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The Status of Improved Forage Production and Utilization in Horro Guduru Wollega Zone, Western Oromiya Regional State, Ethiopia

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Abstract: This study assessed the status of improved forage production, utilization and forage technology adoption in the H/Guduru W/Zone. Both primary and secondary data were collected from three districts, namely, Guduru, Horro and Amuru. The multistage sampling technique was employed and a total of 180 households (HHs) were selected and interviewed on household characteristics, improved forage production and utilization, cattle breeds, herd structure and challenges of improved forage production. The main farming system in all districts was crop-livestock production. The mean grazing landholding (0.75 ha) for the HHs in the districts was 21.95% of the average total landholding of (3.58 ha) households. The land occupied by improved forages in the districts ranged 0.1 ha to 0.18 ha with the highest for Amuru district. Horro breed is the dominant (99.4%) cattle breed in the study sites, while some HHs have Horro × Jersey and Horro × HF crosses of cattle. *Chloris gayana, Pennisetum purpureum, Pennisetum pedicellatum, Vicia sativa* and *Avena sativa* are the major improved forage crops grown in the study sites. Generally, *C. gayana* grass is the most widely grown forage species in all study sites, covering approximately 13.8 ha of land followed by *Pennisetum pedicellatum* (3.76 ha) and *Pennisetum purpureum* (2.94 ha). Free grazing, cut and carry systems and haymaking are the utilization mechanisms of improved forages in the study sites. The major problems of forage production are the lack of forage seeds, lack of awareness, information and land scarcity. Providing training on forage production and utilization, supplying with forage seeds and strengthening extension services will help livestock producers in the study areas to solve the improved forage production and utilization problems.

Key words: Adoption · Improved Forage · Production · Utilization · Technology

INTRODUCTION

Ethiopia has a large livestock population and diverse agro-ecological zones suitable for livestock production. Despite the huge potential of the livestock population and its diversity, the benefits obtained from the arena are low compared to other African countries and also the world standard. Livestock production has mostly been subsistence-oriented and characterized by low reproductive and production performance. This is often mainly attributed to a shortage of feed in quality and quantity [1, 2].

A large proportion of livestock feed resources in Ethiopia are natural pastures, crop residues and aftermath grazing [3-5]. These feed resources cannot support higher animal productivity because of their nutritional limitations. Consequently, different strategies can be used to adjust the nutritional limitations of these feed resources. One such strategy that has received recognition and is considered to be the best option is the use of improved forage species in animal feed. In Ethiopia, improved forage production and utilization strategies in the mixed crop-livestock production system have been implemented and popularized for the last sixty

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years [6, 7]. This integration of improved forage species into a farming system is a promising alternative and/or strategy for addressing a country's chronic feed shortages [8]. In addition, improved forage crops are also critical for improving soil fertility, soil and water conservation activities and natural regeneration of degraded areas.

However, regardless of the extensive efforts made over the years to generate and disseminate forage technologies, their successful adoption and utilization have remained low for smallholder farmers. A recent study has indicated that the contribution of improved forages is insignificant, which is only 0.31% of the country and 0.18% of Oromiya National Regional State of the feed resources [9]. Since agro-industrial processing plants and formulated ration are not accessible in the H/Guduru W/Zone, producing and utilizing improved forage crops with relatively low prices compared to concentrates is more appropriate. Although some improved forage crops like Rhodes grass (*Chloris gayana*), Napier grass (*Pennisetum purpureum*), Desho grass (*Pennisetum pedicellatum*), vetch (*Vicia species*) and oats (*Avena sativa)* are disseminated in the study area, the adoption of improved forage at the farmer level remained very low due to a shortage of forage seeds, the reluctance of most smallholder farmers [8] and the lack of well-organized extension services.

On the other hand, due to the ever-increasing population size, the natural pasture is converted into cultivation purposes and the encroachment of cultivation land year to years has shown a substantial increment in the study area, which turn down the scale size of the natural free grazing land and the prospect of natural grazing land is under threat. Hence, the production of improved forages and the adoption of forage technologies to compromise the aforementioned problems is critical. Moreover, for actual intervention to progress, there is a need for baseline information in the Zone; however, such information is scarce.

Therefore, this study aimed to assess the status of improved forage production, utilization and forage technology adoption in the H/Guduru W/Zone. More specifically, this study aimed to assess farmers' perception toward improved forage production, purposes of improved forage production, the major type of improved forage adopted in the districts, utilization of improved forage and major challenges of adoption of improved forage in the districts.

MATERIALS AND METHODS

Description of the Study Area: This study was conducted in the Horro Guduru Wollega Zone of Oromiya Regional State, Ethiopia. The capital town of the Zone, Shambu city, is located 316km from Addis Ababa to the western part of Ethiopia. Shambu town is geographically located at 9° 38 N latitude and 37° 4'E longitude. The Zone covers a total land area of 8, 097 km^2, a total population of 641, 575, of which 50.09% are male and the rest are female [10]. The study was conducted in three districts/ of the Zone; namely: Guduru, Horro and Amuru.

Data Collection & Source: To develop an effective intervention, it is important to understand the household's current status of forage production, adoption and utilization. Both primary and secondary data were used for the study. Primary data were collected through pre-tested structured questionnaires from the improved forage adopters and non-adopters' farmers and observation of the selected area where secondary information was collected from the selected district offices.

Sampling Techniques: Three districts were purposively selected from Agro-ecological Zones (highland, midland and low lands). Since there is no low land in the Zone, two mid-latitude and one high-altitude located district were taken for the study. Generally, multistage sampling was approached to select and interview districts, kebeles and livestock owning households. Accordingly, the Guduru, Amuru and Horro districts were selected from the 12 districts in the Zone. Three kebeles, each with different agro-ecology, were sampled randomly. Twenty livestock-owning households were selected for interviews and data were collected from households in each kebeles. In this study, a total of 180 households (60 from each district) were interviewed from the three districts.

Data Analysis: Data were analyzed and described using SPSS version 20. The results were reported using descriptive statistics. The study districts (which were categorized based on agro-ecologies) and improved forage adoption were considered as independent variables. The mean comparisons were separated by employing Duncan multiple range tests at a 5% significance level. The generic statistical model was:

$$Y_{ij} = \mu + Hi + Li + R + e_{ij},$$

where,

Y_{ij} = measured variables
μ = overall mean
Hi = strata effect,
Lj = study sites,
R = interaction between strata effect and study sites and
eij = random error

RESULTS AND DISCUSSION

General Characteristics of Farm Households: Data were collected on general household characteristics of the Guduru, Horro and Amuru districts. The results showed that 94.4% were male respondents, whereas 5.6% were female. This showed that most livestock and forage farmers were male by the sex category. The respondents with the age range of 25-40 years were 62.8% while those aged between 40-65 years were 37.2%. From this, we observed that almost all age groups are in a productive stage. The average family size in the study area (for the three districts) was 6.7, indicating that family labor can play a remarkable role in the farming practices of the study sites. The education level of the majority of respondents (94%) was from elementary to a first degree (Bachelor), while only 6% of them were non-educated, confirming proper communication between respondents and enumerators.

Land Ownership of Farm Households: The mean land holding/households in a hectare at the study sites are given in Table 1 below. The landholding size of land allocated for crop production and grazing between improved forage adopters and non-adopters has not significantly different. The landholding size across the districts indicates, in Horro district, landholding size was significantly ($P<0.05$) lower than Guduru and Amuru districts. The current result of Horro district landholding size, which is 2.97 ha/HH, was almost similar to that reported in Abebaye et al. [11] and Hundie and Geleta [12], which was 2.85 ha and 3.08 ha, respectively. But, the present study disagreed with the report of Gurmessa *et al.* [13], which was 4.21 ha within the same district, Horro. This slight decrease in landholding size might be due to the population increase from time to time. The results revealed that the Guduru district households' land allocation for improved forage production was significantly ($P<0.05$) higher than the Horro and Amuru districts. This might be due to the presence of a research center in Guduru district that farmers have awareness of improved forage production and its importance and access to forage seeds. The major crops grown in the study districts are also given in Figure 1 below. The results showed that Maize, Tef, Wheat and Barley are the major crops grown in all the study sites. In Horro District, the majority of households grow Maize, Tef, Noug and Wheat. In the Guduru and Amuru districts, the majority of households grow Maize, Tef and Noug and Tef, Wheat, Barley, Maize and Noug, respectively. The present results for major crops grown in Horro district are in agreement with the report of Duguma, *et al.* [14].

Breeds of Cattles Used and Herd Structure: According to the respondents, almost all (99.4%) of the households had pure Horro breed, 6.1% had Horro × Jersey crosses and 1.67% Horro × Holstein Frisian crosses Figure 2. Horro breeds are the dominant local breed in the study sites because of the geographical locations of the Horro breeds. The results also showed that the distribution of crossbreeds that yield better milk is nil in Amuru districts might be due to the farness of the districts from the zone. Generally, the number of respondents that had cross-breed cattle is very low. This might be due to a lack of crossbreed heifers, poor AI services, high cost of crossbreeds, poor extension service and lack of awareness. The breed structure of the present study disagreed with the result reported by Kebede, *et al*. [15], which was 100% Boran × Holstein Frisian.

Livestock Population, Herd Structure and Composition: The mean livestock herd size and composition of the study sites are given in Table 2 below. Cattle, sheep and goats, horses, donkeys and mules are the major livestock produced in the study area. The results showed that the mean number of improved forage adopters was significantly higher ($P<0.05$) than non-adopters. In the present study, the mean total of cattle in Horro district (10.56) was comparable with that reported in Mekonnen *et al.* [16], which was 13.23 and the mean average of cattle in Horro district was lower than that reported in other Hundie and Geleta [12], Duguma *et al.* [14]. This decrease in the mean number of livestock from time to time in the study area might be related to a decrease in the landholding capacity of farmers from time to time and a shortage of grazing land.

Table 1: Landholding capacity and land management of households in study sites

Variables	Districts			Improved forage adoption	
	Horro n=60	Guduru n=60	Amuru n=60	Yes n=90	No n=90
Landholding per HH in ha [mean (±SE)]	2.97±0.09[a]	3.70±0.21[b]	4.08±0.28[b]	3.81±0.19	3.36±0.16
Cropland in ha [mean (±SE)]	2.34±0.07[a]	2.58±0.16[a]	3.12±0.23[b]	2.79±0.15	2.57±0.13
Grazing land in ha [mean (±SE)]	0.61±0.08[a]	0.77±0.05[ab]	0.86±0.07[b]	0.81±0.07	0.68±0.04
Improved forage land in ha [mean (±SE)]	0.10±0.02[a]	0.18±0.03[b]	0.13±0.02[ab]	0.27±0.02	-

[a-b]means in the same column sharing different letters of superscripts are significantly different (P<0.05)

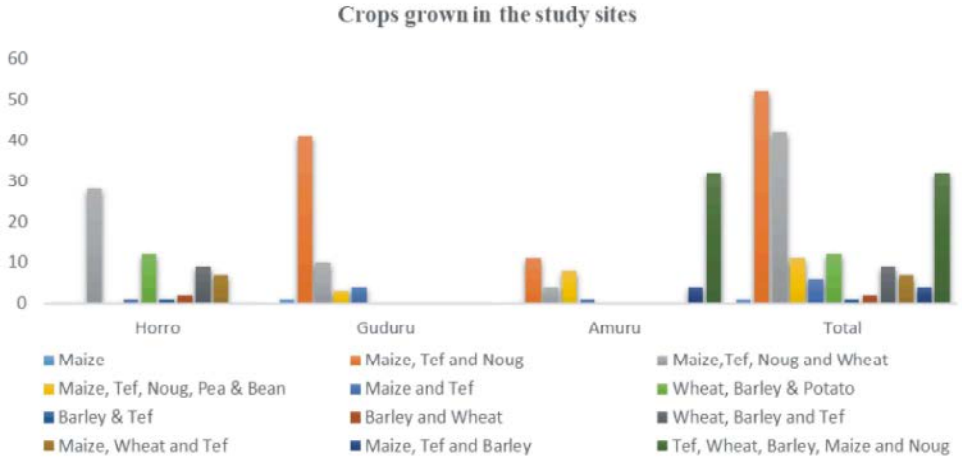

Fig. 1: The major crops grown in the study sites

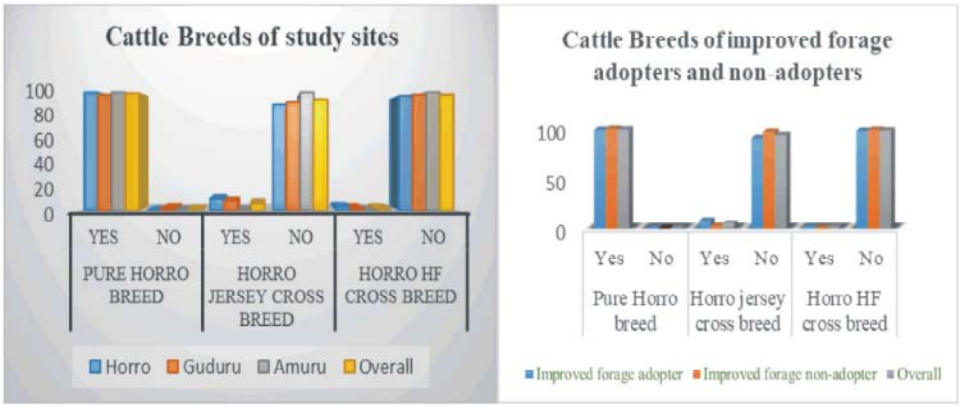

Fig. 2: Cattle breeds of study sites

Table 2: Herd size and herd structure (Mean ±SE) of Households in the study sites

Class of animals	Districts			Improved forage adoption	
	Horro n=60	Guduru n=60	Amuru n=60	Yes n=90	No n=90
Cattle	2.11±0.17	3.72±0.2	2.71±0.37	3.14±0.28	2.55±0.17
• Bulls	1.68±0.25[b]	2.92±0.23[c]	0.98±0.12[a]	2.00±0.20	1.72±0.17
• Oxen	2.73±0.20[a]	4.15±0.21[b]	3.12±0.19[a]	3.58±0.15	3.09±0.20
• Cows (*)	2.85±0.14[a]	4.48±0.20[b]	3.97±0.34[b]	4.22±0.24	3.31±0.17
• Heifers	1.52±0.13[a]	3.53±0.18[c]	2.23±0.20[b]	2.62±0.16	2.23±0.17
• Calves	1.78±0.13[a]	3.53±0.20[b]	3.25±1.0[ab]	3.3±0.67	2.41±0.15
Sheep	6.5±1.16[b]	2.07±0.27[a]	3.92±0.42[a]	5.06±077	3.27±0.42
Goats	1.98±0.26[a]	2.25±0.27[a]	3.58±0.54[b]	2.97±0.35	2.24±0.28
Horses	1.62±0.20[c]	0.68±0.12[b]	0.15±0.06[a]	0.89±0.15	0.74±0.11
Donkey	1.27±0.15[a]	1.42±0.15[ab]	1.78±0.13[b]	1.6±0.12	1.38±0.12
Mule	0.03±0.02[a]	0.02±0.02[a]	0.05±0.03[a]	0.06±0.02	0.01±0.01

[a-b] means in the same column sharing different letters of superscripts are significantly different (P<0.05). *Dry, lactating and pregnant cows

Table 3: Major improved forage produced in the area in hectares [mean±(SE)]

District	Rhodes grass (*C. gayana*)	Napier grass (*P. purpureum*)	Desho grass (*P. pedicellatum*)	Vetch (*Vicia* spp.)	Oats (*A. sativa*)
Horro (n=30)	0.05±0.01[a]	0.02±0.01[a]	0.06±0.01[b]	0.004±0.004[a]	0.04±0.02[b]
Guduru (n=30)	0.30±0.03[c]	0.02±0.01[a]	0.01±0.00[a]	0.000	0.02±0.01[ab]
Amuru (n=30)	0.11±0.02[b]	0.06±0.01[b]	0.06±0.03[b]	0.003±0.003[a]	0.00
Total	13.80	2.94	3.76	0.205	1.80

[a-b] means in the same column sharing different letters of superscripts are significantly different (P<0.05).

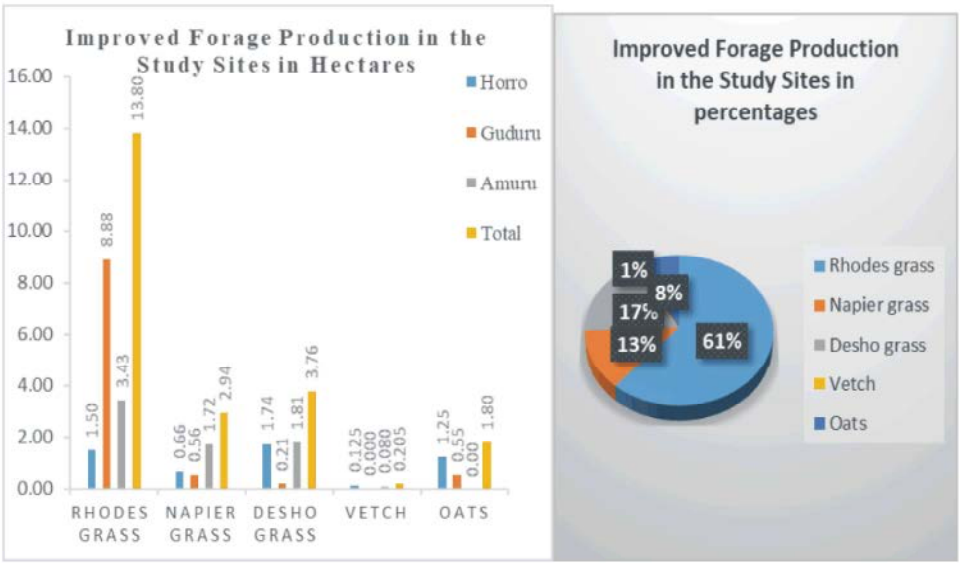

Fig. 3: The major improved forage species grown in the study sites

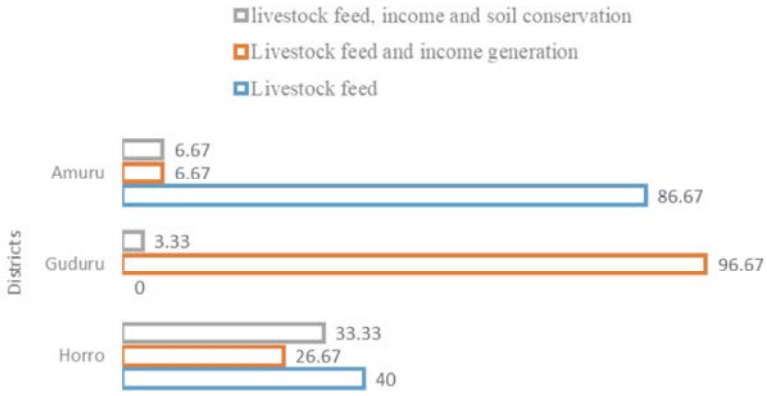

Fig. 4: Purposes of utilizing improved forages

Improved Forage Production and Utilization: The most common improved forage species grown in the study areas are presented in Table 3 and Figure 3 below. These results showed that Rhodes grass (*Chloris gayana*), Napier grass (*Pennisetum purpureum*), Desho grass (*Pennisetum pedicellatum*), Vetch (*Vicia species*) and oats (*Avena sativa*) are the major improved forages grown in the study sites. This dominant improved forage species was similar to the result reported in Zereu and Lijalem [17] in the Wolaita Zone. The average land allocated in hectares for Rhodes grass production was significantly (P<0.05) higher in the Guduru district than Horro and Amuru districts. Generally, Rhodes grass is the most widely grown forage species in all study sites, covering approximately 13.8ha, followed by Desho grass (3.76 ha) and Napier grass (2.94 ha).

In Guduru District, about 8.88 ha of land is covered by Rhodes grass, which the farmers started producing Rhodes grass not only for individual purposes but also for the sale of seeds. This is because the in Guduru Research and Cattle Breeding Center Rhodes grass was widely cultivated and distributed for farmers in the area.

Table 4: Experience and agronomic practice of improved forage

Variables	District			
	Horro (n=30)	Guduru (n=30)	Amuru (n=30)	Overall
When did you start planting?	2005	2000	2002	
Do you manage it properly?				
Yes	23(76.67)	22(73.33)	29(96.67)	74(82.22)
No	7(23.33)	8(26.67)	1(3.33)	16(17.78)
Do you have skill in its management?				
Yes	4(13.33)	5(16.67)	3(10)	12(13.33)
No	26(86.67)	25(83.33)	27(90)	78(86.67)
Do you collect forage seed?				
Yes	6(20)	26(86.67)	19(63.33)	51(56.67)
No	25(83.33)	3(10)	10(33.33)	38(42.22)
If no, why didn't you collect?				
I don't know its harvesting time	6(20)	1(3.33)	1(3.33)	8(8.89)
Do not give seed	0	1(3.33)	0	1(1.11)
I use its forage biomass before it would mature for seed	9(30)	1(3.33)	3(10)	13(14.44)
Its seeds are not viable	10(33.33)	0	6(20)	16(17.78)

In addition, the center gives different training for the farmers in the area, especially on the production and importance of improved forages. This awareness and access to forage seeds helped farmers to produce Rhodes grass.

Purposes of Forage Production: The main purposes of improved forage production by HHs are illustrated in Figure 4. Accordingly, improved forage production is used for livestock feed only, livestock and income generation and livestock feed, income generation and soil conservation. The majority of respondents from Horro and Guduru district have an awareness of the importance of improved forages other than as livestock feed, while only 13.33% of Amuru district respondents have awareness of improved forages as income generation and soil conservation in addition to livestock feed. Farmers consider improved forage seed as a source of income generation, which is similar to the result of Bassa, *et al.* [18], which can be considered as an opportunity for the adoption of improved forage.

Agronomic Practices: It is well known that good management (land preparation, hand weeding and fertilizer application) during forage production are important for the production of good biomass and quality forage. Agronomic management done for improved forage is given in Table 4. Overall, 82.22% of the respondents reported that they managed their forage properly. Only 13.33% of the respondents reported that they had skills in seeding rate, time, fertilizer application, harvesting, preservation, or conservation. This result is in agreement with the result of Zereu and Lijalem [17] in the Wolayita zone. The Guduru district had more experience in forage production than the other two districts, which might be due to the presence of the Research Center in Guduru, which provided seeds and training.

Utilization Mechanisms of Improved Forage: The free-grazing system, cut and carry system, haymaking and both cut and carry systems and haymaking are the utilization mechanisms of improved forages planted in the study area (Table 5). The overall results revealed that the cut and carry system (71.11%) followed by a cut and carry system and haymaking (21.11) were the common utilization mechanisms of improved forages. In contrast, only 2.22% of the respondents allowed their livestock to graze freely and 26.7% practiced feed conservation mechanism, which is haymaking, whereas the other farmers used to cut and carry feeding as fresh biomass feeding. This finding is in agreement with Adugna [19], who stated that feed conservation is not common in most parts of Ethiopia.

Most of the respondents utilized improved forage during the dry season. The results also revealed that most of the respondents believed that feeding improved forage increased milk yield up to 1.37 lit per day, while this yield increase was higher in the Amuru district, followed by the Guduru district. Farmers also believed that the utilization of improved forages improved the physical performance of their livestock and due to this improvement, their income also increased.

Table 5: Improved forage utilization mechanisms, season and purpose in the study sites

Variables	District			
	Horro (n=30)	Guduru (n=30)	Amuru (n=30)	Overall
Utilization mechanisms of improved forage				
Cut and Carry system	22(24.4)	20(22.2)	22(24.4)	64(71.1)
Free grazing	1(1.1)	-	1(1.1)	2(2.22)
Haymaking	2(2.2)	-	3(3.3)	5(5.6)
Both cut and carry system and haymaking	5(5.6)	10(11.1)	4(4.4)	19(21.1)
Season of Utilization				
Wet season	-	3(10)	-	3(3.33)
Dry season	18(60)	10(33.33)	18(60)	46(51.11)
Both Wet and dry season	12(40)	17(56.67)	12(40)	41(45.56)
Is there any change in the milk production of your cattle due to feeding improved forage?				
Yes	22(73.33)	29(96.67)	28(93.33)	79(87.78)
I don't know	8(26.67)	1(3.33)	26.67)	11(12.22)
If yes, amount it increases	1.25±0.08[a]	1.43±0.03[ab]	1.42±0.06[b]	1.37±0.04
Is there any change in their performance (physical) on your livestock?				
Yes	30(100)	30(100)	30(100)	90(100)
Does the utilization of improved forage increase your income?				
Yes	30(100)	30(100)	30(100)	90(100)

Table 6: Willingness to plant and expand improved forage in the future

Variables	District			
	Horro	Guduru	Amuru	Total
Do you plant improved forage in the future?				
Yes	30(100)	30(100)	30(100)	90(100)
If yes, purposes of planting				
It increases the productivity of animals	30(100)	26(86.67)	30(100)	86(95.56)
It increases income	-	4(13.33)	-	4(4.44)
Do you want to expand it?				
Yes	30(100)	30(100)	30(100)	90(100)
If yes, why did you expand it?				
It increases production/productivity of livestock and income	30(100)	30(100)	30(100)	90(100)

Future Prospects and Challenges for Improved Forage Production: The willingness of the forage adopter farmers to plant and expand the improved forages in the future and the major challenges of improved forage production are presented in Tables 6 and 7 below. Accordingly, all forage adopter farmers want to plant and expand improved forages for the future because they have created an awareness that improved forage increases productivity of animals and some farmers from Guduru district started to use improved forage for sale as an income generation like other crops. In general, the current demand for livestock products, the double advantage that farmers will get on the production of improved and year-to-year conversion of natural pasture will lead the farmers to adopt improved forage, which agrees with the result reported in Endalew, *et al.* [20].

The major challenges of forage production for improved forage adopters and non-adopters are different. The major challenges for adopters are the difficulty in seed collection, storage and land scarcity, require more labor, cost and time consumption and lack of different forage seeds. The major reasons for not adopting improved forages for non-adopters' farmers were lack of awareness, information, access to forage seeds and land. The challenges for the adoption of improved forage in the current study area were in line with the review of Fekade [21].

Farmers' access to training is presented in Table 8 below. Accordingly, 86.67% improved forage adopters HHs got training from the development agent, District and Zonal livestock experts, Wollega University and NGO. As observed, the training provided for the farmers did not capacitate them and they needed additional training on forage production and utilization and the role of improved forage on livestock production and productivity.

Table 7: Major challenges of improved forages production in percentages in the study areas

Variables	District			
	Horro (n=30)	Guduru (n=30)	Amuru (n=30)	Overall
The major problems for the production of improved forages (For adopters)				
Difficulty in seed collection, land scarcity, labor, cost & time consuming & lack of forage seed	100	100	100	100
The major problems for the adoption of improved forages (For non-adopters)				
Lack of skill	36.64	56.76	16.82	100
Lack of information	3.30	26.73	0.00	100
Lack of seed	46.85	13.21	69.97	100
Lack of extra land	13.21	3.30	13.21	100

Table 8: Access of HHs to training

Variables	District			
	Horro	Guduru	Amuru	Total
Do you have access to training on improved forage utilization?				
Yes	18(60)	30(100)	30(100)	78(86.67)
No	12(40)	0	0	12(13.33)
If yes by which bodies you trained?				
MoLF (DA, District expert & Zonal)	18(60)	28(93.33)	28(93.33)	74(82.22)
Universities	0	1(3.33)	1(3.33)	2(2.22)
NGO	0	1(3.33)	1(3.33)	2(2.22)
Do you need additional training in the future?				
Yes	30(100)	30(100)	30(100)	90(100)
On what title you need training?				
Forage production and utilization	28(93.33)	20(66.67)	27(90)	75(83.33)
Role of improved forage	2(6.67)	10(33.33)	3(10)	15(16.67)

MoLF= Ministry of Livestock and Fisheries

CONCLUSION AND RECOMMENDATIONS

It is concluded that production, adoption and utilization of improved forages at farmers' levels were still very low in the study sites and therefore intervention in these areas is crucial to solving the problems. The major improved forage species grown in the study areas were Rhodes grass, Napier grass, Desho grass, Vetch and Oats. Farmers practice utilizing the improved forages through free grazing, cut and carry and haymaking. The major challenges of improved forage production and utilization were lack of skills in seed collection and storage, land scarcity, labor problem and cost of inputs and lack of forage seeds. The main drawbacks for non-adopter farmers were lack of awareness, lack of forage seed and scarcity of land.

Therefore, it can be recommended that introducing and demonstrating different improved forage species to overcome the problem is the foremost important activity. Besides, there should be a strong extension service focusing on forage seed production and utilization of improved forages. Research on adaptation trials of different high yielding forage species in the study areas needs to be conducted.

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