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Research Article

On-Farm Demonstration of Improved Forage Varieties in Selected Districts of Southwest Ethiopia

Teka Tefera Bekele*

Ethiopian Institute of Agricultural Research, Teppi Agricultural Research Center, Tepi, Ethiopia

Abstract

Livestock production is a critical component of Ethiopia's agricultural sector, contributing significantly to food security, income generation, and livelihoods. However, livestock productivity remains constrained by inadequate availability of high-quality forage, particularly during dry seasons. This study evaluated the adaptability and productivity of three improved forage varieties—Elephant Grass (Pennisetum purpureum), Desho Grass (Pennisetum pedicellatum), and Rhodes Grass (Chloris gayana)—in selected districts of Southwest Ethiopia. The on-farm demonstration involved 25 smallholder farmers across five kebeles in Shey Bench and Menit Goldiya districts. Farmers were trained in improved forage cultivation, management, and utilization, and data on biomass yield, plant height, and tiller density were collected. Results indicated that Elephant Grass produced the highest biomass yield (20-25 tons/ha/year), followed by Desho Grass (12-15 tons/ha/year) and Rhodes Grass (8-12 tons/ha/year). Farmers reported significant improvements in livestock health, milk production, and dry-season feed availability due to the adoption of these forages. Desho Grass was particularly noted for its soil conservation benefits, while Rhodes Grass demonstrated resilience in low-fertility soils. Farmers expressed strong interest in scaling up adoption, emphasizing the need for continued training and access to planting materials. The study highlights the potential of improved forage varieties to enhance livestock productivity, improve soil fertility, and support sustainable land management practices in Southwest Ethiopia. Recommendations include scaling out these varieties, providing continuous farmer training, integrating improved forages into national agricultural policies, and conducting further research to evaluate long-term performance under diverse agroecological conditions. This initiative underscores the importance of improved forage technologies in addressing feed shortages and improving the livelihoods of smallholder farmers in Ethiopia.

Keywords

Elephant Grass, Desho Grass, Rhodes Grass, Livestock Productivity, Smallholder Farmers

1. Introduction

Livestock production is a cornerstone of Ethiopia's agricultural sector, contributing approximately 20% of the country's Gross Domestic Product (GDP) and 40% of the agricultural GDP [1]. It plays a vital role in ensuring food security, generating income, and supporting the livelihoods of millions of smallholder farmers. However, livestock productivity in Ethiopia remains suboptimal, largely due to the inadequate availability of high-quality forage, particularly during dry seasons [2]. This issue is particularly pronounced in southwest Ethiopia, a region with significant potential for livestock

*Corresponding author: gtefera42@gmail.com (Teka Tefera Bekele)

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production. Traditional forage species, such as native grasses and crop residues, often fail to meet the nutritional needs of livestock due to their low protein content, poor digestibility, and limited biomass yield [3, 4].

Recent studies have highlighted the critical role of improved forage varieties in addressing these challenges. For instance, Mwendia et al. [5] emphasized the potential of Elephant Grass (Pennisetum purpureum) as a high-yielding forage crop capable of producing up to 25 tons of dry matter per hectare annually, even under suboptimal conditions. Similarly, Desho Grass (Pennisetum pedicellatum) has been recognized for its rapid regrowth and high crude protein content, making it an excellent option for smallholder farmers [4]. Rhodes Grass (Chloris gayana), on the other hand, has been noted for its resilience in low-fertility soils and its ability to thrive in areas with limited rainfall [6].

The integration of improved forage varieties into livestock systems has been shown to enhance animal health, increase milk production, and improve soil fertility [7]. Moreover, the adoption of these forages can contribute to climate change mitigation by sequestering carbon and reducing greenhouse gas emissions [6]. Despite these benefits, the adoption of improved forage varieties in Ethiopia remains limited, primarily due to a lack of awareness, inadequate access to planting materials, and insufficient technical support [3].

To address these challenges, the Tepi Agricultural Research Center has conducted adaptation research on improved forage varieties, including Elephant Grass, Desho Grass, and Rhodes Grass, across various locations. These forage varieties have demonstrated strong adaptability and significant potential in enhancing livestock productivity. They are characterized by their high biomass yield, superior nutritional quality, and adaptability to diverse agro-ecological conditions [5, 4]. Given their proven adaptability and benefits, on-farm demonstrations are recommended to increase the availability of improved forage varieties and encourage wider adoption under farmers' conditions [8].

Demonstrating these improved forage varieties under real farming conditions is crucial for enhancing the productivity of the livestock sector in Ethiopia, particularly in southwest Ethiopia, where grazing land is increasingly shrinking. Therefore, this demonstration activity was designed with the following objectives: (1) to evaluate the adaptability and productivity of improved forage varieties (Elephant Grass, Desho Grass, and Rhodes Grass) under farmers' conditions in selected districts of Southwest Ethiopia; (2) to enhance farmers' knowledge and skills in improved forage cultivation, management, and utilization; and (3) to assess farmers' perceptions and feedback on the improved forage varieties for further scaling out. Through these efforts, the study aims to promote sustainable livestock production and improve the livelihoods of smallholder farmers in the region.

2. Methods and Materials

2.1. Site Selection

The districts of Shey Bench and Menit Goldiya in southwest Ethiopia were purposively selected for this study based on several key criteria. First, these districts are recognized for their high potential for livestock production, making them ideal for evaluating the impact of improved forage varieties [9]. Second, they face significant challenges related to the shortage of grazing land, which exacerbates the existing forage deficit and negatively affects livestock productivity [10]. Third, there is a notable lack of adoption of improved forage technologies in these areas, despite their suitability for forage cultivation [3]. Three kebeles (Kusha, Shapa, and Meha) from Shey Bench district and two kebeles (Shokach and Bachuma) from Menit Goldiya district were selected for the demonstration based on their accessibility and representativeness of other kebeles in the area.

2.2. Selection of Farmers

Five farmers were chosen from each kebele for the demonstration activity based on their willingness to participate in the study, their reliance on livestock production, and their access to land for forage cultivation. Accordingly, a total of 25 farmers were selected across selected demonstration districts.

2.3. Capacity Building

The training program was designed to equip farmers, development agents (DAs), woreda experts, researchers, and other stakeholders with the knowledge and skills necessary for the successful adoption and management of improved forage varieties. As presented in Table 1, a total of 30 farmers (25 males and 5 females), 6 DAs (4 males and 2 females), and other stakeholders received hands-on training in all improved agronomic practices in forage cultivation, optimal harvesting times and frequency, cutting heights, and post-harvest handling methods such as drying and storage to preserve forage quality. DAs and woreda experts were trained to provide ongoing technical support, monitor forage performance, and collect data on growth parameters, biomass yield, and livestock productivity. The training emphasized participatory approaches, allowing farmers to share experiences and challenges, fostering adaptive learning and problem-solving. This comprehensive capacity-building initiative aimed to enhance the adoption of improved forage varieties and ensure their long-term sustainability in the study areas.

Table 1. Participants of trainings.

Participants	M	F	Total
Farmers	25	5	30
DAs	4	2	6
Experts	3	1	4
Researcher	4	1	5
Other	3	0	3

2.4. Planting and Management

All three improved forage varieties (Elephant Grass, Desho Grass, and Rhodes Grass) were planted at each farmer's field planting side by side during the main rainy season to ensure optimal establishment and growth. Planting materials (seeds and cuttings) were provided to the farmers by the Tepi Agricultural Research Center. The forage varieties were planted side by side on the same fields of each participants to allow for comparative analysis of their performance.

Figure 1. Photo taken while planting.

2.5. Data Collection

Data on the performance of the forage varieties were collected through regular field visits and measurements. Key parameters assessed included biomass yield, plant height, and tiller density. Farmers' perceptions and feedback on the forage varieties were collected through focus group discussions and structured interviews. The data were analyzed using descriptive statistics and participatory methods to assess the adaptability and performance of the forage varieties under farmers' conditions.

3. Results and Discussion

3.1. Area Coverage and Participants

The on-farm demonstration of improved forage varieties in Shey-Bench and Menit Goldiya districts involved planting three forage types—Elephant grass, Desho grass, and Rhodes grass—on allocated plots of 0.125 ha, 0.0625 ha, and 0.01 ha per farmer, respectively. A total of 25 participants (20 male and 5 female) from 5 kebeles participated, covering a combined area of 1.5625 ha for Desho grass, 3.125 ha for Elephant grass, and 0.25 ha for Rhodes grass. The larger plot allocation for Elephant grass reflects its higher biomass yield potential and suitability for livestock feed, while the smaller plots for Rhodes grass suggest its role as a complementary forage option. The participation of both male and female farmers indicates inclusive engagement, although male participation was significantly higher, aligning with studies by Mekonnen et al. [7] and Tadesse et al. [8], which found that male farmers are more likely to engage in forage cultivation due to land ownership patterns in Ethiopia. However, Abebe et al. [10] emphasized the growing role of women in forage production, particularly in regions where livestock rearing is a shared responsibility. This initiative highlights the potential for scaling up improved forage adoption to enhance livestock productivity and livelihoods in Southwest Ethiopia.

Table 2. Distribution of participants, kebeles, and area covered by grass species.

Name of Districts	No. of kebeles	No. of participants		Area covered in hectares		
		Male	Female	Desho	Elephant	Rhodes
Shey-Bench	3	12	3	0.9375	1.875	0.15
Menit Goldiya	2	8	2	0.625	0.125	0.1
Total	5	20	5	1.5625	3.125	0.25

3.2. Performance of Forage Varieties

The results of the study demonstrated that all three forage varieties—Elephant Grass, Desho Grass, and Rhodes Grass—performed well under farmers' conditions in southwest Ethiopia. The forage varieties exhibited high biomass yields, and adaptability to the local agro-ecological conditions.

3.2.1. Elephant Grass (*Pennisetum purpureum*)

Elephant Grass demonstrated the highest biomass yield among the three forage varieties, with an average dry matter yield ranging from 20 to 25 tons per hectare per year across all cutting frequencies. This finding aligns with studies by Mwendia et al. [4], who identified Elephant Grass as one of the most productive forage grasses in tropical and subtropical regions, yielding between 18 to 30 tons/ha/year. Similarly, Assefa et al. [3] highlighted its superior biomass yield and nutritional quality compared to other forage species in Ethiopia. The crude protein content of Elephant Grass, ranging from 8% to 12%, significantly exceeds that of traditional forage species, a point reinforced by Lemaire et al. [5], who emphasized the role of high-protein forages in enhancing livestock productivity, especially in smallholder systems. The grass exhibited rapid growth and high tiller density, making it an excellent forage option for livestock. Farmers participating in the study reported cutting the grass at a height of 1 meter to feed their livestock, noting that Elephant Grass provided high-quality feed year-round, particularly during the dry season when traditional forage species were scarce.

Figure 2. *On farm performance of the Elephant forages.*

3.2.2. Desho Grass (*Pennisetum glaucifolium*)

In demonstration sites, Desho grass (*Pennisetum glaucifolium*) is typically harvested when it reaches a height of 80-90 cm, allowing for multiple harvests per year with cutting intervals of 30 to 45 days, depending on growing conditions. The grass produces an average dry matter yield of 12-15 tons per hectare, with a crude protein content ranging from 10% to 14%, significantly higher than that of traditional forage species. Thanks to its rapid regrowth, Desho grass can be frequently harvested throughout the growing season, ensuring a continuous supply of fodder for cattle and supporting sustainable livestock feeding practices. Additionally, Desho grass offers soil conservation benefits, such as reducing erosion and improving soil fertility, as noted by farmers who observed better soil quality and reduced erosion in their fields. These findings are supported by studies such as Kebede et al. [9], which reported similar yields and protein content in Ethiopian highlands, and Tadesse et al. [8], which highlighted the grass's adaptability to diverse agro-ecological conditions. Research by Assefa et al. [3] and Mekonnen et al. [7] further underscores the role of Desho grass in sustainable land management practices, making it a valuable forage option for smallholder farmers.

3.2.3. Rhodes Grass (*Chloris gayana*)

Rhodes grass is a highly productive forage grass, ideally suited for demonstration sites, with annual dry matter yields ranging from 8 to 12 tons per hectare. To achieve optimal productivity, it is recommended to harvest the grass at 8-week intervals when it reaches 10-50% heading, ensuring a balance between yield and nutritional quality. The grass demonstrates high resilience to grazing pressure and thrives in low-fertility soils, making it particularly valuable in areas with limited rainfall and poor soil conditions. These findings align with studies by Mwendia et al. [4] and Assefa et al. [3], which highlight Rhodes grass as well-suited for semi-arid regions. Additionally, Kebede et al. [9] emphasized its ability to thrive in low-fertility soils, providing a reliable forage source during dry seasons. Farmers have also reported its effectiveness in challenging environments, further underscoring its adaptability and value.

Figure 3. *Photo taken during data collection.*

3.3. Farmers' Perceptions and Feedback

Figure 4. *Photos taken during field visit and provision of practical training.*

Farmers in the study reported significant improvements in livestock health, milk production, and reproductive performance due to the adoption of improved forage varieties, a finding supported by Adugna et al. [2] and Tadesse et al. [8], who noted increased milk yields and faster animal growth rates among adopters. The year-round availability of these forages reduced reliance on traditional species and crop residues, aligning with Assefa et al. [3], who emphasized the importance of consistent forage supply for enhancing livestock productivity. Farmers also appreciated the soil conservation benefits of varieties like Desho Grass, which reduced erosion and improved soil fertility, consistent with studies by Lemaire et al. [5] and Mekonnen et al. [7]. Participants expressed strong interest in scaling up adoption, particularly with adequate training and support, as highlighted by Kebede et al. [9]. Testimonials during perception assessments revealed that farmers valued the high biomass yields, adaptability, and quality feed provided by the forages, which improved animal growth, milk production, and dry-season availability. Elephant Grass, in particular, was praised for its rapid growth and tiller density, while Desho Grass was noted for its soil conservation benefits. Farmers emphasized the need for further training and extension support to ensure successful scaling of these improved forage varieties. One farmer remarked, *"Using Elephant Grass and Desho Grass has significantly improved my livestock's health and productivity, especially during the dry season when feed is scarce—these forages are a game-changer for us."*

3.4. Actors and Their Responsibilities in the Demonstration of Forage

The demonstration of improved forage varieties relies on a collaborative multi-stakeholder approach, with each participant playing distinct yet interconnected roles. Researchers, primarily from TARC, are responsible for providing planting materials, conducting training sessions, monitoring progress, offering technical support, and organizing field days to showcase results. Woreda experts and development agents contribute by identifying suitable sites and participant farmers, overseeing land preparation and planting, ensuring proper management practices, maintaining records, and organizing field days to disseminate successful practices to the broader community. Participant farmers allocate land, prepare and manage forage plots under the guidance of researchers and development agents, and share their experiences and knowledge with neighboring farmers to promote wider adoption. Studies, such as those by Assefa et al. [3], Lemaire et al. [4], and Franzluebbers et al. [6] emphasize that the success of these projects depends on effective collaboration, knowledge transfer, and continuous technical support, with local community involvement being critical for the sustainable scaling up and long-term sustainability of improved forage systems. This integrated approach ensures the effective implementation and broader adoption of improved forage varieties.

4. Conclusion and Recommendations

4.1. Conclusion

In conclusion, the on-farm demonstration of improved forage varieties—Elephant Grass, Desho Grass, and Rhodes Grass—in selected districts of southwest Ethiopia has shown promising results in enhancing livestock productivity and addressing forage deficits. These forage varieties demonstrated high biomass yields, adaptability to local agro-ecological conditions, and significant nutritional benefits, leading to improved animal health, milk production, and soil conservation. Farmers expressed strong interest in adopting these varieties, highlighting the need for continued training, access to planting materials, and integration into existing livestock systems. Scaling out these improved forage varieties, supported by further research and extension services, holds great potential for sustainable livestock production and improved livelihoods for smallholder farmers in the region.

4.2. Recommendations

Based on the findings of the study, the following recommendations are made:

1) Promotion and Scaling Out: Zonal and woreda agricultural office in collaboration with Teppi agricultural research center scale out the improved forage varieties in southwest Ethiopia.
2) Farmer Training and Support: Government and other development partners should be provided continuous training and support on cultivation and utilization of improved forage varieties I order to encourage wider adoption.
3) Policy Support: Policymakers should consider incorporating improved forage cultivation into national and regional agricultural development plans.
4) Further Research: Further research should be conducted to evaluate the long-term performance of the improved forage varieties under different agroecological conditions and management practices.

Abbreviations

CSA	Central Statistical Agency
DAs	Development Agents
DM	Dry Matter
EIAR	Ethiopian Institute of Agricultural Research
GDP	Gross Domestic Product
Ha	Hectare
TARC	Tepi Agricultural Research Center
Zonal	Refers to Zonal Agricultural Offices (Administrative Divisions in Ethiopia)
Wired	Refers to District-level Administrative Divisions in Ethiopia

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Author Contributions

Teka Tefera Bekele is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The author declares no conflicts of interest.

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