



Pre-extension Demonstration of Improved Faba Bean Varieties in Highlands of Guji Zone, Southern Oromia, Ethiopia

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Abstract: The activity was conducted in 2019/20 main rainy season at Bore, Dama and Ana Sora districts of Guji Zone, Oromia, Ethiopia. The objectives of the activity were to evaluate the yield performance of improved faba bean technologies under farmers' condition, evaluate cost-benefit ratio (income of farmers) and to build farmers' knowledge and skill on faba bean production and management practices and to collect feedbacks from the participants for further research design and the way. Two Kebele per district were selected based on faba bean production potential and 15 farmers were selected from each Kebele as one FRGs member based on willingness, wealthy status and gender consideration. Thus, a total of 6 FRGs comprising 90 farmers (64 male & 26 female) were established. One improved faba bean variety (Aloshe) was demonstrated with standard check (Walki) on the plot size of 100 m² area. Spacing of 40cm between rows and 10cm between plants was used and recommended rate of fertilizer and seed were also maintained equally for all plots. Training, exchange visit and field day were organized to create awareness and enhance farmer to farmer learning on faba bean production. Totally, 113 stockholders participated during training, 33 during exchange visit and 137 stockholders during field day organized. Observation, measurement and face to face interview were employed to collect the data and the collected data were analyzed by descriptive statistics and farmer's feedbacks were analyzed qualitatively. The demonstration result revealed that improved variety and standard check were almost comparable average grain yield which gave 4060 kg ha⁻¹ and 3960 kg ha⁻¹, respectively. Thus, based on grain yield obtained, farmers' feedbacks and economic return (52,632 and 50,743 ETB) from Aloshe and Walki varieties respectively are recommended for further scaling up/out.

Keywords: Demonstration, Faba Bean, Farmers' Feedbacks, FRGs

1. Introduction

Legumes are produced by most of the small holder frames all over the sub-Saharan Africa as a source of food, feed, cash, or income as well as improvement of soil fertility. Diverse legume varieties that could adapt to the changing agro-ecological and sociocultural conditions have developed by farmers, and legumes have constituted an essential component of the smallholder farming systems across the country [15, 13, 16]. They are the second most important crop next to cereals [12], which are grown nationally mainly

for the aforementioned importance's [14].

Of legumes, faba beans have been indicated to be the most important food crop that accounts for nearly one third of entire legume production in Ethiopia, followed by haricot beans, field beans, and chickpeas [11, 14]. Faba bean takes the largest share of area (492,271.60 ha) and production (1041953.5 tones) of the pulses grown in Ethiopia [5]. Ethiopia is currently the world's second largest producer of faba bean [15, 1] and the fourth largest country exporting faba bean next to France, Australia, and the United Kingdom [8].

This crop has manifold advantages in the economic lives of the farming community in the high lands of the country. It is a source of food, feed, cash to farmers and also play significant role in soil fertility practices. The crop usually grows in Nitisol and Vertisol dominated areas of Ethiopia mixed with cereals and field peas. The average national yield of faba bean is about 2.117 ton/ha [5] which is very low compared to the average yield of 3.7 ton/ha in major producer countries [9].

The major factors that are usually mentioned for the low yield of faba bean in Ethiopia include climatic, edaphic, biotic (diseases, pests and weeds) factors, and poor agronomic practices [10, 3, 6]. On the other hand, the on-farm average yield of released faba bean varieties reaches up to 3.5 ton/ha [9]. This indicating the existence of considerable yield gap between farmer managed and researcher managed plots.

Highlands of Guji Zone is one of the administrative Zones in Oromia Region, Southern Ethiopia which has a huge potential for faba bean production. In addition, the area has got plenty of rainfall for a longer duration in a year. Thus, the crop is grown in the highland areas of the Zone. Despite the potential of the area faba bean production is limited by lack of improved varieties which can tolerate disease and certain biotic factor like chocolate spot and rust (personal field observation).

So far, Gebelecho and Walki varieties of faba bean were demonstrated and pre scaled up to farmers. Nevertheless, both varieties were susceptible to chocolate spot and rust. To solve this problem, Bore Agricultural Research Center Pulse Research Team was adapted and evaluated eleven new variety of faba bean during 2017/2018 production season. The adaptation result revealed that (34.55 qt/ha and 31.25 qt/ha) from Walki and Aloshe varieties respectively [2]. From those newly released Aloshe variety was recommended for demonstration due to its relative disease tolerant. Therefore, the pre extension demonstration of improved faba bean varieties in the highland of Guji Zone is essential.

Objectives

The demonstration research was conducted to achieve the following specific objectives.

To evaluate the yield performance and profitability of improved faba bean technologies under farmers' condition.

To improve knowledge and skills of farmers on faba bean production and management practice.

To assess farmers' feedbacks for further development of faba bean.

2. Materials and Methods

2.1. Description of Study Areas

The experiment was conducted at Bore, Ana Sora and Dama districts during the main cropping season of 2019/20 under rain-fed conditions. Bore district is located in the Northern part of Guji Zone, Oromia regional state at a distance of 385 km from Addis Ababa and 210 km from

Zonal capital city, Negele. Astronomically, Bore is located between 6°57'27" - 6°20'52" latitudes and 38°25'51" - 38°50'21" longitudes. It has elevation ranging from 1400-2800 masl. The annual rain fall is about 1200-1400 mm and the annual temperature of the district ranges from 11.1 up to 21°C. The major soils of Bore district are Nitosols (red basaltic soils) and Orthic Acrosols. The two soils are found on the highland areas, and they are red brown and black brown in colors and on sloping topography and their utilization are good under natural vegetation respectively. Bread wheat, food barley, potato, faba bean and enset are the major crops produce in the district.

Ana Sora district is situated at a distance of 410km from Addis Ababa and 180 km from zonal capital city, Negele. Astronomically, the district is located between 6°20'30" - 5°57'30" latitudes and 38°39'30" - 38°57'30" longitudes. The district is characterized by two types of climatic zone, namely temperate, Dega (locally known as Bada) and Woina dega (locally known as Bada-dare). It has humid and sub humid moisture conditions, with a relatively longer growing season. The annual rainfall nearly about 1000-1500 mm and the annual temperature of the district is nearly about 15 up to 20°C.

Dama district is situated at a distance of 401km from Finfinne/Addis Ababa and 235km from the zonal capital city, Negele town. The district has an area of 375.270km². It is an area where a mixed farming economic activity takes place, which is the major livelihood of the people. Astronomically, Dama district is located between 6°7'33" - 6°20'52" northing latitudes and 38°20'46" - 38°39'4" easting longitudes. The district is bordered by, Uraga district in south, Bore in the east and SNNP in the north and northeast. Most of the earth surface of the district is ups and down of the land surface with an elevation ranging from 2400-2932 masl. The district is characterized by two type of climatic zone, namely temperate (locally known as 'Dega') which starts in early June up to August and Sub tropical (locally known as 'Woina dega') which starts late September up to reaches beginning of November. It is the most humid and sub humid moisture condition, which has relatively longer growing season. The major soils of the district are Nitsols (red basaltic soils), and black soil (nitsol). The two soils are found on the highland areas, they are red brown and black brown in colors and on sloping terrain and their agricultural utilization is good under natural vegetation respectively.

Highland Guji districts have similar agro ecology where diverse crops such as bread wheat, food barley, horticultural crops (mostly potato, *enset*, garlic and head cabbage) and highland pulse crops (faba bean and field pea) were largely produced in each district.

2.2. Site Selection

Pre-extension demonstration of faba bean varieties were conducted in Bore, Ana Sora and Dama districts of Guji Zone. Purposively two Kebeles from each district were selected based on their accessibility and faba bean production potential. Enshido Aleyo and Ano Keransa Kebeles from

Bore, Bube Korsaa and Irba Buliyo Kebeles from Ana Sora and Hada Gurati and Gagama Dogo Kebeles from Dama district.

Hosting farmers' selection:

Farmer's research group (FRG) approach was followed to select farmers and group under hosting farmers. FRG groups are selected based on willingness, wealthy status and gender consideration. A total of 6 FRGs were organized having 64 male and 26 female members. Among the FRG members, a total of eighteen (18) interested hosting farmers were selected. Having suitable and sufficient land to accommodate the trials,

initiatives to implement the activity in high-quality, vicinity to the roads and willingness to explain the technologies to others were the criteria used to select the hosting farmers.

2.3. Materials Used and Field Design

The recently released faba bean variety (Aloshe) and the standard check (Walki) were planted on selected hosting farmers land on 10 m x 10 m plot for each variety in the main cropping season.

Table 1. Description of faba bean varieties used for demonstration.

S/N	Name of Varieties	Maintainer	Year of release
1	Aloshe	Sinana ARC	2017
2	Walki (ETH 96049-2)	Kulumsa ARC	2008

Full packages of technologies that include row planting at 40 cm inter- and 10 cm intra- row spacing, recommended seed rate of 150 kg per hectare and fertilizer rate of 100kg of NPS per hectare were applied. In addition, twice hand weeding was also done on time.

Bore Agricultural Research Center (BOARC) was the source of agricultural inputs (seed and fertilizers). Land was provided by hosting farmers. Land preparation was carried out by trial/hosting farmers, whereas land leveling, planting, follow up and visit, harvesting, threshing were handled and managed by BOARC Agricultural Extension Research Team.

2.4. Data Types and Methods of Data Collection

Qualitative and quantitative data such as yield data, total number of farmers participated on training, total number of farmers, DAs and experts participated on field visits, farmers' perception on the attributes of the technology, variable costs incurred and revenue obtained were collected through own observation, household interview and focused group discussion. Feedbacks were collected using checklist by conducting face to face interviews.

$$\text{Technology gap} = \text{Potential yield qt/ha} - \text{demonstration yield}$$

Whereas yield advantage of the demonstrated varieties was calculated using the following formula.

$$\text{Yield advantage \%} = \frac{\text{Yield advantage of new variety} - \text{Yield advantage of st; check}}{\text{Yield advantage of standard check}} \times 100$$

$$\text{Technology index \%} = \frac{\text{potential yield} - \text{demonstrated yield}}{\text{Potential yield}} \times 100$$

3. Results and Discussions

3.1. Capacity Building for Awareness Creation

In order to capacitate the farmers' knowledge on faba bean production trainings were given for selected Farmers Research Group members, Development Agents (DAs), and Subject Matter Specialists (SMSs). Exchange visit and mini field days were organized to enhance farmer to farmer

2.5. Economic Evaluation of the Varieties

The economic evaluation of demonstrated varieties were calculated according to; Total revenue was calculated by multiplying price by yield obtained ($TR = Y \times P$), growth marginal rate were calculated by subtracting total variable cost from total revenue ($GM = TR - TVC$) and the final profitability was calculating by subtracting total fixed cost from total growth margin ($\text{Profit} = GM - TFC$).

2.6. Data Analysis

The collected agronomic data was analyzed using descriptive statistics. Farmers' feedbacks to demonstrated varieties were also analyzed qualitatively and profitability of each variety was also identified by using NFI (Net farm income). Technology gap imply researchable issues for realization of potential yield, while the extension gap imply what can be achieved by the transfer of existing technologies (Dhaka *et al.* 2010). Technology gap and technology index were calculated using the following formula;

learning on the production and management of faba bean. Multidisciplinary research team; crop, extension and socio-economic research team and other stakeholders (Offices of Agriculture and Natural Resource) actively participated by sharing their experience and knowledge during training and field day organized.

Table 2 shows the number of farmers, development agents, district office of agriculture experts and other participants who attended training, exchange visit and field day of faba bean demonstration.

Table 2. Awareness creation methods and number of participant for demonstration of faba bean.

Awareness creation methods	Participants	Number of participant		
		Male	Female	Total
A. Training	Farmers	62	28	90
	Das	9	3	11
	SMSs	11	1	12
B. Exchange Visit	Farmers	17	3	20
	Das	3	1	4
	SMSs	3	1	4
	Others	4	1	5
C. Field day	Farmers	48	22	70
	Das	11	3	14
	SMSs	15	-	15
	Others	31	7	38

Role of farmers' and other stakeholders in technology demonstration

The role of the farmers, extension workers, researchers and other stockholder during the technology demonstration were indicated in the below table.

Table 3. Role of Farmers' and other stakeholder's participation in demonstrated technology.

Actors	Roles
FRG members	Involved in land preparation, sowing, management, yield evaluation and providing feedback.
Hosting farmers'	Trail land provision, record keeping, facilitating of members involvement, field monitoring and reporting in the case of emergency and providing feedback.
Research teams	Provision of training for FRG members and other actors and providing input for FRG members, agronomic data collection, field monitoring, social data collection and analysis, preparing extension materials.
Extension workers	Monitoring, feedback & information transfer, facilitating & organizing community.
Other stakeholders	input supply, technical backup, community facilitating, information dissemination, etc.

Yield performance of the demonstrated varieties

As shown in the following table 4, the mean grain yield obtained from newly released Aloshe variety was 4060 kg ha⁻¹ whereas 3960 kg ha⁻¹ gained from standard check Walki variety. The mean grain yield obtained from both varieties was almost similar.

The result of this demonstration was greater than previously conducted scaling up of faba bean which was 3376 kg ha⁻¹ [4]. Yield advantage of Aloshe variety over Walki were insignificant which was only 2.52%, this implies that yield obtained from both varieties were almost equal.

Table 4. Grain yield performance of faba bean varieties demonstrated.

Yield performance of faba bean varieties in Kg/ha						
Variety	N	Minimum	Maximum	Mean	Std. Deviation	Yield advantage (%)
Aloshe	18	3300	5200	4060	4.65440	2.52
Walki	18	3200	4900	3960	4.29774	

Table 5. Result of independent sample t test.

	Test for Equality of Variances		t-test for Equality of Means				
	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	.087	.769	.632	34	.531	.944	1.493

Table 5 show that if the significance value for the Levene test is high (greater than 0.05), use the results that assume equal variances for both groups. Otherwise, Use the results that do not assume equal variances for both groups. During faba bean demonstration, the equal variances are assumed (p = .769 > .05). A significance value of .531 (greater than .05) this indicates that there is no statistically significant difference between the two means yield of both varieties.

3.2. Technology Gap

Technology gap indicates that the gap in the demonstration yield over potential yield. The observed technology gap is attributed to dissimilarities in fertility, acidity, rainfall and other natural calamities and its contribution is to narrow down the gap between the yields of different varieties and to provide location specific recommendations [7].

Table 6. The result of technology gap and technology index for faba bean varieties.

Variety	Potential yield (qt/ha)	Demonstrated yield (qt/ha)	Technology gap (kg/ha)	Technology index (%)
Aloshe	47	40.6	6.4	13.62
Walki	38	39.6	-1.6	4.2

As indicated in the above table, the technology gap is 6.4 qt/ha and - 1.6 qt/ha for Aloshe and Walki varieties, respectively. The demonstrated yield (39.6 qt/ha) of Walki variety was greater than its potential yield (38 qt/ha). This might be due to good condition during demonstration season than during its releasing time. However, yield gap of Aloshe variety between potential and demonstrated yield were 6.4 qt/ha as the potential yield of Aloshe variety was 47 qt/ha, but 40.6 qt/ha demonstrated mean yield. This indicated that the lowest gap was observed on Walki variety, which in turn shows the demonstration yield is greater than the potential yield by 1.6 qt/ha at the study areas. Technology index indicates the feasibility of demonstrated variety on farmers land. This index should be lowered to be practicable at farmers land. Walki variety is more feasible (4.2) than Aloshe variety although it had lowered technology index (13.62). If the technology index of demonstrated variety/technology is high farmers should be trained to know the production of that

technology on their land.

3.3. Cost Benefit Analysis

In terms of profitability, the cost benefit analysis result shows that an average profit of 52,632.83 and 50,743.94 ETB per hectare was obtained from Aloshe and Walki varieties, respectively, in one production season.

Table 7 Indicate that both varieties were profitable at the study area. The farm get price during production season was 20 ETB for one kilogram of faba bean for both varieties. Total revenue was calculated by multiplying price by yield obtained ($TR = Y \times P$), growth marginal rate were calculated by subtracting total variable cost from total revenue ($GM = TR - TVC$) and the final profitability was calculating by subtracting total fixed cost from total growth marginal rate ($Profit = GM - TFC$).

Table 7. Cost benefit analysis of faba bean demonstrated varieties in ETB/ha.

Parameters	N	Minimum	Maximum	Mean	Std. Deviation
Yield of Aloshe Kg ha ⁻¹	18	3300	5200	4060	4.65440
Yield of Walki Kg ha ⁻¹	18	3200	4900	3960	4.29774
Farm get price (P)	18	20.00	20.00	20.0000	.00000
Total Fixed cost	18	3000.00	3000.00	3000.0000	.00000
Total variable costs	18	24603.00	26403.00	25589.3889	444.45540
Total cost	18	27603.00	29603.00	28644.9444	504.67561
Total Revenue of Aloshe	18	66000.00	104000.00	81222.2222	9308.79126
Total Revenue of Walki	18	64000.00	98000.00	79333.3333	8595.48445
Gross margin of Aloshe	18	40397.00	78697.00	55632.8333	9214.91889
Gross margin of Walki	18	38397.00	72697.00	53743.9444	8465.65677
Profit of Aloshe	18	37397.00	75697.00	52632.8333	9214.91889
Profit of Walki	18	35397.00	69697.00	50743.9444	8465.65677

3.4. Farmers' Feedbacks on Demonstrated Varieties

Research is circular in which improved (new) varieties were released from research center and disseminated to farmers. In participatory research activities like sowing on farmers' field the farmers had sound feedback on what they obtained or observed improved varieties from research centers by researchers. During the demonstration of faba bean farmers provide constructive feedbacks, this feedback goes back to research agenda for further research on faba bean technologies for researchers. The demonstrated faba bean varieties were compared based on farmers' preferences such as: maturity date, disease tolerant, pod per plant, seed per pod, grain yield, good crop stand, seed size and profitability of the varieties farmers preferred both varieties as their first choice.

4. Conclusions and Recommendations

Pre-extension demonstration of faba bean varieties was carried out on eighteen (18) representative trial farmer's fields. Improved variety Aloshe with standard check Walki variety was demonstrated under farmer condition. Training, exchange visit and field day were organized to create

awareness and enhance farmer to farmer learning on faba bean production. The demonstration result revealed that both improve and standard check varieties were good performed which gave 4060 kg ha⁻¹ and 3960 kg ha⁻¹ from Aloshe and Walki varieties respectively. Moreover, final profitability from both varieties was viable at the study area which returns (52,632 and 50,743 ETB) from Aloshe and Walki varieties respectively. In terms of farmer's feedbacks and preference both varieties was preferred as their first choice based on; maturity date, disease tolerant, Pod per plant, Seed per pod, grain yield, lodging status, good crop stand, seed size and profitability. Therefore, based on grain yield obtained, farmers' preference and economic return of both varieties are recommended for further scaling up/out in Guji Zone and similar ecologies.

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