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Demonstration and Participatory Evaluation of Different Improved Forage Grass Species in Danan District of Shabele Zone, Somali, Ethiopia

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ABSTRACT

The study was conducted at Danan district with the objective of introducing and participatory farm evaluation of improved forage for three improved forage varieties; Sudan grass, Rhodes grass and Panicum maximum were evaluated in randomized complete block design (RCBD) with three replications. Data on growth yield and yield related parameters were collected and analyzed using SAS software. The result indicated that the number of tillers per plant, height biomass yield (qt/ha) were significantly different ($P<0.05$) among this forage species. The highest plant height was recorded from Sudan grass (200.00cm) followed by Rhodes grass (84.67cm) and the shortest plant height was recorded from Panicum maximum (70cm) grass. Moreover, Sudan grass and Rhodes grass produced significantly ($P<0.05$) higher branches per plant than Panicum maximum grass. Furthermore, the Sudan grass had significantly ($p<0.01$) higher biomass yield than Rhodes and Panicum grass. On the other hand, Rhodes grass had higher ($P<0.05$) biomass yield than Panicum maximum grass variety. According to the amount of forage product they produce in the areas, biomass, easy management, and palatability, Sudan grass was ranked as first, followed by Rhodes grass, by all the farmers. In conclusion all forage grass was adapted in the areas therefore it is recommendable to scale up this technology in Danan districts and other areas with same agro ecology and based farmer's preferences Sudan grass is highly recommended for scaling up due to its productivity, adaptability and easy management. Further demonstration trials across different agro-ecological zones are highly appreciated.

INTRODUCTION

Although the country has a huge livestock population production and productivity of livestock is low due to multidimensional constraints of which shortage of feed supply and poor nutritional quality are the leading constraints (Tolera *et al.*, 2012). Out of the total supply of livestock feeds in Ethiopia, 56.23% is derived from grazing, 30.06% from crop residues, and 1.21% from agro-industrial by-products (CSA, 2015). Most of ruminant livestock in Ethiopia rely on local grasses for their roughage and much of their nutrition. Many of the available local forage species have low palatability, poor productivity and inadequate nutrient supply to maintain animals, especially during the dry season. Improved forages, have better productivity, palatability and nutrient characteristics that make them desirable for inclusion in improved forage production improvement program (Birhan, 2013). Improved forages would reduce the pressure on natural pastures, improve soil fertility and erosion control on marginal lands, improve carbon sequestration to mitigate climate change, support system sustainability, and enhance natural assets and system resilience.

Livestock feeding is one of the most expensive inputs in livestock production, and the demonstration and development of improved forage crops and the establishment of forage seed production could provide many economic opportunities for agro-pastoralist which would improve their livelihoods, and increase their profitability. Establishing reliable forage production depends on the availability of reliable supplies of quality forage seeds (Legesse *et al.*, 2008) and locally producing forage seed ensures sustainability and it is economical. Many different organizations are requesting seeds of different forage species. But, even at a national scale, despite the presence of high demand, there is a critical shortage of forage seeds.

Somali region is one of the administrative regions of Ethiopia, which is occupied by large population of pastoralists and agro-pastoralists. The region has huge livestock potential and a wide range of geographical coverage for livestock rearing (IPS, 2002). According to the land use system in the region, livestock grazing and browsing constitutes about 44% (13,950,000 ha) of land mass (IPS, 2002). Similar to the other pastoral areas of the country, livestock keeping has been the main practice of the Somali pastoral and agro-pastoral community who occupy almost all the rangelands of Somali region. Pastoralist is pre-dominant land use management system in the semi-arid and arid lands covering extensive areas of the rangelands in the southern and southeastern part of the region. Due to different factors like seasonality, poor animal and human health, they place enormous stress on traditional pastoral and land management practices. As a result, the productivity and economic contribution of the huge livestock population do not definitely much their number. Among the technical factors limiting livestock production, feed scarcity in both quality and quantity and lack of knowledge to properly produce, manage and utilize locally available feeds and improved ones; lack

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of sound conservation management practices are the principal ones. This implies the need for developing and introducing innovative researches on feeds and nutrition options; utilization and conservation practices in a participatory manner in the resettlement areas aiming at improving productivity of livestock in the region.

Therefore, there is a need for participatory approaches which leads more relevant, effective and widely adopted technology by incorporating indigenous knowledge, ensuring relevance and practicality, empowering end-users etc. Feed shortages and poor-quality available feed are significant constraints to livestock productivity in the Somali region. Introducing new, improved forage varieties is critical to addressing these issues, providing a reliable source of feed, and ensuring seed or vegetative material availability for species suited to the local environment. During the problem identification stage, the lack of improved forage crops was identified as a major limitation to forage production and productivity in the Danan district. To address this, participatory variety demonstrations of forage grasses was significant. Thus, the objective of this study was to demonstrate and assess the performance of various forage grass species, identify the top-performing varieties based on pastoralist and agro-pastoralist preferences, and promote adapted species within these communities.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted in Kore Kebele in the Danan district, the district is located the main road between Gode and korahay (Qabridahare) at 6°30'N 43°30'E, the temperature has ranging from 22°C to 34oC and an average rainfall of 275-300 mm per annual. There are two main rainy seasons, including from April to June and from October to December. Based on figures from CSA (2018) projection, Danan has an estimated total population of 87,380, of whom 49,703 are men and 37,677 are women. Danan District has significant potential for agricultural development, particularly in livestock farming, due to its extensive grazing lands and favorable climate for forage production during the rainy seasons. The introduction of improved forage grass species can enhance the productivity and sustainability of livestock. in the Danan District, farming activities are primarily focused on livestock rearing, which is a vital component of the local economy and culture. The region's semi-arid climate and pastoralist traditions have shaped the agricultural practices, emphasizing the importance of sustainable forage production farming in the area. The project duration was one complete growth cycles of the forage species. This period was allowed for comprehensive evaluation of the forage species' performance under one seasonal conditions and ensure that pastoralist can provide feedback based on their experiences over time.

Establishment PAPREG

To ensure the success and inclusiveness of the project, the establishment of the Pastoral and Agro-pastoral Research Group PAPREG was carried out through a participatory process involving local stakeholders. The PAPREG was total of 25 members out of these 17 males and 8 females PAPREG members were selected.

Land Preparation and Forage Plantation and Management

The site for the demonstration was selected based on the accessibility of road, and interest of the pastoral community, the Kore Kebele in the Danan district was selected. Three drought resistant improved forage species namely Sudan Grass, Rhodes grass and *Panicum L.* were used as a treatment. The forage species were planted 30mx30m seed bed with three replications by applying randomized complete design per species. Three drought resistant improved forage species namely Sudan Grass, Rhodes grass and Panicum maximum L. were used for the farm demonstration. The demonstration was conducted one selected PAPREG group. The land preparation was done before planting of the forage crop and seed of Sudan grass, Panicum maximum L., and Rhodes grass were sown based on the agronomic recommendation of each forage crops for instance the spacing of 40cm distance between rows for Sudan grass, Panicum maximum L. and Rhodes grass is used over the entire plots (50mm of each forage) in a randomized complete block design with three replications in the experiments.

The role of each actor

Local administrators were involved on establishment and organization of PAPREG members as well as land identification. The PAPREG members or beneficiaries were afforded the land and implementation of every work of the trial. The extension workers were the responsible to selection of pastorals and forming PAPREG, facilitated routine activity of the trials as a bridge between PAPREG members and researchers and collected data. The researchers were accountable for provide appropriate technical information through training prepare data collection format; help pastoralist analyzing situation and trial results; and process data to verify the results.

Data Collection

The data like disease and pest resistance, drought tolerance and easy of management, plant height, biomass yield, number of tillers, palatability, and early maturity were collected on excel sheet.

Data Analysis

Data on biomass yield and yield component were collected from the field and subjected to analysis of variance using statistical analysis system (SAS) and significant differences among mean values were compared using list significant test (LSD) at $P \leq 0.05$. Descriptive statics were used for agro pastoralist's perception data.

RESULTS AND DISCUSSION

Training of PAPREG Members and Input Delivery

A total of thirty-one 25 PAPREG members and six non-

PAPREG members participated in training on the use of improved seed, recommended agronomic practices, pest management, seed harvesting, post-harvest handling. The inputs delivered to pastoralist and agro pastoralist which were also a part of the demonstrations were three improved forage seeds and farm tools given.

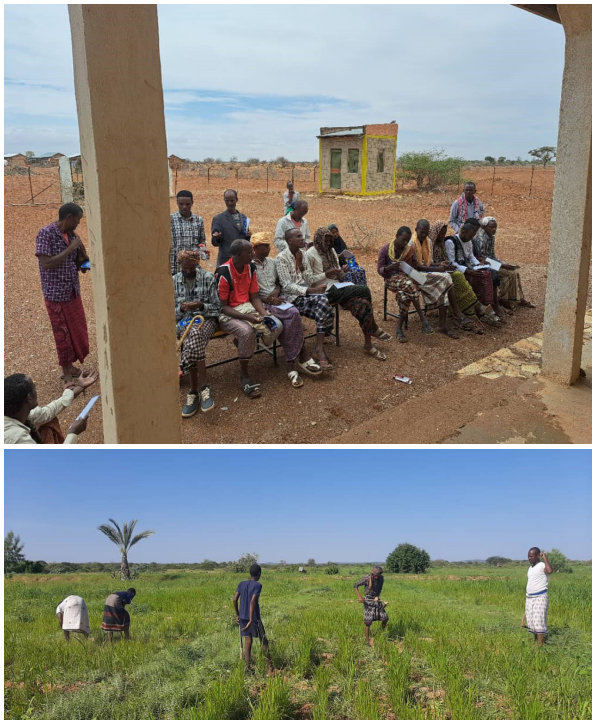

Figure 1: Training of PAPREG members and performance of forage at the field

Agronomic Production Performance

Biomass production, plant height, and the number of tillers per plant for Sudan grass, Rhodes grass, and Panicum maximum are presented in Table 1. The results indicated that the number of tillers per plant, plant height, and dry matter yield (qt/ha) were significantly different ($P<0.05$) among the forage grasses. The highest plant height was recorded for Sudan grass (200.00 cm), followed by Rhodes grass (84.67 cm), while the shortest was observed in Panicum maximum (69 cm).

Similarly, the highest biomass yield (20.8 ± 1.65 qt/ha) was obtained from Sudan grass, followed by Rhodes grass (15 ± 1.3 qt/ha), whereas the lowest yield was recorded from Panicum maximum. Moreover, Sudan grass had a significantly higher biomass yield ($P<0.01$) than both Rhodes and Panicum maximum. Rhodes grass also showed significantly higher biomass yield ($P<0.05$) than Panicum maximum.

In terms of tiller number, Sudan grass recorded the highest number of tillers per plant, followed by Rhodes grass, with a statistically significant difference among species. The lowest number of tillers per plant was observed in Panicum maximum.

Table 1: Plant height, tillers and biomass yield

Tested forage spp.	Plant height (cm)Mean±SEM	Tillers per plant Mean±SEM	BMY(Qt/ha) Mean±SEM
Sudan grass	200.0±19a	5.7±0.33a	20.8±1.65a
Rhodes grass	84.67±10b	5.29±0.88a	15.9±1.3b
Panicum maximum	69±3.3b	0.33±0.3b	8±0.58c
P-value	0.0025	0.0362	0.003

SEM = Standard error of mean; DMY (qt/ha); Dry matter yield quintal per hectare

Perception of Pastoralist's Towards the Forage Technology

As indicated in Table 2, the pastoralists purposely set their criteria's and compare rank them in order of importance. Accordingly, the selection criteria were compared and biomass yield ranked first against all criteria followed by easy management and palatability as second and third respectively. This is inconsistent with Mganga *et al.* (2015) drought tolerance and early maturity were ranked as four and fifth respectively followed by diseases and pest resistance. This finding is comparable with the finding of Belete *et al.* (2018)

Table 2: Pair-wise ranking of pastoralists' selection criteria for different forage grasses

Selection criteria's	BY	P	EM	DT	DPR	EM	Points
Biomass yield		BY	BY	BY	BY	BY	6*
Palatability			EM	P	P	EM	4**
Early maturity				DT	EM	EM	2
Drought tolerance					DT	EM	3*
Disease and pest resistance						DR	1
Easy of management							5**

BY=biomass selection, P=palatability, EM=early maturity, DPR= disease and pest resistance, DT=drought tolerant, EM=easy of management

Pastoralists selected the best forage species over others based on their own criteria. Some of the criteria they used included biomass production, ease of management, and tolerance to diseases and pests. Based on these criteria, Sudan grass was ranked first, followed by Rhodes grass across all parameters. As indicated in Table 3, the pairwise ranking selection of the experimental grasses by the pastoralists is presented.

Table 3: Pair-wise ranking of farmers' selection for different forage grasses

Grass species	SG	RG	PG	Points	Rank
Sudan grass		SG	SG	2	1
Rhodes grass			RS	1	2
Panicum maximum				0	3

Note: SG=Sudan grass, RG=Rhodes grass, PG=Panicum grass

CONCLUSION

The results of this project indicate that all the grass species demonstrated were well adapted and productive in terms of biomass and dry matter yield. This is promising for addressing the shortage of high-quality and adequate livestock feed for pastoral and agro-pastoral communities. Among the evaluated species, Sudan grass exhibited superior performance in yield components within the study area. Moreover, pastoralists ranked Sudan grass as their top choice compared to other grass varieties, citing its high biomass yield, ease of management, early maturity, and drought tolerance. Consequently, it can be concluded that Sudan grass has the potential to serve as a primary feed source and supplementary feed in areas suffering from poor-quality roughage and low-protein, poorly digestible crop residues, which are currently the main livestock feed sources in the region. The demonstration and participatory evaluation of improved forage grasses in Denan District underscored both the benefits and challenges of introducing sustainable feed options in semi-arid regions. Building on the insights and experiences gained from this study, future initiatives can focus on scaling up successful practices, addressing emerging challenges, and ensuring the long-term sustainability of livestock production in the study area and the Somali Regional State of Ethiopia more broadly.

Lessons Learned

• Active Participation Enhances Adoption: The active involvement of pastoralists in the evaluation process significantly contributed to the acceptance and adoption of the forage grasses.

• Location-Specific Adaptability Matters: The different forage species demonstrated varying levels of adaptability to the local conditions, highlighting the importance of location-specific recommendations when promoting forage options.

• Continuous Training is Key: Providing consistent and ongoing training to pastoralists proved essential for the effective management and utilization of improved forage grasses.

Future Focus

• Scale-Up Efforts: Expand successful forage grass varieties to other districts within the region to increase impact.

• Climate-Resilient Forages: Develop and promote forage varieties with enhanced resilience to climate variability and extreme weather conditions.

• Value Addition: Explore opportunities for value addition through the processing and marketing of forage products.

• Market Access: Ensure that pastoralists have reliable access to markets for both livestock and forage products.

Opportunities

• Increased Livestock Productivity: Improved forage availability can lead to higher livestock productivity and increased household income for pastoral communities.

• Capacity Building: Training programs have enhanced the knowledge and skills of pastoralists in forage cultivation and management.

• Sustainable Practices: The project promotes sustainable agricultural practices that support environmental conservation and better resource management.

Emerging Challenges

• Climate Stress: Variability in rainfall and rising temperatures continue to pose significant challenges to forage cultivation.

• Resource Limitations: Limited access to water, quality seeds, and other critical inputs can hinder the successful establishment and maintenance of forage grasses.

• Pests, Diseases, and Market Barriers: The occurrence of pests and diseases, coupled with inadequate market opportunities, threatens the sustainability and profitability of forage production.

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