	Rank
	1st	2nd	3rd	4th	5th			
Sesbania sesban (Sesbania)	75	17	4	1	0	457	0.5734	1
*Vicia dasycarp*a (Vetch)	19	19	3	0	0	180	0.2258	2
Avena sativa (Oats)	6	7	5	0	0	73	0.0916	3
Chamaecytisus palmensis (Tree lucerne)	2	6	2	3	0	46	0.0577	4
Pennisetum purpureum (Elephant grass)	4	4	1		1	41	0.0514	5
Total	106	53	15	5	1	797	1	

Index = Sum [(number of respondents of the 1st rank X 5) + (number of respondents of the 2nd rank X 4) + (number of respondents of the 3rd rank X 3) + (number of respondents of the 4th rank X 2) + (number of respondents of the 5th rank X 1)]/ Total weight

Virtually, the preferences of respondents to the different improved forage crops may vary in the different agro-ecologies, the overall preference of the respondents for animal feed were sesbania (57.34%), vetch (22.38%), oats (9.16%), tree lucerne (5.77%), and elephant grass (5.14%) (Table 11). Farmers' preference of the

fast growing multipurpose sesbania for animal feed is because of providing a better shelter-belt in forage strips and it is better to integrate with cropping system in the soil and water conservation structures and provide better feed with better palatability than other multipurpose forage species. This can concurs with a study conducted in west Gojam, Bahir Dar Zuria district by Abraham (1998) who reported that farmers preferred multipurpose sesbania with same reason. In addition, the above author showed that the farmers' preference and practices in his study area were sesbania, pigeon pea and elephant grass with decreasing order based on the above preference criteria. Vetch is the second preference of respondents in the current study. This might be due to vetch has better soil improvement ability and can be grown with little moisture in the soil after the main crop has been harvested. Since the district has large amount of land which is very poor in soil fertility, this species are also very important in the study area. For better adoption and production of the species, it can be produced either using as crop rotation or after the main crop had been harvested using irrigation/little soil moisture.

Table 12. Correlation between the number of farmers developing the species and preference

Parameters	Number of respondents developing species	Preference as animal feed
Number of respondents developing the species	1.00	
Preference as animal feed	0.996**	1.00

** Correlation is significant at the 0.01 level (2-tailed)

As indicated in Table 12, when we correlate the number of farmers developing the different forage crops in the study area and preference of the forage crops to animal feeds has significant correlation at the 0.01 level (0.996). This is strengthened that respondents who developed the species considered "forages" as the second purpose /objective next to soil conservation activity of developing improved forage crops in the study area.

3.7.3. Purpose of developing of improved forages

Table 63. Purpose and rank of developing improved forage crops in the study district

Purpose	Rank and number of respondents								
	1st	2nd	3rd	4th	5th	6th	Weight	Index	Rank
Soil conservation	48	47	0	2	0	0	529	0.3455	1
Forage	47	35	3	0	0	0	469	0.3063	2
Wind break	0	1	9	33	4	0	146	0.0963	3
Fuel	1	2	17	10	15	3	147	0.096	4
Crop rotation	0	1	29	1	1	1	127	0.0829	5
Fence	0	3	16	7	5	3	113	0.0738	6
Total	96	89	74	53	25	7	1531	1	

Index = Sum [(number of respondents of the 1st rank X 6) + (number of respondents of the 2nd rank X 5) + (number of respondents of the 3rd rank X 4) + (number of respondents of the 4th rank X 3) + (number of respondents of the 5th rank X 2) + (number of respondents of the 6th rank X 1)]/ Total weight

It was noted that, most of the above improved forage crops are developed with the primary aim of soil conservation (34.55%) followed by feed (30.63%) (Table 13). The integrated production/development of improved forage crops with soil and water conservation in the district is promising and is related with the first livestock development project (1990) recommendation for sustainable fodder production. In feed development strategies, to close the feed gap, improving soil fertility in smallholder farming systems should also be considered. In addition to the above purposes, they also used the developed improved forages as a wind break, fuel, crop rotation and fence. In prioritizing the main development objectives of improved forage crops in the current study agreed with BoA (2002) report. Similarly, the works of Abebe (2008) on multipurpose forage trees (MPFT) in Ethiopia also showed that the farmers' criteria of evaluating MPFT broadly combine the intended purposes to meet different farming objectives and agronomic characteristics they wish from trees *i.e.* farmers' appreciation of fodder trees due to; soil fertility improvement, biomass production, multi-functionality, life span of the tree, and compatibility to the cropping system.

3.7.4. Improved forage development strategies used in the study area

Table 74. Improved forage development strategies and respondents' rank to the suitability of the strategies.

Development Strategies	Rank and number of respondents					Weight	Index	Rank
	1st	2nd	3rd	4th	5th			
On strips	48	34	5	4	11	410	0.3616	1
Backyard	67	13	4	0	1	400	0.3527	2
Under-sowing	4	12	17	4	0	127	0.112	3
Under trees	1	16	9	3	1	103	0.0908	4
Over-sowing	6	6	4	13	2	94	0.0829	5
Total	78	47	34	20	4	1134	1	

Index = Sum [(number of respondents of the 1st rank X 5) + (number of respondents of the 2nd rank X 4) + (number of respondents of the 3rd rank X 3) + (number of respondents of the 4th rank X 2) + (number of respondents of the 5th rank X 1)]/ Total weight

Improved forage development strategies practiced in the district are more related with the aim of developing improved forage crops *i.e.* soil conservation and forage (Table 14). Therefore, as apparently 36.16% of the respondents developing multipurpose improved forage crops on strips integrating with soil and water conservation whereas 35.27% of the respondents develop improved forage on backyard. The reason explained is that forage strips would have multiple roles, including the provision of forage for cut and carry feeding system, fuel wood supply and soil erosion control. This is in line with the report of Abraham (1998) in which Ethiopian farmers prefer strip forage establishment for its multiple roles. In addition, according to Woreda finance and economic development office (2011) the need of constructing soil and water conservation structures in most parts of the land in the district makes the strategy preferable. On the other hand, backyard forage development involves the establishment of forage in the immediate vicinity of the house which provides a very convenient point of entry for new species prior to their subsequent use on a wider scale. According to First Livestock Development Project (1990*)* of Ethiopia, this strategy is readily accepted because of its very cost-effectiveness and it provides better protection to the developed improved forage crops from damaging through free grazing which is a bottleneck during dissemination and adoption of the technology to most Ethiopian farmers. Therefore, the respondents' preference of this strategy in the current study is in agreement with the above report.

The major part of the district (53%) is low altitude and there is large amount of sorghum production, the third preferred strategy by the respondents is under-sowing which is a potential and very important forage development strategy to the adoption and production of improved forages in the district. This is in agreement with Abraham (1998) who reported that legumes were grown under crops such as maize, sorghum, barley, wheat or plantation crops such as coffee which grazed with the crop residues or cut and carried away with crop remains. Moreover, under-sowing under annual crops, under tree and over-sowing forage development strategies are practiced in the study district in limited scale. The different forage development strategies practiced in the study district are similar with the strategies reported by BoA (2002) which were practiced in different areas of ANRS.

3.7.5. Farmers perception on improving utilization efficiency of the available feed resources

The majority of the available feed resources are poor quality roughages like crop residues (59.30%), improving the utilization efficiency of the available feed resources is another important issue which should be considered in the district. Even though enough participation is not observed in this regard, some farmers in the current study practiced mixing of different crop residues and chopping/fine threshing of straws to facilitate or improve intake of unpalatable crop residues. However, different studies showed that the utilization efficiency of poor quality feed resources can be improved through different techniques. As Dzowela (1987) reported under-sowing of forage legumes under maize crops can improve the quantity and quality of feed resources and it is a good chance of improving the utilization of low quality by products such as maize stover. Another report also showed that when maize is under sown after second weeding (about six weeks after planting) the grain yield was not affected at all while producing nutritious animal feed (Lulseged *et al*., 1987).

Alemayehu (2005) reported that urea treatment, chopping and mixing with high quality forages can significantly improve the intake and dietary quality of crop residues. The supplementation of treated or untreated low nitrogen containing basal feeds with forage legumes will increase the nitrogen content of the diet, which is likely to increase feed intake and the rate of degradation of the basal diet in the rumen (Topps, 1997). Therefore, using improved forage crops especially leguminous species with crop residues have an advantage of improving quality, availability and intake of the major feed resources of the district. However, most respondents did not consider whether their animals got their nutrient needs or not *i.e.* they are focusing on total DM/roughage content which is provided to their animals and the advantage of the technology from this regard is not efficiently utilized. This is because as shown in Figure 6, mainly farmers lack awareness and skill about the different methods of improving utilization efficiency of the available feed resources. This is also a problem in the involvement of farmers in different livestock development packages shown in Figure 3 which indicates the problem of the

extension system in the area and creates a question to them. Besides, input shortage, land shortage, poor extension service, free grazing and money can be raised as reason by the respondents in the district. These problems are similar to those reported by Ahmed (2006) in the central highland parts of Ethiopia. Generally, farmers in the study area did not give enough attention to the nutrients that the animals should get rather they focus on the total roughage or DM given to their animals. This showed that a lot of work should be needed from the extension system of the study area. Therefore, in order to improve the nutritional status of crop residues strengthening of the farmers' knowhow on the different improving utilization efficiency of the available feed resources through extension service is very important.

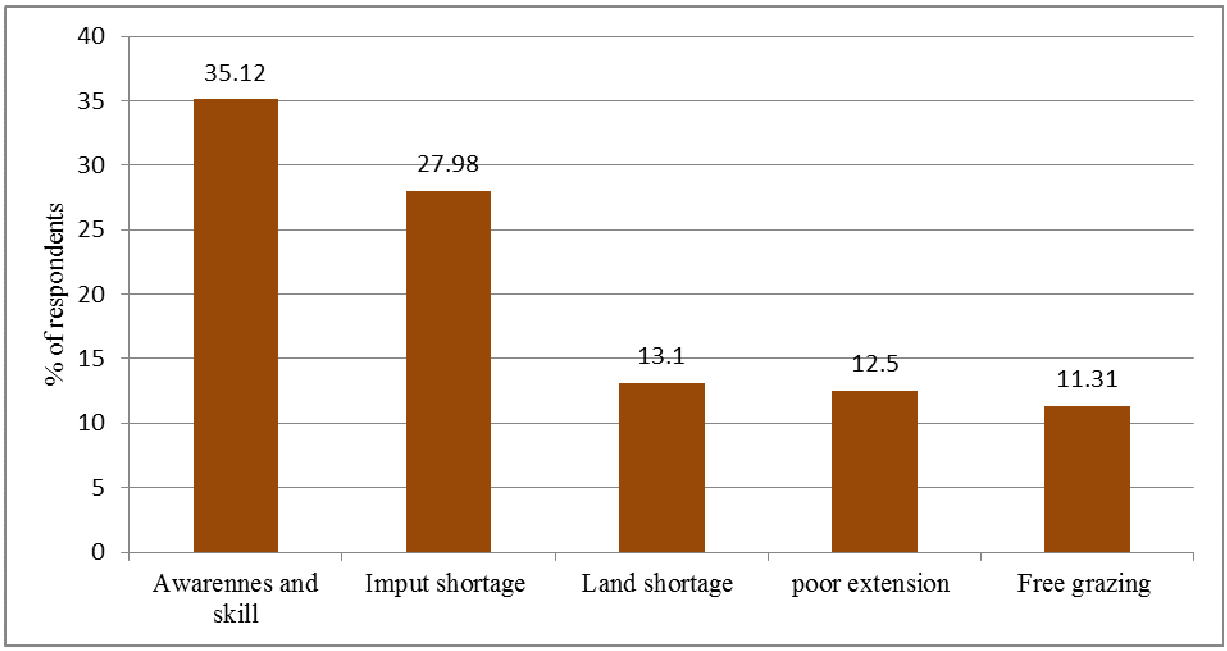

Figure 2. Respondents' reason for the poor participation in improving utilization efficiency of feed resources

3.4 Constraints and Opportunities for Production and Utilization of Improved Forages in the Study district

3.4.1 Constraints

Table 15. The respondents' rank of constraints for improved forage development in Enebsie Sar Midir district

	Rank and number of respondents							
Problems	1st	2nd	3rd	4th	5th	Weight	Index	Rank
Land shortage	65	61	11	3	6	614	0.3114	1
Free grazing	61	58	18	3	6	603	0.3058	2
Input shortage (seed/seedling)	19	18	75	4	1	473	0.2399	3
Poor extension service	1	3	17	40	5	153	0.0776	4
Awareness	0	4	7	9	14	69	0.0350	5
Skill gap	0	4	5	8	13	60	0.0304	6
Total	146	148	133	67	45	1972	1	

Index = Sum [(number of respondents of the 1st rank X 5) + (number of respondents of the 2nd rank X 4) + (number of respondents of the 3rd rank X 3) + (number of respondents of the 4th rank X 2) + (number of respondents of the 5th rank X 1)]/Total weight

Though previous efforts have been made to promote improved forage production in the study district with Worrda agriculture office, Agri-service Ethiopia and Alem Birhan, the contribution is below expectation. However, different factors did not contribute equally for the production and utilization of improved forage crops, land shortage, free grazing, input shortage (seeds/seedling), poor extension service, attitude and skill gap are limiting factors for the production and utilization of improved forage crops as per the result of interviewed household (Table 15). Most of the constraints mentioned above in this study are similar with constraints reported by Bureau of Agriculture (2002) in ANRS. In addition, key respondents indicated that absence of integrating improved forage production with other livestock development packages was one of the problems in the production and utilization of improved forage crops in the current study which is in line with the above report.

Despite the presence of large uncultivated marginal lands in the district, the average arable land holding

per household is only one hectare and the land allocated to improved forage crops and grazing purpose is only 0.02 ha (2%) of their arable land *i.e*. 0.01 ha (1%) used for each. The shortage of arable land is increasing from time to time due to the ever increasing human population and it is critical problem for both crop and livestock productions in the area. Due to this reason farmers gave more priority to the production of immediate need food crops in the available lands than producing feed to their livestock. The shortage of land in the district is also aggravated by poor soil and undulated topography which easily exposes the soil to erosion. This result agrees with a study conducted by Tilahun *et al.* (2005) in Ethiopian highlands and Ahmed *et al.* (2010) in the central highlands of Ethiopia; in which land shortage is sever in the mixed crop-livestock production system. According to the ANRS BoA (2002); due to the absence of comparative study on the profitability of crop production and livestock production per unit of land, generally farmers in the region prefer to produce food crop than producing feeds in their arable lands. In addition, mainly due to the shortage of capital, poor perception and lack of knowledge, farmers did not use efficiently their land in the boundaries, terraces and homestead for the production of forages.

However, farmers kept their livestock in a controlled way during the rainy season, free grazing is the second bottleneck of the farmers in the production and utilization of improved forage crops in the district; especially after crop harvest. Therefore, forages grown on terrace edges attract free moving livestock which destroy the structures and aggravate land degradation and soil erosion which is in line with report of Tilahun *et al.* (2005) in the Ethiopian highlands. The uncontrolled and heavy grazing pressure on pasture land has led to a decline in biomass availability and the grazing pattern has created manifold problems on these pastures and also not suitable for the development of improved forage crops. Excessive and continuous grazing has severely damaging these lands and the herbage species found in the land.

The perception of farmers, in most parts of Ethiopia, to fodder in the district is as common property. The multipurpose perennial improved forages developed in different development strategies by adopters, especially which are far apart from the residence area, are easily damaged by free moving animals of the non adopter farmers. Agri-service Ethiopia did a lot in the community capacity building and provided training on adoption and utilization of different technologies; including improved forages by considering it as one component in their sustainable community development program. However, according to Ashagrie (personnel communication, 2010) due to uncontrolled free grazing feeding system, their effort on forage development were not being successful in the dissemination, production and utilization of the technology. This can concur with different reports in different parts of Ethiopia like BoA (2002) in ANRS and Ahmed *et al. (*2010) in the central highland parts of Ethiopia. But the timely decreasing rate and increasing knowledge of farmers to free grazing can be promising to the future.

Shortage of input/seed and seedlings of required improved forage species could be third important constraint in the production and utilization of improved forage crops in the study district (Table 15) which is in agreement with report of different authors in Ethiopia (Kedir, 2008; ILRI, 2009). According to the development agents and interviewed farmers' response, the absence of suitable species especially for the low altitude agro-ecology is another very important limiting factor in the production and utilization of improved forages in the study area. As Abule *et al*. (2009) noted that despite the presence of high demand of forge seed in Ethiopia, the supply was very low; in which this was mainly attributed to the coverage of the forage seed needs of the country by only ILRI where the supply was limited in quantity, timely in available and price and unaffordable at small scale farmers. The limited seed/seedling availability suitable to the different agro-ecologies and different development strategies might be due to the absence of improved forage seed producing farmers and organizations in different regions of the country at present. Moreover, the shortage of input (seeds/seedlings) indicated in this study is in line with report of FLDP (1990) in Ethiopia, BoA (2002) in ANRS and Ahmed *et al.* (2010) in the central highlands of Ethiopia.

Awareness and skill gap of the farmers and poor extension system of the responsible organizations are also raised as a limiting factor by the respondents in the production and utilization of improved forages in the study area. Farmers in the district did not have full knowledge about the production and utilization systems of improved forage crops.

In addition to the above problems, key respondents (WAO, Alem Birhan, ASE) noted that poor co-ordination between research institutions, development organizations (governmental and NGOs) and farmers was a constraint for the poor dissemination, production and utilization of the technology by the farmers. Due to lack of good co-ordination there is loose link between research and extension. Researchers did not get enough feedback which might have enabled them to plan their research activities based on the interest of farmers. So, most of the time, projects are proposed based on locally perceived problems. This agrees with report of FLDP (1990) and Alemu (1990); in which it was one of the problems in the smallholder sectors of Ethiopia for improved forage crops production. A research conducted by Abule *et al.* (2009) with the participation of farmers research group (FRG) in Adami Tulu and Arsi-Negelle Districts also concluded; doing research with the participation of farmers at all stages, different stakeholders, policy makers, *etc.* are key indicators for

successfulness and sustainability of certain technology. In addition, Ralph *et al*. (2005) noted that lack of adoption of forage technologies had been attributed to the lack of involvement of end-users in the multi-stage research process.

Moreover, key respondents also noted that farmers or producers normally make investment if they get return. If the return is not satisfactory or not directly visible or not immediate, they might be reluctant to the technology. Therefore, one of the causes for limited forage development is the limited economic incentives or the return is not immediate since the production of improved forage crops did not link with productive animals. From this regard, ILRI (2009) round table meeting on forage seed systems in Ethiopia noted that suggesting next steps as: efforts should target forage seed production in niches within value chain like intensive dairy and fattening, peri-urban livestock production, the multiple roles of forage (soil and water conservation, feed, food, ecosystem services and risk management) and comparative economics of forages with other crops was very important since farmers seem reluctant to grow forage because of competition for land from other crops. Kebede *et al.* (2010) also showed that linking forage technologies with a range of value chain issues in livestock enterprises was found to be essential for successful adoption of forage technologies by farmers. The above author emphasized, participatory selection of technologies that addressed farmers' priority problems and demonstrating tangible economic benefits in the short term were found to be effective in winning the trust of farmers and drawing the attention of a wider group of stakeholders.

3.4.2 Opportunities

However, it is not as expected, the availability of better market demand as compared to earlier market of animal products (now increasing price of milk, meat and other animal products) might be an important opportunity in the study area. In the previous year's farmers did not sale their milk to others due to their poor belief which was "milk should not be sold" but now this problem is solved. Besides, the constructed road from Mertule Mariam to Kombolcha served as a bridge between Gojjam and Wollo which facilitates the marketing system of live animals and different animal products for the producers involved in the sector which in turn increases the demand and adoption of improved forage crops in the area to decrease the feed shortage.

The experiences and the development activities that have been done by NGOs for the community can be considered as great opportunity for future expansion of the technology in the study area. In this regard, ASE and Alem Birhan integrated works of developed forage in different enclosure areas and in soil and water conservation structures of the district can be used as model for the provision of practical community trainings. Since the failures of most development activities are poor participation of farmers; Alem Birhan (community based local NGO) can be good opportunity for introducing suitable species with the participation of farmers in to the locality. In addition to ASE and Alem Birhan, World Bank was providing credit services, productive safety net program, World Food Program (WFP) worked in the district with special focus on food in-secured farmers which is very important in enhancing the development of improved forage crops by poor farmers of the study area. Besides, most NGOs in the district did their work with special focus on natural resource rehabilitation and this objective could be integrated with forage development activities by introducing good species which have good influence on the rehabilitation and can provide feed to the animals.

Even though there is a sever land shortage in the study district, the presence of marginal lands that could be more suitable for livestock production through agro-forestry systems also can be an opportunity. About 45% of the district is highly undulated and needs strong soil and water conservation activities to the area. Therefore, the need of this soil and water conservation structures could be very important for developing improved forage crops, if it is integrated with other activities. In addition, the presence of enclosure areas in highly degraded areas of the district can be used for developing suitable improved forage crops for rehabilitation of the area which can supply feed for cut and carry feeding system. This can be supported by the district future directions (plans) on soil and water conservation activities (planting feed and fruit tree species on terraces, area enclosure and development) and natural resource protection (terracing work, protection of degraded land, development of mountain with agro-forestry and protection of soil and water in the mountain), WFEDO (2010).

According to the key respondents, even though free grazing is one of critical limiting factors for improved forage production and utilization, the trend is decreasing from time to time which might be promising in the future. But this needs the government and different NGOs give emphasis and do allot in a participatory approach to shift from free grazing to zero grazing. Moreover, the attention recently given to livestock at federal and regional levels (e.g. establishment of livestock development agency at regional level) can also reduce the different livestock production constraints including feed shortage. This helps for intensification of agriculture through use of technologies including livestock which can be an opportunity for production of forage crops in integration or in rotation.

4. Conclusions and Recommendations

4.1 Conclusions

In Enebsie Sar Midir district, livestock production is constrained by seasonal feed shortage or getting year round

feed supply both in terms of quality and quantity. Virtually most grazing lands are converted to crop fields, the district had better potential to supply dry season feed resources as crop residues and during the early dry season as stubble grazing from crop land. Therefore, the major feed resources are generally characterized by poor quality and unbalanced nature of the nutrients they supply to animals. However, the contribution of better quality feed resources are very limited or absent.

So better efforts had been done in the production and utilization of improved forage crops in the study district. However, shortage of land, free grazing and shortage of suitable seeds/seedling to the different agro-ecologies are the main limiting factors for production and utilization of improved forage crops. Consequently, improved forage had not been produced and utilized efficiently in the study area.

However, there are a lot of soil and water conservation structures; enclosure areas and highly degraded communal grazing lands; which can increase the demand of improved forage crops, efficient work is not done for feed production to the animals and natural resource rehabilitation in integration or in rotation.

The production of improved forage crops did not integrate with better producing animals like fattening and dairying in which the return is not directly visible or not immediate. This might be one of important reason in which farmers prefer production of immediate food crops than animal feeds with their available land.

4.2 Recommendations

- Since lack of suitable seed/seedling of improved forage crops to the different agro-ecologies and farming systems is one of the major problem, on-farm evaluation of the different improved forage crops with full participation of the farmers on its productivity, palatability, integration ability and adaptability to the different land holding and farming system and agro-ecologies should be conducted and strengthened at farmers' management level.
- Since land shortage is one of the main limiting factors in the production of improved forage crops, use efficiently the available marginal lands (enclosure areas, degraded unproductive communal grazing lands and soil and water conservation structures) with desirable forage crops should be encouraged. From this regard, the district future direction on the natural resource protection (terracing work, protection of degraded land, development of mountain with agro-forestry and protection of soil and water in the mountain) provides very good intervention opportunities for improved forage development and should be promoted and assisted with good community based research and extension system for successful production and utilization.
- Since gradually shifting to control grazing/zero grazing system is the key point in the production and utilization of improved forages, full participation of the community in the implementation of zero grazing policy to protect the produced improved forage crops from free moving animals is also very important.

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