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Assessment of Forage Production, Land Use and Utilization in Gursum Woreda, Somali

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Abstract: This paper focused on forage production practice, land use and utilization in gursum woreda somali region. The major forage production in the study areas were Alpha alpha 9.75%, Panicum 14.5%, Sudan grass 40.25%, Elephant grass3.75%, Crop residue 28.25% and Peanuts residue 2.25%. The main purpose of forage production in the study areas were feed, income and soil conservation. As experience of forage production increases, their utilization as feed also increases. However, there was significant strong obvious correlation ($P<0.01$) between the experience of forage production and utilization as animal feeds showing that experienced members of the household respondent community in forage production, prefers to use the grass for other purposes like source of income. Households can enhance their forage availability and quality, leading to improved livestock productivity and health. It recommended improving livestock productivity through sustainable forage production.

Keywords: *forage practice, utilization, income, sustainable, soil conservation.*

1. Introduction

In many developing nations, including Ethiopia, the demand for livestock-derived food products continues to rise due to factors such as rapid population growth, increased urbanization, and improved household incomes (Hatab, 2019). Despite possessing the largest livestock population in Africa (FAO, 2018), Ethiopia's contribution to national nutrition and export revenues remains limited. This is primarily attributed to low animal productivity, inadequate forage availability, and poor-quality feed resources (Bimrew, 2016). Key feed sources in Ethiopia include natural pasture, crop residues, agro-industrial by-products, and aftermath grazing (Bimrew, 2016). However, the role of natural pastures is diminishing due to land conversion for cropping and degradation caused by overgrazing and poor management practices (Gerba *et al*., 2013).

In the Somali Region, livestock feeding largely depends on natural grasses, shrubs, tree browse, and crop residues. However, during extended dry periods, these resources fail to meet the animals' nutritional requirements (Abshir, 2018). Most dry-season roughages from rangelands fall below 62 g CP/kg DM, which is insufficient to maintain animal productivity (Abshir, 2018). Nevertheless, the region offers substantial potential to address this nutritional gap. An estimated 23.05% (7,382,000 ha) of land not suitable for cultivation could be redirected toward forage production if suitable species are adopted (Abshir, 2018). The region's low livestock productivity is primarily caused by overreliance on poorly managed feed resources. Overgrazing has led to reduced carrying capacity, degraded landscapes, and dominance of unpalatable plant species (Alemu *et al*., 2020). In this context, Desho grass has emerged as a promising drought-tolerant forage with high nutritive value (Bimrew *et al*., 2017), making it well-suited for dryland environments.

One potential solution to the ongoing feed shortages is the cultivation of indigenous multipurpose forage species. These forages, being low-input and well adapted to local conditions, have been widely recommended for sustainable livestock feeding systems (Alemu *et al*., 2020). Seasonal harvesting and storage of grass as hay or open-air stacks could ensure feed availability during dry months (Brown, 2008). The adoption of resilient species like Desho grass (Shimelis, 2018) can also significantly enhance forage availability and nutritional quality.

Currently, there is a lack of comprehensive and localized data on improved forage production and land use efficiency, particularly in areas like Gursum Woreda. This study aims to bridge this gap and provide insights into forage production practices, land utilization, and feed performance.

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General Objective

To evaluate forage production techniques, land use efficiency, and forage utilization in Gursum Woreda, Fafan Zone, Somali Region Ethiopia.

2. Literature Review

Significance of Forage Production in Ethiopian Livestock Systems

Dairy production in Ethiopia is characterized by three primary systems: pastoral, agro-pastoral, and sedentary systems. The former two are mainly practiced in lowland regions, where livestock serves as the principal source of livelihood (Alvares & Creemers, 2019). Agro-pastoralists combine crop and animal production but both systems are heavily reliant on local breeds and traditional feeding methods, resulting in low productivity. Although interest in forage cultivation is growing, farmer adoption rates remain low (Million *et al*., 2023). Feed availability in arid and semi-arid lowlands is mostly communal and suffers from seasonal shortages due to erratic rainfall and overgrazing (Alvares & Creemers, 2019).

Feed Resources in Ethiopia

Ethiopia's livestock feed base consists of a combination of grazing, crop residues, agro-industrial by-products, multipurpose trees, stubble grazing, and cultivated or conserved forages (Shimelis, 2018). The relative contribution of these sources is influenced by agro-ecological conditions, seasonal variations, and farming practices. National estimates suggest that natural pasture accounts for 37%, crop residues 33%, hay 14%, agro-industrial by-products 5%, other feeds 10%, and improved forages only 1% of the total feed supply (CSA, 2021).

Natural Pasture

Natural pastures remain a fundamental feed source for ruminants in developing countries. In Ethiopia, grazing lands contribute significantly—about 37%—to livestock feed requirements (CSA, 2021). These pastures typically consist of annual and perennial grasses, as well as herbaceous legumes (Shimelis, 2018). Their availability and productivity are influenced by variables such as cropping intensity, rainfall patterns, and land pressure due to population growth (Bimrew, 2016). Although grazing lands are highly seasonal and mostly dependable during the wet season, they continue to support a wide variety of plant species that are valuable for livestock feeding (Alemayehu, 2011).

Crop Residues

Crop residues are fibrous by-products generated from cereal, pulse, oilseed, and root/tuber cultivation, serving as a crucial feed source during dry seasons (Abshir, 2018). These residues contribute 50% up to 80% of livestock feed, particularly in highland areas (Bimrew, 2016). However, their nutritional value is low, with limited crude protein (2.4–7%) and poor digestibility (IVDMD of 34–52%). Cereal straws contain approximately 4.5% CP and 79.4% NDF, while pulse straws are slightly richer in nutrients (Bimrew, 2016). The intensifying conversion of grazing lands into croplands, driven by human population growth, continues to elevate reliance on crop residues (Aschalew, 2019).

Agro-Industrial By-Products

What was once considered waste in agro-industrial processes now serves as a valuable feed component in Ethiopia. The primary by-products come from oilseed, grain milling, brewery, and sugar industries (Bimrew, 2016). Oilseed cakes such as those derived from groundnut, soybean, and sunflower are rich in proteins and fatty acids and are used as concentrates for livestock (CSA, 2017). Their feeding value varies based on extraction methods and nutrient retention. Supplementing with energy sources like crushed maize can enhance microbial protein synthesis and weight gain in animals. Brewer's grains also provide a good protein source for ruminants (Bimrew, 2016).

Noug Seed Cake

Noug seed cake (Guizotia abyssinica), cultivated mainly in Ethiopia, is a highly digestible protein source. Containing up to 30.8% crude protein, it is suitable for dairy and poultry feed (Sewalem *et al*., 2021). Its nutritional content can be influenced by the processing technique. Due to its accessibility and nutritional profile, it is widely used in livestock rations within Ethiopia (Bimrew, 2016).

Wheat Bran

Wheat bran is a widely available, cost-effective agro-industrial by-product used extensively in livestock feeding systems (Bimrew, 2016; Fekede et al., 2015). It is high in fiber and crude protein, with the Ethiopian variant containing up to 828.6 g/kg DM of CP. It also provides essential nutrients such as carbohydrates, minerals, and vitamins. Due to its palatability and mild laxative effect, it is ideal for supplementation, especially in fattening operations (Mcdonald et al., 2010).

Indigenous Forage

Fodder shrubs and trees play a key role in livestock feeding across various agro-ecological zones in tropical Africa (Kebede *et al*., 2017). Livestock consume the foliage either directly or through cut-and-carry methods (Bimrew, 2016). These trees are rich in crude protein (120–250 g/kg) and continue to offer nutritional benefits even during dry spells. However, the presence of anti-nutritional factors like tannins in some species can reduce digestibility or even harm livestock (Alemayehu, 2011; Ayale and Tolemaria, 2022).

Improved Forages

Enhanced livestock productivity is closely tied to the availability of quality forage. Since the 1970s, various improved forage species such as Desho grass, Rhodes grass, Elephant grass, Oats, and several legumes have been introduced in Ethiopia to boost feed supply (Diribi, 2022). These improved forages are tailored to suit diverse agro-ecological zones and improve both digestibility and nutrient intake. Farmers tend to prefer indigenous multipurpose plants like Vernonia amygdalina and Bambusa spp. due to their adaptability and multiple uses (Bimrew, 2016). Adoption of improved forages remains limited under subsistence systems but is promising in market-oriented setups involving crossbred dairy or fattening enterprises (Shimelis, 2018).

2. Methodology

This study was conducted in Gursum Woreda, Fafan Zone, Somali Region, Ethiopia. A cross-sectional study design was used to assess forage production practices, land use, and utilization.

Data were collected from selected households using structured questionnaires and field observations. Descriptive statistical methods were used to analyze the data.

The study focused on variables such as household characteristics, land holding, forage production practices, utilization patterns, and constraints affecting forage production.

4. Results and Discussion

The average family size in the four kebeles assessed ranges from 6.50 to 6.93 members, with an overall average of 6.67. This indicates that households in these communities tend to have relatively large family sizes. The standard deviation for family size is also similar across the communities, ranging from 1.07 to 1.35, with an overall standard deviation of 1.11. In terms of the age distribution of respondents, there is some variation across the communities. For example, the percentage of respondents age grouped 26-31 is high in Halago (6.7%) and higher in Kubi-jare (14.8%), while the percentage of respondents age grouped 32-38 is highest in Gola-ajo (37.7%). In Aro-as and Kubi-jare, the majority of respondents fall into the 39-46 age group, while in Gola-ajo, the majority are in the 32-38 age group. The assessment of household characteristics in these communities highlights the diversity in family sizes and age distributions.

Education background and gender of respondents in the study area

This finding was also contrasted with that of Diriba *et al*. (2020) who reported that the educational level of his study showed majority from elementary up to first Degree (94%). Therefore, this low level of educational achievement in the study area was a regarding to a smaller number of primary school to extend in the study area and students may require to move on long distances even to the nearest primary schools., which leads to restricted access to modern educational opportunities, this consequence was also in line with the findings of Bimrew *et al* (2017) and Shimelis (2018).

However, high school education as the highest level attained is the lowest across all communities, ranging from 3.33% to 5%, which showed significantly ($p<0.01$) that the fostering level of educated in the study area, the educational level attended by the household heads were very low, and this was in line with the case reported by Abshir (2018) who stated that education was very poor and most of pastoral areas in (Somali Regional State) were illiterate (94%). According to Mohamed *et al.*(2023) who reported that local farmers from the upper fafen and upper harawa complained about the limited quality and inadequate attention given to education in gursum woreda

Ultimately, the data on gender distribution and educational attainment highlight the diversity within these communities. Understanding these household characteristics can help in designing targeted programs that cater to the specific needs and educational levels of the community members.

Major occupation and land holding respondents in the study areas

The standard deviations are also quite diverse, with the highest in Kubi-jare (1.51). The data indicates that the majority of respondents in all communities are agro-pastoralists, with Gola-ajo having the highest percentage. Halago has the highest percentage of farmers, while staff members are relatively consistent across the communities. The mean values for land variables (crop cultivating land, fodder land, settlements) show variation across the communities, indicating differences in land ownership and usage patterns. The standard deviations highlight the variability within each community in terms of land ownership and settlement sizes. The data provides insights into the occupational distribution and land characteristics of the communities, which can be valuable for understanding the socio-economic dynamics and resource utilization patterns in these areas.

The current total average land holding per household (1.5ha) in the study areas were higher than the reports for average land holding (0.5-1ha) by (Shimelis, 2018). In relation to higher land holding acquired from the current study areas could be due to their low population density than the southern region of Ethiopia. Whereas farming is practiced extending in only some of the four village (Aro-as, Halago, Kubi jaare and Gola-ajo villages), cropping season for that villages were from late April to early June and from August to september (keremti season) during the main rainy season whereas the short rainy season cropping extends from early October to late November.

The major reasons that made those Agro-pastoralists to start crop production way of life was a decline in livestock

holding per household than the other districts of Somali region and this is because vegetation composition in communal grazing land were reduced resulting from unreliable rainfall and expansion of new settlement due to human population pressure in the study areas. This indicated that there was a strong experience of land farming and forage production practice activity in the study area.

Forage production practice in the study area

The distribution of these household characteristics varies across the communities, indicating diversity in agricultural practices and resource utilization. Understanding these variations can help in formulating targeted interventions or programs to support sustainable agriculture practices in these communities. Some proportions of forage practice in the current study areas were Sudan grass followed by Crop residue, Panicum, Alfa-alfa, Elephant grass and Peanut residue from highest to lowest.

In the study areas, 70.25% the respondents depend on water availability of forage production, all the respondents reported to have depended on rain fed forage cultivation and about 13.25% respondents to have used irrigation. The other 16.25% reported to have used both rain and irrigation. This report was identical with Diriba *et al*. (2020) who reported that Improved forage species, including Elephant grass, Oats, Rhodes grass, Phalaris and Panicum. Therefore, there is high potential of forage production and engagement that introduced in an endeavor to increase the amount and quality of available forage and have been promoted in the different parts of the country by the research institutes for the last decade because of their multipurpose benefits and rapid growth rates. Ultimately, the goal of this study was to assess farmer's perception of forage production practice, utilization and technologically adoptions.

Forage Utilization Household Respondents

The hypothesis was as experience of forage production increases, their utilization as feed also increases. However, there was significant strong obvious correlation ($P<0.01$) between the experience of forage production and utilization as animal feeds showing that experienced members of the household respondent community in forage production, prefers to use the grass for other purposes like source of income. Likewise, the estimated coefficients and standard errors for explanatory variables related to forage production in households, including variables such as household head age, gender, education level, experience in forage production, purpose of forage production, and the R-squared value.

In addition to this, This finding was an identical with the previous reports on *desho* grass Bimrew *et al* (2017) which indicated that *desho* grass has valuable role in the farmers as income generation. Crop residues, Sudan grass, alpha-alpha, panicum and elephant grass were the major feed resources available and utilized during dry season in the study areas. In addition to this, household respondents were utilized those fodders as fattening of meat animals, as supplementary feed of milking animals and survival during feed shortage of a long dry season. This report was comparable with Shimelis (2018) which indicated the effective extension service so as to encourage farmers to use improved production and utilization systems. Therefore, this study was focused on the experience of farmer's performance of activity, awareness and utilization. Which indicated that the intention of farmers fodder production practice may obviously related.

Purpose of Production Household Respondents

This data indicates varying levels of engagement in different household characteristics across the communities assessed. For instance, feed sources were more widely reported across all communities, while soil conservation activities showed lower participation. Income reporting fell within the mid-range of engagement. This data provides insights into the household behaviors and practices within these communities, which can be valuable for developing targeted interventions or programs to address specific needs or gaps in these areas.

The main purposes of forage production practices was used to produce improved forage for cut and carry system, haymaking and grass as source of income, feed; prevent erosion for two or more of these functions. This study was similar with Diribi *et al* (2022) who reported focusing on cut and carry system of feeding practice to supply succulent green feed and maintaining the health of soil conservation structures on which the forage planted, different improved forage production strategies were developed and implemented. Majority of the household respondents was reported feed, income and soil conservation their purpose to produce forage for more than one function.

Likewise, this finding was identical with a Shimelis (2018) who reported the objective of improved forage production targeted for multipurpose role in the study area. In agro-pastoral areas, most farmers produced forage as a source of feed and to prevent erosion as compared to elephant grass where its production is mainly targeted for feeding and prevention of soil in the study areas. This finding was similar in accordance with Muleta *et al*., (2017) who reported that cut and carry system was the most common feeding system in Hararghe Zone. Most of the farmers keep their animals at backyard and tether them during wet season, and some farmers tether their animals throughout the year. Whereas, majority of respondent households in farmers produce improved forages mainly targeted for cash and feed as income generation of production practice. This result an agreed with Diribi *et al*., (2022) who reported improved forage production were used for livestock feed, income generation and soil conservation.

Seed Marketing Accessibility of Household Respondents

Most of the respondent's experience for accessing forage seeds was very low due to lack of access to the required forage seeds, high seed price (very expensive), and limited knowledge of improved forage seed varieties. This situation is a similar with Shimelis (2018) who reported for Farmers experience in buying forage seeds was very minimum due to lack of access to the required forage seeds, high seed price (forage seeds from traders are very expensive that cannot be afforded by farmers), and lack of awareness (limited knowledge of improved forage seed varieties). However, this result is pivotal with Fekeda *et al*. (2017) who reported a large local seed production is underway using farmers'contracts, Conservation and use of grass germ-plasm has made a significant contribution to the economic development of Ethiopia through the national pasture and forage research program.

Constraints of Forage Production Household Respondents

Lack of skills of improved forage seed/planting material was the primary constraints followed by land shortage and lack of awareness. Farmers with planting land shortage were highest in kubi-jare village. Whereas farmers with lack of awareness of forages production were lower in gola-ajo and kubi-jare than, those in aro-as and Halago areas. This result is agreed in accordance with Diribi (2022) who reported on constraints' of forage production with land shortage, lack of capital to purchase inputs (improved forage seed), lack and high cost of planting materials, lack of knowledge or awareness, crop-dominated farming systems, and poor extension services were identified as major constraints for improved forage cultivation in the Ethiopian farming system. However, the higher number of farmers with lack of forage skill planting material in the study areas could be associated with the limited forage seed supply.

Whereas, the higher number of respondents with land shortage problem in the study areas could be attributed to more production of improved forage grass that took additional land. Lack of awareness on different improved forages and production strategies over the shortage of land and improved forage seeds had hindered the scaling up of improved forage technologies. In addition to this, with respondents to financial problems were manifesting lower in the study areas. Improved forage production is believed to overcome feed shortage but is constrained by many challenges including small landholding, encroachment of food crop production, lack of forage seeds, and limited knowledge on forage species and their production systems (Shimelis, 2018). Therefore, lack of Feed quality and quantity is the major constraints of livestock feed in Ethiopia (Fekede *et al*,. 2017). However, grazing lands do not fulfill the nutritional requirements of animals particularly in the dry season, due to poor management and their inherent low productivity and poor quality (Fekede *et al*, 2017).

5. Conclusion

The result of this study demonstrated that the average household size of the study areas was 6.67 persons per family. Most of the household head respondents in the study site were active working age groups. Male heading household respondents were larger than female. Large proportion of the respondents did not attend formal education. The fact is that only 4.16% attends high school, there is a smaller number of primary schools, which indicated that the students can move a long distance and study showed that the high level of illiteracy in the study area.

Ordinarily, most of the Somali people are pastoralists and the dominant farming activity in the study sites was Agro-pastoralist production (80%), farmers (16%) and staff (4%), which implies that most of the inhabitants were Agro-pastoralists. These Agro-pastoralists owned diversified land that used for cultivating crops, forage and settlements. There is spread power of the household activity in the study areas, men was the household head, leading major agricultural production like ploughing and harrowing of field activity. Whereas women were mainly housewife activity, observe agricultural crops, encouragement of their husband and caring children.

The major forage production in the study areas were Alpha alpha, Panicum, Sudan grass, Elephant grass, Crop residue and Peanuts residue. The main purpose of forage production in the study areas were feed, income and soil conservation. On the other hand, the major factors affecting utilization of forage performance was gender, educational status, and experience year of fodder practice and aim of forage production practice. Likewise, planting materials was accessible in the study areas. The major constraints of forage production practice in the current area were lack of skills, land shortage, lack of awareness and financial problems.

Therefore, this study reveals the importance of sustainable forage management to improve livestock production and contribute to the overall livelihoods of the communities in the region. By implementing better forage production practices and utilizing land effectively, households can increase their forage production availability and quality, leading to improved livestock health and productivity.

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