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Large-Scale On-Farm Production Performance of Common Bean Varieties in Central Rift Valley of Oromia Regional State, Ethiopia

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ABSTRACT

Common bean is an essential crop in Ethiopia and the Central Rift Valley of Oromia regional state. The majority of smallholder farmers in these areas cultivate common beans using old varieties or local ones with their production practices. Because of this, the actual smallholder farmers' yield is very low (1779 kg/ha) as that of -research center yield data of 3,500 kg/ha using improved varieties and improved management techniques Even though there are many contributors to these yield gaps, it is mainly attributed to lack of utilization of improved varieties and recommended production practices that are accessible to smallholder farmers. This study, therefore, was conducted to assess the performance of the newly released common bean varieties through large-scale demonstrations in farmers' fields. The experiment was carried out for two consecutive years (2019-2020) by using three varieties (SER-125, SER-119, and Awash-2) with recommended agronomic practices. The study was conducted in 69hectare (ha) by participating 85 farmers. The results of the study showed that if farmers cultivate the improved varieties (SER-125, SER-119, and Awash-2) in large-scale clustered farms, the common bean yield will be improved by up to 46% compared with the local yield potential. The yield advantage of Awash-2, SER-119, and SER-125 varieties was 12.3%, 45.6%, and 43.5 over the local Adama and Shalla districts respectively. The study also found the newly released varieties are preferred by farmers based on the pairwise ranking because of their high-yielding, early maturity, and drought-tolerant traits, respectively. However, farmers reported they were challenged to access the common bean seeds. For sustainable production of improved common bean technologies, the seed system should be taken into consideration to deliver the seed supply to the entire common bean producers. So any seed multiplier organizations like unions and cooperatives should give due emphasis to improved common bean seed. In addition, research institutions need to focus on solving insect (Bean stem maggot) and diseases (Rust and Halo blight) problems faced by common bean producers to improve the production of common beans in the study area and similar Agroecology.

Keywords: Challenges, Farmers' preference, Improved varieties, the Yield gap.

1. INTRODUCTION

In Ethiopia, the agricultural sector is the mainstay of the country's economy. It contributes the largest share to the GDP, export trade earnings, and employment. It also provides raw materials for the various industries in the country to a great extent (Getachew, 2018). However, it is heavily dependent on rainfall and the seasonal shocks that are frequently observed. The smallholder farming system is the most important or dominant system. It accounts for more than 95 percent of agricultural production. It is characterized by mixed farming where 86 percent of this community cultivates farmlands with areas less than 2 hectares each (Aweke, 2017).

Grain crops (cereals, pulses, and oilseeds) are the major food crop and source of income at the household level cultivated by smallholder farmers. According to a central statistics agency report in 2021, within the category of grain crops, cereals are the major food crops both in terms of the area they are planted and the volume of production obtained. Pulses are also among the various crops produced in all the regions of the country after cereals. Faba beans and common beans (white and red) are the major ones in the production area and total production.

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Common bean (Phaseolus vulgaris L.) is one of the most important pulse crops grown in Ethiopia, both in area coverage and quantity produced. It is cultivated mostly in the Oromia (43%), Amhara (25%), and 29% in Southern Nations Nationalities and Peoples regions (CSA, 2021). It grows twice a year (Belg and Meher season) in some areas with bimodal rainfall patterns. In the first season known as Belg (March to mid-May), it is usually inter-cropped with maize and sorghum while in the main cropping season, Meher (end of June to September) and planted as the sole crop. Common bean farmers prefer the crop because of its fast maturing which enables households to get additional cash income because of the possibility of double cropping (Berhanu et al., 2018).

The production area for common beans in Ethiopia in 2014 was 323,318ha and decreased to 311,583ha in 2020. Even though the area coverage decreased in the stated period, the total production increased from 51,373 tons to 68,752 tons. This is because of productivity improvement (CSA, 2021).

However, the productivity level is far below the corresponding yield (3500 kg/ha) recorded at research stations (MoANR, 2016). This shows the yield gap between the farmers' average yield and the potential of the crop is about 1721 kg/ha. The lack of improved varieties of common bean is the bottleneck problem that aggravates the lower yield of the common bean in the study area. Although there is a general understanding and recognition of the benefit of using improved varieties, the

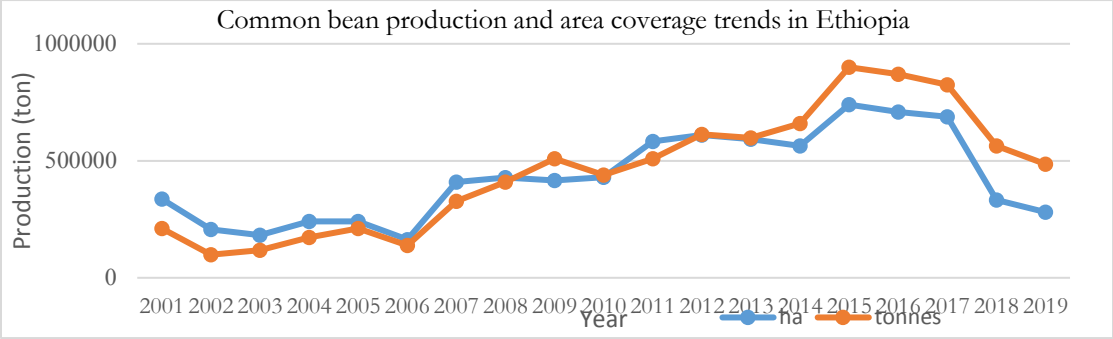

Figure 1. Trends in common bean production and area coverage (2010–2019)

Source: FAOSTAT www.fao.org

accessibility of improved common bean varieties is lacking and farmers are growing unknown varieties in the study areas. Hence, there is a huge yield gap of up to 96% to be bridged in the production, productivity, and income of smallholder common bean growers. The lack of improved varieties is one of the top problems for the low yield of common beans (Fekadu, 2007).

To overcome the above-stated problems, the Ethiopian Institute of Agricultural Research (EIAR) released and registered multi-disease-resistant high yielder common bean varieties (Berhanu et al. 2018). However; the newly improved varieties are not cultivated by farmers on a large scale. Therefore, there is a need to introduce the improved common bean varieties to the target area is paramount important to come up with improved productivity and production of common beans in the study area. Given these limitations, the study is proposed to quantify the yield potential and yield gaps of common bean across the major growing areas using large-scale demonstration plots to show the worth of the new variety and convince farmers to adopt improved production management practices of haricot bean for enhancing the productivity of haricot bean production to popularize improved haricot bean variety in the study area.

2. MATERIALS AND METHODS

Description of The Study Area

The study was conducted in three districts: namely, Shalla, Shashemene, and Adama. The study areas were selected based on the potential and area coverage of the crop. The selection was done in collaboration with district experts of the respective agricultural and natural resource offices.

Adama district is located between 8°33'35" N to 8°38'46"N and 39°10'57" E to 39°30'15"E. Its annual temperature and rainfall vary between 15°C and 20°C and 700 mm-800 mm, respectively (Hurgesa et al., 2019). Shalla district is one of the districts in the West Arsi Zone of Oromia National Regional State. The area receives annual rainfall ranging from 1000-1200 mm and the main growing season is from June to September. The altitude of the district is between 1000 and 2300 meters above sea level. The mean annual temperature of the district is 22°C and 25°C. Agriculture is the primary economic activity for 95% of the population where maize, wheat, common bean, and teff are the major crops cultivated by the farmers (Ahmed et al., 2018).

Shashamane district is found around 253 kilometers far from Addis Ababa to the South. The geographical extent of the Shashamane district ranges from 7° 04'50" to 7° 22'45" N and 38° 23'00" to 38° 48'00" E. Its total area coverage is 76787.86 hectares. The elevation of the district varies between 1683 m to 2742m above mean sea level. Annual total rainfall distributions range from 862-1111mm. A bimodal rainfall is common and the peak rainy season is in May followed by the second peak in August. The major crops produced in the district include maize, wheat, barley, teff, common bean, and potato (Tadesse et al., 2016).

Description Common Bean Varieties Cultivated

Common bean large-scale demonstration was carried out in the central Rift valley areas of Ethiopia's main growing season. In the study areas, improved varieties of common beans with recommended practices were introduced by the Melkassa research center of the Ethiopian Institute of agricultural research. According to Adam et al., (2005), six local cultivars: Bora, Waka, Dima, Bolonde, Fosolia, and Gale-Abesha; and three improved varieties: Awash 1, Mexican 142, and Roba 1 are cultivated by the farmers. To grow these varieties, farmers mostly use informal local seed sources. This constitutes farmer-to-farmer exchanges, using their seed stocks, and using undeveloped seed markets (Tebeka et al., 2017). As a result of this, the productivity of the crop was low compared with the newly released varieties' potential (Fistum et al., 2021).

Site and Farmers' Selection

Evaluation of yield performance of common bean varieties through large-Scale On-farm Production was conducted in three potential districts of the central Rift valley. Adama, Shalla, and Shashemene districts were selected from the central Rift Valley (CRV) area using a purposive sampling technique based on common bean production potential and their accessibility for field monitoring and follow-ups. Kebele and hosted farmers were selected carefully from each district with the help of development agents and experts by considering the performance and willingness to implement the large-scale demonstration. Large-scale demonstration hosting farmers were responsible to manage the demonstration plot of land allocated for the activities. Two kebeles were identified from each district randomly. Two kebeles (Awara gama, and Bekele girisa) from Shalla district and Mermersa and Guraja kebeles from Adama district, and also oine shago from Shashemene districts were used for this large scale demonstration. Eighty-five farmers were randomly selected to host the on-farm trials in all selected kebeles. A primary criterion for selection was farmers' interest and experience level in the common bean production, willingness to manage and allocate land for the study, and willingness to collaborate with extension agents and researchers. In each kebele farmers contributed on average 0.8ha of land for the large-scale demonstration.

Table 1. Description of the large-scale demonstration areas

District	kebele	Location			Total area covered	Mean area covered	Participant farmers	
		Latitude	Longitude	Altitude			M	F
Shalla	Awara Gama	038° 26.83'	07° 16.87'	1682	20 (29%)	1	17	3
	Bekele Deya	038° 24.52'	07° 17.29'	1673	10 (14 %)	1.4	7	0
Adama	Mermersa	039° 24.32'	08° 24.6'	1655	7 (10%)	1.8	4	0
	Guraja	039° 22.3'	08° 36.67'	1654	22 (32%)	0.5	36	9
Shashemene	OineChafo	038° 32.76'	07° 13.881'	1799	10 (10%)	1.11	8	1
Total					69	0.81	72	13

Experimental Design and Management

The experiment was conducted under clustered farm plots in three districts in two cropping seasons. Based on the cluster farms' size a minimum of 10ha and a maximum of 22ha of land of 10 cm by 10cm and spacing of 40 cm between rows was cultivated. Three common bean varieties (Awash-2, SER-125, and SER-119) were used in the experiments and compared to the local variety as a control. Theoretical and practical training was provided to hosted farmers and experts regarding

production management and marketing before implementing the demonstration. Although planting date varies between farmers and research center recommendation of improved variety due to the maturity date difference of the variety used by the farmers and the research center improved one. The varieties (SER-125 and SER-119) were planted in Shalla and Awash-2 planted in the Adama districts in the second week of July. A seed rate of 100 kg per hectare and chemical fertilizer (100kg NPS fertilizer per hectare rate) was applied. A total of 6900 kg of seeds of the three varieties were supplied to the demonstration host farmers. The seeds were sewn by hand in the rows as uniformly as possible and covered with soil manually. Moreover, all other necessary field management practices were carried out as per the recommendation. The cost of fertilizer including field management was covered by the farmers. Similarly, for comparison purposes in the selected districts non target farmers' information on common bean production and yield potential was recorded (Table 2).

Table 2. Comparison of Common Bean Production by improved Practices and Farmers' Practice

Specifics	Research recommended practices	Farmers practice
Seed rate (kg/ha)	100	100-120
Seed source	formal	informal/ savings
Planting time	the second week of July	the first week of July
Use of an improved variety	SER-125, SER-119, and Awash-2	local cultivar (unidentified)
Method of sowing	row planting	row planting
Seed quality standards	90 % germination and 100% purity	unknown
Spacing(cm)	40 x10 cm	not uniform
Nutrient management	100 kg/ha of NPS	< 100kg/ha
Weeding	two-three times	one time
Farming situation	rain-fed	rain-fed

Capacity Development

On-spot training on the full package of haricot bean production methods and management practices and concepts and principles of large-scale demonstration in cluster farming were given to farmers, Development Agents (DAs), and Subject Matter Specialists (SMSs) before starting the activity. An exchange visit was also conducted within the cluster farming group and lessons were learned in the field about the performance of the technologies happened due to the strengths and weaknesses of the members in management practices. As indicated in Table 3 below a total of 126 participants attended the training and exchange visit.

Table 3. Capacity building methods and participants

Participant	Number of participants		Total
	M	F	
Hosting farmers	72	13	85
Development agent	12	10	22
Experts	13	7	19
Total	97	30	126

Approaches Followed

This activity was the follow-up to the demonstration of the varieties a year before the large-scale demonstration. The large-scale demonstrations are implemented on a relatively medium-scale after technologies prove their performance under pre-extension demonstration (Derese, 2020). In the past three years, demonstration and evaluation of newly released varieties of common bean were undertaken and three varieties (SER-119, SER-125, and Awash-2) were recommended for large-scale promotion. The large-scale demonstration of common beans was conducted for two consecutive years (2019-2020) in a clustered sizeable area and several farmers to create wider demand to enhance the adoption of improved production practices of common beans and create and strengthen linkages among actors.

Selection of the districts was accomplished by a multidisciplinary team of Melkassa Agricultural Research Center in collaboration with experts of the respective districts. Accessibility and potentiality were the most important criteria to select both the districts and the kebeles under consideration. For the effectiveness of the experiment and to bring change in the knowledge, skill, and attitude of the farmers. Accordingly based on the need assessment module-based training was made before the conduct of the large-scale demonstration for the large-scale demonstration participants and development agents. The selected farmers and development agents took part in a brief orientation on the large-scale demonstration plan before the implementation. Based on the orientation, roles were defined.

The districts are assigned to play the role of selecting farmers, providing technical information and inputs required to participant farmers, regularly following up and keeping records, and facilitating information exchange between farmers and stakeholders, while the Melkassa research center provides improved seed, technical backstopping and training, organize field days jointly with the districts. In line with orientation, training (practical and theoretical) was provided on the different components of the improved production practices for the farmers and extension experts in the second week of July 2019 and 2020. At different stages of the crop, a group of farmers evaluated the varieties. At the maturity stage, to popularize the potential of the varieties, field days were prepared.

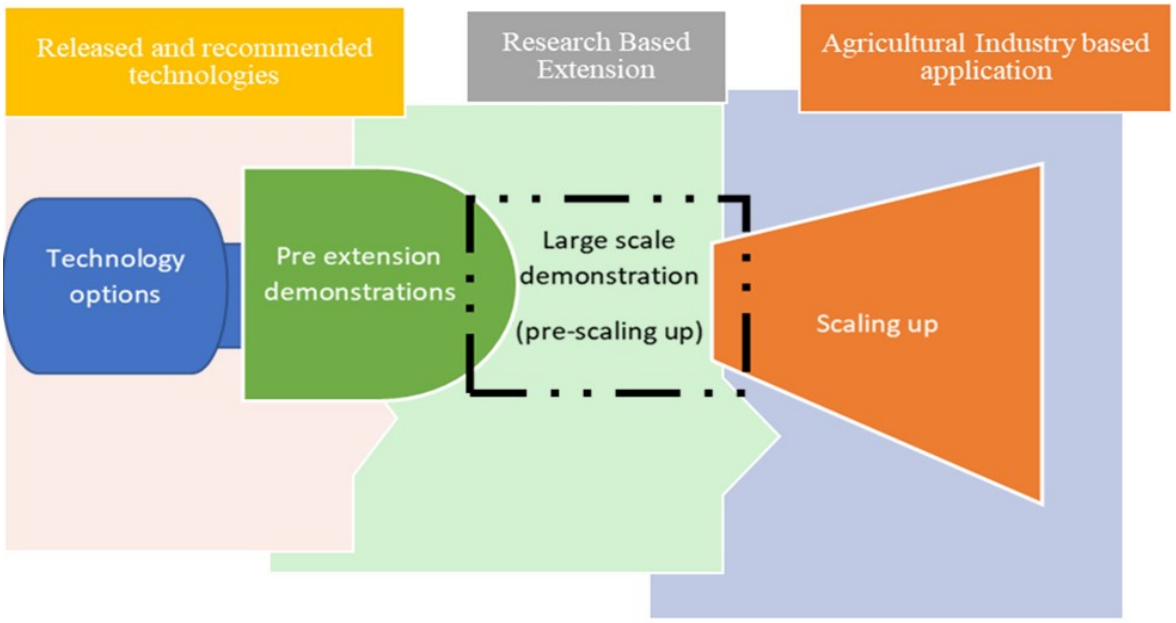

Figure 2. The Large-scale technology demonstration

Source: Adopted from Derese (2020)

Monitoring and Evaluation

The large-scale demonstration was monitored majorly by researchers and the Agriculture and Natural Resource Office of the districts which they represented by the development agents (DAs) in each kebele of the districts. Development agents monitor and manage the activity day to day since they are nearer to the farmer's resilience and also give technical assistance to the farmers. Joint monitoring and evaluation of the activities were conducted among the participating farmers of the districts based on the necessities and requirements. As a result, development agents, subject matter specialists, and researchers offered advice based on the practical problem observed on all the trial sites.

Data Collection

Both primary and secondary data were collected from various sources using a different method from all plots of beneficiary farmers. For the study, quantitative and qualitative data were collected. During the individual interview schedule, collected data included age, sex, family size, years of experience in and yield of common bean in the production year, educational level, total land holding, common bean cultivated area, and constraints related to common bean production. The whole plot harvest method was used to collect yield data. In addition perception data of the Variety were collected. Concerning farmers' preferences, preference data were collected through focus group discussions in each district. The group comprises eight common bean producers of both sexes and different age categories. The

farmers' preference treats were collected at the crop maturity stage by assessing the crop at different stages. The respondents were responding to their perceived level of the relative advantages of each characteristic of the Variety compared to the local/previously introduced variety.

Data Analysis

The collected data was organized and summarized. Data were entered into computer software for analysis. The collected data for achieving all objectives in the study were analyzed using descriptive statistics, such as averages and standard deviations using SPSS software to generate tables and figures. The calculation was done by converting the parameters per hectare. Farmers' variety preference was also analyzed qualitatively. Yield advantages of the improved variety over the local calculated by using the following formula;

$$\text{Yield advantage of x variety} = \frac{\text{yield of x variety} - \text{yield of standarad check}}{\text{yield of standard check}} * 100$$

3. RESULTS AND DISCUSSIONS

Demography of The Demonstration Host Farmers

As clearly indicated in table 3 Farmers who hosted the large-scale demonstration experiment (85 farmers) were interviewed. Among the sampled farmers from each district, 73 were male and the remaining 12 were female farmers. The target farmers were the majority (86%) men. This show that male households are more likely to participate in common bean large-scale demonstration. According to the collected data result, a majority of common bean farmers attended a primary level of education (60%) and only 2.4% of the respondents had a higher level of education. More than half of the common bean producers (60%) are aged between 31 to 50 years. The average year of large-scale demonstration participants was 40. The common bean farmers' family size ranged from 1 to 10, with an average size of 6. The majority 47.1% had a family size of 1-5. Farm experience of households from common bean production is taken to be the number of years. The farmers' experience in common bean production ranges from 2 to 45 years, with an average farming experience of 23 years. A producer with a better experience in common bean production is expected to adopt new technology than less experienced. The total farm size owned by the farmers averaged 1.67ha with a minimum of 0.25ha and a maximum of 10ha. Most farmers (64.7%) grow common beans on plots of size between 0.5 and 1ha. The participant data result indicates that the average household size of the sample household is 6 with a minimum of 1 and a maximum of above 10 members 7 respondents.

Table 3. Demographic Characteristics of large-scale demonstration participant farmers (N=85)

Variables		Number of farmers	Percent	Mean	SD
Education level	No formal education	26	30.6	-	
	Primary education	51	60		
	Secondary	6	7		
	Higher education	2	2.4		
Age (years)	≤30	22	25.9	40	11.747
	31-50	51	60		
	51-70	12	14.1		
Sex	Male	73	14.1	-	
	Female	12	85.9		
Experience (years)	≤10	12	8.2	23	10.09
	11-20	23	27.1		
	21-30	34	40		
	31-40	11	12.9		
	>40	5	5.9		
Farm size (ha)	<1	28	32.9	1.67	1.53
	1-3	51	60		
	>3	6	7.1		
Area allocated to common bean (ha)	≤0.5	19	22.4	0.81	0.46
	0.5-1	55	64.7		
	1≥	11	12.9		
Family size	1-5	40	47.1	6	2.93
	6-10	38	44.7		
	>10	7	8.2		

Source: Own computation from 2019 and 2020 data

Yield Performance

Based on the biological data when comparing the mean yield performance of improved common bean varieties, the maximum yield was recorded by the SER-119 variety (3066 kg/ha), and the minimum was recorded by Awash-2. Accordingly, in the Shalla district, the yield level of SER-119 is high (2566kg/ha) compared with the yield performance level in Shashemene (2392). Even though there was yield variation among common bean producers of the variety across the districts the improved variety has shown consistent yield performance over the local variety. The yield obtained by the new varieties, including the improved production practices, was higher than farmers' practices (local ones). This could be due to the advantages of improved management practices which include tolerance of the variety to drought and better yielder.

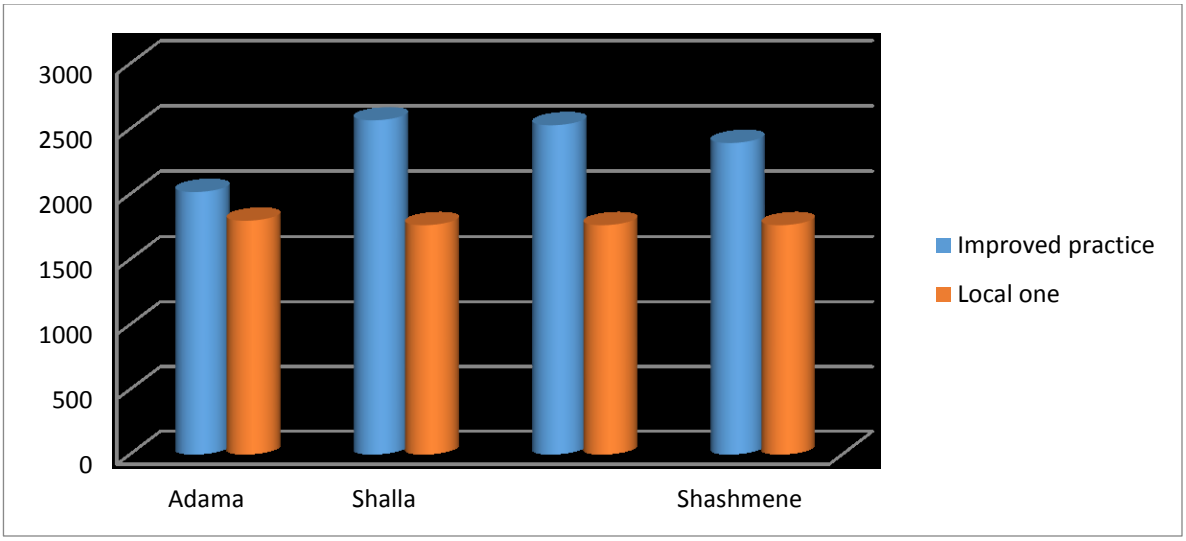

Figure 3. Productivity level comparison of improved varieties and local ones (cultivar)

Yield data were collected from the farmers' field and the result of the data were shown in table 4. The average yield of Awash-2 in the Adama district was 2016 kg per hectare that of SER-19 and SER-125 in the Shalla districts was 2566kg and 2528kg per hectare respectively. The mean yield of SER-119 in the Shashemene district was 2392kg per hectare. SER-119 shows better yield performance in the Shalla district than in Shashemene. The yield of SER-125 and SER-119 are more likely better yielders than that of Awash-2. The result of the study indicated the improved production practice using the recently released varieties of common bean has a higher yield increment over the yield of common bean using farmers' practices (local ones) in all districts. The larger yield increment was reported from the Shalla district, with a 46% increment with the SER-119 variety. The minimum (35%) yield increment was obtained in the Shashemene district with the SER-119 variety. This shows there is a yield advantage in adopting the improved production practices of the common bean. The result confirms and suggests the positive effects of demonstrations over the existing farmers' practice towards enhancing the yield of common beans with its positive effect on yield. The result confirms that of MoANR (2016) and Yitayal and Lema (2019). The yield difference across a location may come from management practices performed by experimental farmers. Overall evaluation of the on-farm large-scale demonstration indicates that all the large-scale demonstrated improved varieties dominated the locally available seeds regarding mean grain yield.

Table 2. Summary of the large-scale demonstration yield performance of common bean varieties, 2019–2020 (N=85)

District	Varieties	Productivity over years (qt/ha)						Combined mean	SD	CV
		2019 (n=29			2020 (n=56)					
		Min	Max	Mean	Min	Max	Mean			
Adama	Awash-2	1600	2880	2404	1520	2950	2073	2201	409	17%
Shalla	SER-125	1800	2800	2440	2300	2900	2573	2529	269	7%
	SER-119	1800	2840	2212	2680	3030	2850	2584	446	20%
Shashmene	SER-119				1950	3070	2392	2392	360	13%
Total	Awash-2	1600	2880	2404	1520	2950	2073	2201	409	17%
	SER-125	1800	2800	2440	2300	2900	2573	2529	269	7%
	SER-119	1800	2840	2212	1950	3070	2593	2502	413	17%

Source: Own computation from 2019 and 2020 data

Yield Gap and Advantages

The result of the evaluation depicted in Table 5 showed that all the large-scale demonstrated improved variety seeds had a significant yield advantage over the control in all testing sites**.** Despite the variability in performance, the yield performance of the varieties was promising. The variability in yield performance across location and within location might have stemmed from a difference in the status of the soil fertility, the difference in management (usage of recommended cultural practices and inputs), and others. The maximum yield advantages observed from SER-119 variety Shalla district followed SER-125 again in Shalla districts. The least yield increment over control was observed from the Awash-2 variety in Adama districts. Based on the result of this study as indicated in table 5 below Adama district Awash-2 shows 220 kg per hectare 12.3% yield advantages over that of the farmers' practices. While SER-119 and SER-125 at Shalla district show 804 kg and 766 kg per hectare and 45.6% and 43.5% yield increase and yield advantage over the farmers' practice respectively.SER-125 at Shashemene district also shows a 630kg per hectare 35.8% yield increase and yield advantages over the farmers' practice(local standard check). Farmers primarily selected SER-119 and SER-125 varieties in the Shalla districts due to their significant yield advantage and requested seeds for large-scale production for other cropping years.

Table 3. Mean yield advantages of improved common bean practice over local ones in a large-scale demonstration (kg/ha)

Location	Variety	On-farm yield (improved)	Farmers practice (local)(kg/ha)	Yield advantage (kg/ha)	% advantage (kg/ha
Adama	Awash-2	2016	1796	220	12.3
Shalla	SER-119	2566	1762	804	45.6
	SER-125	2528	1762	766	43.5
Shashmene	SER-119	2392	1762	630	35.8

Source: CSA, 2021 and large-scale demonstration plots

Analysis of the t-value of data in table 6 below depicts that there is a statistically significant mean yield difference among the varieties. The mean yield of SER-125 was higher than that of the local ones. The mean yield of Awash-2 was significantly higher than that of the local one ($t(48)=4.323$, $p=.000$). Awash-2 gives a significant yield advantage of 237 kg per hectare. SER-125 gave a significantly higher yield than the local one ($t(14)=10.799$, $p=.000$) in which the mean yield difference of 749 kg per hectare. Similarly, the SER-119 variety has a 712 kg per hectare mean yield difference compared with the local one ($t(20)=8.280$, $p=.000$). This shows that there is an option to increase the yield up to749 kg/ha if farmers cultivate the improved varieties with their recommended practices. This confirms the productivity and income of common bean farmers can improve by adopting the production practices in the respective districts.

Table 4. t-test of yield difference among the demonstrated varieties

Variety	t-test	df	Sig(.2-tailed)	Mean difference
Awash-2	4.323	48	.000	237.24
SER-125	10.799	14	.000	749.33
SER-119	8.280	20	.000	712.48

Control means yield: 1779 kg/ha

Source; own computation from 2019 and 2020 data

Publicity of Result

To popularize the potential of the improved varieties, field days were arranged. To show the performance of the large-scale demonstrated haricot bean varieties and create awareness, a field day was arranged on which participant farmers shared experience and knowledge of production about demonstrated haricot bean varieties in both cropping years and study locations. In other words, it is to show the performance and profitability of new practices/technology/innovation and to convince about the applicability. The total number of farmers who took part in the field day was 355 farmers

(284 males and 71 women). Sixty-eight of them were district experts and development agents (55 male and 13 women) and 24 researchers also participated and shared their views on the demonstrated technology. In addition, attended the field days organized. To this end, a mini field day was organized. Besides, regular joint monitoring and evaluation, follow-up actions, and provision of technical advice were undertaken at different crop stages based on necessary emerging knowledge, skill, and technical advice needed. In addition, 500 leaflets were prepared on improved common bean production practices and distributed to stakeholders. At the end of the visit, we conducted a group discussion to grasp farmers' feedback and reach a common consensus with partners for future scale-up.

FARMERS' FEEDBACK

Farmers' preferences towards the demonstrated common bean varieties on large scale were assessed by enhancing them to reflect their preference for varietal attributes by setting their varietal selection criteria. During the large-scale demonstration process and at the final stage of the activity, an assessment was made to know how the farmers perceived the technologies under different parameters. Information about the farmers' variety preferences and major challenges was identified through focus group discussion. In each study district, we held a focus group discussion. Twenty-four farmers (one group consist eight members) who have different sex, ages, and farm experience in common beans were selected. Based on the farmers who were involved in the discussion from the Shalla district preferred the newly introduced varieties (SER-119 and SER-125) over the local because of tolerance to disease, drought tolerant/ early maturity, good test, red seed color, and market preference for further popularization. Contrary to this, the local variety produced low yield, low tolerance to disease, and takes a longer time to mature (late by two weeks). Similarly, in the Adama district, the participant farmers also showed their interest in cultivating in larger areas for the coming cropping calendar.

The participant farmers in the field visit requested the seed multipliers and district agricultural office for the delivery of the newly introduced varieties in the coming cropping calendar so that they can cultivate and earn good production and income. Farmers also explained the key challenges in producing common beans. In the Adama district, shortage of rainfall, the prevalence of insects (bean stem maggot) improved seed shortage, and the prevalence of disease (rust and hallo blight) are considered the major challenges for common bean producers. In the Shalla district, insects (bean steam maggot) are the first key challenge followed by disease (rust) and rainfall shortage. Similarly, in the Shashemene district, farmers identified insects and diseases as the major challenge for common bean production in addition to the improved seed shortage.

According to farmers' observation, the new varieties captured their interest mainly because of their yield advantage and their early maturity characteristics. Finally, the yield performance of the improved common bean production practices was compared to the farmer's cultural common bean production practices. Accordingly, farmers lastly have decided to grow the improved common bean varieties and share the available seed with other follower farmers who eagerly follow the demonstration activities.

Lesson Learnt

During the accomplishment of the course of the work, the team came to learn that concerted effort among different actors is instrumental for fruitful work. Thus, identification and collaboration with key stakeholders was one important lesson learned from the process. The other lesson drawn was the importance of using innovative farmers as their fields speak louder and clearer than researchers, DAs, and experts. Thus, using them for technology dissemination is a wise approach to reach the vast majority.

CONCLUSIONS AND RECOMMENDATIONS

Common bean is the most important crop cultivated on a large area of land in the central Rift valley part of Ethiopia for consumption and market purpose, also planted as intercropping with different crops. Despite the widespread cultivation of the common bean in the central Rift valley, the production and productivity of the crop are very low. The low productivity of common bean is stemmed from among others, inaccessibility of improved varieties and poor management practices in the study areas. Following this problem evaluation of yield performance of common Bean varieties through Large-Scale demonstration on farm production was conducted at Adama, Shalla, and Shashemene districts purposively because of accessible, potential districts for common bean production and demonstration made before. The main objective of the study was to popularize improved common bean variety in the central Rift valley of Ethiopia.

Large-scale demonstrations through cluster farming approaches were followed in implementing the activities. statistical software SPSS used for the analysis and process of the data. Descriptive analyses such as percentage, frequency, mean and standard deviations were used to describe characteristics of households and to calculate the mean grain yield for collected data. T-test was used for continuous variables. Three improved variety along its improved practices with their local variety implemented on 85 hosting farmers in two consecutive cropping years. Improved common bean varieties were compared with the local and all improved common bean varieties (Awash-2, SER-119, and SER-125)

met the farmers' criteria. This variety has high market demand, and shorter maturity dates and they are droughts tolerant.

The study showed that the improved common bean production practices had better yield performance than the local ones in all locations. The results indicated that the improved variety gave a promising yield in the Adama district. Awash-2 (220kg/ha) has a yield advantage of 12.3% over farmers' variety, in Shalla district SER-119 and SER-125 get yield performance of 804kg/ha and 766kg/ha having yield advantages of 45.6% and 43.5% over farmers variety respectively. At Shashemene district SER-119 gave 630kg/ha having yield advantages of 35.8% over farmers' Variety. Thus, the cultivation of common beans with improved production practice was found more productive.

Therefore, farmers can increase yield capacity and income up to 46 percent by replacing local ones with improved practices. It was learned that a demonstration of new technology using appropriate extension methods such as training and farmers' days are among the best approaches in technology transfer. Experiences were shared among target farmers, researchers, agricultural development agents, and other stakeholders through group discussion on the specific improved practices during the farmers' days. Hence, the office of agriculture and the natural resource of the respective districts should further scale up the improved production technology of common bean for many farmers in similar agroecologies. Seed producer enterprises, unions, or organized seed producer farmers should continuously and consistently multiply and supply the seeds SER-125, SER-119, and Awash-2 varieties so that there is sustainable seed supply in the study area. Research institutions should also give attention to solving common bean farmers' problems, insects (Bean stem maggot), and diseases (Rust and Halo blight).

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