International Journal of Sustainable Development Research
2023; 9(4): 58-67
http://www.sciencepublishinggroup.com/j/ijsdr
doi: 10.11648/j.ijsdr.20230904.11
ISSN: 2575-1824 (Print); ISSN: 2575-1832 (Online)

Impact of Community Based Seed Production in the Ethiopia Seed System: Evidence from West and Southwest Shewa Zone, Oromia Region

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To cite this article:
Mamaru Tesfaye. Impact of Community Based Seed Production in the Ethiopia Seed System: Evidence from West and Southwest Shewa Zone, Oromia Region. *International Journal of Sustainable Development Research*. Vol. 9, No. 4, 2023, pp. 58-67.
doi: 10.11648/j.ijsdr.20230904.11

Received: September 5, 2023; **Accepted**: September 28, 2023; **Published**: October 14, 2023

Abstract: Community based seed multiplication approaches have been used by agricultural research and development actors to improve farmers' access to quality seed in many developing countries like Ethiopia. Recently it has gained popularity as an alternative to the formal seed sector of disseminating new crop varieties developed by the research system. Almost every smallholder farmer in the country uses the recycled seeds from their farms for the next planting season. Seed producer cooperatives produce quality seed of diversified crops and varieties and directly sell to customers locally and beyond. Community based seed multiplication approach was introduced and evaluated at national level particularly in Oromia regional state of Ethiopia from 2015/16-2017/18 cropping season and by the implementing center of Holetta agricultural research center from 2015/16 to 2019/20 cropping season. Holetta Agricultural Research Center implemented on five seed producer cooperatives. A total of 830 quintals of basic seed of bread wheat, faba bean, chickpea, and malt barley and teff technologies were distributed through EIAR and by the support of USAID_ICARDA faba bean-malt barley project. Overall, in these specific crop technologies a total of 1524 farmers out of which 1192 male and 332 female farmers were directly benefited and more than 680 hectares of land was covered. Over the last five years about 11300.3 quintals of pure seed was produced through the CBSM scheme. Moreover, 80% of the seed produced was inspected and certified by the seed regulatory laboratory and farmers sale their produced seed with 15% premium price. Lastly, to improve the technical skills of zonal and district level agricultural experts and cooperative leaders, training of trainers was provided on seed production and management technics. Similarly, Various theoretical and practical training on seed production and management practices also given to members of CBSP farmers and kebele development agents. Therefore, these kinds of measures effectively address the severe seed deficit in the community and must continue to be implemented periodically in the future.

Keywords: Community Based, Impact, Regional, Production, Seed

1. Introduction

In Ethiopia, the agricultural sector is the main producer of food and the supplier of export products. It is also the largest sector providing employment in the country, with more than 80% of the population engaged in the sector. Seed is a fundamental input in crop farming. It has played a critical role in agricultural development since humans domesticated the first crop around 11,000 years ago. It is a carrier of genetic information that controls the maximum crop productivity, resistance to disease, and tolerance to environmental stresses such as drought [1, 2].

Seed is an essential agricultural input and access to quality seed is of crucial in improving farm household food security in agrarian nations particularly in Sub-Saharan Africa (SSA) and elsewhere. Agriculture provides food, and jobs for about two-thirds of SSA and contributes about 32% of Gross Domestic Product (GDP) [3]. Agriculture led growth in SSA is the most effective and a pro-poor growth strategy than those in the non-agricultural sector [3].

Given the significant current and future role of the agriculture sector, a vibrant seed system that provides quality

seed to meet the demands of farmers is an essential enabler to continued economic and social development of Ethiopia [4].

In addition, providing farmers with increased access to improved, high-quality seeds is a key step toward raising individual yields throughout Ethiopia, and thereby overall national production. In conjunction with other inputs, high-yielding seed varieties can significantly impact crop productivity. Such productivity enhancement offers obvious potential impact to Ethiopia's smallholder farmer's livelihoods. Achieving this goal, however, takes coordinated, systematic and innovative approaches to address the prevailing chronic shortage of improved seed in the country.

As part of executing its responsibility and mandate, the National Agricultural Research System has been engaged in investigating the seed system of the country and as a result limited availability of released crop technologies has been identified as one of the most crucial bottleneck that undermined productivity of smallholder farmers in the country. This suggested the need to strengthen the country's seed system through designing and implementing well designed innovative approach to promoting intermediate and informal seed systems that can contribute for increased availability of improved seeds to farming communities.

The need for engaging in strengthening the intermediate and informal seed systems emanates from the fact that the formal seed system has remained far from reaching and coping with the pace of the ever increasing demand for improved seed. Recognizing such shortfall of the formal seed system, the seed sector development strategy was designed to embrace and consolidate the intermediate and informal systems in anticipation of their immense contribution towards alleviating the chronic shortage of improved seed in the country.

Though, the size of formal seed system in Ethiopia is relatively small, its role in the transfer of seed of improved crop varieties is very important. This implies the dominant role of the informal and intermediary clusters of the seed systems in the country. Community based seed production has been promoted by different actors as one of the components of the national seed system.

In this regard, the national agricultural research system has been employing various approaches to transfer generated/adapted technologies to end users primarily through demonstration and popularization activities with an aim to enhancing farmers' access to improved technologies.

However, as the demand for seeds of improved technologies is growing beyond the capacity of the formal seed system, the national agricultural research system apart from its mandate of multiplying and delivering pre-basic and basic seeds of different crops, it has assumed responsibility of designing and implementing innovative approaches of establishing and strengthening community based seed systems with a prime objective of enhancing transfer of technologies generated throughout the national agricultural research system.

This activity is therefore, designed and implemented with a purpose of promoting community based seed system which involves a multi-stakeholder process and building capacity of community based institutions to strengthen their capacity of multiplying and supplying quality seeds of different crops to famers.

1.1. General Objective

To enhancing the national seed system in general and community based seed systems in particular through timely transfer newly released crop technologies.

1.2. Specific Objectives

1. Enable creation of sustainable institutional linkage among actors of CBSP
2. Improved access and adoption of new crop varieties
3. Increasing seed production and profitability

2. Literature Review

2.1. Definition and Importance of Seed

Seed is the basic agricultural input, and access to preferred and adapted seed is a prerequisite for sustainable production [5] or, the part of a plant from which a new plant can be grown or a vital input in crop production [6]. Seed performs various functions in agriculture and as such plays a strategic role in a range of debates, in particular those concerned with rural development and food security, biodiversity, business development, knowledge and technology [7].

Seed is crucial to food security, hence household nutrition. For example, for rural household to have an adequate diet, they should be able to have a variety of seeds which allow them to produce different types of crops. The availability of seed supported by other input and service are importance for increased crop yield and agricultural production and in most cases guarantee household food security. Good supply systems ensure farmers' or households sustained ability to sufficient quality of the desired types of seed at right time [8]. Genetic resources (seed) provide the fundamental mechanics that enable plants to convert soil, water and sunlight into something of critical value to human's food.

Diverse genetic resources allow humans to select and breed plants and animals with desired characteristics, thus increasing agricultural productivity. Ever since seed was considered an important vehicle to extend intensified production techniques in developing countries, and the supply system has received considerable attention. Limitations of these systems have led to the development of the concept of integrated seed supply for the use of quality seed, along with other inputs and appropriate cultural practices/husbandry practices, is recognized as the most cost effective way of increasing crop production and productivity. The availability of seed supported by other input and service are importance for increased crop yield and agricultural production and in most cases guarantee household food security. Good supply systems ensure farmers' or households sustained ability to sufficient quality of the desired types of seed at right time [8].

2.2. Status of the Ethiopian Seed Industry

Seed system in Ethiopia represents the entire complex organizational, institutional and individual operations associated with the development, multiplication, processing, storage, distribution, and marketing of seed in the country [9]. Farmers, particularly smallholder ones, are involved in multiple kinds of seed systems, which can guarantee them in obtaining the quantity and quality of seeds they need and to market their produce [10]. Seed systems in Ethiopia can be divided into two broad types: the formal system and the informal system [10]. Both systems are operating simultaneously in the country and difficult to demarcate between the two. There is however, a fact that the formal system is the original source of improved seeds in the informal system. There is also a system that interact the two systems referred to as integrated seed system. Other forms of seed systems operating in both systems also exist such as Community-Based Seed System (CBSS). Though not well developed, few commercial seed systems are also operating in the country [10].

2.3. Strengthening the Informal Seed System in Ethiopia

Improving the local seed system means improving seed security, enhancing seed quality, and the availability of good varieties and reliable seed source structures. A number of avenues exist for improvements to the small scale farming seed supply system. The most important to build on farmers' knowledge and capacities. Farmers have particular knowledge of their seeds and varieties. They are good selectors of varieties for their own use because they can weigh the different requirements. At the same time, they can consider the needs of the household how the variety fits into the total production system and how it adapts to the environment [11]. The complementarities of the formal and informal sector offer multiple opportunities to develop a well-integrated seed sector in which both formal and informal actors play significant role. Farmers' capacities and knowledge regarding local conditions, seed selection and traditional mechanisms of seed exchange are valuable elements in the functioning of thin formal seed sector.

Instead of replacing this sector the formal sector can build on these elements to address more effectively seed demands of small-scale farmers. Introducing improved seed technology to local condition can help in improving seed production by the small-scale farmers. Farmer based organizations can play an important role in this respect through participatory approaches. Provision of training can further reinforce such farmers 'capability and knowledge. In addition, the regulatory framework can be changed to suit and facilitate community based seed provision systems.

Integrated seed supply system can be achieved by organizing farmer to produce improved seed in their village. There are seed market niches that can be occupied by organized groups of small-scale farmers. These opportunities are usually neglected by the formal system because the market is not large enough to attract large-scale farmers or because they require hand labor [12]. These market niches need to be identified and suitable conditions developed in order that small-scale farmers may explore them. One strategy is to decentralize and diversify seed supply by the promotion of local seed producers and merchants. And farmers who are known in their community for the quality of their seed may be assisted to develop into small-scale seeds men, thus filling the gaps that the larger formal seed units leave in remote areas or in the market for particular seeds.

3. Materials and Methods

3.1. Description of the Study Area

Community based seed production was conducted in selected farmer seed producer cooperative of west and south west shewa, zone, Oromia region. The research was conducted at Ada'a district only in 2015/16 season at the national level and on five farmer primary seed producer cooperatives of kersa worko and Gudina chala in Kersa Malima; Awash Melka in Sebeta Hawas; Telila Ketero in Wolmera and Negafile in Toke kutaye districts of Oromia Regional state of Ethiopia from 2015/16 to 2019/20 cropping season.

Kersa Malima District: Geographically the woreda is located between latitudes of 8.360 N to 8.710 N and with longitudes of 38.340 E to 38.710 E. The woreda is located at 60 Km south west of Addis Ababa with the total area of 58613 hectare (586 Km2). Elevation varies from 1839 to 3568m a.s.l. It is bounded with S. N. N. P. national regional state to the south west, East Shewa Zone to the east, Sodo Dachi, Alemgena, and Tole Woredas to the south, north east and North West, respectively. The study area is characterized by tropical and warm too cold humid temperate climates. These areas are characterized by an average temperature that ranges from 10-19 0C and the rainfall that ranges from 974-1319 mm. The highland part of the woreda is characterized by; moderate an average temperature 10-15 0C and 1170-1319 mm rainfall. The vegetation type in the woreda is juniperous forest, podocarpus, sub afro alpine region with discontinuous canopy and larger trees limited in spatial cover [13].

The farming system in the district is mixed crop-livestock type, whereby crops contribute larger share to farmers' income. As of potentialities, the district has high potential for crop production. The five major crops grown in the area are wheat, teff, barley, faba bean and chick pea. In 2014/15 cropping season, about 31.25% of crop land was covered by wheat, 19.79% by teff, 18.47% by barley, 10.19% by faba bean and 6.30% by chickpea of the cultivated area [13]. Kersa Malima is a potential faba bean producing district where, faba bean production is about 22.77 quintal per ha is greater than the national average, which is the highest next to Arsi zone in Oromia region.

Sebeta Hawas District: Sebeta Hawas is the second District of the study area which is found in Oromiya Special Zone around finfine, Oromia Region which is located at a distance

of 24 km to 45 km south west of the capital Addis Ababa and between 8° 44' 59.99" N latitude and 38° 39' 59.99" E longitude respectively. The district has an area of 87,532 ha. It has shares borders with Akaki district in the east, Kersa and Tole district in the south, Wolmera district in the north and Ilu and Ejere districts in the west. The land feature of Sebeta Hawas is characterized by mountains and hills and marshy plains and is surrounded by Awash water shade in the west. The altitude in the district ranges between 1800 and 3385 masl [14]. The district has 36 rural and 4 town kebeles; the total number of population accounts 162,852 out of this 83,528 male and 79,324 female [14].

Agricultural activity is the dominant means of livelihood in the district. According to annual report of Sebeta Hawas District Rural and Agricultural Office, out of 87, 532 ha of land 73, 838 ha (84%) are used for agriculture to cultivate different crops for household consumption and sale in local market, and 3,689 (4.2%) of land is used as grazing area [14]. The district is divided into two agro-ecological zones i.e. highland (12%) and mid land (88%) areas respectively. The major crops grown in the districts are cereals, highland pulses and vegetables. Based on woreda level crop production ranking of Ethiopia, Sebeta Hawas is third in chickpea, tenth in teff and 18th in wheat production.

Toke Kutaye District: Nega File is the other seed producer cooperatives involved in CBSM activities located in west Shewa zone at Toke Kutaye district. Toke Kutaye district is one of the 18 districts in West Shewa zone, Oromia, Ethiopia, located at 135 km West of Addis Ababa, districts capital city is known as Guder which is located at 9 km from Ambo zonal city 10 km from Gorosole town to the North.

There area of Toke Kutaye is about 78,887 ha of which 45,651 ha was used for social service, 11,602 ha for grazing, 3651 for forest about 4,579 ha is for road and other services. The total population of the district was 119,999 from these 59,788 males, whereas, 60,211 were females Toke Kutaye is one of the most agricultural potential area of West Shewa zone. Farmer in district extensively cultivates creels and vegetables and rise medium amount of shoot and cattle the shortage of rain fall (moisture stress) at some times is major constraints of agricultural production in the district. The climate is classified into three agro ecological zones are high land 17%, Midland 65% and low land 18%, [15]. Research site altitude 1900-2850 m.a.s.l. and mean annual temperature: 16-29°C. The average annual rainfall of the area is 1291 mm.

3.2. Site and Farmer Selection

Initially, the project activity implementation was started by creating contacts with Oromia, regional bureaus of agriculture officials followed by a step wise communication with zone and district level officials in selected areas. The overall objective of the project was shared by travelling to the target sites with the presence of respective district, community seed production experts, primary seed producer cooperative representatives, seed producer farmers groups. To implement community based seed production activities, consultative meeting was organized.

Presentation and discussion was made on field management, mechanisms of provision, monitoring and support procedures and post multiplication and return procedures of wheat, chickpea, faba bean, barley, bread wheat, and teff and seeds.

The consultative meetings established functional linkages among the stakeholders including farmers, primary cooperatives, seed producer farmer associations by the project implementers of the respective centers and EIAR. Participating farmers with adjacent farm plots were selected purposively in consultation with the selected cooperatives executive committee members, woreda agricultural office experts, development agents and representative of kebeles administration.

3.3. Improved Crop Technologies Distributed Across Districts

The CBSM of selected crop technologies with their production package was conducted in targeted seed producer cooperatives in Oromia region, from 2015/16 to 2017/18 and by the implementing center of Holetta agricultural research centers from 2015/16 to 2019/20 cropping season. Based on the demand assessment of seed the cooperatives/ seed producer groups need to produce, for the last five years by the implementing center a total of 830 quintals of crop technologies/varieties of bread wheat, food barley, faba bean, chickpea, malt barley, and teff were distributed to cover an area of 680 hectares of land. In these technologies, a total of 1524 (1192 male and 332 female) farmers organized in primary seed producer cooperatives and seed producer group were directly benefitted both from hosting the seed multiplication and training.

Community based seed production (CBSP) activity was also carried out in Oromia at Ada district nationally during 2015/16 season and by the implementing center of Holetta agricultural research center from 2015/16 to 2019/20 cropping season. Improved varieties of faba bean, chickpea, bread wheat, teff and Malt barley varieties with their production package were conducted on five different seed producer cooperatives found in South West Shewa, West Shewa and Finifine Liyu zone of Oromia region. The districts are Kersa malima, Sebeta Awas, Wolmera and Toke Kutaye.

In the last five years 830 quintals of faba bean, chickpea, bread wheat, teff and malt barley technologies were provided to 1524 (1192 male, 332 female) participating farmers and 680 hectares of land was covered (figure 1).

3.4. Training and Exposure Visit

Building technical capacity of farmers and cooperative executive committee members, agricultural experts and Development agents is the key steps towards promoting viable community based seed enterprises. At the beginning of the project activity i.e. in 2015/16 cropping season, ToT was organized at the national level to strengthen their technical capacity in CBSM concept, seed production techniques and management practices. Theoretical as well as practical

training was also provided to DAs and farmers to demonstrate the technique of field and crop management, rouging off type plants and management of quality seed production.

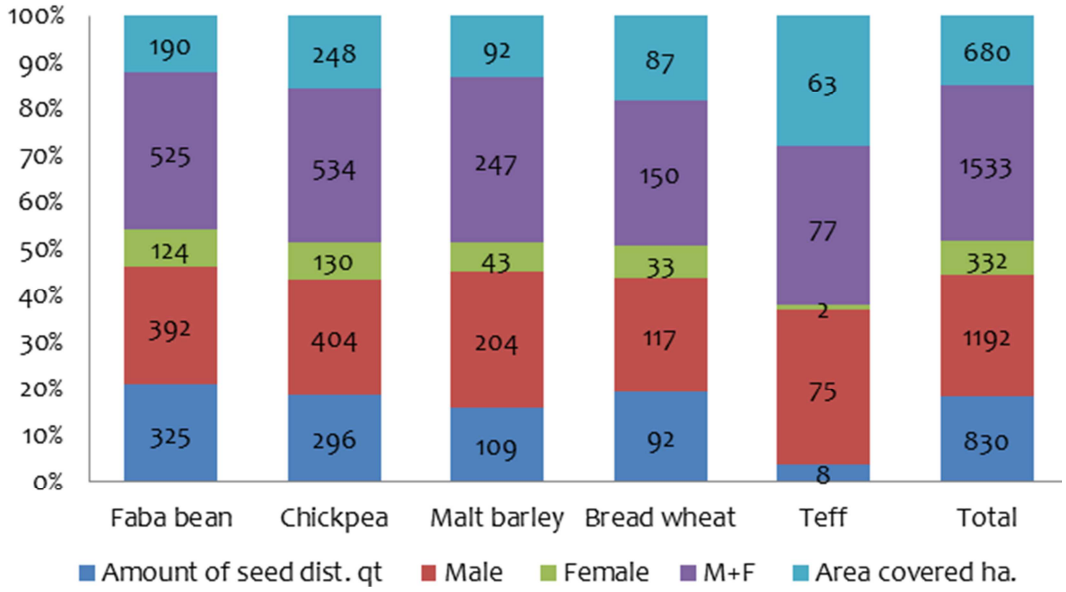

Figure 1. *Crop technologies distributed for the target Districts in CBSP by Holetta ARC from 2015 to 2017/18 cropping season for seed producer cooperatives.*

3.5. Monitoring and Evaluation

A team of researchers and woreda experts have been actively involved in periodic follow up and inspection of each and every seed multiplication field to assure the desire quality and standards of quality seed production is maintained. The necessary data were collected at different stages for the desired actions. The Regional Regulatory Body (RRB) was invited to assess the quality of seed for further distribution and sale. Accordingly, the seed regulatory body inspected the CBSM field at different crop growth stages and finally seed samples were taken for germination and purity test and those who fulfilled the desired standard were accepted as Certified - 1 seed.

3.6. Field Days

Field days were undertaken at national level as well as by the implementing centers to demonstrate the performances of the best-bet practices to participating agricultural experts, Development Agents, farmers, researchers and other stakeholders in the project area to evaluate the performance of the technologies, to exchange experience and to collect feedback about introduced technologies for betterments of future project activities.

3.7. Data Collection and Analysis

Both Quantitative and qualitative data were. The collected quantitative data were subjected to analysis using SPSS software version 20 (minimum, maximum average and total seed yield, yield advantage and percent yield increase) while qualitative data collected using group discussion and field observation and farmers perception towards the technology using descriptive statistics.

4. Results and Discussion

The result of Community Based Seed production conducted on selected farmers' seed producer cooperatives in Oromia regional state of Ethiopia from 2015/16-2019/20 by the implementing center was indicated in Table below. Totally, 11300.3quintals of improved seed of bread wheat, faba bean, chickpea, malt barley, and teff was produced across all locations engaged in seed production activities (Table 1).

4.1. The Overall Produced Seed by Different Seed Cooperatives

In Oromia region, Community based seed production activities was conducted at Ada'a district by introducing one improved wheat variety of Hidase for 2015/16 season only at the national level. A mean seed yield of 40 qt/ha and a total seed yield of 2400 quintals was obtained from this district.

Holetta Agricultural Research Center is one of the implementing centers conducted community based seed multiplication in selected primary seed producer cooperatives of west Shewa, south West Shewa and Finifine special zone of Oromia region. Five crop technologies of faba bean, chick pea, bread wheat, tef and malt barley with their production package were promoted to farmers organized in seed producer cooperatives for five years i.e. 2015/16 to 2019/20 cropping season. In 2015/16 cropping season, improved faba bean variety of Wolki was distributed to Kersa Malima, Sebeta Awas and Toke Kutaye districts. When we compare the yield result of this variety across the three districts the

highest mean grain yield 25.84 qt/ha was recorded at Toke Kutaye followed by kersa Malima 24.48 qt/ha and Sebeta Awas 23.5 qt/ha respectively. The lowest minimum seed yield 14.0 qt/ha and the highest maximum seed yield 42.0 qt/ha was recorded from Sebeta Awas district (Table 1). This result showed that there was high yield variation among seed producer farmers. The overall mean seed yield of the three districts was 24.77 qt/ha.

In the same year, improved chickpea varieties were distributed to Kersa Malima, Sebeta Awas and Toke Kutaye districts. The result in table 1 showed that the minimum, maximum and the average seed yield recorded in kersa Malima and Sebeta Awas was 24.0, 40.0, and 28.2 qt/ha and 9.0, 20.0 and 15.5 qt/ha respectively. The mean seed yield of chickpea varieties obtained from from the two district was 21.85 qt/ha. At Toke Kutaye, during 2015/16 cropping season there was no any harvest of chick pea because of shortage of rain after planting in the area.

In 2016/17 season, three improved varieties of faba bean, chickpea and malt barley were distributed to four districts of Kersa Malima, Sebeta Awas, Toke Kutaye and Wolmera. The result of faba bean in (table 1) showed that the lowest mean grain yield of 16.0 qt/ha was recorded at Wolmera in Dufa Kebele (Telila Ketero coop.) and the highest mean grain yield 32.0 qt/ha was obtained from Kersa Malima by variety Gora. The highest maximum yield 41.2 qt/ha was also obtained from variety Gora at Kersa Malima district. On the other hand the lowest minimum yield of faba bean 10.0 qt/ha was recorded at Wolmera district because of high frost damage at grain filling stage of the crop. Across the four districts, the mean seed yield obtained from faba bean was 22.27 qt/ha. In total, among the four districts 1013.5 quintals of seed yield was produced.

When we see the yield result of chickpea in the table, it showed that the lowest minimum grain yield 12 qt/ha was obtained from Awash Melka primary seed producer cooperatives and the highest maximum seed yield 38 qt/ha was harvested at Kersa Malima district at Kersa worko farmer seed producer cooperatives. The overall average seed yield and the total yield produced from the three districts of Kersa Malima, Sebeta Awas and Toke Kutaye were 19.81 qt/ha. and 887 quintals respectively. Malt barley was the third crop technology multiplied at Wolmera district in 2016/17 season. The result in the table below showed that the mean seed yield obtained from variety IBON was 25.0 qt/ha and a total of 400 quintals of seed was produced by Telila Ketero seed producer cooperatives.

During 2017/18 cropping season faba bean, chickpea and malt barley varieties were tested When we compare the yield data of faba bean among the four districts, the highest maximum yield 40.0 qt/ha was obtained from Kersa Malima followed by 32.0 qt/ha at Toke Kutaye and 29 qt/ha at Wolmera. The mean seed yield produced during 2017/18 season was 21.62.qt/ha and totally 828.5 quintals of faba bean seed was produced across the tested districts. Chickpea was the second crop technology multiplied in three seed producer cooperatives of Kersa Worko, Awash Melka and Negafile. The lowest minimum and the highest maximum seed yield of 10 qt/ha and 48 qt/ha was harvested at kersa Malima district. In the three seed producer cooperatives the total amount of seed produced was 918 quintals and the overall mean seed yield obtained from the three cooperatives was 20.03 qt/ha. Similarly malt barley variety IBON was conducted at Wolmera district in Dufa Kebele by Telila Ketero seed producer cooperatives. In this district variety IBON gave a mean seed yield of 28.5 qt/ha and a total production of 285 quintals.

In the year 2018/19, a total of 3282 quintals of improved faba bean, chickpea, malt barley, bread wheat and teff seed was multiplied by farmer seed producer cooperatives. The result of faba bean in the table showed that the lowest minimum yield 8 qt/ha and the highest maximum yield 33 qt/ha was recorded at Kersa malima district of seed producer cooperatives. The mean seed yield and the total yield harvested across the seed producer cooperative in this season was 19.5 qt/ha and 841.7 quintals respectively. The result of chickpea in the table also showed that the mean seed yield of 23.13 qt/ha and a total yield of 1260.65 quintals were harvested in the same season. Teff and bread wheat were the third and fourth crop technology produced at Kersa Malima district. The mean seed yield and the total amount of yield produced by seed producer cooperatives of teff were 13.9 qt/ha and 738 quintals. Bread wheat was the last crop multiplied in 2018/19 season at kersa Malima. The mean seed yield of teff harvested during the season was 13.9 qt/ha with a total seed production of 282 quintals. Malt barley was the last crop tested in CBSP at Wolmera, Dufa kebele. The average yield of malt barley variety IBON gave a mean seed yield of 20 qt/ha and a total yield of 160 quintals.

In the fifth year faba bean, chickpea, teff and bread wheat varieties were multiplied in CBSP on four primary seed producer cooperatives. The result of faba bean in the table showed that the lowest minimum yield, highest maximum yield and mean yield across location was 12, 32 and 25.23 qt/ha with a total yield of 597.5 quintals of seed. The result of chickpea varieties grown in the three districts of Kersa Malima, Sebeta Awas and Toke Kutaye was also presented in table 1. The lowest minimum and the highest maximum seed yield recorded during 2019/20 season across the tested sites was 11 qt /ha and 30 qt/ha with a mean of 21.5 qt/ha and a total seed production of 785 quintals. Teff was the second crop conducted at Kersa Malima district and the mean seed yield was 16.39 qt/ha with a minimum, maximum and a total seed production of 14, 22.5 qt/ha and 216.25quintals. Bread wheat was the last crop in CBSP multiplied at Kersa malima district in kersa worko seed producer cooperatives. Similarly the mean seed yield obtained from bread variety Wane was 24.36 qt/ha with a minimum, a maximum and a total yield of 21, 28 and 24.36 qt/ha respectively. In general, the result of faba bean yield was lower as compared to the research recommendation because of faba bean gall disease, frost and water logging. Chickpea yield across districts in the last three years showed that there was high yield difference due to African ball worm and wilt root rot, frost and ascochyta

blight. Furthermore, the yield of bread wheat was also lower as compared its potential because of its vulnerability to yellow and steam rust.

Table 1. *Minimum, maximum, average yield qt/ha and total seed produced in quintals in CBSS Oromia (HARC) from 2015/16 to 2019/20 cropping season.*

Year	District	Cooperatives	Crop	Variety	Grain yield qt/ha			Total seed produced (qt.)
					Min	Max	Aver.	
2015/16	Kersa Malima	Kersa Worko	FB	Wolki	16.0	32.0	24.48	306
			Chickpea		24.0	40.0	28.2	443
	Toke Kutaye	Nega file	Faba bean	Wolki	14	40	25.84	192.2
	Sebeta Awas	Awash Melka	Faba bean	Wolki	15	42.0	23.5	410
			Chickpea		9.0	20.0	15.5	235
	Adaa		Bread wheat	Hidase			40	2400
	Sub total							3986.2
2016/17	Kersa malima	Kersa Worko	Faba bean	wolki	18.0	32	25.5	260
				Gora	30.0	41.2	32.0	150
			Chickpea		14.0	38.0	20.85	427.0
	Sebeta Awas	Awash Melka	Faba bean	wolki	10.0	24.0	16.92	334.5
			Chickpea		12	24.0	19.5	245.0
	Toke Kutaye	Nega file	Faba bean	wolki	15.0	32.0	20.93	114.0
			Chick pea		12.0	24.0	19.09	215.0
	Wolmera	Dufa	Faba bean	Dosha	10.0	22.0	16.0	155.0
			Malt barley	Holker	18	34	25.0	400
	Sub total							2300.5
2017/18	Kersa malima	Kersa Worko	Faba bean	Wolki &gora	10.0	40.0	26.04	305.5
		Gudina chala	Chickpea	Arerti	10.0	48.0	22.18	378.5
	Sebeta Awas	Awash Melka	Faba bean	Wolki & dosha	14	28.0	19.43	407.0
	Toke Kutaye	Nega Fle	Chickpea	Arerti Wolki & Dosha Arerti	12.5	24.0	18.5	355.0
			Faba Bean		13	32.0	19.5	210
			Chickpea		14.0	24.0	19.42	184.5
	Wolmera	Telila Ketero	Faba Bean	Dosha	12.0	29.0	21.5	95
			Malt Barley	IBON	19.5	37.0	28.5	285.0
	Sub total							2031.5
2018/19	Kersa Malima	Kersa worko	Faba bean	Gora	8	21	19.2	120.0
				Wolki	16	33	21.0	60.0
			Teff	Kora	8	20	14.3	250.0
			Chickpea	Arerti	12	35	27.0	592.65
			Bread wheat	Danda	18	35	27.2	85.0
			Faba bean	Gora	15	24	18.0	54.0
		Gudina Chala	Faba bean	Wolki	18	28	24.3	73.0
			Chickpea	Arerti	17	37	25.0	190.0
			Teff	Kora	8	17	13.5	488.0
			Bread wheat	Hidase	14	29	22.5	197.0
	Sebeta Awas	Awash Melka	Faba bean	Dosha	9	20	18	344
			Chickpea	Arerti	15	33	20.5	350
	Tokekutaye	Negafile	Faba bean	Dosha	12	27	20	100.7
			Chickpea	Arerti	15	29	20	128
	Wolmera	Telila ketero	Faba bean	Dosha	8	25	20	90
			Malt barley	IBON	12	30	20	160
	Sub total							3282.35.
2019/20	Kersa malima	Kersaworko	Teff	Dagem	14	22.5	16.39	216.25
		Gudina chala	Faba bean	wolki	25	30	27.4	255
				Dosha	21	32	26	65
			Bread weat	wane	21	28	24.36	332
			Chickpea	Arerti	15	30	23	370
	Sebeta Awas	Awash Melka	Faba bean	Dosha	12	32	26	224.5
			Chickpea	Arerti	11	25	18	175
	Tokekutaye	Negafile	Faba bean	Wolki	13	27	21.5	53
			chickpea	Habru	17	29	23.5	240
	Sub total							1930.75
Five years total								11300.3

4.2. Training

Training is one of the instruments used in technology transfer; hence a training secession was organized to train farmers, development agents, Wereda agricultural experts, coop. leaders, and member of district administrative councils, regional and zonal agri. experts and researchers.

In Oromia region particularly, the implementing center, Holetta agricultural research center organized a serious of trainings for 505 (418 male and 87 female) cooperative

member farmers, woreda administrator and councils, agricultural experts and Development Agents on seed production and management practices from 2015/16 to 2019/20 season (Figure 2) on the following thematic areas. Experiences of Integrated Seed System Development (ISSD), Local Seed Business: Organization of Seed Producers Cooperatives, Local Seed Business: Organizational Management, Crop production and management practices, Soil fertility and acid soil management, Crop protection and management practices, Community based seed multiplication, Seed quality and regulatory aspects, Quality seed production (QDS), and in Seed business skill.

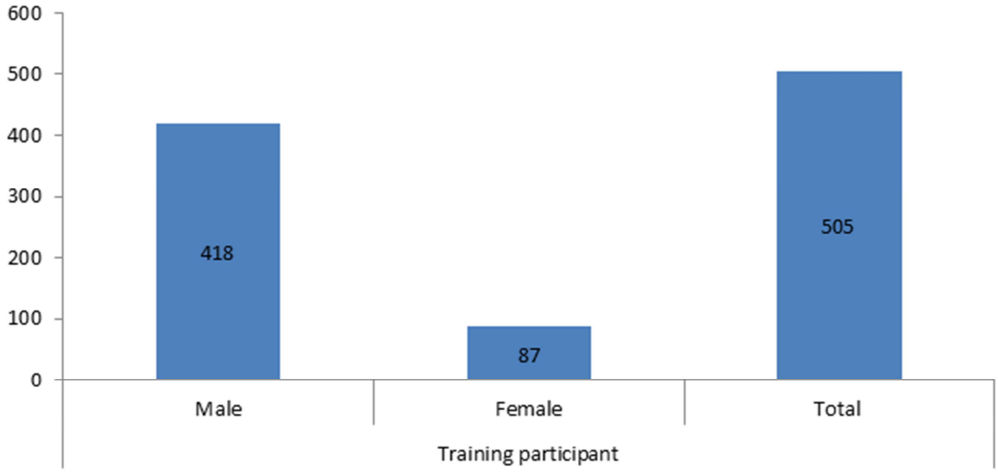

Figure 2. *Training organized for agri. experts, Development agents, farmers, researchers and other stakeholders from 2015/16 - 2017/18.*

4.3. Field Days Organized

In the last five years, national, zonal, district and kebeles level field days were organized to create demand for technologies and encouraged farmers to buy the technologies being demonstrated, to create awareness on technologies availability, suitability and market opportunity. It was also one opportunity to get feedback from farmers and other stakeholders about the technology and CBSM seed production scheme for the better future works. Totally 1489 (1255 male and 234 female) participants representing Region, zonal and woreda administrators, bureau of agriculture officers and experts, development agents, regulatory bodies, and farmers were involved in the field days as indicated in (Figure 3).

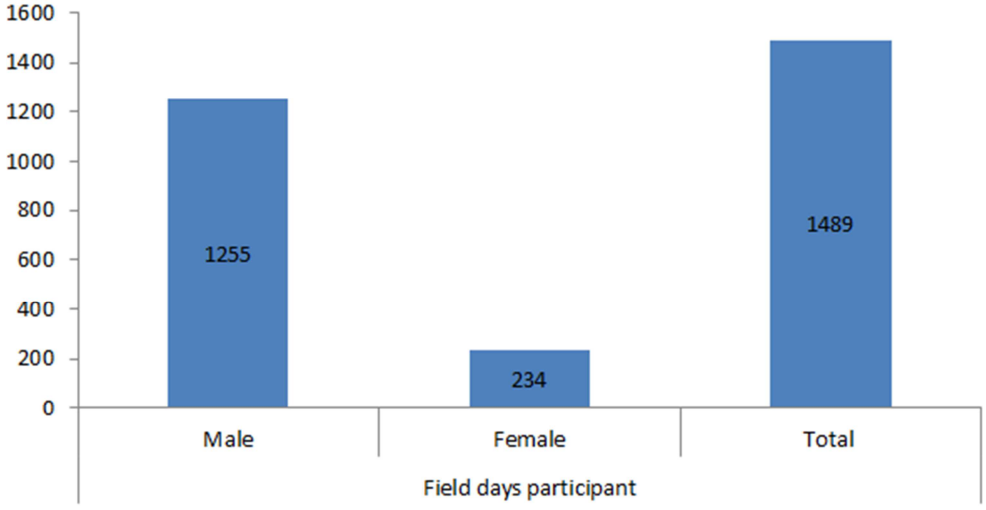

Figure 3. *Field days organized for agri. experts, Development agents, farmers, researchers and other stakeholders from 2015/16-2017/18.*

4.4. Challenges

The following were the major challenges encountered during the implementation of CBSM Scheme from 2015/16-2019/20 cropping seasons.

1. Capacity development both technical and institutional is crucial if CBSM has to thrive and sustainably address the demand for seed. Farmers' and extension workers' need to be equipped with all the necessary knowledge and skill for production of quality seed. Besides, farmers' cooperatives/ unions capacity to deal with marketing of farmer produced seed including

storage facility and market linkage should also be developed.
2. Some farmers were observed managing the seed multiplication plots not differently from the normal grain production plots resulted in dropping of plots from the scheme during the seed inspection.
3. Unless there is a significantly differentiated price between seed and grain, it may force seed producing farmers to lose interest in seed production. There must be a price reward for producing quality seed.
4. Natural disasters: Low yield and low crop performance due to high pressure of diseases and insects; water logging and frost occurrence at grain filling stage.

4.5. Lessons Learnt

Some of the key lessons learnt from the CBSM initiative are briefly discussed below:

1. A willing community: the first step is to sensitize the farmers on the concept of CBSM and find out their interest in taking up seed production as potential farm enterprise. Selection of farmers to form a CBSM group is very important for the success of the group. If only poor farmers with limited land holding are selected, they may not be able to produce seed, as whatever they produce may be just enough for their consumption.
2. Access to improved technologies: small holder farmers who practice CBSM have much faster access to quality seed, new varieties and other production technologies which enhances their production;
3. Site selection and clustering: selection of CBSM site is critical for its success. The site has to be preferably near the road as it facilitates regular monitoring, seed collection and delivery of inputs. The site has to be selected with good isolation to avoid field contamination during harvesting. The CBSM site has to be in a central or accessible area, so that other farmers can see the seed production and it can be used for demonstration to other farmers.
4. Monitoring: regular monitoring and inspection by an experienced person with good knowledge on seed production is necessary for successful and good quality seed production. The Bureau of agriculture, cooperative bureau and extension officer of the area needs to devote their time to nurture the CBSM group.
5. Training on crop management and quality seed production techniques: CBSM farmers are expected to produce good quality seed and hence they have to master the art and skill of seed production. Farmers have to be trained on field management, crop production and protection techniques, quality seed production and post-harvest handling.
6. Assured supply of source seed: for good quality seed production, the CBSM groups have to be assured of high quality source seed. As the CBSM groups have become the seed producers, the channel for obtaining basic seeds has also been defined and put in place in the national seed production scheme. The CBSM group who are the seed producers should change the source seed annually to produce high seed quality. Technically, seed of highly self-pollinated crops like barley should be recycled for a maximum of three seasons without significant yield loss.
7. Cleaning, packaging and marketing: The packaging of seed, quality control and marketing are an important issues for the CBSM groups to promote their produce for a stable market. The assurance of quality is very important and hence the involvement of the Regional Regulatory Body (RRB) for quality control has to be strengthened.
8. Future prospects for CBSM: CBSM basically entails the strengthening of the informal seed production system for production of good quality seed at the farm level. It can improve the access to quality seed and enhance production. It can also be a good seed business for small farmers, if they are committed to work together as seed producers.
9. The CBSM and delivery system have been proven as a viable alternative seed production scheme for making improved seeds available to farmers across the entire crop growing environments. It involves the organization of interested farmers or a community into a seed producer group. They have to follow all technical requirements for seed production. Farmers have to be trained on the skills of seed production and provided with good start-up seed initially. The support of research institutions, bureau of agriculture, extension and formal seed sector is very important for a sustainable CBSM scheme.

5. Conclusion and Recommendation

In summary, Community based seed system is efficient and a sustainable seed production model for small holder farmers, especially when the formal seed sector cannot service the need of the farmers. It can improve the access to quality seed and enhance production and productivity and ensures the faster dissemination of suitable improved varieties through farmer to farmer seed exchange.

All stakeholders and concerning bodies should strongly work in market linkage among seed producers and agro-dealers in order to strengthen CBSP and marketing in a sustainable manner in the area. Cooperatives and seed unions in the respective districts and kebeles should maintain sustainable seed system in order to strengthen the linkage between producers and agro-dealers.

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