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Pre-Extension Evaluation and Demonstration of Faba Bean Technologies in the Highlands of Guji Zone, Oromia Region, Ethiopia

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A B S T R A C T

New varieties have a big influence on crop yield when they are shown and offered to farmers. This study examines profitability and production performance of Matti variety under farmer settings. A 100m² sample of 14 farmers' land was used for the study. Matti variety which was recently released was demonstrated with the standard check (Walki variety). To promote faba bean technology, mini-field days and training extension methods were employed. Likert scales, descriptive analysis, and net income were utilized to examine the data that was gathered through measurement and interviews. Matti and Walki harvests were found to be 25.86 and 23.77 Qt/ha, respectively. Farmers could profit from 81083.93 and 70966.07 ETB/ha from Matti and Walki production, respectively. The number of branches per plant, disease resistance, and sweetness are among the traits that farmers value most in faba bean production. The results of this study showed that, according to the characteristics that farmers require, the recently released Matti variety was ranked top in faba bean production. The Matti variety has been suggested to increase faba bean production in the highlands of the Guji zone because of its better yield, higher profit, and farmer preference. Farmers' preferences for certain qualities should be taken into account when spreading faba bean varieties at study areas.

INTRODUCTION

Ethiopia's economy is mostly based on agriculture. It accounts for 79% of employment, 34.1% of GDP, and 79% of foreign exchange income, and it provides most of the raw resources and investment capital (Diriba, 2020). Low yields, subsistence farming, and conventional methods of cultivation are characteristics of Ethiopian agricultural sector, although significant economic implications (Sigaye *et al.,* 2022). Agricultural Development Lead Industrialization (ADLI) is the government's primary policy answer to Ethiopia's problems with agricultural production and food security. Better agricultural practices are encouraged by the policy to increase production and productivity (Daemo, 2022).

In terms of cultivated area, faba beans rank third among the world's pulse crops, after soybeans and field peas (FAOSTAT, 2022). Faba beans are grown in more than 60 countries worldwide, with China leading by far in production, followed by Ethiopia, Egypt, and the UK (Dhull *et al.,* 2022). China and Ethiopia are the two nations that produce the most faba beans, accounting for around 28% and 18% of global output in the fiscal year 2022, respectively (Rahul *et al.,* 2024). Ethiopia supplies 56% of Africa's faba beans, which are the primary source of protein for most smallholder farmers (Genetu *et al.,* 2021). Ethiopia's significant development and production of grain legume crops are mostly due to favorable soil conditions and a suitable agro-ecological environment (Alemu and Wato, 2023). According to Alemayehu *et al.* (2024), the Guji highlands, Hadiya, Sidama, Gamo-Gofa, the Arsi and Bale Highlands, the Central Highlands of Ethiopia, Tigray, North and South Wollo, North and South Gondar, the East and West parts of Gojjam, and Wollega are among the regions where faba beans are grown. Over 4.5 million smallholder farmers grew 1078265.5 metric tons of faba beans on 518466.39 hectares of land during the 2020–2021 cropping season (CSA, 2021).

For human consumption, animal feed, and sustainable agricultural practices like fixing nitrogen to increase soil fertility, faba beans are important crops in Ethiopia. Environmental sustainability may be promoted by including faba bean intercropping into integrated pest control, which can protect the main crop and reduce the need for pesticides (Hiwotu *et al.,* 2023; Mekonnen and Mnalku 2021). According to Alemu and Wato (2023), faba beans are rich in protein and antioxidants, vitamins, and minerals that have a therapeutic effect. Additionally, faba beans are a cash crop for farmers and a source of foreign exchange revenues for the country (Biri *et al.,* 2024; Tamiru *et al.,* 2023).

Faba beans are only productive at 2.1 t/ha (Asrat *et al.,* 2022) as opposed to 5.2 t/ha (Bedada *et al.,* 2024; Alemayehu *et al.,* 2023) in Ethiopia, despite their larger space and agro-ecological coverage, varied significance as food, animal feed, enhancing soil fertility, and foreign currency earnings. The production of faba beans must be increased by using high yield varieties. Bore Agricultural Research Center released a reliable and high-yielding faba bean cultivar called Matti to boost productivity and assist farmers in the Guji zone. It is essential to demonstrate the released varieties on farmers' fields in order to increase faba bean production and enhance faba bean technology in the prospective districts.

The objectives of this activity was to examine farmers' feedback for the advancement of faba bean production in highland areas, as well as to evaluate

the yield performance of released faba bean technologies and estimate their profitability under farmers' conditions.

LITERATURE REVIEW

Breeding aims to produce the optimal variety for farmers' situations, while agricultural research extension aims to spread released technology and kinds throughout communities. In order to demonstrate and promote the released faba bean technologies (varieties and recommendations), this project employed a demonstration strategy in which farmers actively engaged. The primary function of agricultural extension in Ethiopia is to promote proven agricultural technologies (new varieties, improved varieties, new production techniques, new instruments, or recommendations) that can boost farmers' yields (Kebede, 2024). Promoting agricultural technology is therefore crucial to enhance commercialization, lower poverty, and improve household food security.

Ethiopia has been using a number of extension strategies to highlight its agricultural sector since the middle of the 1960s. The goal at the time was to raise living conditions by increasing output (Abate 2007). However, the majority of the methods were top-down, ignoring the conditions of farmers and unable to be sustainable to improve the agricultural sector.

Ethiopian Agricultural Research System currently employs a bottom-up design in which farmers' perceptions and interests serve as stepping stones for technology promotion in pre-extension demonstration, pre-scaling, and cluster approaches. In order to validate the significance of the suggested new variety or technology in accordance with the agro-ecology conditions, farmers took part in the research from land preparation to post-management during the pre-extension demonstration stage. Farmers' choices and preferences at this point can influence whether the variety is adopted. Through pre-scaling up and a large-scale strategy, the best variety chosen at the pre-extension demonstration stage can become even more popular, increasing excess output and optimizing farmers' benefits (Kebede *et al.,* 2023).

Agricultural research extension employed a variety of strategies to promote recommended agricultural research technologies through demonstration fields, community based seed production (group method), cluster-based demonstration, and village based demonstration (integrated technology). The transformation of rural lives and agricultural growth greatly depend on demand-driven agricultural extension and consultancy services (Getahun and Milkias, 2021). The purpose of agricultural extension services is to educate farmers, spread knowledge, advance agricultural technology, and enhance farming (Geneti and Hailu, 2023).

RESEARCH METHODOLOGY

Farmers and Site Selection

This demonstration was held in Ana Sora and Bore highlands districts of Guji zone. Based on their potential for producing faba beans, the sites were selected. There were 14 experimental fields in all, comprising two kebeles from each district, three experimental farmers from each kebele, and two farmer training centers.

Materials and design of demonstration

The recently released Matti variety was tested in the 2023/2024 production year using the Walki variety as a standard check. As a replication, each type was planted side by side on a 10 m × 10 m plot of farmers' land. For the experiment, 200 kg of seed and 150 kg of fertilizer (NPS) per hectare were used, along 40 and 10 cm spacing between rows and plants, respectively.

Faba bean demonstration and promotion approach

Farmers received both theoretical and practical instruction to increase the productivity and production of faba beans. Training on the importance of the recently introduced Matti variety and faba bean production guidelines was given to farmers and other stakeholders. During monitoring and follow-up operations, the farmers also offered guidance on the management strategies needed for faba bean production. At the mature stage of the faba bean demonstration, a mini-field day was organized to promote faba bean technologies (varieties and suggested methods of faba bean cultivation) in the highlands of the Guji zone.

Methods of data collection and analysis

Farmers' preferences for particular faba bean varieties and features, as well as the production costs related to growing faba beans were measured and interviewed. The yield data were evaluated using descriptive statistics. The profitability of the faba bean cultivars that were demonstrated was evaluated using net income (NI).

TR= QxP ……..... (1)

Q= yield obtained (Qt/ha) and P farm gate price in ETB/ha

NI=TR-TVC-TFC……. (2)

NI = net income, TR= total revenue, TVC= total variable cost and FC= fixed cost.

Farmers cultivate faba beans according to their own specifications. Each farmer who participated in the study was asked to name the characteristics of demonstrated faba bean varieties. On a Likert scale of 1 to 5, farmers evaluated the best variety based on characteristics they found (1 being very poor, 2 being poor, 3 being medium, 4 being very good, and 5 being exceptional).

RESULTS AND DISCUSSIONS

Advertising of Faba Bean Technologies in the Guji Zone Highlands

Agricultural production is not just labor-intensive but also needs production knowledge. This sort of production knowledge is taught to farmers through training. For the highlands of the Guji zone, a new faba bean variety known as Matti has been made offered. Therefore, production training is required for farmers to use this new variety. As a result, both theoretical and practical training was given to farmers, development agents, and subject matter specialists. In addition to training, a mini-field day was arranged to increase awareness of the Matti variety's the possibility of faba bean production. The mini-field day was attended by a diverse group of people (Table 1). On mini-field day,

attendees saw that the Matti variety outperformed the Walki variety in terms of branch and pod counts.

Table 1. Promotion of faba Technologies at the stage of demonstration

Means of promotion	Development Agent			Farmers			Subject Matter Specialists		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Mini-field day	17	3	20	73	8	81	18	1	19
Training	14	4	18	108	52	160	10	2	12

Yield performance of faba bean demonstrated varieties

In the Ana Sora district, the yields of the Walki and Matti were 20.96 and 22.17 qt/ha, respectively, while in Bore, the yields were 28.63 qt/ha of Matti and 25.88 qt/ha. This implies that the Bore district has a somewhat greater chance of growing faba beans from highlands. According to the demonstration result, Matti and Walki yielded mean yields of 25.86 and 23.77 qt/ha, respectively (Table 2). The results of this experiment were lower than those of the previous one, which was conducted in the same area and yielded 39.6 qt/ha from Walki and 40.6 qt/ha from Aloshe (Amare *et al.*, 2021). In addition, Kebede and Korji (2017) revealed that Gebelcho and Walki supplied 33 qt/ha and 27 qt/ha, respectively, in the districts of Bore and Ana Sora. The yield disparity shown in this demonstration within the same region might be explained by differences in soil characteristics, farmer management techniques, and the genetic performance of several cultivars. However, this demonstration's yield performance exceeded both the national yield of 20.97 qt/ha and the regional yield of 22.82 qt/ha for Oromia (ESS, 2022).

Table 2. Yield of faba bean varieties

District		Walki variety (qt/ha)	Matti variety (qt/ha)
Bore	N	8	8
	Mean	25.88	28.63
	Std. dev.	5.17	4.58
Ana Sora	N		
	Mean	20.96	22.17
	Std. dev.	6.96	6.76
Total	N	14	14
	Mean	23.77	25.86
	Std. dev.	6.28	6.32

Analysis of profitability of faba bean production

In addition to output, farmers want variety must be profitable, thus it is crucial to look at Matti and Walki's profitability in this example. The fixed cost of land was 20464.29 ETB/ha, and the estimated farm gate price for each variety during production was 5132.14 ETB/Qt. Farmers spend 27194.64 ETB/ha on faba

bean production, which includes variable expenditures such seed, fertilizer, land preparation, planting, weeding, harvesting, threshing, and other expenses. According to the net revenue result, the production of the Matti and Walki varieties yielded 81083.93 and 70966.07 ETB/ha, respectively (Table 3). This showed that highland farmers in the Guji zone were making money from the cultivation of both types, even though Matti yields a higher return than Walki.

Table 3. Analysis of Profitability Demonstrated Faba Bean Varieties

Production cost and returns	N	Mean	Max	Min	Std. dev.
Price of each variety (ETB/Qt)	14	5132.14	6500	4200	717.26
Yield of Walki variety (Qt/ha)	14	23.77	30.00	12.00	6.28
Yield of Matti variety (Qt/ha)	14	25.86	35.00	14.00	6.32
FC (ETB/ha)	14	20464.29	25000	18000	3078.86
TVC (ETB/ha)	14	27194.64	29700	24250	1396.05
TR of Matti variety (ETB/ha)	14	128742.86	149500	91000	18538.64
TR of Walki variety (ETB/ha)	14	118625.00	165000	77000	24362.22
NI of Matti variety (ETB/ha)	14	81083.93	99175	47075	18052.43
NI of Walki variety (ETB/ha)	14	70966.07	118550	32750	24636.40

Traits and varieties preference on faba bean production

The five most significant traits in faba bean production that farmers identified were disease resistance, sweetness, yield, number of seeds per pod, and number of branches per plant. The three most traits in faba bean production were disease resistance, branches per plant, and sweetness. For every attribute, farmers have favored the Matti variety above the Walki. There are more branches per plant in the Matti variety than in the Walki type. The mean score of attributes ranked the Matti variety first, followed by the Walki variety (Table 4). In the highlands of the Guji zone, this showed that the newly released variety Matti was prioritized above the existing Walki variety.

Table 4. Farmers' Preference on Demonstrated Faba Bean Varieties (n=14)

Varieties	Faba bean Traits					Total	Mean	Rank
	Disease tolerance	Number of seed per pod	Yield	Number of branche per plant	Sweetness			
Matti	53	49	49	54	56	261	52.2	1
Walki	48	47	46	45	55	241	48.2	2

CONCLUSIONS AND RECOMMENDATIONS

To boost agricultural productivity and output, novel varieties released by the research centers must be verified. A demonstration is an important preface to an extended, extensive production and promotion strategy. Pre-extension demonstrations of the Matti and Walki faba bean types were conducted in the

highland Guji zone districts of Bore and Ana Sora. The new Matti variety was more advantageous to farmers than the Walki variety. Farmers in the study areas made a solid profit from growing the Walki and Matti varieties. The most important characteristics for faba bean production, according to farmers in the districts of Bore and Ana Sora, were yield, disease resistance, sweetness, number of branches per plant, and number of seeds per pod. When it comes to planting faba beans, farmers prefer the Matti. Because of its better yield and farmers' preference, the Matti variety is suggested for large-scale faba bean cultivation in the Guji zone's highlands. It is advised that farmers should produce faba beans using the Matti variety. Agricultural research should include farmers' preferences on particular faba bean attributes while breeding new faba bean varieties in the study areas.

ADVANCED RESEARCH

In this research all highland districts of Guji zone were not addressed due to lack of manpower and research facilities. Matti variety production is suitable for all highlands. Therefore, agricultural cooperative and research center should focus on the distribution and production of Matti variety in potential districts of Guji zone until new variety.

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