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Participatory Evaluation and Field Demonstration of Forage Varieties in Ondere Kebele, Dhagahmadow District, Somali Region, Ethiopia

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Authors' contributions

This work was carried out in collaboration among all authors. Author AMA was responsible for the data collection, initial data cleaning, statistical analysis, and drafting of the research report. Author MDA contributed to grammatical editing, journal formatting, and proofreading, and also assisted with data entry and further data cleaning. Author AAI played a key role in proofreading the manuscript, cleaning the dataset, and coding the data. This research was a collaborative effort involving all authors, each of whom made substantial contributions to the study. All authors critically reviewed the manuscript and approved the final version for publication.

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ABSTRACT

Background: Livestock productivity in agro-pastoral systems is often constrained by feed shortages, which limits animal growth, reproduction, and overall production. Developing and integrating improved forage crops is a key strategy to address this challenge and enhance sustainable livestock feed availability.
Objectives: This study aimed to evaluate and demonstrate the performance of improved forage crops under rainfed conditions in agro-pastoralist areas, with a focus on their growth characteristics, biomass yield, and agro-pastoralists perceptions to facilitate adoption.
Methods: The study was conducted in the *Degahmadow* district, Jarar zone, Somali Regional State, Ethiopia, using a participatory approach involving 25 community members, including women, under the PAPREG/PRG initiative. Agronomic practices, including land preparation, sowing, and forage management, were implemented following standard recommendations. Participatory variety evaluation and field demonstrations were conducted to assess species performance based on agropastoralist selection criteria.
Results: The analysis of variance showed significant species differences in key growth parameters such as crop emergence, days to flowering, plant height, herbage yield, and days to first harvest. Sudan grass and Panicum maximum had similar emergence rates (3.44 and 3.37 days, respectively), while Chloris gayana (Rhodes grass) was significantly delayed by 4 days. Rhodes grass also had the longest time to flowering (53.9 days), whereas Panicum maximum (35.8 days) and Sudan grass (38.3 days) matured earlier. Fresh biomass yields ranged from 13 to 23 tons per hectare per harvest, with no significant yield difference between Sudan grass (7.56 tons per hectare) and Panicum maximum (7.43 tons per hectare). However, Rhodes grass recorded significantly lower dry matter yield. Sudan grass had the greatest plant height, though not significantly different from Panicum maximum, and both were significantly taller than Rhodes grass. The optimal harvesting date was significantly earlier for Panicum maximum (57 days) compared to Sudan grass (78 days) and Rhodes grass (74 days).
Conclusion: Agro-pastoralists ranked Sudan grass highest due to its superior biomass yield, early maturity, ease of establishment, multiple harvest potential, and adaptability to environmental stresses, followed by Panicum maximum. The close alignment between agro-pastoralists preferences and scientific findings highlights the potential for integrating improved forage varieties into local livestock systems. This study underscores the importance of participatory approaches in forage development, promoting adoption and enhancing feed security in agro-pastoral communities.

Keywords: Feed shortage; improved forage; participatory evaluation; Sudan grass; Panicum maximum; rhodes grass.

1. INTRODUCTION

The Somali Region stands as one of Ethiopia's largest regions, with over 85% of its population relying on livestock for their livelihoods (Tesfaye et al., 2020; Ahmed, 2003). Livestock husbandry in the region is primarily categorized into migratory pastoralist and sedentary systems. However, the region faces significant challenges, including environmental degradation, water scarcity, increasing human and livestock populations, and the expansion of crop cultivation, all contributing to the reduction of productive rangelands (Gatdet, 2023).

Recent data underscores the severity of these challenges. As of 2020/21, only approximately 33.2% of the Somali Region's population had access to potable water, marking it as the region with the lowest access in Ethiopia. This represents an improvement from 28% in the preceding year but still indicates a critical need for water development initiatives. Furthermore, the region has been severely impacted by climate variability, experiencing the worst drought in 40 years as of 2022, affecting over 3 million people and leading to the loss of more than one million livestock.

Forage availability is markedly seasonal. During the wet season, fodder is relatively abundant, but the dry season brings significant shortages. The limited forage during these periods is often characterized by low protein and high fiber content, leading to declines in livestock weight and milk production (Mtengeti, 2008). These factors, coupled with health challenges for both animals and humans, exert immense pressure

on traditional pastoral and land management practices. Consequently, the productivity and economic contributions of the region's substantial livestock population are not commensurate with their numbers (Tolera et al., 2007).

In response to these challenges, the Somali Region Pastoral and Agro-pastoral Research Institute has introduced and tested the adaptability of various promising forage species. The institute has identified improved forage grasses and legumes suitable for both rainfed and irrigated agroecologies of the region. However, despite the availability of these improved forage varieties, their adoption by pastoral and agro-pastoral communities remains limited. Therefore, it is crucial to demonstrate and promote these promising forage species in areas where they have not yet been introduced or widely adopted, intending to enhance livestock productivity and ensure sustainable feed availability. This study specifically aimed to facilitate the adoption of improved forage varieties among the PAPRG in selected areas by assessing their effectiveness, management practices, and community acceptance.

2. METHODOLOGY

2.1 Description of Study Area

The study was conducted in the Degahmadow district of the Jarar Zone, Somali Regional State, Ethiopia. The district is located east of the Dagahbur district within the Jarar Zone and is bordered by the Erer Zone to the south and northeast, and by the Goljano district in the Fafan Zone to the west. The district's temperature ranges from a minimum of 20°C to a maximum of 28°C, with an annual rainfall of 200–600 mm. The topography varies between 200 and 1,600 meters above sea level. According to the 2007 Central Statistical Agency (CSA) census, the total population of the district was 58,487, comprising 34,199 men and 24,288 women. Of this population, 1,265 individuals (2.16%) were urban inhabitants, while 46,213 (79.01%) were pastoralists.

2.2 Establishment of PAPREG Members

The selection process was carried out by a team of researchers in collaboration with the district livestock and pastoral development office. Intervention kebeles were identified, and from these selected kebeles, a PAPREG group of 25 members, including women, was established.

2.3 Experimental Design

The project was implemented in the Dhagahmadow district, specifically in *Ondhere Kebele*, to evaluate three forage varieties through participatory on-farm variety trials. PAPREG members carried out land preparation and sowing. The spacing for each forage variety was 40 cm between rows; no spacing was required for the forage crops. The seeding rate and propagation method for each experimental crop were as follows: 8 kg/ha for Rhodes grass, 50 kg/ha for Sudan grass, and 6 kg/ha for Panicum maximum. Standard agronomic practices, including weeding, pest management, and other routine activities, were followed throughout the experimental period.

Each forage species was tested on individual PAPREG farmer plots, with each farmer assigned a single plot containing forage grass species. The varieties on each of the 25 farmers' fields were randomly assigned. The forage varieties were grown in a 10m × 10m net plot, incorporating all grass species. The trials were conducted at different sites within *Ondhere Kebele*, Dhagahmadow district, with all varieties planted on the same day.

2.4 Data Collection

The collected data included planting date, days to emergence, days to flowering, days to harvest, plant height, total fresh biomass yield, and dry matter percentage. Additionally, non-parametric data on pastoralists' preferences for the forage species were gathered during participatory evaluations and field days through focus group discussions.

2.5 Data Analysis

The data were analyzed using a one-way analysis of variance (ANOVA) following standard statistical procedures. When significant differences were detected, mean separation was performed using the least significant difference (LSD) test. Additionally, agro-pastoralists perceptions of the performance of improved forage varieties were collected and analyzed using a pairwise matrix ranking method to determine their preferences.

2.6 Expected Role of Each Actor

- ✓ Researchers provided training, forage seeds, technical information, and monitoring

throughout the fieldwork. They were also responsible for data collection, analyzing results, and writing the research report.

- ✓ Extension workers were involved in selecting pastoralists, organizing PAPREG members, monitoring field activities, and connecting other agro-pastoralists with PAPREG members and researchers.
- ✓ Pastoralists and agro-pastoralists were responsible for land allocation and implementing all field activities.

3. RESULTS AND DISCUSSION

3.1 Output of Study

The project began with the purchase of agricultural inputs and the organization of pre-field activities, such as preparing field layouts and training manuals. Participatory on-farm research requires the active involvement of key stakeholders, particularly Development Agents (DAs) and farmers. In this demonstration, both farmers and DAs participated in various activities, from planning to the final evaluation of field performance.

In addition to providing land and performing traditional practices, farmers contributed to action plan preparation, field monitoring, data collection, and sharing their experiences with other farmers during field visits. They kept records of key information, including planting dates, germination dates, weeding, and harvesting dates. Similarly, DAs were involved in planning, field monitoring, data collection, and final evaluation, extending to post-harvest handling.

The actual project activities began with training for PAPREG members before the trials were conducted. Detailed reports on the process are presented below.

3.2 Training of PAPREG

Capacity building is an essential mechanism for improving the performance of PAPREG members in the participatory research approach. Training was provided to PAPREG members over three consecutive days prior to the establishment of trial sites. A total of 25 PAPREG members, 5 non-members, 2 DAs, and 5 local authorities were trained on the participatory research approach, methods to enhance forage production and productivity, and improved agronomic practices. Additionally, discussions were held with PAPREG members, DAs, and kebele administrators to ensure the smooth implementation of the planned activities in the project.

3.3 Forage Grasses Growth Characters

As seen in Table 1, the analysis of variance revealed that species differences among the fodder grasses significantly affected key growth characteristics, including days to 50% crop emergence, days to flowering, herbage yield, plant height, and days to first harvest. From the demonstration and participatory variety trial, it was observed that there was no statistically significant difference in crop emergence between Sudan grass and *Panicum maximum*, with values of 3.44 and 3.37 days, respectively. However, the crop emergence of *Chloris gayana* (Rhodes grass) was significantly delayed by 4 days compared to the other grasses. Additionally, *Chloris gayana* recorded the highest number of days to flowering at 53.9 days, while the lowest mean days to flowering (35.8 and 38.3 days) were observed for *Panicum maximum* and Sudan grass, respectively.

These results align with previous findings indicating that early emergence and flowering are desirable agronomic traits contributing to improved stand establishment and more efficient forage utilization, particularly under rainfed conditions (Kumar et al., 2012). In forage research, more emphasis is typically placed on herbage yield rather than grain yield due to its direct impact on livestock feeding. As shown in Table 1, fresh biomass yields ranging from 13 to 23 tons/ha were recorded from a single harvest. There was no statistically significant difference in yield between Sudan grass and *Panicum maximum*, which produced 7.56 and 7.43 tons/ha, respectively. In contrast, *Chloris gayana* yielded significantly less dry matter than the other grasses.

Herbage yield remains a fundamental criterion for assessing forage grasses, as it determines the total biomass available for animal consumption. The superior yield performance of *Panicum maximum* and Sudan grass supports earlier findings that highlight their high biomass accumulation and rapid regrowth under favorable conditions (Dereje et al., 2024).

Plant height, another important factor influencing biomass production, showed that Sudan grass attained the tallest growth compared to the other species. However, the difference in height

between Sudan grass and *Panicum maximum* was statistically insignificant, though both were significantly taller than *Chloris gayana*.

Regarding maturity, data indicated that Sudan grass and *Chloris gayana* reached physiological maturity at 78 and 74 days, respectively, which was significantly later than *Panicum maximum*, which matured in just 57 days.

3.4 Agro-Pastoralists' Perception of Forage Performance

As shown in Table 2, findings from this pairwise comparison align closely with existing research on forage selection preferences among agro-pastoralists. Early maturity emerged as the most critical factor, as farmers prioritize fast-growing forages that provide a quick and consistent feed supply for livestock. This is particularly important in semi-arid and arid regions, where rainfall is limited, and prolonged growth cycles increase the risk of feed shortages. Studies indicate that early-maturing forages help mitigate seasonal feed scarcity, ensuring continuous livestock productivity (Abebe et al., 2011).

Similarly, biomass yield ranked second, highlighting the need for high-yielding forage varieties that maximize feed availability. Research in Ethiopia has shown that species such as Napier grass (*Pennisetum purpureum*) and Desho grass (*Pennisetum pedicellatum*) are widely preferred due to their high biomass production and adaptability to local climatic conditions (Aleme et al., 2024).

Palatability was the third most important factor, indicating that farmers consider livestock acceptance a key determinant in forage selection. Forages that animals readily consume lead to higher feed intake, improved digestion, and better overall animal productivity. Studies have shown that leguminous forages like alfalfa (*Medicago sativa*) and lablab (*Lablab purpureus*) are particularly favored due to their high protein content and superior palatability (Simone et al., 2023). Drought tolerance, which ranked fourth, remains an important consideration, particularly in dryland areas where prolonged dry spells can severely affect forage availability. Research has highlighted that deep-rooted forage species such as Brachiaria and Buffel grass (*Cenchrus ciliaris*) are highly valued for their ability to withstand moisture stress and maintain production under challenging conditions (Abu-Alrub et al., 2014).

Cutting frequency ranked fifth, suggesting that while the ability to harvest multiple times per season is beneficial, it is not as critical as yield, maturity, or palatability. Studies on forage management have shown that Napier grass and Rhodes grass (*Chloris gayana*) are preferred in many pastoral systems because they allow for multiple cuttings, ensuring a more sustainable and consistent feed supply (Osman et al., 2014). On the other hand, leaf smoothness, plant height, and tillering ability ranked lower, indicating that structural traits are not major selection criteria among agro-pastoralists. While these characteristics may play a role in plant resilience and growth habits, they appear to be secondary compared to the core traits that directly influence forage availability and quality (Indu et al., 2024).

The results suggest that agro-pastoralists prioritize forage varieties that are high-yielding, fast-maturing, and palatable, with moderate consideration for drought tolerance and sustainable harvesting. These insights are crucial for breeding programs, policymakers, and extension services, as they provide a clear understanding of which traits should be emphasized when developing improved forage varieties. Future breeding efforts should focus on selecting and promoting forages that maximize productivity while ensuring resilience to climate variability.

Table 1. Growth traits and yield variations among fodder grass species

Treatments	DTCE	DTF	DTFH	PH (cm)	TGMWPH	TADMWPH	DM (%)
Sudan grass	3.90^{a}	38.3^{a}	78.4^{a}	33.4^{a}	23.4^{a}	7.56^{a}	33.3
Panicum	3.20^{b}	35.8^{b}	57.1^{b}	20.4^{b}	23.8^{a}	7.43^{a}	34.7
Rhodes grass	4.00^{b}	53.9^{c}	74.7^{c}	19.1^{c}	13.3^{b}	4.34^{b}	34.5
LSD (0.05)	0.36	6.27	8.03	23	3.17	1.10	3.88

Values with the same letters are not statistically significant differences DTCE=days to crop emergence, DTF=days to flowering, DTFH=days to first harvest, PH=plant height, TGMWPH=total green matter weight per hectare, TDMWPH= total dry matter weight per hectare and DM=dry matter percentage

Table 2. Pairwise Comparison of Three Forage Varieties Based on Agro-Pastoralist Preferences

	Biomass yield	palatability	Cutting frequency	Ease of establishment	Early maturity	Leaf smoothness	Plant height	Drought tolerance	Tillering ability	Score	Rank
Biomass yield	X	BY	CF	EE	EM	BY	BY	BY	BY	8	2
Palatability		X	P	P	EM	P	P	PH	P	7	3
Cutting frequency			X	EE	EM	CF	CF	EE	CF	5	5
Ease of establishment				X	EM	BY	EE	DT	EE	4	6
Early maturity					X	EM	EM	EM	EM	9	1
Leaf smoothness						X	DT	DT	DT	3	7
Plant height							X	LS	P	2	8
Drought tolerance								X	DT	6	4
Tillering ability									X	1	9

4. CONCLUSION

The participatory evaluation and demonstration of improved forage species in the *Dhagahmadow* district have provided valuable insights and positive outcomes for the pastoral and agro-pastoral communities. The project successfully introduced and evaluated various forage species under rain-fed conditions, intending to enhance livestock productivity by improving feed availability. Sudan grass emerged as the most preferred forage species due to its higher fresh and dry matter yield, as well as its better adaptability to stress conditions. Panicum maximum, though maturing earlier, was noted for its high biomass yield. Based on these findings, Sudan grass and Panicum maximum are recommended for further extension and promotion in Dhagahmadow district and similar areas.

The participatory approach, involving active engagement from PAPREG members, proved to be effective in ensuring knowledge transfer within the community. The project also demonstrated the alignment between agro-pastoralists preferences and scientific criteria for forage evaluation, emphasizing the value of integrating local insights into agricultural research. Given the success and achievements of this project, extending the program to other vulnerable households in different Kebeles of Dhagahmadow district and across other districts in the zone is essential to mitigate the impact of drought and improve resilience to future climate challenges.

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DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

REFERENCES

Abebe, A., Eik, L. O., Holand, Ø., Ådnøy, T., & Tolera, A. (2011). Pastoralists' perceptions of feed scarcity and livestock poisoning in southern rangelands, Ethiopia. Tropical Animal Health and Production, 44(1), 149–157. https://doi.org/10.1007/s11250-011-9902-5

Abu-Alrub, I., Ahmed Aran, O. H., & Awaga, A. (2014). Yield and quality of Cenchrus ciliaris (L.) affected by nitrogen and phosphorus fertilization. *J. Food Agric. Environ*, *12*, 139-142.

Ahmed Bashir, 2003. Soil condition and vegetation cover in human-impacted rangelands of Jigjiga, Somali Regional State. An MSc. Thesis Presented to the School of Graduate Studies of Alemaya University Ethiopia. 108p.

Ahmed Sh. (2003). Participatory on-farm forage legumes and fodder grasses adaptation and species evaluation trial in Gode district. SoRPARI proceeding research report.Unpublished document.

Aleme, M., Tulu, D., & Dejene, M. (2024). Biomass production, growth performance and character relationship of six varieties of Napier (Pennisetum purpureum L schumach.) grass at Teppi south west Ethiopia. Heliyon, 10(23), e40528. https://doi.org/10.1016/j.heliyon.2024.e40528

CSA, 2007. The 2007 population and housing census of Ethiopia, Central Statistical Authority, Addis Ababa, Ethiopia.

Dereje, F., Mengistu, A., Geleti, D., Diba, D., & Feyissa, F. (2024). Herbage Yield and Nutritive Value of Selected Grasses in Subhumid Agroecological Environments in Ethiopia. International Journal of Agronomy, 2024, 1–8. https://doi.org/10.1155/2024/6170361

Gatdet, C. (2023). The pastoralism system in South-Western Ethiopia: The practices, constraints, and determinants in Itang Special district, Gambella Region. Cogent Food & Agriculture, 9(2).

https://doi.org/10.1080/23311932.2023.2273627

Indu, I., Rana, M., Mahesha, H. S., Dikshit, N., Singhal, R. K., Bhargavi, H. A., ... & Ahmed, S. (2024). Evaluation of indigenous and exotic fodder sorghum accessions for fodder-related traits and host resistance to zonate leaf spot disease. Plant Genetic Resources, 22(3), 165-172.

Kumar, S., Dev, I., Agrawal, R. K., Dixit, A. K., & Ram, S. N. (2012). Agronomic research on forages in India: An overview. *Indian Journal of Agronomy*, *57*(3s), 92-104.

Mtengeti, E. J., Phiri, E. C. J. H., Urio, N. A., Mhando, D. G., Mvena, Z., Ryoba, R., Mdegela, R., Singh, B. R., Mo, M., Wetlesen, A., L⊘rken, T., &Reksen, O. (2008). Forage availability and its quality in the dry season on smallholder dairy farms in Tanzania. Acta Agriculturae Scandinavica, Section A - Animal Science, 58(4), 196–204. https://doi.org/10.1080/09064700802492362

Osman, A. A. M., Aziz, A. A. H. A., & Babiker, F. S. H. (2014). A Comparative Study between Rhodes Grass (Chloris gayana Kunth) with Local Grass Forages. Universal Journal of Agricultural Research, 2(2), 50–55. https://doi.org/10.13189/ujar.2014.020203

Simone, S. K., Urge, M., & Yeheyis, L. (2023). Effect of Alfalfa (Medicago Sativa L.) Hay Supplementation and Urea Molasses Block on Feed Intake, Digestibility, and Body Weight Change of Yearling Local Sheep Fed Grass Hay as Basal Diet. Turkish Journal of Agriculture - Food Science and Technology, 11(6), 1067–1073. https://doi.org/10.24925/turjaf.v11i6.1067-1073.5989

Tesfaye, Y., Alemu, S., Asefa, K., Teshome, G., & Chimdesa, O. (2020). Effect of blended NPS fertilizer levels and row spacing on yield components and yield of food barley (Hordeum vulgare L.) at High Land of Guji Zone, Southern Ethiopia. Acad. Res. J. Agri. Sci. Res, 8(6), 609-618.

Tolera A and Abebe A 2007: Livestock production in pastoral and agro-pastoral production systems of southern Ethiopia. *Livestock Research for Rural Development. Volume 19, Article #177.* Retrieved April 4, 2025, from http://www.lrrd.org/lrrd19/12/tole19177.htm

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