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Cluster-Based Large-Scale Demonstration and Popularization of Malt Barley (IBON 174/03) Technology at Gedeb District of Gedeo Zones, Ethiopia

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ABSTRACT

Background and Objective: Ethiopia has high potential for malt barley production. However, a large portion of malt barley seed is still imported to meet industrial demand, resulting in significant foreign currency expenditure by the government. This situation is mainly attributed to limited attention to extension and technology transfer and inadequate access to improved seed among smallholder farmers. This study aimed to demonstrate and popularize malt barley technology packages, assess stakeholder feedback on the demonstrated technologies, and evaluate the on-farm grain yield performance of malt barley. **Materials and Methods:** Selection of demonstration sites and beneficiary farmers was conducted in collaboration with district and kebele extension personnel. At initial phase, awareness-creation training was provided to farmers and relevant stakeholders. The recommended technology package included a seed rate of 100 kg/ha, fertilizer application of 100 kg NPS/ha and 100 kg urea/ha, and lime application at a rate of 500 kg/ha. Evaluations and popularization activities were conducted through field visits and field days. Farmer feedback was collected through field day and focus group discussions, while yield data were obtained by harvesting grain from sample plots. Data were analyzed using descriptive statistics and qualitative approaches. **Results:** The average grain yield performance from on-farm demonstrations of malt barley achieved 54 quintals per hectare. The demonstration results convinced farmers and stakeholders about the benefits of using improved varieties and recommended production packages for enhancing malt barley productivity. It also provided practical experience that can help sustain and scale up the demonstrated practices within the community. **Conclusion:** The findings indicate that the proper application of the recommended technology package plays a crucial role in improving malt barley production and productivity among smallholder farmers. Therefore, greater attention should be given by concerned stakeholders to ensure the effective implementation of the recommended full packages. Agricultural extension workers should also strengthen communication among farmers and cooperatives to improve access to improved seed.

KEYWORDS

Cluster-based demonstration, full-package, malt barley, popularization, smallholder farmers

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INTRODUCTION

Malting barley (*Hordeum vulgare* L.) is one of a strategic cash crop that serves as a primarly raw material for the brewing industry while also contributing to household food security in Ethiopia. Athough the country's has suitable highland agroecology for malt barley production , domestic malt barley production remains insufficient to satisfy the rapidly increasing demand of the expanding brewing sector, consequentely substantial foreign exchange expenditure on imports. This wide supply demand gap is primarily associated with low adoption of improved malt barley technologies, weak extension support, limited access to quality seed, and poorly developed market linkages[1-4].

At present time research and development interventions on malt barley in Ethiopia have been spatially concentrated in the Arsi and Bale highlands, with comparatively limited emphasis on other agroecologically suitable regions. However, recent evidence suggests that the highlands of southern Ethiopia, particularly Gedeb district in the Gedeo Zone, possess considerable potential for malt barley production. Notwithstanding this potential, the area remains largely underserved by improved technologies and institutional support systems. Consequently, farmers continue to rely on traditional production practices characterized by low productivity and substandard grain quality that does not meet malting industry requirements.

Empirical studies have demonstrated that the adoption of improved malt barley varieties in combination with recommended agronomic practices significantly enhances both yield and grain quality[5,6]. Nevertheless, in Gedeb district and similar settings, farmers have limited access to these integrated technology packages and insufficient practical exposure to their application under real farm conditions. Furthermore, constraints such as weak seed systems, inadequate extension delivery, and limited access to structured and reliable markets continue to undermine farmers' incentives to adopt and sustain improved technologies[7-10].

Despite these insights, a clear research and development gap persists in the context of Southern Ethiopia: there is a lack of location-specific empirical evidence generated through on-farm demonstration of improved malt barley technologies under farmers' management conditions. In particular, the performance, acceptability, and scalability of improved malt barley varieties and associated production packages have not been adequately validated in Gedeb district, where both high production potential and significant adoption constraints coexist.

To address this gap, a cluster-based demonstration of improved malt barley technology was conducted using the variety IBON 174/03, selected for its adaptability and yield performance in highland environments. The cluster approach was employed to enhance technology visibility, strengthen farmer-to-farmer learning, and improve coordination among key stakeholders, thereby facilitating accelerated dissemination and adoption. The demonstratin was implemented to: Demonstrate and popularize improved malt barley technology to farmers; assess stakeholders' feedback on the demonstrated malt barley technology; and evaluate the on-farm grain yield performance of the malt barley technology under farmers' conditions.

MATERIALS AND METHODS

Description of the demonstration area: Gedeb woreda is one of the woredas in Gedeo Zone, Southern Ethiopia, and is part of the Southern Ethiopian highlands. The area is characterized mainly by highland and midland agro-ecologies with elevations generally above 2000 meters above sea level. It receives relatively reliable rainfall and moderate temperatures, making it suitable for rain-fed mixed farming systems. The farming system is predominantly smallholder-based and integrated, where enset, coffee, cereals, pulses, root crops, and livestock are produced together under an agroforestry system. Although Gedeo Zone is

Table 1: Participants of awareness creation training

Location	Category	Male	Female	Total
Gedeb	Farmers	17	5	22
	Agricultural experts	6	1	7
	Researchers	6	2	8
	Other officers	7	2	9
Grand total				46

Source: Field data (2024)

widely known for enset-coffee agroforestry, the highland areas of Gedeb also support cereal production, including barley, due to favorable altitude and climatic conditions. However, malt barley production in the area remains limited compared to major producing zones such as Arsi and Bale, mainly due to limited access to improved seed, weak extension services, and underdeveloped market linkages.

Demonstration site and beneficiary farmer selection procedure: Demonstration sites (district and kebele levels) were purposively selected based on production potential, accessibility, and suitability for cluster-based demonstration. Host farmers were selected in collaboration with development agents, ensuring that their farmlands were adjacent to facilitate cluster formation. In total, 22 farmers covering 20 hectares of land participated in the demonstration activity.

Awareness creation training (before implementation of demonstration): Before the implementation of the field demonstration, awareness creation training was conducted for selected farmers, development agents, and agricultural experts, as shown in Table 1. The training focused on the yield advantages of improved malt barley varieties, cluster-based production approach, recommended agronomic practices, and proper utilization of production packages to be applied during the demonstration. This was done to enhance stakeholders' understanding and ensure effective implementation of the demonstration activities.

Implementation of the demonstration and interventions: The demonstration was implemented during the 2024 Meher cropping season using a participatory approach involving researchers, development agents, administrative staff, and host farmers. Improved malt barley variety (IBON 174/03) was used, along with recommended packages including NPSB and urea fertilizers, soil lime, and plant protection chemicals. Field activities such as land preparation, planting, fertilizer application, weed management, pest and disease control, training, and field visits were jointly carried out by stakeholders.

Agronomic practices: The following agronomic practices were applied during the demonstration:

- Land preparation and application of lime at 5 quintals per hectare
- Application of 100% NPSB and 25% urea at sowing, while the remaining 75% urea was applied 35-40 days after sowing
- Regular weed management and disease control, particularly for leaf rust using recommended chemicals
- Continuous monitoring and field supervision by researchers, development agents, and farmers

Data collection methods: Yield data were collected by harvesting grain from sampled plots and measuring using a sensitive balance. Farmers' feedback data were collected through Focus Group Discussions (FGDs), field observations, and field days involving beneficiary farmers and stakeholders.

Data analysis methods: Quantitative yield data were analyzed using SPSS version 20. Descriptive statistics, mainly mean values, were used to summarize the data. The yield performance of demonstrated barley was compared with farmers' practices. Qualitative data obtained from farmers' and stakeholders' feedback were analyzed using thematic analysis, including summarizing and interpreting responses.

Ethical approval: The demonstration was conducted at the field level using selected malt barley varieties and did not involve human subjects as experimental treatments. However, interviews and discussions were conducted to evaluate the demonstration's performance. Therefore, informal consent was obtained from all participants before conducting the interviews and group discussions.

RESULTS

Field day was conducted at the maturity stage of the malt barley demonstration with the participation of 136 people (Table 2), including host farmers, development agents, researchers, and extension personnel at woreda, zonal, and regional levels, to showcase the field performance of the malt barley and thereby disseminate information and hand over responsibility for forthcoming scaling-up activities.

Collection of grain yield data was conducted through collaborative participation with crop and PED researchers from HwARC, as well as woreda and kebele crop experts from the study area. Accordingly, grain yield data were collected from 10 out of 22 beneficiaries by randomly selecting a 4×4 m sample plot twice from each selected farmer's field, and the samples were threshed manually. The clean grain yield was then carefully measured, converted to a per-hectare basis, and analyzed using descriptive statistics. The average grain yield performance of the demonstrated malt barley was 54 quintals per hectare (Table 3).

The demonstration was evaluated through field days, Focus Group Discussions (FGDs), and yield assessment sessions involving farmers, researchers, and extension personnel. Farmers reported high satisfaction with the demonstration and expressed strong interest in continuing and expanding the practices due to the high grain yield obtained. The malt barley variety IBON 174/03 was identified as superior in terms of grain yield, tillering capacity, spike length, lodging resistance, disease tolerance, and early maturity in Table 3.

Extension personnel reported that the cluster-based approach facilitated effective supervision and enabled proper implementation of the recommended production package across participating farmers. They also indicated plans for wider dissemination of the technology.

Several implementation challenges were recorded, including delays in budget release, limited availability of improved seed, occurrence of leaf rust during the growing stage, and excessive rainfall that affected timely field operations. Despite these challenges, the demonstration plots remained largely intact throughout the production period.

DISCUSSION

The awareness creation training conducted prior to implementation played a critical role in enhancing stakeholders' understanding of improved malt barley production technologies and cluster-based demonstration approaches. The participation of farmers, development agents, agricultural experts, and

Table 2: Participant composition during field day activities across different stakeholder groups and locations

	Participant lists												
	Farmers			Agri-experts			Researchers			Other officers			
Location	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Total
Gedeb	71	20	91	9	-	9	9	1	10	23	3	26	136

Source: Field data (2024)

Table 3: Yield performance (kg/ha) of barley variety across study district and kebele based on field data (2024)

District	Kebele	Variety	Min yield in kg/ha	Max yield in kg/ha	Mean grain yield in kg per ha
	Harmufo (N = 10)	IBON 174/03	42	57	54

Source: Field data (2024)

coordinators (Table 1) facilitated knowledge sharing, strengthened coordination, and improved accountability during implementation. Similar findings have been reported in extension studies, indicating that participatory training enhances farmers' confidence and significantly improves adoption of agricultural innovations by strengthening farmer–extension linkages and trust-building mechanisms[11].

The field day served as an effective platform for showcasing the performance of the demonstrated malt barley technology under real farm conditions. The participation of 136 stakeholders (Table 2), including farmers, researchers, and extension personnel, enabled wide dissemination of results and encouraged experiential learning. Observing the crop performance directly in the field helped participants to better understand the advantages of improved varieties and recommended agronomic practices. This observation aligns with diffusion of innovation theory, which emphasizes that visible and observable results accelerate the adoption process by reducing uncertainty among potential adopters[11]. Furthermore, agricultural innovation systems literature highlights that multi-stakeholder engagement enhances knowledge exchange, coordination, and collective decision-making, thereby accelerating technology dissemination[10].

The average grain yield of 54 qt/ha obtained from the IBON 174/03 variety (Table 3) demonstrates a substantial improvement compared to the district-level average yield of 29.7 qt/ha reported in previous records. This represents a yield advantage of approximately 81.8%, indicating the strong potential of improved malt barley technologies when full production packages are properly implemented. This yield gain can be attributed to the combined effect of improved seed, appropriate fertilizer application, soil acidity management through lime application, and improved agronomic practices. Similar yield improvements have been reported in previous studies, where integrated management practices and improved malt barley varieties significantly increased productivity under Ethiopian highland conditions[12,13].

The findings further suggest that the production potential of Gedeb district is relatively high; however, current productivity remains constrained due to limited adoption of improved technologies, inadequate access to quality seed, and insufficient application of recommended agronomic practices. These constraints are consistent with earlier studies which identified weak input supply systems, limited extension support, and poor market integration as major barriers to malt barley production in Ethiopia[1,3,7].

Stakeholder evaluation through field observations, field days, and focus group discussions revealed a strong positive response toward the demonstrated technology. Farmers expressed high satisfaction with the yield performance and identified IBON 174/03 as a superior variety in terms of grain yield, tillering capacity, spike length, lodging resistance, disease tolerance, and early maturity. These attributes are critical for improving both productivity and production stability under smallholder farming systems.

Extension personnel also emphasized that the cluster-based demonstration approach enhanced supervision efficiency and improved the uniform application of recommended production packages across participating farmers' fields. The proximity of demonstration plots allowed continuous monitoring and facilitated rapid technical support. This finding supports the view that cluster-based approaches are effective in accelerating technology diffusion and improving extension service delivery in smallholder farming systems[10].

Despite these positive outcomes, several implementation challenges were encountered, including delays in budget release, limited availability of improved seed, and occurrence of leaf rust disease during the growing season. Additionally, excessive rainfall during critical field operations affected timely chemical application and field management practices. However, these challenges did not significantly compromise the overall performance of the demonstration due to strong collaboration among farmers, researchers, and extension agents.

The demonstration also contributed to behavioral and practice changes among farmers. Initially, farmers were reluctant to adopt row planting and use of lime for soil acidity management. However, through continuous engagement and practical demonstration, farmers adopted these practices and recognized their importance in improving productivity. This indicates that experiential learning approaches are highly effective in changing traditional farming practices and promoting sustainable intensification.

Overall, the cluster-based demonstration approach proved to be an effective mechanism for enhancing farmer learning, improving technology adoption, and strengthening research–extension–farmer linkages. It also demonstrated the importance of integrated input use and coordinated stakeholder involvement in improving malt barley productivity. However, for sustainable scaling, constraints related to input supply systems, market access, and extension capacity must be addressed.

CONCLUSION

The cluster-based demonstration of improved malt barley technology, particularly the variety IBON 174/03 in Gedeb district, confirmed its strong potential to enhance smallholder productivity under farmers' conditions. The technology significantly outperformed traditional practices, resulting in higher grain yields and indicating the possibility of substantially increasing barley production when recommended agronomic practices are properly implemented.

Beyond grain yield gains, the demonstration improved farmers' awareness, knowledge, and interest in improved technologies through participatory approaches and effective communication. The strengthened research-extension-farmer linkage played a critical role in facilitating knowledge transfer and promoting adoption. Moreover, coordinated input provision, technical support, and integrated crop management practices were identified as key drivers of the observed improvements.

Despite these positive outcomes, challenges such as limited access to quality seed, weak market linkages, and the need for sustained extension support persist. Addressing these constraints through strengthened seed systems, improved market integration, and enhanced institutional support will be essential to scale up adoption and sustain productivity gains in the region.

SIGNIFICANCE STATEMENT

The study demonstrates that cluster-based dissemination of improved malt barley technology significantly enhances on-farm productivity and farmer adoption in underutilized highland areas. By integrating improved varieties with recommended agronomic practices, the approach reduces yield gaps and strengthens local seed systems. It provides a scalable model for boosting domestic production, reducing dependence on imports, and improving smallholder livelihoods.

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