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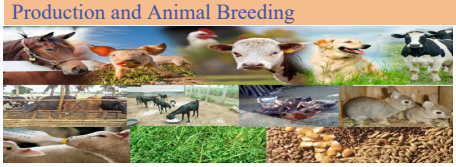

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# Survey on determinants of improved forage adaptation in Lemo districts of Hadiya zone, Ethiopia

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## ABSTRACT

This study was conducted to determine the problem in the way of adaptation of improved forage practices in Lemo districts of Hadiya zone, Ethiopia. The questionnaire was used to collect the data from 20 households of five kebeles. Natural pasture (94%) was the main feed resource during wet season whereas crop residue (59%) in the dry season. Only 37% of respondents replied that there was communal grazing land in their area. Feed shortage (50%), water shortage (25%), animal disease (15%), the low genetic potential of animal (7%) and extension services (3%) were the major problem in the study area. The major forage species widely planted in the study area were desho grass, elephant grass and Guatemala grass. Among multi purpose trees planting sesbania was common in the study area. The major determinants for improved forage cultivation were a shortage of land (45%), shortage of forage seed (25%), lack of awareness (16%) and poor extension services (14%). Therefore, the integration of improved forage with crops production and soil and water conservation structure is the best opportunity for increasing adaptation of this technology. Increasing accessibility of forage seed for the farmer and creating awareness is also another way to achieve widespread adapting of improved forage technologies.

**Keywords:** Constraints, Feed resource, Improved forage species, Communal grazing, Water conservation structure

## INTRODUCTION

More than 85% of the Ethiopian populations are lives in a rural area and their economy depends largely on a livestock production system. Livestock serves as a source of income, food security and also indicate the prestige and social status in the rural community. On the other hand, feed shortage both in quantity and quality remains the foremost constraint to good animal performance in Ethiopia. Feeds are either unavailable in sufficient quantities due to fluctuating weather conditions or are available but of such poor quality that they do not provide adequate nutrition. As grazing land declines and cropping expands to marginal areas, access to traditional feed resources is further constrained. Previously natural pasture grazing land was the main forage feed source for livestock. Currently, the size and quality like species composition, vigour and palatability of communal grazing lands have been substantially reduced across all areas of the country due to fast growth of the country's population with increasing land demand for crop cultivation. The remaining uncultivated pasture land reduced in forage production because of overgrazing and reduction in soil fertility (Endalew A, et al., 2016).

Improved forages play a varying role in different livestock production systems. In general, they are important as adjuncts to crop residues and natural pastures and may be used to fill the feed gaps during periods of inadequate crop residues and natural pasture supply (Hassen A, et al., 2010). Most improved forage, in particular legumes, is multi purpose plants (Alemayehu M, 2005). The promotion of integrated forage crops development has multiple functions in the feeding of livestock, improving the productive capacity of arable lands, and providing fuel and timber values (Mekonnen A, 2014). Use of improved forages would reduce the pressure on natural pastures, improve soil fertility and reduce erosion on marginal lands, improve carbon sequestration to mitigate climate change, support system sustainability and enhance natural assets and system resilience (Gebremedhin B, et al., 2009).

Livestock production is part of the farming system in the study area. One of constraint for livestock production in the study area is seasonality in quality and quantity of forage supply (Abba B, 2010). Use of open grazing is limited as there is a shortage of communal grazing lands. Therefore, this problem influences to find an alternative way to fulfill the feed requirements of animals to sustain their productivity throughout the year. Introduction of improved forage technologies that can fit into the existing land use system coupled with improved feeding systems is the best way to resolve the feed related problems (Bezabih M, 2016). On the other hand, cultivated forage crops are not widely adopted due to shortage of land, lack of awareness of farmers on benefits of cultivating forage crops and shortage of forage seed and planting material in other parts of the country (Fekadu D, 1996).

In the study area, farmers have experiences of cultivating improved forage through extension service and a level of expansion is not as expected. Therefore, identifying problems that hinder farmers adaptation of this technology is one of the preliminary steps to planning appropriate strategies (Talore DG, 2015). Thus, constraints that hamper adaptation of this technology should be identified in the study area. Therefore, this paper was initiated to identify determinants to improved forage adaptation in the study area (Yadessa E, 2015).

## MATERIALS AND METHODS

### Study Area

The study was conducted in Lemo district of Hadiya zone of South nation national peoples regional state. Lemo district is far 232 km away from Addis Ababa which is the capital city of Ethiopia. Lemo district is located between 7°.22'-7°.45' north latitude and 37°.40'-38°.00' east longitude. The mean annual temperature of the study area is ranges between 15.1-20ºC and elevation ranges from 1780-2780 above sea levels. The annual rainfall ranges from 1001-1200 mm/year (Assefa F, et al., 2015). Generally, the study site has a bimodal rainfall distribution with short and long rainy seasons covering from March to April and June to September, respectively. The plain topography combined with the availability of optimum climatic and fertile soil condition makes the woreda suitable for mixed crop livestock production (Gebremedhin B, 2003).

### Sampling Methods

Multi stage sampling procedures (purposive and random) was employed to select the study sites and households of the district. For data collection 5 sample kebeles were selected purposively based on livestock population, improved forage production potential and accessibility (Gebre MS, et al., 2010). To obtain the sample households, random sampling technique was employed. From each kebeles, 20 households were chosen randomly from total households in the kebeles (Katunga MMD, et al., 2014).

### Data Collection

In order to address the objectives of this study, discussion with key informants for baseline information and formal survey using a semi structured questionnaire was used. In the primary phase of the study, group discussion was held with key informants to investigate and have an overview about the major feed resource, improved forage species, improved forage utilization and challenges of improved forage production in the study area (Hussen K, et al., 2008). The information generated in the group discussion phase was used for the preparation and development of the questionnaire for the formal survey. The questionnaire was pretested on sample households out of the study area. Secondary data regarding land holding, land coverage by crop type, livestock population by species and number of kebeles was collected from Lemo district office of agriculture (Lal R, 2010).

### Statistical Analysis

Survey data was analyzed using Statistical Package for Social Sciences (SPSS) version 20 (SPSS, 2007). Descriptive statistics such as mean, frequency and percentage were calculated (Birhan M and Adugna T, 2014).

## RESULTS AND DISCUSSION

### Farming Activity

Livestock rearing and crop productions were the main farming activities in the study area. About 100% of the respondents depend on livestock and crop production for livelihood (Mbabwine Y, et al., 2004). The main economic source of livelihood is based on both crop and livestock production. The main crops grown include wheat, barley, maize, teff, faba bean, field pea, fruits, enset, and vegetables, while the livestock species kept include cattle, sheep, goats, poultry and equine (Mekonnen A, et al., 2014).

### Household Characteristics

Respondent household characteristics are presented in Table 1. In this study 86% of the respondent households were male headed and 14% were female headed. Education plays a great role in transferring technology to farmers and to initiate their willingness to adapt technologies (Mesay Y, et al., 2013). In this study out of the total respondent, 52% can read and write. About 30%, 6% and 4% of respondents were attending elementary, secondary and junior secondary school, respectively. This shows that people who were much involved in agricultural activities either did not attend any

formal education or stopped at lower levels (primary and secondary levels) (Misginaw T and Ayalneh B, 2012).

**Table 1:** Socio-economic characteristics of households in the studied sites.

| Variable | (N) Percentage (%) |
|---|---|
| **Sex** | |
| Male | (86) 86.0 |
| Female | (14) 14.0 |
| **Educational level of household heads** | |
| Read and write only | (52) 52.0 |
| Elementary | (30) 30.0 |
| Illiterate | (6) 6.0 |
| Secondary | (6) 6.0 |
| Junior secondary | (4) 4.0 |
| Above secondary | (2) 2.0 |

The mean age of respondents in the study area was 44.59 year and the average family size in the study area was 6.47 (Table 2). Family size has positive and negative effects on economic development (Musemwa L, et al., 2007). Large family size with limited economic activities and income sources lead to an increase in the number of dependent groups which lead to adverse living conditions. Lemo district is among the most densely populated areas in the country. Labour demanding agricultural activities in the area may be contributed to such higher family sizes. This was higher than the family size of 5.6 reported by Misginaw and Ayalneh from Soro and Gombora district of Hadiya zone. In general, a large number of persons per family are an indicator of high population pressure and land fragmentation in the area (Negash D, 2018).

**Table 2:** Average family size and age in the studied sites.

| | Study area | | | | | |
|---|---|---|---|---|---|---|
| **Descriptors** | **Jawe** | **Hayise** | **Belessa** | **Shesha-Gimba** | **Ambicho Gode** | **Overall** |
| Family size | 7.8 | 6.1 | 6.7 | 6.65 | 5.1 | 6.47 |
| Age | 42 | 40.1 | 49.1 | 39 | 52.75 | 44.59 |

**Livestock and Land Holdings**

The result of land and livestock holding is presented in Table 3. The land is the most important limiting production factor and the size and fertility of land greatly determine the amount of production. Cultivation land is decreasing from time to time due to increasing human population density in the study area (Osterle N, et al., 2012). On average landholding per household was 0.8 ha which is consistent with the finding of Ashenafi, et al. from smallholder farmers in Lemo district of Hadiya zone. This result is greater than the value of 0.5 ha per household reported by Mekonnen, et al., from Doyogena district. However, this result is lower than the value of 1.3 ha reported by Yenesew, et al. for Burie district and the value of 2.55 ha per household reported by Yeshitila from Alaba Woreda (Tefera S, et al., 2019).

**Table 3:** Average land and livestock holdings in the studied sites.

| Study area | | | | | | |
|---|---|---|---|---|---|---|
| **Variable** | **Jawe** | **Ambicho Gode** | **Belessa** | **Shesha-Gimba** | **Hayise** | **Overall** |
| LH (ha) | 0.75 | 0.85 | 1 | 0.75 | 0.65 | 0.8 |
| **Livestock** | | | | | | |
| Cattle | 2.56 | 4.06 | 5.6 | 3.5 | 2.2 | 3.58 |
| Sheep | 1.9 | 2.4 | 1 | 2.3 | 1.2 | 1.98 |
| Goat | 2.5 | 1.5 | 2 | 1.5 | 2.67 | 2.03 |
| Horse | - | - | 1.5 | 1.67 | 1 | 1.32 |
| Donkey | 1.07 | 1 | | 1 | 1.29 | 1 |
| Mules | 1 | - | - | 1 | | 1 |
| Poultry | 6.25 | 5.5 | 8 | 7.25 | 8 | 7 |

LIH: Livestock Holding; LH: Land Holding

The average cattle, sheep, goat, horse, donkey and chicken were 3.58, 1.98, 2.03, 1.32, 1.0 and 7.0, respectively. Types of livestock owned vary considerably from one wealth group to the other. Most of the households in the study site owned local and exotic cattle breed. Due to a lack of grazing land farmers keep small numbers of animals. Size of the herd could be related to unavailability of feeds that support the existing livestock throughout the year. Similar to this result Ashenafi, et al. has been found a similar result from the same area. Consistence with this result Bayush, et al. and Solomon, et al. reported that livestock holdings of households were related to the shortage of grazing land and feed. Nina Osterle, et al. states that stock sizes are high in the area where most people had access to large communal grazing areas (Zewdu S, et al., 2014).

**Purpose of Livestock Production**

There is a wide range of reasons for which households keep cattle and the reasons vary across ethnic groups, agro ecological and socio-economic conditions. Most farmers in the study area keep cattle for draught power (43%). About 35% of respondents keep cattle for home consumption. As expressed by respondents, they use oxen for ploughing land during cropping season and then use these oxen for fattening after cropping season accomplished. Small ruminants were kept for home consumption (60%) like for slaughtering to religious sacrifice. Chicken was kept primarily for income (70%) followed by home consumption. All equines are used for transportation (100%) of human and farm products from and to market. Livestock is also sources of food (meat, milk, milk products) and non-food products (hides, manure and skins) and cash income through sales of live animals and animal products. In agreement to this result, Solomon, et al., reported that livestock are used for draft power, milk, meat, skin and hides, and they are also the main sources of income (Table 4).

**Table 4:** Reasons of keeping livestock in the study area.

| Parameter (%) | Cattle | Small ruminant | Equines | Chicken |
|---|---|---|---|---|
| Draught power | 43 | - | - | - |
| Home consumption | 35 | 60 | - | 30 |
| Income | 22 | 40 | - | 70 |
| Transportation | - | - | 100 | - |
| Overall | 100 | 100 | 100 | 100 |

**Livestock Production Constraints**

Major livestock production constraints in the study are presented in Table 5. In the study area, livestock feed shortage (50%) was the major problem followed by water shortage (25%). In addition to this, animal disease (15%), the low genetic potential of animal (7%) and extension services (3%) was also identified as a constraint in the study area. This is in agreement with the result of Endale and Sintayehu, et al. in which feed shortage, animal diseases, water shortage, shortage of artificial insemination, veterinary services, extension services, market and poor genetic potential of the animals was a major problem for livestock production. Feed problem is one of the major factors that hinder the development and expansion of livestock production. Most rivers are seasonal and some farmers were digging groundwater around their compound. The farmers were prepared pond in some parts of the study area to collect water at the rainy season to overcome water shortage at dry season. Most farmers use spring and ground water for drinking their animal during the dry season. They use groundwater for drinking animals which are mostly tethered around their compound.

**Table 5:** Major livestock production constraints in the study.

| Variables | (N) Percentage |
|---|---|
| Feed shortage | (50) 50 |
| Water shortage | (25) 25 |
| Animal disease | (15) 15 |
| Low genetic potential | (7) 7 |
| Extension services | (3) 3 |
| Overall | 100 (100) |

**Feed Resources**

Natural pasture, crop residue, improved forage, fodder tree and non-conventional feeds were feed resources available for livestock in the study area and shows varied availability in different seasons. Natural pasture (94%) was the main feed resource during the wet season whereas crop residue (59%) in the dry season which is consistence with Ashenafi, et al. report from the same area. Similar to this result, Feleke, et al. found that natural pasture was main feed during wet season whereas crop residue and conserved hay at dry season. This is agreed with the findings of Zereu and Lijalem who concluded that natural pasture was the main source of feed for animals. Similarly, a study conducted by Addisu, et al. showed that crop residues and natural pasture from communal grazing land were the main feed resource in Enebsie Sar Midr district of East Gojjam zone. Currently, the rapid increase of human population and increasing demand for food are gradually shrinking grazing lands by being converted to arable lands. More utilization of improved forage was noticed in the dry season than in wet season which could be due to supplementation to crop residues. A small amount of feed was obtained from trees and shrubs as farmers lop the leaves and branches of various trees and shrubs and feed them to their animals during the dry season. Agro industrial by products like wheat bran was used by small farmers for lactating animal especially for exotic and cross breed cows. As expressed by farmers, they have the interest to follow market oriented dairy cattle production. But they cannot implement their idea in practice due to feed shortage and less accessibility and high price of agro industrial by products.

During dry season farmer allows their cattle to graze at communal grazing land, road side and rive side. Animals are suffered due to feed shortage during dry season and the beginning of rain. At the beginning of rainy season cultivation land is ploughed and animals are restricted from access to grazing land in which cultivation land is covered by crop. Therefore, most farmers tether their animal at their private land and use a cut and carry system to feed their animal. In agreement with this result, Mesay, et al. reported that there is severe feed shortage during the dry season and at the start of the rains. In addition to this, only 4% of respondents have private grazing lands. Private grazing land owners were those peoples who hold large land size (Table 6).

**Table 6:** Available feed resources in the study area.

| Dry season (%) | Frequency | Percentage |
|---|---|---|
| Crop residues | 60 | 60 |
| Natural pasture | 40 | 40 |
| | Wet season | |
| Natural pasture | 94 | 94 |
| Natural pasture and improved forage | 6 | 6 |

Respondents were used non-conventional feed for their animals. Banana leaves, enset leaves, sugar cane top, khat leave and avocado leaves were used as feed in dry season. At dry season farmers use enset parts for animals especially for stressed cattle due to feed shortage, milking cow and oxen. Enset leaves are the major source of feed to the livestock, especially at dry season. A similar result was reported by Deribe in which enset plant parts (root, pseudo stem and leaves) have been contributing a lot as basal feed as well as supplement especially for draught animals and milking cows. In consistence with this result, Dereje reported that during the dry season the domestic livestock are substantially dependent on parts of the enset not normally eaten by humans, in particular the leaf and the petiole, and the upper parts of the leaf sheaths and the core (the soft inner part of the central shoot) composing the pseudo stem which is discarded during harvesting.

There was a difference in crop residue storage from one area to another. In most parts of the study area, farmers use shade (79%) to store crop residue. Storage under shade was one of mechanism to minimize wastage of crop residue due to animals. In another part of the study area farmers simply stack crop residue in front of their house. Most farmers (79%) do not prepare hay for the dry season of the year because of less availability of land for harvesting grass. However, some farmers have experience of conserving grass as hay. Those farmers who prepare hay were purchase grass from compounds of religious place and government institution like schools. For deciding to harvest hay grass they use eye opinion (Table 7).

**Table 7:** Use of non-conventional feed and conservation of feed in the study area.

| Variables | Frequency | Percentage |
|---|---|---|
| | **Use of non-conventional feed** | |
| No | 80 | 17 |
| Yes | 20 | 80 |
| | **Conserve hay** | |
| No | 79 | 79 |
| Yes | 21 | 21 |
| | **Types of conserved feed** | |
| Crop residues | 79 | 79 |
| Hay and crop residue | 21 | 21 |
| | **Hay and crop residue storage methods** | |
| Store under shade | 79 | 21 |
| Stacked outside | 21 | 79 |

**Communal Grazing Land Availability**

A result of grazing land is present in Table 8. In the study area, only 37% of respondents replied that there was communal grazing land in the study area. In general, all respondents (100) indicated that communal grazing land was decreasing in size. As expressed by respondents

now day communal grazing lands are used for the construction of religious place and government institutions like farmers' demonstration site and school. Similar to this result, Berhanu, et al. reported that the importance of natural pasture is gradually declining because of the expansion of crop production into grazing lands, redistribution of common lands to the landless and land degradation. Similarly, Ahmed, et al. reported that the size of the grazing land is decreasing over time with the expansion in farmland size, which is a result of the increase in human population. Thus, because of less availability of communal grazing land farmers keep a small number of animals due to a gradual decrease in the area of grazing land.

**Table 8:** Communal grazing land availability and its status in the study area.

| Communal grazing land | Frequency | Percentage |
|---|---|---|
| Yes | 37 | 37 |
| No | 63 | 63 |
| | Status of communal grazing land | |
| Decreasing | 100 | 100 |
| | Private grazing land | |
| Yes | 4 | 4 |
| No | 96 | 96 |

**Improved Forage Species**

A survey result on improved forage species is presented in Table 9. There are many different ways of forage development techniques to be adopted to cope up feed scarcity periods by smallholder farmers even though the extent of these techniques usage by farmers of our country is quite minimal. From total respondents, only 48% were planted improved forage. Therefore, the trend of improved forage utilization in the study area calls for effective extension service to encourage farmers to grow improved forage species. The same trend was observed in Workye, et al. study in which a small number of farmers (44.4%) were cultivated improved forage. Similarly, Ahmed, et al., reported that only 35% of households used improved forage to alleviate feed shortage during the dry seasons in the central highlands of Ethiopia. Most farmers around forage development demonstration sites and main road side have a chance to plant improved forage. Farmers around this area have access to forage species and extension service by development agents. This indicates adaptation of this technology depends on the distance from farmer demonstration site.

**Table 9:** Common improved forage species in the study area.

| Parameter (%) | Frequency | Percent |
|---|---|---|
| | Plant improved forage | |
| Yes | 48 | 48 |
| No | 52 | 52 |
| | Utilization system | |
| Cut and carry system | 48 | 100 |
| | Livestock class | |
| Lactating cows | 46 | 95.8 |

| | | |
|---|---|---|
| Lactating cows, pregnant and fattening cattle | 2 | 4.2 |

The major forage species widely planted in the study area were desho (*Pennisetum pedicellatum* Trin.) grass, elephant grass (*Pennisetum purpureum*) and Guatemala (*Tripsacum laxum* Nash*)* grass. Planting multi purpose tree like *Sesbania* is common in the study area. From sampled households, most farmers were planted desho grass which indicates that this species of improved forage is suitable for this agro ecology. This result is similar to the result of Feleke, et al. from Shashogo Woreda. Likewise, Ashenafi, et al. also reported that desho grass is the dominant improved forage produced under different forage development options including soil and water conservation structures in Lemo districts of Hadiya zone. Respondents explained that they mostly plant forages around their backyard and soil and water conservation area because of a shortage of lands. There are also few farmers who allocate land for improved forage plantation. Using improved forage production for soil conservation might be due to the recent campaign to soil and water conservation in the country. The same result has been reported by Ashenafi, et al. from the same area.

Most farmers plant forage for utilizing as animal feed. In addition, farmers also use improved forage species for soil and water conservation, fencing, as a windbreak and as ornamental plant. *Sesbania* is common multi-purpose tree cultivated as an ornamental, wind break and fencing plant. A similar result has been reported by Feleke, et al. in which farmers in Shashogo Woreda use forage as animal feed, for soil and water conservation, fencing and as a windbreak. A study conducted by Addisu, et al. showed that farmers cultivate improved forage for soil conservation and animal feed. Apart from utilizing for feed, farmers use improved forage species for soil and water conservation (desho grass), fencing and as a windbreak (*Sesbania* and *Leucaena*). According to respondents cut and carry system (100%) was the main ways of utilizing improved forages. Farmers also give high priority for lactating cows (95.8%) followed by pregnant and fattening cattle (4.2%) during feeding this forage. This indicated that farmers prioritize forage utilization based on feed sensitivity of animals. This result was in line with Ahmed, et al. report in which farmers feed improved forages for animals in cut and carry system, and in the form of hay at Central Highlands of Ethiopia.

**Determinants for Improved Forage Adoption**

A survey result on constraints of forage adaptation in the study area is presented in Table 10. Shortage of land (45%) was identified as the major determinant which may be due to farmers' reluctance to allocate land for forage cultivation other than food production. Shortage of forage seed (25%), lack of awareness (16%) and poor extension services (14%) was also another constraint which needs to be alleviated. The result is in agreement with the finding of Yeshitila in which farmers do not plant improved forage due to shortages of land, seeds, lack of awareness and no effort made to introduce these technologies. Endale and Addisu, et al. also reported that the major reasons for not planting improved forage were a shortage of land, shortage of forage seeds, lack of awareness, unevenness of rainfall and lack of farmer's interest. Likewise, shortage of land, lack of awareness and the increased price of forage seed were the main constraints that hinder the cultivation of improved forage. Extension service is an important way to expand adoption of this technology but the study result indicates that only 51% of respondents have access to extension service. This can contribute to low delivery of information to farmers. Therefore, farmers in the study area lack awareness on the importance of this improved forage production (Table 10).

**Table 10:** Determinants for improved forage cultivation in the study area.

| Parameters (%) | Frequency | Percentage |
|---|---|---|
| | Extension service | |
| Yes | 59 | 59 |
| No | 41 | 41 |
| | Determinants | |
| Shortage of land | 45 | 45 |

| | | |
|---|---|---|
| Seed shortage | 25 | 25 |
| Lack of awareness | 16 | 16 |
| Extension service | 14 | 14 |
| Over all | 100 | 100 |

## CONCLUSION

In the study area, livestock production is one of the main agricultural activities and plays a great role in livelihood of farmers. However, animal feed shortage is one of the leading constraints that hamper the productivity of this sector. Farmers in the study area have less access to communal grazing land for their animal. The available feed is also not meeting the requirement of animals both in quality and quantity. Because of less accessibility of grazing land, farmers keep a small number of animals and their number decreases from time to time. Efficient utilization of available feed resource and adoption of new technology support farmers to maximize and sustain productivity of livestock. Thus, the integration of improved forage technology in the farming system can support farmers in a different way. However, farmers in the study area not cultivate improved forage due to shortage of land, shortage of forage seed, lack of awareness and poor extension services. Therefore, it can be recommended that increasing accessibility of forage seed and creating awareness on the importance and possible ways of integration in the farming system is important for extensive adaption of this technology.

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