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Constraints of Improved Forage Adoption in East Gojjam Zone, Ethiopia

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Abstract

Inadequate quality and quantity of animal feed is a highly significant factor that affects production of livestock in Ethiopia. The major feed sources (crop residue and natural pasture) did not support even the annual maintenance requirement of livestock feed. Thus, to fill this gap, the production of cultivated forage is essential. However, the production and utilization of improved forage to animal feed is low in the highlands of Ethiopia due to different constraints. So, identifying constraints and opportunities of improved forage production isimportant for designing forage development strategies and intervention options for forage and livestock production. So, this study was conducted to identify the main constraints of forage production in three agroecologies. Of all agroecologies, two districts were selected by simple random sampling system, and a total of 12 peasant associations from six districts (two peasant associations from each district) were selected by simple random sampling system. Thus, a total of 30 respondents were selected by simple random sampling system from each peasant association. Of all agroecologies, a total of 360 respondents were interviewed by simple random sampling system. The data were gathered through focus group discussion and interviewing of individuals and analyzed by SPSS. Approximately 51% of the respondents did not produce cultivated forage crops due to land shortages, lack of awareness and seed, and fear of farmers towards birds set on forages. Thus, awareness on forage production, efficient utilization of cultivated land, utilization of fallow land for forage production, and planting or sowing of improved forage crops with food crops, in contour strips areas and homesteads areas can enhance the adoption of improved forage production in the study areas.

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Introduction

Ethiopia is the largest livestock producer in Africa as it contributes up to 80 percent of farmers' income and about 20 percent of agricultural GDP.[27] However, livestock production and productivity are very low[7] due to inadequate feed quality and quantity.[17] Inadequate quality and quantity of animal feed, particularly in the dry period, is a highly significant factor that affects livestock production and productivity.[2] Most of the feed in the Ethiopian highlands is obtained from crop residue and natural pasture[4] which varied in quantity and quality throughout the year. The utilization of improved forage to animal feed is low that represents< 1% of the total feed offered to livestock.[8]

Natural pasturesare not sufficient due to fluctuation of rainfall andalso reduced due to the rapid growth of the human population in Ethiopia with the increased land made available for crop production. The remaining pasture land further declined feed production due to poor grazing and soil fertility reduction.[13] Overgrazing and poor management practices favor the growth of invasive plant species causing a shift in the plant composition of pastoral grazing and decreasing their livestock carrying capacity.[26] Currently, the major feed sources for animals are crop residues, which have low digestibility and high fiber; as a result,the production and productivity of livestock decrease[4,13,23] which resulted in low productive and reproductive performance of livestock.

Thus, the production and utilization of improved forages can help to mitigate livestock feed shortages and to reduce pressure on natural pastures, support system substantially and enhance natural assets and system reliance.[4] Moreover, improved forage maintains continuous feed supply during scarcity period andalso provides protein rich more efficient quality feed than low-quality crop residues.[23] However, improved forage adoption is low in Ethiopia due to the highly increasing rate of the human population, which results in a shortage of land, awareness and skill gaps for farmers.[4,14]

In the east Gojjam zone, inadequate quality and quantity of feed are the main constraints that affect the expansion and development of livestock production. In this zone, the dry matter feed production support satisfied only 68.25% of the maintenance requirement of animals. As a result, especially during the dry season, animals shrink their body condition, which indicates feed deficiency and suggests that livestock production is hindered by feed shortages. To enhance livestock productivity, the feed supply should match the requirement of livestock in a given area. Thus, to fill this gap, the production of cultivated forage in the study area is essential. Despite different forages that have been introduced in the country; they have been not used well in the highlands of Ethiopia. The information about the constraints and opportunities of improved forage isimportant for designing forage development strategies and intervention options for forage and livestock production. However, there were insufficient information opportunities and constraints for forage production in the study area. Therefore, this study was initiated with the objectives of identifying the constraints and opportunities for improved forage in the study areas.

Research Objectives

- To identify the cultivated forages in the study areas
- To identify the constraints of the adoption of cultivated forage in the study areas

Materials and Methods

Description of the Stud Areas

The study was conducted in the east Gojjam zone of the Amhara region, Ethiopia. The zone is located in the northwestern highland of Ethiopia at geographical locations of 10° 1'46'' and 10°35' 12'' N latitude and 37° 55' 52'' E longitude and at distances of 305 and 251 km from Addis Ababa and Bahir Dar, respectively. The East Gojjam zone has different agroecology. According to the reports of east Gojjam agricultural offices, the altitude of districts ranges from 1500 to 3577 meters above sea level. The mean annual rainfall varied from 900-2000 millimeters, and the mean minimum and maximum temperatures ranged from 7-15 and 22-25°C, respectively.

Sampling Techniques and Sample Size

The agroecology of the zone is broadly categorized into low, mid and highland. Based on the agroecology, the zone districts were stratified into 3 categories.

Two districts were taken by simple random sampling method from each agroecology. A total of 12 peasant associations from six districts (two peasant associations from each district) were selected by using simple random sampling method, which represents corresponding agroecologies. In each peasant association, 30 farmers (households) were chosen by simple random sampling method, and thus, a total of 360 farmers were taken randomly for individual interviews.

Data Collection

During the survey, information was mainly gathered through focus group discussion (FGD) and interviewing of individuals. The FGD captured data on opportunities and constraints of forage production and utilization in the study areas.The individual farmer was interviewed using questionnaires designed to captureland size, livestock holdings, household characteristics, strategies and constraints of improved forage production. In addition, key informant interviews and discussions with district and peasant associations were conducted to confirm the information obtained from group discussions and individual interviews.

Data Analysis

The data were summarized and analyzed by SPSS (version 25) software. The General Liner Model procedure was used to analyze the effect of agroecology on livestock and landholding size and constraints on forage production.

Results and Discussion

Household Characteristics

The mean age and family size of the respondents in the study areas were 48.3 years and 6.6, respectively, which were not significantly ($p > 0.05$) different among agroecologies (Table 1). Out of the total respondents, 30.0, 4.2, and 0.8% of respondents had attended grades 1-4, 5-8, and 9-12, respectively. Moreover, 8.3% of respondents had attended religious education, and the remaining 57% of respondents were illiterate.This shows that the highest numbers of respondents were illiterate in all agroecologies, and the lowest number of respondents attended education more than grade 5, as indicated in Table 1. This low level of education affected the adoption of new agricultural technologies.[6,11]

Table 1: Household characteristics in the study areas

		Agroecology				
Household Characteristics		**Highland**	**Midland**	**Lowland**	**Total**	**P value**
Education level (%)	Illiterate	20.0[a]	17.5[a]	19.2[a]	56.7	
	1-4	8.3[a]	10.0[a]	11.7[a]	30.0	
	5-8	0.8[a]	1.7[a]	1.7[a]	4.2	0.076
	9-12	0.0[a]	0.0[a]	0.8[a]	0.8	
	Religious	4.2[a]	4.2[a]	0.0[a]	8.3	
Occupation (%)	Agriculture	100.0[a]	100.0[a]	100.0[a]	100.0	---
Age of respondents (mean ± se)		48.3±1.1[a]	48.5±1.5[a]	48.2±1.2[a]	48.3±0.2	0.029
Family size (Mean ± SE)		6.7±0.26[a]	6.6±0.28[a]	6.5±0.17[a]	6.6±0.14[a]	0.086

Means within the same row with different superscripts are significantly different ($p<0.05$) among agroecologies; SE = standard error

Live Stock Herd Size Per Household

The main livestock types in the study area were cattle, sheep, goats, equines and chickens, which were significantly varied across agroecologies (Table 2). Cattle (47.5%) contributed the highest herd size compared to other animals, which supports the results of [5,10, 21, 24,25] who reported the same result in mixed crop livestock production systems. The reason for the higher number of cattle in the study area is associated with cattle being used for tilling croplands and threshing crops. There was no significant difference in local dairy cattle owned

by households across the agroecologies (Table 2). On the other hand, the overall proportion of improved dairy cattle (7.9%) in the study area was greater than the national proportion (2.6%).[8] The reason might be due to the adoption of improved dairy cattle as a result of access to the milk market in the study area.

The mean number of goats owned per respondent in lowland areas was significantly higher ($p < 0.05$) than that in highland (HL) and midland (MD) agroecologies. The reasons for the variation may be due to the availability of browsing species, a preference for feed for goats, and the adaptation of goats to hot environments. On the other hand, the average number of sheep owned per respondent in HL was significantly the highest ($P<0.05$) compared to the others. The reasons for the highest number of sheep holdings in HL agroecology may be due to the adaptation of sheep to cold environments and partly due to the culture of the society they prefer sheep to goats, which supports the report, that the highest sheep number in HL agroecology compared to LL and MD in Enebsie Sar Midir district.[1]

Table 2: Livestock herd size per household in the study area

Livestock species		Agroecologies				Contribution (%)	P value
		Highland	Midland	Lowland	Overall		
Cattle	Local dairy	2.58±0.83[a]	3.94±0.73[a]	3.27±0.08[a]	3.28±0.19		0.208
	Improved dairy	0.06±.0.24[a]	0.78±0.14[b]	0.46±0.27[a]	0.44±0.01	47.5	0.012
	Draft	1.06±0.89[c]	2.64±0.43[a]	1.69±0.73[b]	1.83±0.52		0.000
Sheep		5.79±4.80[a]	4.28±0.38[b]	2.88±0.44[b]	4.42±0.44	37.8	0.002
Goats		0.00 ±0.00[b]	0.03±0.16[b]	0.69±0.50[a]	0.24±0.85	12.1	0.020
Horses		0.64±0.74[a]	0.42±0.90[b]	0.00±0.02[b]	0.38±0.74	3.3	0.040
Donkey		0.07±0.02[b]	1.60±0.055[a]	1.23±0.81[a]	0.92±0.05	7.9	0.000
Mules		0.48±0.75[a]	0.00±0.00[b]	0.00± 0.00[b]	0.17±0.02	1.5	0.000
Chicken	Local	1.76±0.45[a]	1.97±0.90[a]	0.46± 0.208[a]	1.48±0.95	42.6	0.112
	Exotic	2.64±0.006[a]	1.50±2.27[a]	1.85± 0.46[a]	1.99±0.47	57.4	0.568

Means within the same row with different superscripts have significant differences ($P<0.05$)

The average number of horses and mules per household was significantly ($P<0.05$) higher in HL than in ML and LL areas. This is because the area has rugged mountains and undulating topography, where equines are preferred due to their strength, physical fitness and adaptation to the environment. According to the respondents, equines are used for the transportation of people, agricultural products and performing other routine activities in the study area. Out of the total chickens, improved/ exotic chickens were larger (57.4%) than local chickens (42.6%) in the study areas. In the future, the genetic source of Ethiopian chickensmay be lost. The existing variation in livestock holdings across agroecology in the study area indicates the existence of variation in livestock type preference; therefore, the livestock development strategy should take into consideration their number per household to design livestock improvement plans in the area.

Land Allocated for Crop and Forage Production

As indicated in Table 3, the average land covered by crops was (1.86 ha) higher than 1.07 hain Enebsie Sar Midir district,[1] and the Ethiopian average land size was 1.14 ha per household.[8] The average land size covered by crops per respondent in the study areas was significantly varied ($P<0.05$) across agroecologies (Table 3). The average total land holding per respondent in the lowland (LL) was significantly higher ($P<0.05$) than that in the midland (ML) and highlands (HL). This might be due to the expansion of grazing land into cropland and the sparse density of the human population in LL. This large land size per household in the areas is the pointer of inter cropping forage development in future interventions. Generally, the land allocated for cultivated land was much lower than the land allocated for food crop production for all agroecologies.

Table 3: The total landholding size (ha) per household in the study area

Crop types	Agroecologies			Total	P - value
	Highland	Midland	Lowland		
Cereal	0.52±.05[c]	1.41±.0.48[b]	2.37±0.40[a]	1.577±0.390	0.020
Vegetable	0.27±0.14[a]	0.01±0.04[b]	0.00 ±0.00[b]	0.093±0.150	0.000
Oil crop	0.01±0.02[a]	0.05±0.20[a]	0.0 ±0.00[a]	0.023±0.010	0.080
Pulse	0.1110.08[b]	0.26±0.15[a]	0.04±0.03[b]	0.141±0.050	0.0320
Other crops	0.00 ±0.00[a]	0.001±0.03[a]	0.08±0.03[a]	0.034±0.003	0.4450
Total	0.91±0.85[C]	1.731±0.60[b]	2.50±0.49[a]	1.868±0.003	0.0001
Forage crop	0.003±0.003[a]	0.005±0.003[a]	0.002±0.003[a]	0.003±0.003	0.0630

Mean values with different superscript letters within the same row are significantly different (P<0.05) among agroecologies

Major Livestock Feed Sources

The major feed resources in the study area were natural pasture, crop residue, stubble grazing, agricultural by products and cultivated forages in descending order as ranked by respondents (Table 4), which is consistent with the reports of. [9,12,18] Natural pasture and crop residues were the first and second sources of feed to livestock in all agroecologies (Table 4), which was the case in most developing countries.[19] Furthermore, respondents and key informants reported that local brewery by products were also an alternative feed resource used in the area as a supplementary feed resource.

Table 4: Main feed resources ranked by Henry Garret

Feed resources	Agroecology						Overall	
	Highland		Midland		Lowland			
	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Natural pasture	85.0	1	82.3	1	85.0	1	85	1
Crop residues	76.8	2	79.5	2	82.3	2	74	2
Stubble grazing	68.0	3	68.0	3	68.0	3	68	3
Agro-industrial byproduct	14.8	5	62.0	4	63.0	4	63	4
Cultivated forage and pasture	60.0	4	60.0	5	59.0	5	59	5

Private Grazing Lands

The percentage of households having private grazing lands was 44.2%, which was significantly higher in highland (HL) than midland (ML) and lowland (LL) areas. This might be due to the lower production of forages and lower size of communal grazing land on the highland. The total percentage of respondents who managed private grazing land was low, as indicated in Table 5. No one introduced the improved forage on private grazing lands in any of agroecologies, which indicates a lack of recognition of farmers about the advantage of improved forage and a shortage of skilled extension services in the study areas. However, the manure and fertilizer application and control of invasive weeds were better than other management practices of private grazing lands in all agroecologies (Table 5), although there were no significant ($p > 0.05$) variations in themanagement practices of private grazing lands amongst agroecologies.

Table 5: Management practices of private grazing land

agroecology	Respondents (%) had private grazing land	manure Application	Weed control	Improved forages	Fertilizer	Irrigation application
Highland	21.1[a]	6.3[a]	6.3[a]	0.0[a]	8.4[a]	1.1[a]
Mid land	16.8[b]	8.4[a]	7.4[a]	0.0[a]	5.3[a]	0.0[a]
Lowland	6.3[c]	3.2[a]	3.2[a]	0.0[a]	2.1[a]	0.0[a]
Total	44.2	17.9	16.8	0.0	15.8	1.1
p value	0.006	0.556	0.613	0.00	0.207	0.387

Superscript letters with different values within the same column are indicative of significant difference (P<0.05 among agroecologies

Type of Improved Forage Crops

The types of improved forage crops introduced include *Chamaecytisus palmensis*, *Sesbania sesban*, *Vicia dascarpa*, *Pennisetum purpureum*, *Avena sativa*, *Chloris gayana* and *Pennisetum pedicellatum* (Table 6). These improved forage crops are commonly introduced in different areas of the Amhara region.[12,20,22] As reported from the respondents and direct observations, *Chamaecytisus palmensis* (tree Lucerne) was the only forage in the highland (HL) areas, and it was significantly (P<0.05) higher than that in the midland (ML) and lowland (LL) areas. This issimilar to the report of.[20] This may be due to the absence of other improved species that adapted to cold environmental conditions. The type of improved forage crops was greater in ML than in HL and LL (Table 6). This may be due to the absence of forage species that adapted to high moisture in highlands and high temperatures in lowlands.[3] Moreover, the percentage of respondents who had *Viciada scarpa* and *Sesbaina sesban* was significantly lower (p<0.05) in HL and LL than in ML. Thus, intervention of forage species that adapt in highland and lowland areas may require increasing the production of livestock. The percentage of respondents who had *Pennisetum purpureum*, *Avena sativa, Chloris gayana* and *Pennisetum pedicellatum* was not significantly (p>0.05) different across agroecologies.

Table 6: Percentage of respondents who had improved forage crops

	Agro Ecology				
	Highland	Midland	Lowland	Overall	P value
Farmers (%) sown/planted improved forage	17.7[a]	27.1[a]	4.2[b]	49.0	0.000
Types of improved forages					
Chamaecytisus palmensis	17.7[a]	1.0[b]	0.0[b]	18.8	0.000
Sesbania sesban	0.0[b]	25.0[a]	3.1[b]	28.1	0.000
Pennisetum purpureum	0.0[a]	1.0[a]	2.1[a]	3.1	0.237
Chloris gayana	0.0[a]	4.2[a]	2.1[a]	6.3	0.165
Avena sativa	0.0[a]	2.1[a]	0.0[a]	2.1	0.196
Viciadasycarpa	0.0[b]	5.2[a]	0.0b	5.2	0.015
Pennisetum pedicellatum	0.0[a]	2.1[a]	0.0[a]	2.1	0.196

Means within the same row with different superscripts are significantly varied (P<0.05) among altitudes

Forage Development Strategies in the Study Areas

The development of forage strategies enables farmers to enhance the supply of high quantity and quality animal feed, reinforce the traditional linkage between livestock and crop production, enhance water and soil conservation and reduce bare grazing lands.[15] The dominant improved forage development strategies in all agroecologies were backyard, which was significantly higher (P<0.05) in HL and ML than in LL, which agreed with the reports of.[22] This might be because backyard methods did not compete with food crop production and required a small amount of land around the homestead areas. None of the respondents sown/planted improved forage crops within food crops in all agroecologies. This indicated the low awareness of farmers about the importance of improved foraging and the lack of skilled extension services in the study areas.

Table 7: Percentage of respondents who practiced improved forage production strategies

	Agroecology				
	Highland	**Midland**	**Lowland**	**Overall**	**P value**
Improved forage development strategies (%)					
Backyard	16.7[a]	25.0[a]	3.1[b]	44.8	0.000
Intercrop/under sowing	0.0[a]	0.0[a]	0.0[a]	0.0	0.000
Forage strips	0.0[a]	3.1[a]	0.0[a]	3.1	0.085
Stock exclusion	0.0[a]	1.0[a]	0.00[a]	1.0	0.447
Alley cropping	0.0[a]	0.0[a]	2.1[a]	2.1	0.064

Means within the same row with different superscripts are significantly varied (P<0.05) among altitudes

Constraints of Improved Forage production

The production of improved forage crops was not practiced by the majority (51.0%) of the respondents in the study areas (Table 6), which is comparable to the reports of.[20] This was due to land shortage, lack of awareness, lack of seeds and fear of farmers due to crop grain feeder birds set on forages (Table 8), which supports the findings of other studies.[1,20] The Land shortage was the major constraint of improved forage production, and it was significantly (P<0.05) higher in HL than in ML and LL, which confirmed the reports ofin the Hadiya zone[1,2] and in the Libokemkem.[16, 20] The average land holding per house hold was 1.86 hectares, and the land allocated to improved forage crop purposes was low (0.003 ha) (Table 3). This was a problem because farmers gave more priority to the production of food crops in the available lands than to producing feed for their livestock. This poor practice of forage development might be challenged by information and technology limitations. Because of the absence of comparative findings on the profitability of crop production and livestock production per unit of land, farmers in the study area prefer to produce food crops rather than to produce feeds in land.

Awareness of the farmers was also noticed as a limiting factor by the respondents in the production of improved forages and no significant (P < 0.05) difference among agroecologies. Farmers in the study areas did not have full knowledge about the production and utilization systems of improved forage crops, which was in line with the study of.[16,20] Because of awareness, farmers did not sow/plant improved forage crops under sowing/inter cropping, boundaries, and terraces. The shortage of seeds and planting materials for required improved forage species was also a constrainton the production of cultivated forage crops (Table 8), which agreed with the results of.[1,20] According to the development agents and interviewed farmers' response, the absence of suitable forage species, especially for the highland agroecologies, was a very important limiting factor in the production of improved forages. The limited availability of seed and planting materials suitable to the different agroecologies and different development strategies was the absence of improved forage seed-producing farmers and organizations in

different areas. However, as ranked by respondents, peasant association and district experts, the opportunities for cultivated forage production were increasing demands for animal products, high-priced feed, inter cropping/under sowing, seasonal fallow land, agroecologies, expansion of soil erosion and protection from climate change.

Table 8: Constraints of forage production in the study areas

	Agroecologies				
Constraints of forage production	**Highland**	**Midland**	**Lowland**	**Total**	**pvalue**
Land shortage	26.0[a]	16.7[b]	17.7[b]	60.4	0.018
Lack of awareness	8.3[a]	7.0[a]	12.5[a]	24.0	0.062
lack of seed and planting materials	5.2[a]	4.2[a]	5.2[a]	14.6	0.643
Fear of farmers birds set on forages	3.1[a]	0.0[a]	0.0[a]	3.1	0.052
water shortage	2.1[a]	2.1[a]	4.2[a]	8.3	0.312
Lack of capital to purchase seeds	2.1[a]	1.0[a]	0.0[a]	3.1	0.407

Percentages within the same row with different superscript letters are significantly varied (P<0.05) among altitudes

Conclusion

Inadequate quality and quantity of animal feed is a highly significant factor that affects production and productivity of livestock. The types of improved forage crops introduced in east Gojjam zone were *Chamaecytisus palmensis*, *Sesbania sesban*, *Pennisetum purpureum*, *Avena sativa, Chloris gayana* and *Pennisetum pedicellatum*. The dominant improved forage development strategy in all agroecologies was backyard. The adoption of production and utilization of improved for age to animal feed is low due to land shortage (60.4%), lack of awareness (24%), lack of seed and planting materials (14.6%), fear of farmers birds set on forages (3.1%), water shortage (8.3%), and lack of capital to purchase seeds (3.1%).

Recommendations

To improve the quantity and quality of feed resources available for animals, the following recommendations are provided

a) Awareness about importance of forage production, and feeding of improved forage should be provided to farmers and experts.
b) Efficient utilization of the cultivated land, utilization of fallow land for forage production, and hay and silage making should be implemented in the study areas.
c) Planting or sowing of improved forage crops under sowing/intercropping with maize and wheat crops in contour strips areas and home steads areas.
d) Further studies need to be conducted on economic importance of improved forage production than food crop production to enhance the adoption of forage in the study areas.

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Conflict of Interest

There is no conflict of interest for this work.

References

1. Addisu Endalew, Firew Tegegne, Getnet Assefa. 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. *Journal of Biology, Agriculture and Healthcare*;2016; 6 (9):136.
2. Ahmed Hassen, Abule Ebro, Mohammed Kurtu, TrystA.C. Livestock Feed Resources Utilization and Management as Influenced by Altitude in the Central Highlands ofEthiopia. *Livestock Research for Rural Development*; 2010; 22(12).
3. Alemayehu Mengistu.Forage Production in Ethiopia: A Case Study with Implications for Livestock Production. *Ethiopian Society of Animal Production;* 2002; Всего страниц: 111
4. Belay Duguma,Geert P. J.Assessment of Livestock Feed Resources and Coping Strategies with Dry Season Feed Scarcity in Mixed Crop–Livestock Farming Systems around the Gilgel Gibe Catchment, Southwest Ethiopia. *Sustainability: Agricultural Production, Food Insecurity, and the Environment;* 2021; https://doi.org/10.3390/su131910713.
5. Birhan M.,Adugna T.Livestock Feed Resources Assessment, Constraints and Improvement Strategies in Ethiopia. *Middle-East Journal of Scientific Research*; 2014; 21(4): 616-622.
6. Bruna N. R., Barros C.P., DosJ.M. Education and Agricultural Production in Mozambique; 2014; The case of Maize. PhD Dissertation, Mozambique.
7. Central Statistical Agency (CSA). Report on livestock and livestock characteristics (private peasant holdings). *Agricultural sample survey;* 2017;Volume II. Federal Democratic Republic of Ethiopia.
8. CSA.Agricultural Sample Survey 2020/21 volume II Report on Livestock and Livestock Characteristics Central Statistical Agency (CSA); 2021; Addis Ababa, Ethiopia
9. Dachu Jobir, Jemal Juhar. Assessment of Cattle Feed Availability and Constraints in DillaZuriya Woreda. *International Journal of Advanced Research in Biological Sciences*; 2021; 8 (4). DOI: http://dx.doi.org/10.22192/ijarbs.2021.08.04.009
10. Dereje Abera, Tariku Jibat Beyene, Sori Teshale,Ashenafi Feyisa Beyi. Assessment of Plant and Chemical Poisoning in Livestock in Central Ethiopia. *Journal of Environmental & Analytical Toxicology*; 2014; 4(3):1-5. DOI:10.4172/2161-0525.1000215.
11. Ezeibe A.B., Okorji E.C., Chah J.M., Abudei R.N. Impact of Entrepreneurship Training on Rural Poultry Farmers' Adoption of Improved Management Practices in Enugu State. *African Journal of Agricultural Research*;2014; 9(20): 1604-1609.
12. FirewT., Getnet A.Feed Resource Assessment in Amhara Regional State." Ethiopia Sanitary and Phyto-Sanitary Standards and Livestock and Meat Marketing Program (SPS-LMM), Adiss Ababa. 2010
13. Malede Birhan, Takele Adugna. Livestock Feed Resources Assessment, Constraints and Improvement Strategies in Ethiopia. *Middle-East Journal of Scientific Research*; 2014; 21(4): 616-622.
14. Mamaru Malede Birhan, Takele Adugna. Livestock Feed Resources Assessment, Constraints and Improvement Strategies in Ethiopia. *Middle-East Journal of Scientific Research*;2014; 21(4): 616-622.
15. Mamaru Tesfaye, Tadele Melaku. Determinants of Adoption of Improved Highland Forage Type: Evidence from Dendi District, West Shoa Zone, Ethiopia. *Journal of Experimental Agriculture International*; 2017, 15(1): 1-8.
16. Mekonnen Yirga, Ali Seid. Enhancing Communities' Adaptive Capacity to Climate Change in Drought-Prone Hotspots of the Blue Nile Basin in Ethiopia; 2013.
17. Workye Melese, Aschalew Assefa, Kirkim Dehninet. Improved Forage Production Practice and Challenges in Libokemkem District, Ethiopia. *Agricultural Science Digest-A Research Journal;* 2018; 38(4): 280-284.
18. Ministry of Agriculture (MOA). Major

Challenges and Achievements in Ethiopian Livestock Production; 2013; http://www.africanafrican.com.

19. Ashenafi Miresa, Solomon Demeke, Gebremeskel Gebretsadik. Assessment and Evaluation of the Major Ruminant Feed Resources in Bedele Wereda, Oromia, Ethiopia.Journal of Fisheries and Livestock Production an Open Access Journal; 2019; 7 (2):292.
20. Notenbaert A., Herrero M., Kruska R., You L., Wood S., Thornton P., Omolo A. Classifying Livestock Production Systems for Targeting Agricultural Research and Development in A Rapidly Changing World; 2009; ILRI Discussion Paper 19. ILRI (International Livestock Research Institute), Nairobi, Kenya. 41 pp.
21. Salo S., Tadesse G., Haylemeskel. D.Survey on Constraints of Improved Forage Adoption in Anelemo Woreda, Hadiya Zone, Ethiopia. *Agric. Res. Tech*; 2017; 12(2): ARTOAJ. MS.ID.555839.
22. Samson Leta,Frehiwot Mesele. Spatial Analysis of Cattle and Shoat Population in Ethiopia: Growth Trend, Distribution and Market *Access. SpringerPlus*; 2014; 3(310); http://www.springerplus.com/content/3/1/310.
23. Muluken Shiferaw, Bimrew Asmare, Firew Tegegne, Dessalegn Molla. "Farmers perception and utilization status of improved forages grown in the natural resource areas of northwestern Ethiopia." Biodiversitas *Journal of Biological Diversity*; 2018; 19(4): 1568-1578.
24. Solomon Bogale, Solomon Melaku, Alemu Yami. Potential Use of Crop Residues as Livestock Feed Resources under Smallholder Farmers' Conditions in Bale Highlands of Ethiopia. *Tropical and Subtropical Agro-Ecosystems*; 2008; 8: 107-114
25. Tadesse Amsalu,Solomon Addisu. Assessment of Grazing Land and Livestock Feed Balance in Gummara-Rib Watershed, Ethiopia. Curr Agri Res;2014;2(2). DOI : http://dx.doi.org/10.12944/CARJ.2.2.08.
26. Aranguiz A. A., Creemers J.Quick Scan of Ethiopia's Forage Sub-Sector: *Netherlands East African Dairy Partnership (NEADAP) Working Paper;* 2019; (pp. 68). https://edepot.wur.nl/504124.
27. Mengistu A., Kebede G., Assefa G., Feyissa F. Improved Forage Crops Production Strategies in Ethiopia: A review. Acad. Res. *J. Agri. Sci. Res*; 2016; 4(6): 285-296