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Research Article

Pre-scaling up of Desho grass technologies at highlands of Guji Zone, Oromia, Ethiopia

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Abstract

Forage production is fundamental for livestock production. This activity was conducted to increase the production of improved Desho grasses, to increase wider demand for desho grass technologies, and to strengthen stakeholders' linkage on desho grass production. In the 2022/23 and 2023/24 seasons, 64 farmers were selected from eight kebeles in Bore, Arda Jila Mea Boko, and Ana Sora districts, based on their livestock and desho grass production. Kindo Kosha DZF No# 591 and Areka DZF No# 590 improved desho grasses were pre-scaled with the recommended 50cm between rows and 10cm tillers, and 100 kg/ha NPS fertilizer was applied during planting, followed by 50 kg/ha UREA after establishment of the tillers. Desho grasses were promoted in areas ranging from 100 m^2 to 400 m^2. Training and a mini-field day were used to promote Desho grasses. Plot cover, plant height, regeneration, fresh biomass, and survival rate were collected through interviews and analyzed using descriptive statistics. The findings revealed that the Kindo Kosha DZF No# 591 variety (3.98) covered the land more than Areka DZF No# 590 (3.51). The higher plant height was recorded from Kindo Kosha DZF No# 591 (95.83 cm), followed by Areka DZF No# 590 (82.95 cm). Regenerations following harvest can provide more feed from fixed land. Farmers reported that Kindo Kosha DZF No# 591 and Areka DZF No# 590 varieties have 90.91% and 84.61% regeneration capacity, respectively. The Kindo Kosha DZF No# 591 variety has a higher survival rate (91.13%) than the Areka DZF No# 590 variety (87.22%). The grasses performed well in terms of fresh biomass yield, plot coverage, plant height, regeneration capability, and survival rate on farmers' fields and their production can help to alleviate feed shortages in the highlands of the Guji zone. As a result, Kindo Kosha DZF No# 591 and Areka DZF No# 590 desho grasses should be disseminated to highland areas of the Guji zone.

Introduction

The raising of livestock is a major economic activity in the tropics, producing both food and non-food products [1]. Ethiopia has the largest livestock population in Africa, with an estimated 38 million sheep, 46 million goats, 2.14 million horses, 10 million donkeys, 7 million camels, and 66 million cattle [2]. Livestock supports around 70% of Ethiopians' livelihoods and accounts for up to 40% of agricultural GDP, over 20% of total GDP, and 20% of national foreign exchange [3]. Despite Ethiopia's large livestock population, its contribution to the national economy is below potential due to a variety of factors such as a lack of sufficient and high-quality animal feed, poor genetic potential of animals for productive traits, poor health care, and poor management practices [3,4]. Smallholder dairy farmers in underdeveloped countries have several challenges, including a scarcity of feed during the dry season [5].

Population growth, growing earnings, and changes in lifestyle and dietary trends are all driving increased worldwide demand and supply for animal-sourced food [6]. The ever-increasing human population has surpassed land-carrying capacity, resulting in environmental degradation and jeopardizing the long-term viability of crop-livestock production systems. Farmers are making more land accessible for the development of food crops to fulfill the rising food demands of the expanding human population, and as a result, grazing lands have decreased [7]. This transition from rangeland to crop cultivation has far-reaching consequences for the temporal and geographical availability and quality of forage supplies [8].

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In Ethiopia, crop residues and natural pasture account for more than 90% of all livestock feed. Both feed types are either unavailable in sufficient quantities due to changing weather conditions, or they are available but of poor quality, and do not provide adequate nutrition for sustainable animal production. Using improved forages would lessen the stress on natural pastures, increase soil fertility, and prevent erosion [9]. Utilization of enhanced forage might help to bridge that gap while also delivering economic advantages by lowering feed costs and environmental benefits by lowering greenhouse gas emissions [10,11]. Methane is a powerful greenhouse gas, and it has substantial implications for climate change mitigation [10], and improved forages are vital for carbon sequestration [12].

Livestock productivity has substantial yield gaps due to constraints in quality and quantity of timely and affordable feed supply. To address low livestock productivity in Ethiopia, including overcoming feed deficiency during dry periods and emergency situations, the inclusion of improved forages in the feed supply is inevitable [10,11]. Several studies have highlighted the major importance that better forages may play in sustainably increasing productivity in both meat and milk production, resulting in higher profits for farmers [13,12].

Desho grass is one of the improved forage grasses suggested in Ethiopia, and it contributes significantly to pasture and animal productivity [9,14,15]. Therefore, promoting desho grass is required from the country's agricultural extension system. To overcome feed shortage extension services should focus on the promotion of improved forage varieties [16]. There are several types of technology promotion, including pre-scaling up and cluster forms [17]. However, the number of forages expanded in many locations, and cluster production like crop production, is restricted under Ethiopia's farming system.

Guji zone is well-known for cattle rearing and moving from one location to another in search of grass for their livestock. Nowadays, there is no free land for grazing because the majority of the land is used for crop production, which is expected to feed the growing population. As a result, every season there is a forage production shortage for livestock. As a result, most livestock died or were inactive during peak times, producing poor meat and milk for rural farmers.

Forages such as Desho grass, which can be harvested for animals year-round, are critical for dairy production in the highlands of Guji Zone. Therefore, in order to feed a larger number of cattle, Desho grass must be promoted by pre-scaling up. The objectives of this study were to increase the production of improved Desho grasses, to increase wider demand for desho grass technologies, and to strengthen stakeholders' linkage on desho grass production in the highlands of the Guji zone.

Materials and methods

Description of study districts

Ana Sora district is situated at a distance of 410 km from Addis Ababa and 180 km from Negelle. Astronomically, the district is located between 6°20'30"-5°57'30" northing latitudes and 38° 39'30"-38° 57'30" easting longitudes. It is the most humid and sub-humid moisture condition, which has a relatively longer growing season. It comprises an annual rainfall of 1,750 mm and a mean temperature of 17.5 °C - 28 °C [18]. The district is well known for cattle and selling of milk was one of the income-generating activities in rural areas. Ana Sora district is also known for beekeeping as different honey is harvested from diverse vegetation and trees found in the district. After finishing the ploughing in the calendar year farmers of Ana Sora district focus on fattening their cattle as income generating activities [16]. Recently Arda Jila Mea Boko district is separated from Ana Sora district. The district is well known for maize, barley, wheat, tef, and horticultural crops. The other farming conducted in the district is livestock production such as cattle rearing and honey production. Bore is 385 km away from Addis Ababa to the South. The district is bordered by the Hula district of SNNPR in the North, the Ana Sora district in the South, the Bona district of SNNPR in the East, and the Dama district in the West. The major agroecology of the district was highland (90%) and midland (10%). The annual average temperature of the district is 16.05 °C. The mean annual rainfall is 1300mm while its altitude ranges from 1400 up to 2910 meters above sea level allowing a favorable opportunity for crop and livestock production. Root crops such as potatoes, carrots, and onions, and vegetable crops like cabbage could be grown in the area. In the Bore district, cattle, horses, sheep, and beekeeping are the dominant livestock. Selling milk is one of the income-generating activities for rural women. Bore is also well known for its 'white honey' which is produced from different plants found in the district [19].

Sites and farmers' selection

Bore, Arda Jila Mea Boko, and Ana Sora areas were selected given their potential for desho grass production and animal population. The districts were similar in their agroecology for desho grass production. Eight kebele, Songo Baricha, Ano Kerensa, Gutu Reji, and Enshido Aleyehu from Bore district, Raya Boda from Ana Sora district, Sololo Kobo, Mea Melka Galma, and Kilenso Babicho from Arda Jila Mea Boko district, were selected for pre-scaling up desho grass. 64 farmers were selected based on their willingness to offer land for the desho grass and animal population. Farmers were selected with the help of district agriculture offices and kebele-based development agents.

Research materials

Improved Areka DZF No# 590 and Kindo Kosha DZF No# 591 Desho grasses were used for scaling-up purposes. Both grasses were planted in the Bore and Arda Jila Mea Boko districts except Areka DZF No# 590 was planted in Ana Sora district. The grasses were suggested for scaling up at adaptation and demonstration stages due to their best performance in biomass yield. The grass was planted by splitting the roots. Based on the land ownership of farmers, the grass was planted on 100 m^2 – 400 m^2 areas during the 2023 and 2024 production years. The recommended 50cm between rows and 10cm tubers, 100 kg/ha NPS fertilizer was applied at planting and 50 kg/ha of Urea was applied after the establishment of the tillers.

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Extension methods used

Capacity development methods like as training were utilized to prepare farmers for Desho grass production. The content of training includes production, utilization, and promotion of desho grass for livestock feed. At each district, training was conducted for two days to improve the knowledge and skills of farmers, development agents, and subject matter specialists on desho grass production. Field day is one of the extension methods used to popularize proven agricultural technologies. Different groups of agricultural stakeholders visited the performance of grasses on farmers' land to approve for compatibility with the existing farming conditions. In this study, a mini-field day was organized at the harvesting stage and used to promote Desho grasses in the surrounding area. This could contribute to the further adoption of desho grass in study areas.

Methods of data collection and analysis

Plot cover (1-5 scale; 1 very poor, 2 poor, 3 medium, 4 good, 5 very good), plant height (cm), regeneration (%), fresh biomass (t/ha), and survival rate (%) were collected through interview method. Plant height was taken randomly from five tillers. Fresh biomass was taken by quadrant of $1m^2$. Farmers rated the plot cover of the grass from 1-5 ranges. Farmers also asked about the regeneration and survival rate of planted desho grass in percent. Regeneration in this activity is defined as the ability of desho grass to rejuvenate after harvest and it was estimated by percentage. The survival rate is the ability of desho grass existence to frost and drought as well as the survival of desho grass after harvest. Descriptive statistics was used to analyze the data.

Results and discussion

Distribution of desho grass varieties

Desho grass tillers were provided to 64 farmers. Six farmers in the Ana Sora district received Areka DZF No. 590 desho grass variety. More tillers were provided to the Bore and Arda Jila Mea Boko districts. Areka DZF No# 590 variety was delivered to 41 farmers, whereas 23 farmers received Kindo Kosha DZF No# 591 variety (Table 1).

Desho grass promotion

The role of agricultural extension is to promote effective agricultural technology by the most effective extension approaches [20]. In this preliminary scaling up, training and a mini-field day were employed to enhance desho grass production in the Guji zone's highlands. Selected farmers and side farmers received training in desho grass production and usage. To enhance the demand for desho grass, many adult male farmers (254), adult female farmers (58), youth boys (19), and youth girls (11) were trained in the production and use of improved Areka No# 590 and Kindo Kosha DZF No# 591 varieties. In addition, 37 subject matter specialists and 41 development agents received training on how to pre-scale up desho grass in the study area (Table 2).

Table 1: Distribution of desho grass in the highlands of the Guji zone.

Desho grass varieties distributed	Number of farmers obtained desho grass			Total
	Ana Sora district	Arda Jila Mea Boko district	Bore district	
Areka DZF No# 590	6	12	23	41
Kindo Kosha DZF No# 591	0	10	13	23
Total	6	22	36	64

A mini-field day on Areka No# 590 and Kindo Kosha DZF No# 591 desho grass varieties was held on a farmer's field. Many people attended the field visit (Table 3). The participants in the mini-filed day acknowledged the performance of desho grass as a solution to feed shortages in their locations. Stakeholder collaboration is essential for the promotion of agricultural technologies. As a result, linkages between farmers, development agents, agricultural offices, subject matter specialists, and researchers were strengthened through training and a brief field day on desho grass pre-scaling up. Some farmers who planted desho grass in their first year sell it for income, while others give it out for free to neighboring farms. Such knowledge transmission boosted farmer-to-farmer linkages and expanded wider production of desho grasses in the Guji highlands.

Performance of desho grass

Both improved desho grass varieties were effective at covering the area. According to farmer responses out of five points, Kindo Kosha DZF No# 591 (3.98) covered more land than Areka DZF No# 590 (3.51) (Table 4). In contrast to Gadisa, et al. [21] study, which found that Areka covered more than Kindo Kosha, this study found that Kindo Kosha DZF No# 591 tillers swiftly covered the land for surplus feed supply for cattle, and the root tillers developed more spontaneously to fill the area. This kind of grass is crucial since a few tillers can supply a wider area.

Plant height is a crucial characteristic for increasing animal feed. More height results in more chopped material, which increases the amount of feed for cattle. Desho grass should be harvested at an optimum height to maximize herbage feed. Kindo Kosha DZF No# 591 had a higher plant height (95.83 cm), followed by Areka DZF No# 590 (82.95 cm) (Table 4). The mean plant height of desho grasses measured in this study was comparable to the mean value reported by Gadisa, et al. [21] and lower than Keba [8]. The plant height values reported by Jabessa, et al. [22] from the same highlands were a little bit greater than the value reported in this study, which might be attributed to weather variations.

The most crucial aspect of forage is regeneration after harvest. Regenerations following harvest might provide extra feed from fixed land. Farmers reported that the Kindo Kosha DZF No. 591 and Areka DZF No. 590 types had regeneration capacities of 90.91% and 84.61%, respectively (Table 4). This study's regeneration capabilities in both varieties were higher than those found by Kebede, et al. [7] in the highlands of the Guji zone. Desho grass was significant for animal feed since it is an annual animal feed with a regeneration attribute. The capacity to recover after harvest influences the amount of desho grass utilized for animals.

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Table 2: Trainee on desho grass production.

NS	Years	Training days	Subject Matter Specialists			Development Agents			Farmers				
			M	F	T	M	F	T	Adult male	Adult female	Youth boys	Youth girls	Total
1	2023	4	10	2	12	14	4	18	98	42	10	10	160
2	2024	2.5	22	3	25	24	9	33	156	16	9	1	182
Total		6.5	32	5	37	38	13	41	254	58	19	11	342

M = Male; F = Female; T = Total

Table 3: Mini-field day participant on desho grass pre-scaling.

District	Farmers					District Agricultural Extension experts			Others		
	Adult male	Adult female	Youth boys	Youth girls	Total	Male	Female	Total	Male	Female	Total
Ana Sora (Raya Boda kebele)	40	6	3	2	51	8	2	10	2	-	2

Table 4: Performance of desho grass on farmers' land.

Desho grass variety promoted		Plot cover	Plant height in (cm)	Regeneration (%)	Fresh biomass (t/ha)	Survival rate in the year (%)
Areka DZF No# 590	Mean	3.51	82.95	84.61	34.46	87.22
	N	41	41	41	41	41
	Std. Dev.	0.823	17.013	9.110	8.767	12.565
Kindo Kosha DZF No# 591	Mean	3.98	95.83	90.91	32.91	91.13
	N	23	23	23	23	23
	Std. Dev.	0.682	19.164	7.025	6.822	5.521

Another essential characteristic of forage production is its biomass yield. Though the grasses were not uniformly distributed across districts the performance of the grasses was discussed in this study since the districts have similar agroecologies [23]. This study exclusively considers fresh biomass. The Areka DZF No. 590 variety produced more fresh biomass (34.46 t/ha) than the Kindo Kosha DZF No. 591 variety (32.91 t/ha) (Table 4). This finding was consistent with Jabessa, et al. [22], who found that Kindo Kosha DZF No. 591 had a lower fresh biomass production than the Areka DZF No. 590 variety. However, Atum [24] observed that the Kindo Kosha DZF No. 591 variety produced better fresh biomass yields than Areka DZF No. 590. Such differences might be attributed to a variety of variables, including soil, climate, and management practices. Kindo Kosha DZF No. 591 and Areka DZF No. 590 desho grasses are the greatest alternatives to other feed preferences in small landholding areas due to their capacity to provide high herbage yields with low inputs.

Farmers assessed the survival rates of desho grasses. Farmers reported that the Kindo Kosha DZF No# 591 variety had a higher survival rate (91.13%) than the Areka DZF No# 590 variety (87.22%) (Table 4). This showed that the Kindo Kosha DZF No. 591 variety can withstand various harvesting conditions, including frost and drought throughout the year. In certain locations, frost and drought have hampered forage production. However, Areka DZF No. 590 and Kindo Kosha DZF No. 591 desho grasses were drought-resistant and drought-tolerant due to their high survival rate. As a result, the production of Areka DZF No. 590 and Kindo Kosha DZF No. 591 desho grasses can mitigate the threat of frost and drought to livestock feed. Except for fresh biomass yield, the Kindo Kosha DZF No# 591 variety outperforms the Areka DZF No# 590 variety in terms of plot coverage, plant height, regeneration capacity, and survival rate.

The survival rate of Kindo Kosha DZF No# 591 variety across districts was greater than that of Areka DZF No# 590. The greatest survival rate was seen in Arda Jila Mea Boko district, followed by Bore (Figure 1). This indicates that the Arda Jila Mea Boko district is more suited for desho grass cultivation among the highlands of districts of the Guji zone.

Farmers' perception of improved desho grass production

Farmers stated that improved Areka DZF No. 590 and Kindo Kosha DZF No. 591 desho grasses were critical for feeding livestock. Because of their strong regeneration capability, desho grass varieties were predicted to alleviate feed shortages. In addition to animal feed, farmers indicated that Areka DZF No. 590 and Kindo Kosha DZF No. 591 desho grasses were useful in soil erosion control. Soil erosion occurs in the Guji highlands due to their up-and-down topography and the availability of significant rainfall. When desho grasses are planted on high plateaus, soil erosion is reduced because desho grasses have large tillers that can reduce erosion force. Farmers preferred the enhanced Areka DZF No. 590 and Kindo Kosha DZF No. 591 desho grasses due to this benefit. Some farmers began to make money by selling these desho grasses.

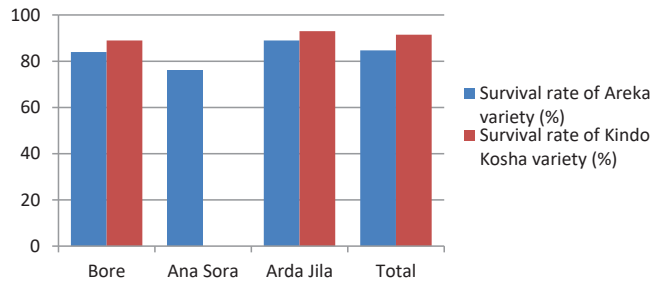

Figure 1: Survival rate of desho grass varieties across districts.

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Conclusion and recommendation

This research summarizes the performance and promotion of improved desho grass for animal feed. In addition to cattle feed, Desho grass serves as soil conservation and income-generating forage. Kindo Kosha DZF No. 591 and Areka DZF No. 590 desho grass were expanded into Ana Sora, Arda Jila Mea Boko, and Bore districts. Training and mini-field days were significant extension approaches for promoting desho grasses in the Guji zone's highlands. Improved desho grasses performed well in terms of fresh biomass yield, plot coverage, plant height, regeneration capability, and survival rate on farmers' fields, and their production can help alleviate feed shortages in the highlands of the Guji zone. To maximize the advantages of Kindo Kosha DZF No. 591 and Areka DZF No. 590, desho grasses should be dispersed in highland areas.

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