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Research Article

Demonstration and promotion of Cluster based Improved Mung bean Technology at Gisma-babo PAPREGs in Bena-Tsemay Worded, South Omo Zone

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Abstract

Mung bean is one of the most important cash crops in the low-land areas of the South Omo Zone; however, its production and productivity is influenced by multiple factors such as lack of awareness on improved technology packs and practices related to genetics, pests and environments. The objectives of this was to create agro-pastoral awareness towards feasible improved mung bean varieties and mung bean -based food products. The trial site selection and PAPREG member's establishment was carried out based on technology demand and the production potential for mung bean production. Accordingly, twenty-five (25) agro-pastorals were selected. Technical training was provided before implementation started. Initially, a total of 75kg of seeds of the improved mung bean variety (NVL-01) and 3kg for one agro-pastoral were given to target agro-pastorals and a total of three (3) hectares (0.12 hectares for each household) were covered by mung bean in a cluster-based approach. Yield data and agro-pastoral perceptions were collected at different crop growth stage and during field day and after harvest. Simple descriptive statistics were used to examine the quantitative data, such as the amount of plant height, pods per plant and yield, whereas the Likert scale was used for qualitative data, such as agro-pastoralists perceptions. In this study, an average of 11.24 Qt/ha of mung bean yield was obtained. The demonstrated technology was preferred by almost all participant agro-pastorals as very good due to its high yield, early maturity period, pest resistance and net income obtained. In addition, the positive sensory acceptability of processed maize and mung bean food products satisfies agro-pastoral preferences. Most agro-pastorals (92%) were motivated and expressed their willingness to use the demonstrated technology for mung bean production in the future. Based on the result obtained, Agro pastorals obtained enough awareness on demonstrated technology NVL-01 variety that is proven; adapted, available and scalable is recommended for wide scale production in the study district and other similar lowland environments because it is preferred among agro pastorals due to very good yield, pest tolerant and sensory acceptability of its food product.

Keywords: *Demonstration, Mung bean technology, Cluster-based, Sensory acceptability.*

Introduction

Ethiopian economy is based on agriculture that contributes almost 42% of the GDP, 85% of the export earnings and 80% of the employment opportunities (ATA, 2017). The government of Ethiopia has planned to transform agriculture to increase agricultural productivity through demonstration of improved agricultural technologies. However, the current rate of technology adoption is low compared to the efforts of various governmental and non-governmental organizations working in agriculture. Furthermore, the supply of improved agricultural technologies that help increase agricultural production and productivity has increased overtime, but still falls short of the target set in order to transform smallholder agriculture (MoFED, 2016; Ayinalem *et al*. 2018).

South Omo zone is one of arid and semi-arid areas of South Ethiopia Regions in Ethiopia mainly based on pastoralism of livestock rearing practices and mixed mode of farming practices in which livestock's are the predominant and supported by opportunistic crop productions to tackle food insecurity problem. There is a greater potential need to increase crop production and productivity through research and technology innovation. Thus, it can be realized through coordinated efforts of various actors includes agricultural research institutes development organization, and private sector entities. Maize, Sorghum, Mung bean, Banana, Sesame and Onion were the major crop produced in Bena-tsemay district depending on irrigation system from Woyito River due to erratic rainfall in the study areas.

Mung bean [*Vigna radiata* (L.)], is an important annual legume crop (Rahim *et al.,* 2010). It is a recently introduced crop in the Ethiopian pulse production and grown widely in some areas of the country. Mung bean is a warm season crop with an optimum temperature range of 27- 30°C for good production; very early maturing quick crop, requiring 75–90 days to mature; Best adaptation at 1,000-1,650 meters above sea elevation level; with annual rainfall of 600-750mm; with clay loam types of soil. Mung bean productivity in Ethiopia is estimated to be on average from 12 up to 15 $Qtha^{-1}$ as compared with world productivity in average yield was 9 $Qtha^{-1}$(CSA, 2021). The crop usually sown at both "Belg" and "Meher" seasons under both rain fed and irrigation system. The crop is also produced in moisture stress areas of the country such as Gofa, Konso, Konta special district and South Omo zone (Asrate *et al*., 2012; Wedajo, 2015). Currently the crop has been familiarized in different regions of Ethiopia and its volume of production increasing steadily from year to year (Dame and Tasisa, 2019; Deresa *et al*., 2018)

Based on the nutritional point of view, mungbean grain is rich in proteins (23-25%) that considered as a cheap source of protein for human consumption, carbohydrate, minerals (especially potassium, phosphorus), micronutrients (especially iron and zinc), and amino acids especially glutamic, cysteic and aspartic acids, leucine and lysine (Dahiya et al. 2015). Mung bean is associated with low anti-nutritional factors such as those, which cause flatulence, making it a suitable food for weaning babies (Paul *et al*., 2011; Puranik *et al*., 2011) [8]. Seeds of mung bean mainly used for making soups, bread and biscuits (Sehrawat *et al*., 2013). It also used as forage or green pods and seeds as vegetables (Tang *et al*., 2014). It tolerates or escapes drought conditions, short maturity periods and improves soil fertility through biological nitrogen fixation (Swaminathan *et al*., 2012). The crop also has good nutritive value and reasonable cost for the consumers (Asrate *et al*., 2012; Wedajo, 2015)

Agro-pastoralists are producing mung bean to supplement their protein demands; thus, it is necessary to increase its production in the intended potential areas where moisture stress is a challenge for producing mung bean crops. Although mung bean production is widespread in some areas of Bena Tsemay district, it primarily focuses on local cultivars that have low yielders, delayed maturation periods and disease susceptibility.

Jinka Agricultural Research institutions in collaboration with various organizations strive to assist the communities living in the lowland areas of south omo zone through different interventions to improve mung bean crop production. Several crop technologies have been developed and disseminated through the use of participatory approaches. Some of the technologies include improvement of adaptable and high yielder mung bean crop variety such NVL-01(22.34$Qtha^{-1}$) (Tekle, 2022); Wedajo, (2015) reported that the crop is produced in moisture stress areas of South Omo zone. In addition, seed production, integrated pest management, processing and storage; utilization of mung bean-based food product was recommended for the agro pastorals of the area.

Despite the availability of various knowledge channels, most agro pastorals do not have access to information on good agricultural practices to enhance crop production. There was inadequate knowledge on suitable variety selection, proper agronomic practices, good pest management and even dissemination of mung bean technologies in the area. Lack of awareness, information and knowledge on mung bean production packages and mung bean-based food products were also not disseminated to wide communities in the area. To solve this problem, this study was aimed to demonstrate and promote cluster-based improved mung bean technology and mung bean-based food products in the selected area of south omo zone.

Objectives

- To demonstrate and promote improved mung bean varieties and mung bean-based food products
- To create agro-pastoral awareness towards improved mung bean varieties and mung bean -based food products
- To evaluate agro-pastoral perception towards improved mung bean varieties and mung bean -based food products
- To identify the economic advantage of producing improved mung variety

Methodology

Descriptions of the Test Environment

The demonstration studies were conducted at Bena-Tsemay district, Gisma Babo kebele during 2022–2023 cropping season under supplementary irrigation conditions. Bena-Tsemay district is located in the South Ethiopia Region. The district is situated between 5°01' and 5°73' North latitude & 36°38' and 37°07' East longitude. The climate of the district varies from warm to hot semi-arid, with altitudinal variation ranging between 500 and 1800 meters above sea level. Rainfall in the district is bimodal, with the main rain from March to May and the short rain from September to October. The ten years (2000 to 2010) mean annual rainfall in the upper part of Bena-Tsemay district was 1400 mm and the average daily temperature ranges from 15.6°C to 26.5°C. The soil type and textural class of the experimental area is sandy loam soil with a pH of 7.9–8.1 (Haileslassie *et al*., 2015) · Over 48% of the total land area of the district is used for grazing or browsing by cattle, sheep and goats (Admasu *et al.,* 2010) · The economic activity in the districts is mainly based on livestock, crops, forage, and fishing production. In the district, rainfall is both low and irregular, making the pastoralists and agro-pastoralists vulnerable to famine and drought. Crop production is mainly dependent on the irrigation system from the Woyito River. The major crops grown are maize and sorghum. Mung bean, banana, Sesame, onion and Sorghum were the most demanding crop technologies in the agro-pastorals of Gisma Babo kebeles (Unpublished technology need assessment report, 2015).

PAPREGs Selection and Establishment

PAPREGs member selection was based on volunteer agro-pastorals, willing to provide feedbacks on the introduced mung bean technologies and considering gender. Accordingly, twenty-five (25) volunteer agro-patorals who can provide their land are able to cover the wage costs of production, and are willing to give attention to the introduced mung bean technology were selected. A special effort was made to bridge the gender gap through participating female household farmers.

Figure 1. During technology need assessment, PAPREGS Selection, and Awareness creation

Experimental Design and Data Collection

Trial Site Selection

The trial site was selected based on technology demand and the potential area for mung bean production. In addition, land availability, irrigation facilities, clustering, and accessibility issues were used as criteria during trial site selection. Previous history of the agro-pastorals field with regard to the use of rotation crops such as pulses with cereals was also used as selection criteria. Information on the land use pattern of the farm household was obtained from the kebele and district development agents.

Treatments and Materials Used

A mung bean variety called "NVL-1" was used as a test crop. Other inputs such as: Insecticides (diazinon and dimethoate) and fertilizer (NPS) were used during the demonstration. In order to improve the availability and use of mung bean technology, the Jinka Agricultural Research Center and Low Land livelihood regional Project (LLRP) were jointly engaged in demonstrating improved technology and providing mung bean seeds to Agro-pastorals in selected mung bean-producing kebele of Benna-Tsemay districts of South Omo Zone. Initially, a total of 75 kg of seeds of the improved mung bean variety (NVL-1) (3kg for one agro-pastoral) were given to selected agro-pastorals for

demonstration purposes in the 2015 E. crop-growing seasons. Accordingly, a total of three (3) hectares (0.12 hectares for one household) of land were allocated and covered by mung bean in a cluster-based approach. Then, they grew the variety at a seed rate of 20–25 kg/ha with 10cm spacing between plants and a 30 cm row spacing to compare the yield amount and pest resistance of the variety with the local variety they had before. Basal application of NPS fertilizer was used as a source of phosphorous (P) at a rate of 100 kg/ha at the time of planting. Weeds were removed by hand weeding two times. Supplemental irrigation was given at a five-day interval throughout the crop-growing period. Diseases and insects such as leaf pot, damping off, pod borer, aphid and white fly occurred. For insect pests, diazinon at a rate of 1.2 l/ha and dimethoate at 0.5 l/ha were applied to reduce crop damage. Harvesting was done manually by hand sickles and pod picking. Then, at the end of the production period, they quantify the yield obtained. All agro-pastorals promised to use seed for themselves in the next season and to share and redistribute seed to other agro-pastorals.

Awareness Creation Training

Agro-pastorals access to agricultural technologies without appropriate orientation or training might result in the failure of the technology. To reduce such problems, prior to starting the demonstration trial, a training manual was developed on mung bean production packages such as land preparation, planting and other mung bean agronomic practices, crop protection, post-harvest handling, processing and utilization of mung bean flour was provided for PAPREGs members, experts and DA by respective researchers and stakeholders (Table 1). The major areas of the training include: the importance of improved Mung bean varieties (NVL-1); agronomic and disease management; seed systems; mechanization and crop diversification; environmental safety guards during pesticide application; and mung bean-based food products.

Table 1. Number of Participants during capacity building on Mung bean technologies

Gender	Agro-pastorals	Agricultural Experts	Researchers	Development Agents	Total
Male	23	2	3	2	30
Female	2		1		3
Total	25	2	4	2	33

Figure 2. Capacity building training for PAPREGs members, Experts and Developmental Agents

Role of Stakeholders

While conducting the demonstration activities, a researcher team composed of crop protection, agronomists, breeders, pathologists, and agricultural extension, PAPREGs members, agricultural experts and developmental agents was formed with clear responsibilities for each member. Accordingly, the researcher team gave training to PAPREG members, DAs, and experts to better align their duties. Besides training, the team provides improved mung bean seeds, coordinates trial activities, input provision, and preparation of manuals, facilitates field visits, field days and workshops, follow-up, data collection, report writing and publishing.

While the researcher team performed these activities, agro-pastorals provided land, covered the labor needed for field management, participated in training and field visits, and participated in focus group discussions and experience sharing. Developmental agents assisted agro-pastorals through regular follow up of the demonstrating activities, coordinating them for training, and reporting work progress to the researchers and respective sectors. Regular monitoring and meetings at different stages of the crop were organized to share information/field reports among the researchers, agro-pastorals and extension team members. The Pastoral and Agro-Pastoral Research and Extension Group (PAPREG) members provided the land for the demonstration, actively participated in field management activities such as weeding and watering, and attended training sessions and field visits.

Data Collection

Both qualitative and quantitative data were collected. Quantitative data included yield-related parameters such as plant height, number of branches, number of pods, and number of seeds per pod, seed weight and grain yield. Qualitative data were preference and perception data. Economic feasibility of the demonstrated technology was assessed.

Data Analysis

The collected data were analyzed using descriptive statistics such as percentage and mean and presented in tabular and graphical form. Sensory acceptability data was statistically analyzed using the analysis of variance (ANOVA) using the statistical package SAS version 9.1 Software for Windows (SAS, 2008) [15]. Statistical differences in samples were tested at $P<0.05$ and the differences between means were compared using the least significant difference (LSD). The result was expressed as the mean ± standard deviation.

Results

Awareness Creation and Field Day

The field days were organized by Jinka Agricultural Research Center in collaboration with the Lowland Livelihood Resilience Project (LLRP) and Benna-Tsemay woreda Agricultural offices on August 9, 2023, at Benna Tsemay district, Gisma Babo Kebele. Model pastorals and agro-pastorals, development agents, agro-pastorals from trial sites and out of trial sites, researchers with multidisciplinary backgrounds, NGOs and respective higher officials participated in the field day. Fifty (50) agro-pastorals (25 PAPREGs members and 25 non-PAPREGs), 12 agricultural experts, 6 researchers and 2 developmental agents' participants were involved during field day. A special effort was made to bridge the gender gap through the participation of female household experts and agro-pastorals during the field day.

Table 2. Number of Participants during the field day

Gender	Agro-pastorals	Invited non-PAPRGs	Agricultural Experts	Multidisciplinary Researchers	Development Agents (DAs)	Total
Male	23	20	12	5	2	62
Female	2	5	12	1	2	22
Total	25	25	24	6	4	84

Figure 3. Field day on Mung bean technology demonstration at Benatsemay district, Gisma Babo kebele.

Growth and Yield performance of Mung bean (NVL-1) Variety

In this demonstration study, an average of 11.24 Quintal/ha of mung bean yield was obtained from the NVL-01 variety. The growth performance of mung beans was also good when compared with national standards (Table 2).

Table 3. Average Yield and yield-related traits of the demonstrated mung bean variety (NVL-01)

Crops (Variety)	Area (Hectare)	PH (cm)	NB (Branchplant^{-1})	NP (podplant^{-1})	NS (seedplant^{-1})	BM (ha^{-1})	GY (qha^{-1})	1000 SW (g)
Mung bean (NVL-1)	3	66.72	9.96	21.65	12	25.2	11.24	45.4

PH=Plant Height (cm), NB-Number of Branch per pant, NP-Number of Pod per pant, NS-Number of seed per pod, BM=Biomass=yield, 1000SW=Thousand seed weight

Benefit Cost Analysis

Improved mung bean technology demonstrated at Gisma Babo kebele incurred the cost of production (32,620 ETB/ha) for both agricultural inputs and labor costs. Gross return (123,640 ETB/ha) was recorded from demonstrated technology. Considering the cost of production incurred and gross income obtained a net return of 91,020 ETB/ha was obtained from demonstrated improved mung bean technology (Table 3). This may reflect the better adaptability and suitability of the technology for the area, resulting in increased yield attributes and gross returns, and thereby increasing the net return. The benefit-cost ratio (4:1) was recorded using demonstrated technology. It reveals that demonstrated mung bean technology resulted in a net return/ income four times the cost of production incurred. This could be attributed to technology requiring minimum inputs and resulting in the highest gross return.

Table 4. Cost-Benefit Analysis of Demonstrated Mung Bean Technology at Gisma Babo kebele

Gross Return/income					
Crop	Variety	Unit	Quantity/ha	Unit Price(ETB)	Total price (ETB)
Income	NVL-1 yield per hectare	Quintal	11.24	110	123,640
Variable Costs					
Variables	Category	Unit	Quantity/ha	Unit Cost(ETB)	Total Cost(ETB)
Seed	NVL Seed Cost per ha	Kg	25	110	2750
Fertilizer	NPS cost per ha	Quintal	1	5200	5200
Insecticides	Diazinon	Litre	1.2	1600	1920
	Dimethoate cost	Litre	0.5	1200	600
Labor costs per ha	Land ploughing and ridge preparation	Hectare	1	7000	7000
	Sowing	Person	25	150	3750
	First irrigation	Person	8	150	1200
	Second irrigation	Person	8	150	1200
	Third irrigation	Person	8	150	1200
	First weeding	Person	16	150	2400
	Second weeding	Person	16	150	2400
	Chemical sprayer	Person	3	200	600
	Harvesting and threshing	Person	16	150	2400
	Total Cost				32620
Net Benefit and Benefit Cost Ratio					
Gross Return (ETB)	Total Cost (ETB)	Net Return (ETB)		Benefit- Cost ratio(B:C)	
123,640	32620	91,020		3.79:1~ 4:1	

Agro pastoral's Perceptions towards Mung Bean Technology

Both growth and yield attributes of demonstrated improved mung bean technology were considered as agro-pastorals selection criteria. These were early maturity, resistance/tolerance to diseases, resistance/tolerance to insect pests, pod per plant, yield and marketability of the NVL-1 mung variety. Hence, the NVL-1 mung variety was selected/preferred by agro-pastorals due to its very good early maturity/maturity period, pod number per plant, yield, marketability and disease resistance/tolerance, whereas it was preferred as good in terms of insect pest resistance/tolerance. Most Agro-pastorals (92%) responded that the technology was appropriate for them.

Table 5. Agro-pastorals preference for demonstrated mung bean variety (NVL-1) based on different criteria

Agro pastorals preference mean score on different criteria of demonstrated mung bean technology (N=25)							
Criteria	Early Maturity	Disease Resistance	Insect tolerance	Pod per plant	Yield	Marketability	Mean
Mean	5	4.00	3.92	5	5	5	4.65

NB. Scoring was according to Likert scale: 1=Very poor, 2=Poor, 3=Fair 4=Good, 5=Very good

Table 6. Agro pastoral willingness on the continuity and adoption of improved mung bean technology

Appropriateness; Agro pastoral willingness on the appropriateness of technology, continuity and adoption of improved mungbean technology					
Criteria	Appropriateness of demonstrated technology	Agro pastorals promised to continue the technology in the future		Agro pastorals promised to share technology for others	
	Frequency	Percent	Percent	Frequency	Percent
Yes	23	92	92	23	92
No	2	8	8	2	8
Total	25	100	100	25	100

Agro-pastorals Perceptions towards Mung Bean Food Based Products

Sensory quality serves as a cornerstone in assessing the overall excellence of a product, emphasizing its appeal to the human senses of sight, smell, taste, hearing, and touch. The sensory quality evaluation in this study included acceptance of color, flavor, taste, mouth feel and overall acceptability of maize and mung bean-based food products was used to evaluate the acceptability of maize and mung bean-based food products. The sensory acceptability data of maize and mung bean-based food products are presented in Table 5. The sensory acceptability scores of processed maize and mung bean-based traditional food products such as "Kurkufa", "Fosesie", "Kita", porridge and "*Nufro"* regarding parameters like color, taste, flavor, mouth feel, and overall acceptability showed a positive acceptability value that is above moderately to close to like very much.

Table 7. Sensory acceptability of maize and mung bean-based food products among agro-pastorals of Gisma babo kebele, Bena Tsemay district

Food products	Flavor	Taste	Color	Appearance	Mouth feel	Overall acceptability
Fossesie	4.93±0.36^{a}	4.93±0.36^{a}	5.00±0.00^{a}	5.00±0.00^{a}	5.00±0.00^{a}	4.97±0.18^{a}
Porridge	4.67±1.03^{a}	4.67±1.03^{a}	4.73±1.01^{a}	4.73±1.01^{a}	4.73±1.01^{a}	4.67±1.03^{ab}
Kita	4.67±1.03^{a}	4.67±1.03^{a}	4.97±0.18^{ab}	4.97±0.18^{ab}	4.83±0.53^{a}	4.70±0.60^{ab}
Nifro	4.93±0.25^{a}	4.93±0.25^{a}	4.93±0.25^{ab}	4.93±0.25^{ab}	4.93±0.25^{a}	4.93±0.25^{ab}
Kurkufa	4.93±0.25^{a}	4.93±0.25^{a}	5.00±0.00^{b}	5.00±0.00^{b}	4.93±0.36^{a}	4.93±0.25^{b}
CV	14.29	14.29	9.64	9.64	11.24	11.59
LSD	0.35	0.35	0.24	0.24	0.28	0.29

NB: -The 5-Point Hedonic scale: 1=dislike extremely, 2=dislike slightly, 3=neither dislike nor like 4=like slightly, 5=like extremely; CV= coefficient of variation; values are Mean ± SD and mean values followed by the same letter in a column are not significantly different at 5% level of significance; LSD = least significance difference

Discussions

The main objective of field day was to know the perception and preference of target pastorals and agro- pastorals on demonstrated mung bean technology; to create demand and promote technologies among agro- pastorals and other stakeholders; to get organized feedback about the mung bean technology; and to ensure maximum publicity of the technology under consideration both for potential users and to actors who may play a substantive role in the subsequent stage.

Field day process includes a demonstration field visit, asking questions, and a detailed discussion. Media and leaflets were prepared for displaying the output of demonstrated technology. During the field visit, PAPREGs expressed their willingness, as they were interested and happy with the demonstrated mung bean technology. Participant PAPREGs were thanking all concerned bodies involved in the demonstration, and they expressed their thoughts on the appropriateness of the technology and their willingness and interest in continuously using improved mung bean technology. They also raised the idea of the need to form an informal seed production organization in the area. At the final stage of the field day program, pastorals and agro-pastorals were reminding the research center and respective agricultural offices to continue providing the improved technologies other crops in addition to mung beans. Professional experts from all levels also confirmed that the mung bean variety (NVL-1) has shown a good performance in the area, is tolerant to pests, and utilizes technology at large scales for sustainable commercial mung bean production. The district offices of agriculture promised to provide technical support to pastorals and agro-pastorals on mung bean technologies through different educational and extension methods to maximize yield and net return by tackling production challenges. All agro-pastorals promised to share and redistribute seed to other agro-pastorals so that the seeds were disseminated among them and reached many agro-pastorals for future technology continuity and sustainable mung bean production.

The cost of production incurred during improved mung bean technology demonstration is for agricultural inputs and labor costs. Low cost of production incurred and good net income were obtained. This may reflect the better adaptability and suitability of the technology for the area, resulting in increased yield attributes and gross returns, and thereby increasing the net return. The benefit-cost ratio recorded reveals that demonstrated mung bean technology resulted in a net return/ income four times the cost of production incurred. This could be attributed to technology requiring minimum inputs and resulting in the highest gross return. Based on Agro pastorals promised to continue the technology in the future and to share it with other agro-pastorals. Similarly, they remind support stakeholders to tackle technology constraints, especially the unavailability of an improved seed system and pest problems.

Sensory quality serves as a cornerstone in assessing the overall excellence of a product, emphasizing its appeal to the human senses of sight, smell, taste, hearing, and touch. Overall positive acceptability recorded promotes agro pastorals produce mung bean crop to make part of their daily diets.

Conclusion

In the current demonstration study site, Mung bean production is predominantly experienced with traditional farming and the use of local cultivars by substance smallholder agro-pastorals. According to group discussion, reports show that there is a knowledge and information gap on the use of improved technology. Moreover, the participant agro-pastorals highly emphasized the constraints of pest infestation and the unavailability of seeds.

According to feedback obtained from agro-pastorals, when they produce a local variety of mung bean, it needs a long time to mature, incurs a high cost of production and a low gross return due to regular weeding, high pest infestation, and low awareness of field management operations. For a long time, the agro-pastorals of the area have needed improved technology for the mung bean crop, which is suitable for the area and has a high yield, early-mature disease, and insect pest tolerant that improves net income. Jinka Agricultural Research Center (JARC) in collaboration with the Lowland Livelihood Resilience Project (LLRP) and the Benatsemay district Agricultural office identified technology demand among agro- pastorals and decided to demonstrate profitable improved mung bean technology.

Consequently, the high yield, early maturity period, pest resistance and net income obtained from demonstrated mung bean technology satisfy the demand of major participant agro-pastorals, which they accept as profitable technology. In addition, the positive sensory acceptability of all processed maize and mung bean-based traditional food products such as "Kurkufa", "Fosesie", "Kita", porridge, and "Nufro" satisfies agro-pastoral preferences and expectations, thereby motivating them to adopt demonstrated mung bean technology. They expressed their happiness with the improved mung bean technology and their willingness to continue mung bean production. They also promised to motivate other agro-pastorals to adopt this profitable mung bean production technology. Therefore, the district offices of agriculture should provide technical support to pastorals and agro-pastorals on mung bean technology through different educational and extension methods to maximize yield and net return.

Important Lesson Drawn

Important lessons learned during mungbean technology demonstration were Establishment of project implementation teams at zonal and woreda level contributed to successful execution of the project; Practical and technical training provided built up the capacity of agro-pastorals; Experience shared to Non-PAPREGs group and facilitate continuity of the technology; Collaboration with partners is key for successful implementation of the good practice; Agro pastoral selection and participation should be carefully done with the involvement of agro-pastoral themselves, local stakeholders and community leaders; Gender gap was considered during agro pastoral selection; Improved variety is the most effective technology for increase crop yield and improves food security.

Emerging challenges and opportunities

Challenges encountered during the demonstration of mung bean technology were lack of awareness and knowledge on technology adaptation among agro pastorals; Market inaccessibility; Lack of information on seed system; Pest incidence and shortage of agricultural inputs supplier; Pod shattering nature of the crop; Irrigation water variability and lack of irrigation facility.

Regardless of challenges encountered, the opportunities available at the study area were high demanding of agricultural technologies from agro-pastoralists; Fertile and accessible land; Good irrigation potential; potential for seed multiplication and establishment of seed system of improved variety in the area; Good integration and linkages with government and non-governmental organization; Potential for mechanization and availability of market for the crop.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper manuscript.

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