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Pre-Scaling Up: The Case of Desho Grass Technologies in Highlands of Guji Zone, Oromia Regional State, Ethiopia

Basha Kebede[1]*, Tekle Bobo[2], Girma Amare[3]
Bore Agricultural Research Center, Oromia Agricultural Research Institute, Ethiopia
Corresponding Author: Basha Kebede bashakbd48@gmail.com

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A B S T R A C T

This activity was conducted to increase the production of improved Desho grasses. About 64 farmers were selected from eight kebeles. The improved desho grass varieties, Kindo Kosha DZF No. 591 and Areka DZF No. 590, were planted using the recommended spacing of 50 cm between rows and 10 cm between tillers. During planting, 100 kg/ha of NPS fertilizer was applied, followed by 50 kg/ha of UREA once the tillers were established. Data on plot coverage, plant height, regrowth, fresh biomass, and survival rate were gathered through interviews and analyzed using descriptive statistics. The results indicated that Kindo Kosha DZF No. 591 had greater ground coverage (3.98) compared to Areka DZF No. 590 (3.51). Kindo Kosha DZF No. 591 also exhibited a taller average plant height (95.83 cm), surpassing Areka DZF No. 590 (82.95 cm). Post-harvest regrowth suggests the potential for increased forage yield from the same area of land. Farmers reported regeneration capacities of 90.91% for Kindo Kosha DZF No. 591 and 84.61% for Areka DZF No. 590. Additionally, Kindo Kosha DZF No. 591 showed a higher survival rate (91.13%) compared to Areka DZF No. 590 (87.22%). Both grass varieties demonstrated strong performance in terms of fresh biomass yield and survival under farmers' field conditions, indicating their potential to help address forage shortages in the highlands of the Guji zone. Therefore, it is recommended that Kindo Kosha DZF No. 591 and Areka DZF No. 590 be promoted in the highland areas of the Guji zone.

INTRODUCTION

A significant economic activity in the tropics is the rearing of cattle, which yields both food and non-food items (Walie *et al.,* 2023). With an estimated 38 million sheep, 46 million goats, 2.14 million horses, 10 million donkeys, 7 million camels, and 66 million cattle, Ethiopia is home to the most livestock in Africa (ESS, 2022).

About 70% of Ethiopians rely on livestock for their livelihoods, and it contributes up to 40% of agricultural GDP, more than 20% of the country's total GDP, and 20% of its foreign currency earnings (Entity, 2021). Even though Ethiopia has a sizable livestock population, its economic contribution falls short of its potential for a number of reasons, including inadequate and subpar animal feed, animals' low genetic potential for desirable traits, inadequate management techniques, and poor health care (Tarekegn *et al.,* 2022). One of the many difficulties faced by smallholder dairy producers in developing nations is the lack of feed during the dry season (Shanku *et al.,* 2022).

Global demand and supply for food derived from animals are rising due to factors such as population growth, rising incomes, and shifts in dietary and lifestyle patterns (FAO, 2023). The land-carrying capacity of the ever-growing human population has been exceeded, endangering the long-term sustainability of crop-livestock production systems and causing environmental degradation. Grazing areas have declined as a result of farmers making more land available for the growth of food crops in order to meet the growing food demands of the growing human population (Kebede *et al.,* 2023). The quality and availability of forage supplies in terms of time and location are significantly impacted by this shift from rangeland to crop cultivation (Keba, 2023).

In Ethiopia, about 90% of all animal feed is obtained from natural pasture and agricultural leftovers. Because of shifting weather patterns, either type of feed is not accessible in large amounts or when available it is low quality, not offering enough nutrients for sustainable animal production. Utilizing improved forages would improve soil fertility, reduce stress on natural pastures, and minimize soil erosion (Tsegaye *et al.,* 2024). Utilizing improved forage might help feed shortage while also providing environmental benefits by reducing greenhouse gas emissions and economic benefits (Dey *et al.,* 2022; Mijena *et al.,* 2023). Improved forages are essential for sequestering carbon, because methane is a potent greenhouse gas with significant consequences for mitigating climate change (Dey *et al.,* 2022).

LITERATURE REVIEW

Due to limitations in the amount and quality of timely and reasonably priced feed delivery, livestock productivity has significant yield gaps. Improved forages must be incorporated into the feed supply in order to solve Ethiopia's poor livestock production, including overcoming feed shortages during severe droughts and emergency situations (Dey *et al.,* 2022; Mijena *et al.,* 2023). Better forages may have a significant role in sustainably raising meat and milk production productivity, which would increase farmer profitability, according to several studies (Sandova *et al.,* 2023; Karimi *et al.,* 2022).

One of the better fodder grasses recommended in Ethiopia is desho grass, which greatly increases pasture and animal production (Tsegaye *et al.,* 2024; Kafyalew *et al.,* 2020; Zemene *et al.,* 2020). Desho grass promotion is thus necessary in technology promotion of agricultural extension. According to Kebede and Bobo (2023), extension services should concentrate on promoting improved forage variety in order to address the feed scarcity. Cluster method and pre-scaling up are two examples of the many modes of technology promotion (Kebede, 2024). However, in many places of Ethiopia, the amount of land for forage production is not comparable to the area used for crop cultivation. More land is used for crop production for human consumption than forage production for livestock feed. On the other hand, human beings need sufficient livestock products.

Raising cattle and relocating frequently to find pasture for their animals are well-known practices in the Guji zone. These days, there isn't much free space for grazing because most of it is used to produce crops that will feed the expanding population. As a result, there is a scarcity of animal feed production every season. Rural farmers were left with subpar meat and milk as a result of the majority of livestock dying or becoming idle during peak times. In highlands Guji Zone, desho grass is important for dairy production because it provides sufficient biomass for cattle all year round. Pre-scaling up is therefore necessary to promote Desho grass in order to feed more cattle. Objectives of this study were to increase the production of improved Desho grasses, to increase wider demand of desho grass technologies, and to strengthen stakeholders' linkage on desho grass production in the highlands of Guji zone.

METHODOLOGY

Locations and farmers' choices

The districts of Bore, Arda Jila Mea Boko, and Ana Sora were selected due to their favorable conditions for desho grass cultivation and their high livestock populations. The agro-ecological conditions suitable for growing desho grass were consistent across these districts. For the pre-scaling up initiative, eight kebeles were identified: Songo Baricha, Ano Kerensa, Gutu Reji, and Enshido Aleyehu in Bore district; Raya Boda in Ana Sora district; and Sololo Kobo, Mea Melka Galma, and Kilenso Babicho in Arda Jila Mea Boko district. A total of 64 farmers were selected based on their willingness to allocate land for desho grass cultivation and their livestock holdings. The selection process was supported by district agricultural offices and kebele-level development agents.

Research materials

To scale up, improved Areka DZF No# 590 and Kindo Kosha DZF No# 591 Desho grasses were utilized. Except for Areka DZF No. 590, which was planted in the Ana Sora area, both grasses were planted in the districts of Bore and Arda Jila Mea Boko. Since the grasses performed best in terms of biomass output, they were recommended for scaling up throughout the adaptation and demonstration stages. Grasses were planted by splitting their roots. In the 2023 and 2024 production years, depending on the farmers' land ownership the grass was planted on 100m^2-400m^2 of land. For this scaling up, 50kg/ha of NPS fertilizer

was applied at planting, 50kg/ha of urea was applied after the tillers were established, and the recommended 50cm between rows and 10cm roots were used at planting time.

Extension methods used

Training and other capacity-building techniques were used to get farmers ready to produce Desho grass. Desho grass cultivation, use, and promotion for animal feed are among the topics covered in the course. Two days of training were held in each district to increase the knowledge and proficiency of farmers, development agents, and subject matter experts in the production of desho grass. One extension strategy used to spread awareness of established agricultural technology is field days. The performance of grasses on farmers' land was inspected by several groups of agricultural stakeholders to ensure that grasses were suitable with the current farming conditions. In order to promote Desho grasses in the nearby area, a mini-field day was organized at harvesting stage of grasses. This mini-field day encouraged more desho grass production in study areas.

Methods of data collection and analysis

Interviews were used to gather data on plant height (cm), regeneration (%), fresh biomass (t/ha), survival rate (%), and plot cover (1–5 scale; 1 very poor, 2 poor, 3 medium, 4 good, 5 very excellent). Five tillers' length of plant height was randomly selected. A $1m^2$ quadrant was used to collect fresh biomass. Plot cover of the grass was graded by farmers on a scale of 1 to 5. Additionally, farmers inquired about the percentage of desho grass that was regenerated and survived after harvest. The ability of desho grass to regenerate after harvest is the definition of regeneration in this activity, and it was calculated as a percentage. The capacity of desho grass to withstand drought and frost, as well as to survive after harvest, is known as its survival rate. To examine the data, descriptive statistics were employed.

RESEARCH RESULTS AND DISCUSSIONS

Distribution of Desho Grass varieties

The sixty-four farmers received Desho grass tillers. The desho grass variety Areka DZF No. 590 was distributed to six farmers in the Ana Sora district. Bore and Arda Jila Mea Boko districts received more desho grass tillers. The Kindo Kosha DZF No# 591 variety was given to 23 farmers, whereas the Areka DZF No# 590 variety was given to 41 farmers (Table 1).

Table 1. Distribution of desho grass in the highlands of 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	-	10	13	23
Total	6	22	36	64

Desho Grass Promotion

Promoting efficient agricultural technology through the most efficient extension strategies is the responsibility of agricultural extension (Basha *et al.*, 2022). To increase the production of desho grass in the highlands of the Guji zone, training and a mini-field day were used in this scaling up activity. Desho grass production and use instruction was given to a select group of farmers and side farmers. The production and usage of enhanced Areka No# 590 and Kindo Kosha DZF No# 591 varieties were taught to a large number of adult male farmers (254), adult female farmers (58), youth boys (19), and youth girls (11) in order to increase the demand for desho grass. Furthermore, 41 development agents and 37 subject matter experts were trained on pre-scaling up desho grass in the study areas (Table 2).

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

There was a mini-field day in a farmer's field featuring the desho grass types Areka No# 590 and Kindo Kosha DZF No# 591. The field visit attracted a large number (Table 3). The mini-filed day participants recognized the effectiveness of desho grass as a means of addressing local feed shortages. Collaboration among stakeholders is crucial to the advancement of agricultural technology. As a consequence, training and a quick field day on desho grass pre-scaling up enhanced partnerships between farmers, development agents, agricultural offices, subject matter experts, and researchers. After planting desho grass for its inaugural season, some farmers sell it to make money, while others distribute it to other fields for free. In the Guji highlands, this type of information transfer increased farmer-to-farmer ties and increased desho grass production.

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

Desho grass' performance

Both of the improved desho grass types covered the land effectively. Table 4 shows that Kindo Kosha DZF No# 591 (3.98) covered more land than Areka DZF No# 590 (3.51) based on farmer responses on a five-point scale. The Kindo Kosha DZF No# 591 tillers quickly covered the field for excess cow feed supply, and the root tillers expanded more spontaneously to fill the space, according to this study, in contrast to the Gadisa *et al.* (2019) study, which revealed that Areka covered more than Kindo Kosha. The fact that a few tillers can serve a larger area makes this type of grass essential.

One of the most important traits for growing animal feed is plant height. There is more fodder for cattle when there is higher height because more material is cut. Harvesting desho grass at the ideal height will enhance the amount of herbage feed. The taller plants were Kindo Kosha DZF No# 591 (95.83 cm) and Areka DZF No# 590 (82.95 cm) (Table 4). The mean plant height of the desho grasses examined in this study was lower than Keba's (2023) and equivalent to the mean value reported by Gadisa *et al.* (2019). Perhaps as a result of weather fluctuations, the plant height values reported by Jabessa *et al.* (2019) from the same highlands were somewhat higher than the value obtained in this study.

After harvest, regeneration is the most important factor in forage. After harvest, regenerations may yield additional feed from fixed land. According to farmers, the regeneration capabilities of the Areka DZF No. 590 and Kindo Kosha DZF No. 591 varieties were 84.61% and 90.91%, respectively (Table 4). The two types in this study had greater regeneration capacities than those discovered by Kebede *et al.* (2023). Since desho grass is an annual feed with the ability to regenerate, it was important for animal feed. The quantity of desho grass used for animals depends on its ability to rebound after harvest.

In forage production, biomass result is another crucial factor. This study examined fresh biomass performances of scaled up desho grasses. The Kindo Kosha DZF No. 591 variety generated 32.91 t/ha of fresh biomass, whereas the Areka DZF No. 590 variety produced 34.46 t/ha (Table 4). In line with the findings of Jabessa *et al.* (2019), Kindo Kosha DZF No. 591 produced less fresh biomass than the Areka DZF No. 590 variety. But according to Atum (2024), the Kindo Kosha DZF No. 591 variety outperformed Areka DZF No. 590 in terms of fresh biomass production. Numerous factors, including as soil, climate, and management techniques, might be responsible for these variations. Due to their ability to produce high herbage yields with little inputs, Kindo Kosha DZF No. 591 and Areka DZF No. 590 desho grasses are the best substitutes for other feed preferences in small landholding areas.

Figure 1. Performance of desho grass at Raya Boda kebele, Ana Sora district, 2023

Farmers evaluated desho grasses survival rates. Table 4 shows that farmers replied a greater survival rate (91.13%) for the Kindo Kosha DZF No# 591 variety than for the Areka DZF No# 590 variety (87.22%). This showed that Kindo Kosha DZF No. 591 can tolerate drought and cold all year long. Forage production has been hindered in certain areas by drought and cold. Areka DZF No. 590 and Kindo Kosha DZF No. 591 desho grasses, on the other hand, had a high survival rate and were drought-tolerant at study areas. Areka DZF No. 590 and Kindo Kosha DZF No. 591 desho grass production, thus, lessen the risk of drought and frost for animal feed. In terms of plot coverage, plant height, regeneration capacity, and survival rate, the Kindo Kosha DZF No# 591 variety performs better than the Areka DZF No# 590 variety, with the exception of fresh biomass yield.

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

Compared to Areka DZF No# 590, the Kindo Kosha DZF No# 591 variety had a higher survival rate throughout districts. Arda Jila Mea Boko district has the highest survival rate, followed by Bore (Figure 1). This suggests that among the Guji zone's highland districts, the Arda Jila Mea Boko area is more suitable for the growing of desho grass.

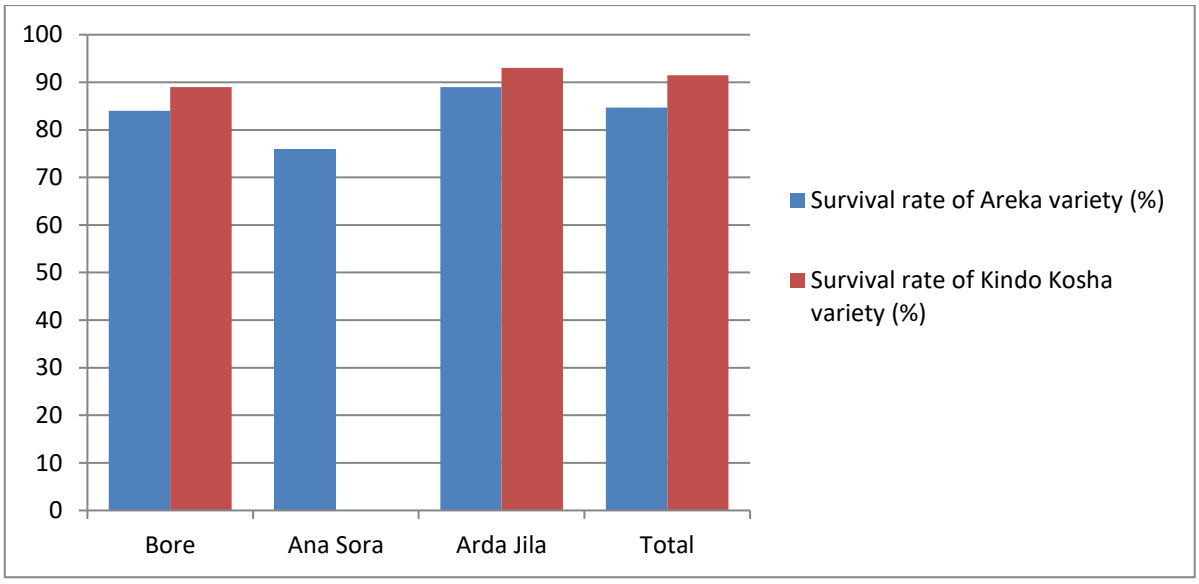

Figure 1. Survival Rate of Desho Grass Varieties Across Districts

Perceptions of farmers regarding production of desho grasses

For the purpose of feeding cattle, farmers said that improved Areka DZF No. 590 and Kindo Kosha DZF No. 591 desho grasses were essential. Desho grass varieties were expected to help feed shortages due to their high capacity for regeneration. Apart from animal feed, farmers reported that the desho grasses Kindo Kosha DZF No. 591 and Areka DZF No. 590 were helpful in preventing soil erosion. The Guji highlands experience soil erosion because of their undulating terrain and abundant rainfall. Scaled up Desho grasses have huge tillers that can lessen the power of erosion, therefore planting them on high plateaus reduces soil erosion. This benefit led farmers to favor the improved Areka DZF No. 590 and Kindo Kosha DZF No. 591 desho grasses. By selling these desho grasses, some farmers started to get incme from desho grass production.

CONCLUSIONS AND RECOMMENDATIONS

This study provides an overview of the effectiveness and promotion of improved desho grass for animal feed. Desho grass is used as fodder to save soil and generate revenue in addition to being used as animal feed. In the districts of Ana Sora, Arda Jila Mea Boko, and Bore, Kindo Kosha DZF No. 591 and Areka DZF No. 590 desho grass were promoted during 2023 and 2024. In the highlands of the Guji zone, training and mini-field days were important extension strategies for spreading desho grasses. On farmers' fields, improved desho grasses showed good results in terms of fresh biomass yield, plot coverage, plant height, regeneration ability, and survival rate. Their production can also assist to ease feed shortages in the Guji zone's highlands. Further promotion of desho grasses in highland areas is necessary to optimize the benefits of Kindo Kosha DZF No. 591 and Areka DZF No. 590.

ADVANCED RESEARCH

Only a small number of kebeles from highland districts were included in this study. Therefore, feed supply for livestock production may be sustained by further promoting improved desho grasses by scaling up in several districts and kebeles in the Guji zone.

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