

Large Scale Demonstration and Yield Performance of Selected Crop Technologies: Evidence from West Shewa Zone, Oromia Region, Ethiopia

Addisu Getahun*, Chernet Assefa

Ethiopian Institute of Agricultural Research (EIAR), Holetta Agricultural Research Center, Addis Ababa, Ethiopia

Email address:

addisgeta127@gmail.com (Addisu Getahun)

*Corresponding author

To cite this article:

Addisu Getahun, Chernet Assefa. (2023). Large Scale Demonstration and Yield Performance of Selected Crop Technologies: Evidence from West Shewa Zone, Oromia Region, Ethiopia. *International Journal of Science, Technology and Society*, 11(6), 195-199.

<https://doi.org/10.11648/j.ijsts.20231106.11>

Received: November 3, 2023; **Accepted:** November 23, 2023; **Published:** December 5, 2023

Abstract: Large-scale demonstrations of selected crop varieties with their production package were conducted in the West Shewa zone of Oromia, Ethiopia. The objective of the study was to create wider access to recently released agricultural technologies using large-scale technology demonstration approaches and enhancing the productivity of selected crop varieties to smallholder farmers in the study areas. Improved crop technologies of tef, bread wheat, food barley, malt barley, chickpea, and faba bean with their production package were demonstrated on a cluster basis. For the success of the LSD, the training of trainers was provided for the agricultural experts, development agents, government officials, and farmers focusing on crop production and management practices, post-harvest handling, and market linkage. During the 2018/19 cropping season, 56.26 quintals of improved seed were distributed and a total of 134.92 hectares of land were covered. In this LSD a total of 242 farmers directly benefited from the introduced technologies. From the areas covered a total of 1,387 quintals of outputs was harvested from the demonstrated technologies. To evaluate the performance of the technologies and to share experiences among the participants field days were conducted in the Ejere and Ejersa Lafo districts. In the field days organized, a total of 363 participants representing farmers; region, zone, and district-level agricultural experts, researchers, and other stakeholders participated. The yield performance of crop technologies with full production package and appropriate crop rotation was more beneficial to farmers through clustering approaches. Hence, governments, farmers' organizations, and concerned stakeholders have to focus on availing full crop technology packages for cluster farming with rotational crops to enhance crop production and productivity.

Keywords: Crop Technologies, Large Scale Demonstration, Crop Varieties, Yield, West Shewa

1. Introduction

In Ethiopia, agriculture plays an important role as the primary source of food and income for the farming communities. In the Ethiopian agricultural sector, grain crops constitute a total area of about 12.2 mill hectares of land and a total of about 327.9 mill quintals of outputs were produced [1]. The agricultural sector in the country provides a total of 98% of calorie intake and 70% of raw material for industry [2]. The sector remains largely dominated by rain-fed subsistence farming by smallholder farmers. Smallholder farmers in Ethiopia are characterized by subsistence

agriculture with a low level of productivity in part due to the traditional production system, lack of improved farming practices, and limited supply or use of improved technologies. The majority of smallholder farmers cultivate the through use of endogenous cultivars and technology and food security is a growing concern for smallholder farmers [3].

Successful agricultural technology development and dissemination contribute to achieving food security, poverty elevation, and economic development by increasing production and productivity through providing new technology and skills. The sound achievement in agricultural production not only means getting enough food crops to

achieve food security but also bodes well for the economy. In this regard, joint efforts aim to ensure the desired level of agricultural production so that Ethiopia can achieve food security [1]. Improved crop technologies play a catalytic role in agricultural development by bringing a positive change in the entire economy. Given its potential and catalytic role, agricultural research has been conducted by different organizations since the late 1940s in Ethiopia. Since then, a quite number of high yielder agricultural technologies have been generated and transferred.

Despite the efforts made so far in generating and transferring agricultural technologies, the rate of adoption of these technologies remained low, primarily because of limited location-specific recommendations, and inadequate capacity to multiply source technologies and dissemination activities. The Ethiopian government uses several methods of agricultural extension to disseminate and popularize improved technologies among farmers through pre-extension introduction, scale-up, and large-scale introduction [4]. Creating a favorable condition for the wider application of proven agricultural technologies to have production and productivity is one of the priority intervention areas. This research activity is intended to demonstrate proven crop technologies and to evaluate their performance in potential agro-ecologies at full package technology adoption and large-scale clustered approach and thereby, contribute to improved agricultural production and productivity that to enhanced food security. The general objectives of this research activity were to create awareness and wider access to recently released agricultural technologies through large-scale technology demonstration approaches in selected cluster areas. The specific objectives are:

- 1) To demonstrate and enhance the adoption of improved crop production technology packages
- 2) To strengthen the agricultural research and extension linkage for joint crop technology dissemination; and
- 3) To evaluate the yield performance of the selected crop varieties

2. Research Methodology

2.1. Description of the Study Area

This research was carried out in the Ejere, and Ejersa Lafo districts West Shewa zone of the Oromia national regional state, Ethiopia. West Shewa is classified under midland agroecology which is a mixed farming system that is the main economic activity that includes both crop production and livestock raising. The zone was characterized by diversified landforms predominantly plateau with some small hills, mountain peaks, plateaus, plains, valleys, and lowlands. The major soil type is sandy loam and clay is moderately productive. The main crops grown in the areas are tef, wheat, barley, maize, sorghum, pulses, and oil seeds. The main rainy season is the period from June-September and the short rainy season is the period from March to the end of April [5]. The area receives an annual rainfall ranging from 500 to 1600

mm where the minimum and maximum temperature is 10°C to 28°C, respectively.

The first large-scale demonstration site Ejere district is among the 23 districts of the west Shewa zone, which is located at 40 kilometers of west Addis Ababa along Nekemte road. Ejere district is bordered by Wolmera district to the east, Ejersa Lafo district to the west, Adaberga and Metarobi district to the north, and Illu and Alemtena district to the south [6]. The district has a total of 30 kebeles of which 27 are rural-based kebele administration areas and 3 are town. The district has two agroecologies which are Dega (45%) and Weina Dega (55%) [7]. The farming system of the district is characterized by a mixed crop-livestock farming system. Cereal crops widely produced in the area include tef, wheat, barley, and maize, pulse crops like chickpeas, haricot beans, faba beans, and noug are the major crops grown. The agroecological zones of the district are highland 45 % and midland 55 %. The latitude and longitude of the district 9° 2' N 38° 24' E. The population of the district is 114,714 with a household head of 14,538. The altitudes of the area range from 2060 to 3185 m.a.s with an average rainfall of 1100 mm and the minimum and maximum temperature of the district is 9°C and 28°C, respectively.

The second demonstration area Ejersa Lafo is situated at the general elevation ranges from 2080 to about 3000 meters above sea level. The geographical coordinates of the district are 9° 2' 0" N, 38° 19' 0"E and the temperature ranges from 15.5°C in November to 19.9°C in May with the mean annual temperature being 16.5°C. The average total annual rainfall was 1100mm. The area generally lies within the Dega and Weina dega traditional climatic zones. Agriculture is the main economic activity that mixed farming (animal rearing and crop cultivation) is widely practiced in Ejersa lafo. The main crops cultivated in the area include cereals, pulses, spices, and oil seeds. Among cereals, tef covered 50% of the total cropland and the second most important crop in area coverage and volume of production next to tef is wheat which covered about 40% of the crop field and chickpea is the third important pulse crop next to tef and wheat in area coverage.

2.2. Types, Sources, and Methods of Data Collection

In this study both primary and secondary data types were used to compute the performance-improved crop technologies demonstrated through large-scale demonstration. Here the quantitative and qualitative data was collected using appropriate data collection methods field observation and measurement; agronomic data, grain yield, and technology need assessment were also assessed. A semi-structured questionnaire was used to collect the primary data from cluster participant farmers. Secondary data on clustered-based large-scale production were taken from different published and unpublished sources.

2.3. Participants' Farmers and Site Selection Procedures

For the efficient crop technology demonstration and

performance evaluation, appropriate site selection was carried out by a multidisciplinary team of researchers, district office experts, and development agents. Potential kebeles suitable for the production of selected crop technologies were selected purposively one kebele from Ejersa lafo district and four kebeles from the Ejere district. Next, farmers who are willing to provide labor and willing to participate in the large-scale demonstration within the selected cluster were purposively selected.

2.4. Methods of Data Analysis

The methods of data analysis used this was descriptive statistical tools to discuss the findings of the study. The descriptive statistical tools mean, maximum and minimum were employed to present the data that was collected through structured questionnaires and focus group discussions.

3. Result and Discussion

3.1. Technical Training Delivered on the LSD

For proper technology promotion and dissemination in the rural as well as urban areas capacity building training is a

prerequisite for farmers, development agents, agricultural experts, and other stakeholders. At the implementation of the activity in the selected districts training of trainers was given to 21 development agents, 23 agricultural experts, and 3 government officials on the full crop production package and application of agronomic practices of those selected commodities in collaboration with relevant stakeholders.

3.2. Crop Technology Dissemination in the Study Areas

The experiment was conducted at Ejere, and Ejersa Lafo districts to evaluate the performance of improved technologies in the 2019/20 cropping season about six different crop technologies were disseminated (teff, bread wheat, faba bean, malt barley, food barley, and chickpea) varieties along with their management practices under farmer's circumstances. In the year 2019/20 cropping season a total of 56.26 quintals of improved varieties of seed were distributed to the selected farmers and about 134.92 hectares of land was covered (Table 1). In these technologies, 242 farmers (186 male and 56 female) participated in large-scale demonstrations and enhanced the dissemination of improved varieties in the study area.

Table 1. Technologies disseminated through large-scale demonstration.

District	Crop	Varieties	Amount of seed dist. (Qt)	Area covered (ha)	Beneficiaries	
					Male	Female
Ejere, Ejersa Lafo	Teff	Dagem, Kora, Kuncho. Boset	16.66	111.11	150	44
Ejere	Bread wheat	Wane	6.0	4.4	3	2
Ejere	Malt barley	IBON	6.6	4.41	6	1
Ejere	Faba bean	Dosha	10	5.0	12	4
Ejere	Chickpea	Arerti, Habru	14	10	15	5
	Total		53.26	134.92	186	56

Source: Own computation result

In addition, other agricultural inputs including fertilizer, chemicals, fungicides, insecticides, bio-fertilizers, and lime technologies were employed in the LSD. It reported that [8] mass extension methods using and demonstrating full production package technology were operative in terms of grain yield achieved. At Ejersa Lafo and Ejere district, the recommended amount of fertilizer required for planting was purchased and supplied by the farmers themselves. The fungicide and insecticide chemicals were supplied by the Holeta Agricultural Research Center.

3.3. Knowledge Sharing Field Days Conducted to Display Technology

For further demonstration of the technologies to the larger community field days and knowledge-sharing platforms were organized at crop maturity stages, and key stakeholders have actively participated. The implementation of large-scale technologies demonstration was visited, monitored, and evaluated by different stakeholders. The performances of the technologies were assessed from different perspectives focusing on agronomics performance and productivity of the varieties. Both local and national media outlets gave

extensive coverage and reported several events of the field days. The participants of the field days include farmers, DAs, agricultural experts, administrators, higher officials, EIAR leaders, development partners, policymakers like parliament representatives, and researchers (Table 2).

From the discussion at the field day, farmers appreciate the outputs they got from the harvested crop and acknowledge the Center for the initiative to avail those productive crop technologies. The research results [9] indicated that the reflection from field day participants valued the extensive demonstration found to have a better efficiency. From the participants, it's also raised that all stakeholders through the value chain have to be involved in the input supply and output market including the agricultural technology development and advisory service for farmers. In most cases, smallholders pursue buyers of cereal products at the village level in market trading, where farmers have no guarantee of buyers and market prices for their products [10]. Hence, farmers cooperatives and associations have to be strengthened to guarantee the bargaining power of smallholders at the market.

Table 2. Field day participants attended at Ejere and Ejersa Lafo district.

Districts	Participants in the agricultural production knowledge-sharing platform															
	Farmers		DAs		DBoA		ZBoA		RBoA		EIAR Mgt.		Researchers		Others	
Ejere & Ejersa	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Lafo	150	45	35	10	52	9	4	1	3	1	6	1	15	1	25	5
Total	150	45	35	10	52	9	4	1	3	1	6	1	15	1	25	5

Source: own computation result

3.4. Yield Performance of the Crops Across Districts in 2019/20

The mean yield result of a large-scale demonstration of improved tef variety Kora at Ejersa Lafo district was 15 qt/ha. With the minimum and maximum yield of 10 and 19.5 qt/ha, respectively. The most commonly used indicator of agricultural productivity is crop yield per area (the amount of harvested crop per cultivated area) [1]. In Ejere district six

crop technologies/ varieties were demonstrated along with their recommended crop package in LSD. The technologies were teff, faba bean, bread wheat, malt barley, food barley, and chickpea. The mean grain yield of teff variety Dagem was 12.0 qt/ha and its minimum and maximum were 8 and 15 qt/ha respectively. The second crop demonstrated in the district was faba bean and the average yield obtained from variety Dosha was 23.0 qt/ha. The maximum and the minimum yield recorded were 31.2 and 10 qt/ha.

Table 3. Grain yield of different crop varieties at Ejere and Ejersa Lafo district.

District	Crop	Variety	Area	Grain yield qt/ha			Total seed produced (qt)
				Min	Max	Aver.	
Ejersa Lafo	Teff	Kora	37	10	19.5	15	585
	Teff	Dagem	6	8	15	12	75
	Bread wheat	Wane	4.4	14	30	25	120
Ejere	Faba bean	Dosha	5.0	10	31.2	23.0	112
	Malt barley	IBON	5.62	27	40	35	200
	Food barley	HB 1307	3.36	23	35	27	95
	Chickpea	Arerti & Habru	10	12	24	19	200
	Total		71.38				1387

The third crop planted in Demos was barley i.e. food and malt barley. One improved malt barley variety IBON and one improved food barley variety HB 1307 were used to promote the technologies to the farmers. The minimum, maximum, and average yield obtained from these varieties were 27, 40, and 35; 23, 35, and 27, respectively (Table 3). It's suggested by [11] that research centers and relevant stakeholders work with farmers to focus on the generation of well-adopted technology and dissemination to improve production and productivity. The fourth crop grown during the cropping season in the area was bread wheat Wane variety. The highest, the lowest, and the average yield recorded from variety wane were 30, 14, and 25 qt/ha, respectively. The last crop demonstrated in the Ejere district was the chickpea variety called Habru. The yield results from the Habru variety in the table showed that the mean was 19 qt/h and its minimum and maximum were 12 and 24 qt/ha, respectively. The yield harvested from the cultivated crop varieties is encouraging and higher than the local varieties. This yield increment was supported by the results of [12] that farmers reflect higher yields from improved varieties than local varieties.

3.5. Challenges Encountered and Productive Lessons Learned from LSD

The most important factors affecting yield are weather, inputs used, changes in agricultural practices, amounts of fertilizers used, quality of seeds, and irrigation technology [1].

Key challenges encountered during the large-scale demonstration were identified, including Poor or partial use of recommended packages can reduce productivity. The lack of improved seeds and variety required by farmers is one of the bottlenecks in technology development. Findings by [13] indicated that seed availability needs to be enhanced to ensure sustainable cultivation. Thus, seed companies should produce varieties that are in high demand by farmers based on the regional seed demand assessment. It has been observed that new weeds, diseases, and insect pests have appeared in the fields of the farmers which reduce the yield. Therefore, farmers and relevant authorities must pay special attention to the control of weeds, diseases, and insect pests.

The encouraging lessons attained from LSD operations are training in improved crop cultivation and large-scale technology critical to promoting sustainable production and productivity. The use of agricultural technology in the full packaging with recommended agronomic practices. The research by [14] discussed in popularizing the technology among farmers, it is important to adopt the entire technological package. Technology dissemination based on soil taste results is necessary since most cultivation land with nitrosol produced poor yields due to soil acidity problems. Awareness among farmers and the understanding of other stakeholders is more important and valid for further adoption of improved agricultural technologies [15]. Strong stakeholder partnerships between research, extension systems, district administration, and farmers' associations have to be

strengthened from planning to the end marketing phase.

4. Conclusion and Recommendation

The large-scale demonstrations of crop technologies with fully recommended production package yields encouraging output and are essential to ensure food security and improve farmers' livelihood. This LSD was conducted at Ejere, and Ejersa Lafo districts of the West Shewa zone in the 2018/19 production year, and a total of 56.26 quintals of different crop seeds were disseminated with 134.92 hectares of areas covered with a total beneficiary of 142 (186 male and 56 female) Farmers. Promoting agricultural technologies under cluster large-scale demonstration is not an easy task in rural districts where no all-weather road access and insecure areas. However, it was a blessing opportunity and gave satisfaction in seeing successful results as farmers became happy and heard that the technology was highly profitable from farmers and stakeholders.

In 2018/19 from the areas covered by cluster farming a total of 1,387 quintals of outputs was produced from demonstrated technologies crop technologies. Therefore, all have to encourage the transfer of technology to unaddressed areas. A total of 363 stakeholders have participated in the technology showing and information-sharing field days organized. As feedback from the technologies demonstrated production and productivity were increasing and more demand was created by farmers for the new crop technologies with full production package. The questions raised by farmers are looking to have market linkage and institutional and financial support from the agricultural office of the district. Therefore, delivering improved agricultural production technologies with a full package was recommended in cluster farming areas, and availing of rotational crops, and other income-generating assets like improved dairy cows is crucial.

Conflicts of Interest

The authors declare no conflicts of interest.

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