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SCALING UP OF IMPROVED MUNG BEAN TECHNOLOGY IN THE POTENTIAL AREAS OF NORTH SHEWA ZONE AMHARA REGION

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ABSTRACT

Pulse crops are important components of crop production in Ethiopia's smallholders' agriculture, providing an economic advantage to small farm holdings as an alternative source of protein, cash income, and food security. Mung bean is one of the most important cash crops in the low land of the North Shewa zone. This research was, therefore, initiated to provide an insight of scaling up of Rasa (N-26) mung bean variety and documenting best approaches to maximize production and productivity of the crop through improving the availability of improved varieties to farmers. The activities were done in the lowlands of North Shewa areas of Efiratana gidim, Kewot, Shewarobit, Ensaro, and Merhabetie districts, under main growing season for two consecutive years (2016 – 2017) using Rasa variety. About 54 ha of land were covered through disseminating 2.17tons seed and a total of 203 (including 2 female farmers) farmers participated and directly benefited during the dissemination of mung bean variety. The productivity of mung bean in the area was boosted to 1.6 tons ha^{-1} and a yield advantage of 45.5% was obtained from improved varieties compared to the local cultivar. The introduction of the improved variety Rasa (N-26) which has a large seed size, high biomass, and grain yield attracts the attention of farmers, experts, and local traders. Developing and verifying pesticides, technical backstopping and supplying of early generation seed, and introducing post-harvest storage materials is very crucial for sustained production and productivity improvement of the crop.

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INTRODUCTION

Pulse crops are important components of crop production in Ethiopia's smallholders' agriculture, providing an economic advantage to small farm holdings as an alternative source of protein, cash income (CSA, 2016; Shahidur *et al.*, 2010; USAID, 2014). Ethiopia is ranked 13th among pulse-producing countries in the world (FAO, 2015). The crops have been used for many years in crop rotation practices. Some of them have also played an important role in the export sector generating foreign currency for the country (ATA, 2015; Boere, 2015). The major varieties of pulses grown in Ethiopia are faba bean, field pea, haricot bean, chickpea, lentils, and grass pea (CSA, 2018).

Mung bean (*Vigna radiata* L.), which is introduced recently, is an annual herb of the Leguminosae family. It ranked six with an annual area coverage and volume of production 41,633.3ha and 514,227.41qt, respectively

(CSA, 2018). It has green skin and is also called green bean (MoA, 2011). It is sweet in flavor and cold in nature (EPP, 2004). Green mung bean is less used domestically and mainly grown for generating cash income. It is attributed to having high nutritional value, including (24 to 26%) protein content (Ali and Gupta, 2012; Umata, 2018). Despite its growing demand in the international market, there is a chronic supply gap in Ethiopia from the production side. Ethiopia's mung bean export trend has grown slightly mainly due to the Ethiopian Commodity Exchange (ECX) installed mung bean as the sixth commodity to be traded on its floor since 2014 (ECX, 2014). This inspired many farmers to get involved in mung bean production. More than 327,788 smallholder farmers were engaged in mung bean production (CSA, 2018).

According to CSA 2015 data, mung bean grown in 2014/15 (2007 E.C.) covered 0.12% (14,562 hectares) of the grain crop area and 0.05% (about 140,676.54 quintals) of the national grain production. Of which the Amhara region covers 77.5% (about 11,281.69 hectares) of the national mung bean production area and 85.2% (11,982.85 tons) of the total production of the country. Especially it was common in North Shewa and South Wollo zones. North Shewa covers 48% of the national area coverage and 53.1% of the total volume of production (CSA, 2016). It is used as a potential rotational crop in the lowlands which have limited access to proper crop rotation on cereal crops and it fits well in the teff and sorghum cropping system (Yehuala *et al.*, 2018). It can easily grow with a few available soil moistures with no land resource competition in the bulge.

In the North Shewa zone, participatory evaluation research was done on improved mung bean varieties, namely Rasa (N-26), NVL-1, and Arkebe, in the 2015 main growing season. The result of the previous study showed that the variety of Rasa (N-26) had a yield advantage of up to 300 kg ha^{-1} compared to the local cultivars with recommended practices and 1100kg ha^{-1} over farmers practice with an average yield of 1442 kg ha^{-1} (Yehuala *et al.*, 2018). However, this improved variety did not reach many farmers due to a lack of awareness about the availability of improved varieties and also farmers lack access to improved seed. According to CSA (2018), from the total land allocated for pulse production only 0.8% of the land was covered by improved seed. As the result, the production and productivity of mung bean in the North Shewa zone are very low and the farmers did not get the potential benefit out of it. This research, was, therefore, initiated to create wider demand, linkage among concerned stakeholders and to enhance the adoption and dissemination rate of the variety in North Shewa and even beyond to improve production and productivity of the crop.

Conceptual framework

This scaling-up activity was based on the Linn *et al.* (2010), a scaling-up model which involves three phases. The innovation phase, which is the first phase of the model, involves testing, verification, and validation of mung bean technologies. In this study, the previously implemented research experiment, participatory evaluation of improved mung bean varieties comprising of three improved mung bean varieties including Rasa (N-26) variety falls under the innovation phase. At this stage participant farmers were interested in the performance of Rasa (N-26) improved variety and also the variety had a yield advantage of up to 300 kg ha^{-1} compared to the local cultivars with recommended practices. Yehuala *et al.* (2018) recommend Rasa (N-26) variety based on its yield potential and farmers' preference. Therefore, this scaling up was implemented following the findings of the previous experiment. Demonstrations are a critical tool for extension promotion allowing the farmer to evaluate, test, and learn about the new technologies (Mbure and Clare, 2017). Farmers are more likely to test new technology with higher expected benefits and relatively lower risk (Pannell *et al.*, 2006). During the learning phase, farmers learned by directly observing the demonstration plots and as group dynamics taught each other. Also, farmers and other actors were capacitated through training and field visits and as well contributing through forwarding their feedback. In the scaling-up phase, the innovations or technologies demonstrated and tasted during the innovation and learning phases were brought to a large scaling-up.

METHODOLOGY

The activities were done in the lowlands of North Shewa areas of Efiratana Gidim, Kewot, Shewarobit, Ensaro, and Merhabetie districts, under main growing season for two

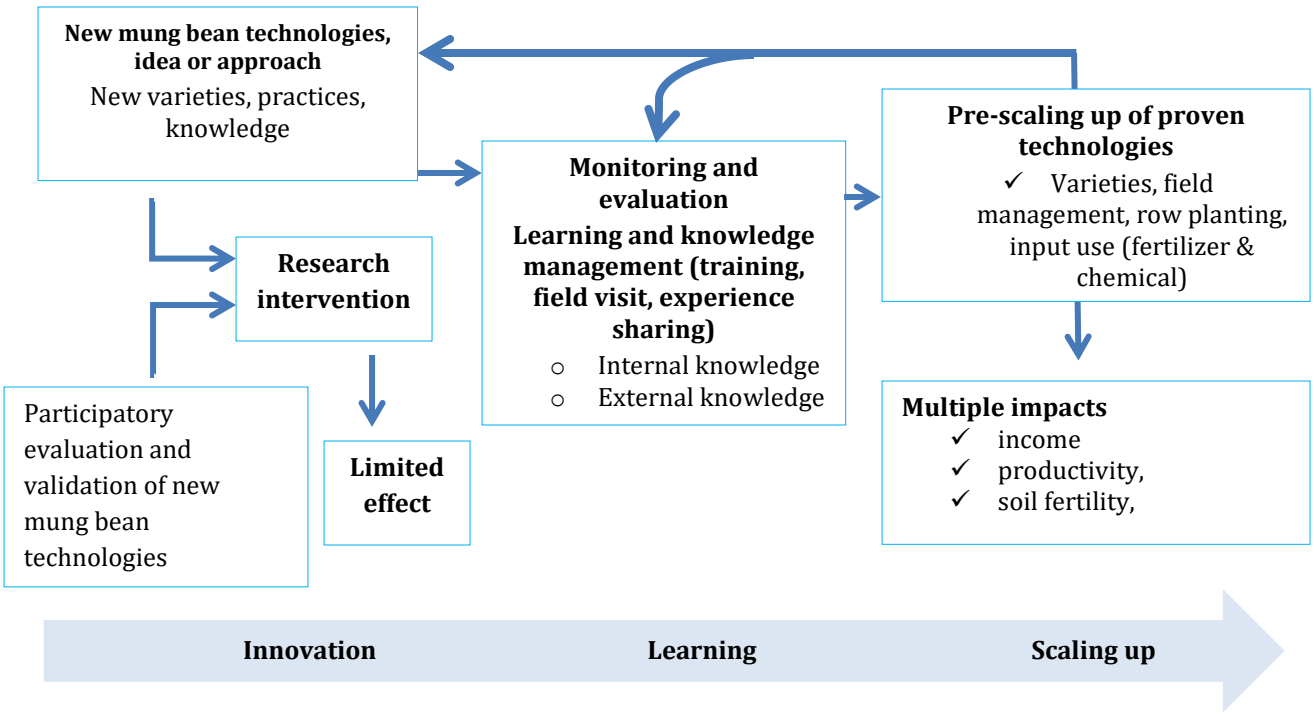

Figure 1. Conceptual framework of the scaling up activity. Source: Adopted from Linn et al. (2010).

consecutive years (2016 – 2017). These areas were selected purposively based on production potential for mung bean production. The area is characterized by a unimodal rainfall pattern and receives an average annual rainfall ranging between 943 and 1199 mm while the annual average temperatures range between 17.6 and 23°C. The altitude ranges between 1263 and 2164 meters above sea level for all intervention areas.

The production system in the study area is characterized as a mixed crop-livestock agricultural system. Sorghum, teff, and mung bean are among the major crops mostly grown in the area. Among the major pulse crops, land covered by mung bean is important. The crop is mainly grown for generating cash income. Cattle, sheep, and poultry are also important domestic animals kept by the smallholder farmers integrated with crop production. Thus, both crop and livestock contribute their share to the farmers' agricultural income.

The variety used for this research was Rasa (N-26) which was recommended for the area by Yehuala *et al.* (2018). The agronomic practices for the implementation of the research were using a spacing of 30 cm and 5 cm between row and plant, respectively. A seed rate of 38 kg and phosphorous fertilizer at a rate of 46 kg P2O5 per hectare were applied. The activity was implemented in a cluster base so that the participant farmers were selected voluntarily. The required number of seed was delivered by the Research Center to participant farmers free of payment through the kind repayment approach. Integrated extension approaches were used during the implementation of the study. Institutional linkage among the actors and strong information exchange between all stakeholders leads to effective technology scaling up. Site selection and farmland clustering were done by development agents (DAs) and the respective district agricultural office experts. The training was organized for farmers and experts on full production packages. Continuous field monitoring and evaluation were done by researchers in collaboration with district experts, DAs, and farmers. Finally, field day was organized for different stakeholders and farmers to create wider demand and to get more organized feedback from the participants about the new variety introduced.

RESULT AND DISCUSSION

Capacity building of farmers and extension workers through training

Capacity building of various stakeholders has a vital role in transferring innovations among the farming community by the extension systems. The adoption and diffusion rate of new technologies increased when the knowledge, skill, and attitudes of farmers and DAs

improved. Before the implementation of the activity, training was organized in each district for farmers, DAs, and district experts on the full production package of the improved mung bean variety. A total of 174 (7 female) farmers and 41 (13 female) experts were trained on mung bean agronomy, seed production, post-harvest handling, and marketing during the implementation period. Also, the training focused on full production packages, post-harvest storage, value addition, and market linkage for both seed and grain purposes. Farmer's attitudes and opinion towards the introduced improved varieties of chickpea and seed production and marketing were remarkably changed due to continuous training, field monitoring, partnership strength, market linkage, access to improved seed, and experiences of production and marketing activities.

Amount of improved seed supplied and area covered

Improved seeds of Rasa (N-26) variety were used for the pre scaling up based on farmers' preference. During the implementation periods, 2.17 tons of improved seed was delivered and more than 54ha of land was covered. About 203(2 female) farmers were addressed directly through the dissemination of improved mung bean seed. Most importantly the technology was spread out over mung bean production potential areas through farmer to the farmer seed exchange. As a result of this intervention, many farmers benefited to easy access to improved seeds through direct seed marketing, farmer to farmer seed exchange system, and revolving seed. As traced back from each respective district's agriculture office, during the implementation period more than 83 ha of land were covered with improved varieties of Rasa (N-26) seed through farmer-to-farmer seed exchange systems.

Field day events and stakeholders feedback assessment

The other way through which technology pre-scaling up activity was enhanced, is through field day. Field days play a vital role to create demand and promote technologies to farmers and other stakeholders and get organized feedback about the technologies. The field days were organized by the Research Center in conjunction with the respective Agricultural Offices involving model farmers, development agents, and farmers from the trial sites, subject matter specialists, local NGOs, and higher officials. The field day program includes field visits, experience sharing, and detailed discussions on the demonstrated technologies. A total of 276 (19 females) participants visited the trial and applaud to Rasa variety for its good growing performance.

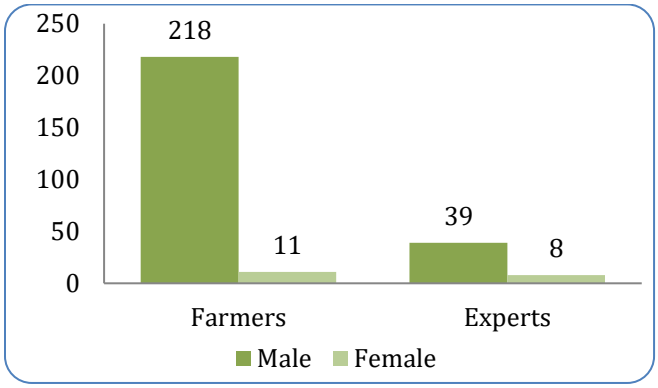

Figure 2. Number of field day participants.

During the field visit, farmers were explaining that they were growing mung bean because the crop holds the key as a potential rotational crop, high market value, easily grow with a few available soil moistures with no land resource competition in the bulge, short date of maturity, an alternative source of animal feed and can be easily grown with a minimum labor requirement (Figure 3).

Farmers were interested and happy with the variety Rasa (N-26) for its higher grain and straw yield as compared to their local variety. Because it has a large seed, many pods per plant, and high biomass and the straw are very important for fattening. Participant farmers were thanking all concerned bodies involved in the scaling up and they were expressing their interest to continue growing this improved variety. Finally, the farmers were also connoting the research center to continue supplying the improved seed of mung bean and other potential crops suitable for their areas. Experts were also confirmed that the variety is suitable for the area and has good performance.

Yield advantages of growing Rasa (N-26) variety

The average yield obtained from the improved Rasa (N-26) variety and farmers' local cultivars were 1600 and 1100 kg ha-1, respectively. This implies that the introduced improved variety had a yield advantage of 45.45% compared to the local variety. It was also highly demanded by farmers and experts in the study area because of its higher biomass, yield, and seed size

than the local variety. This result was by far better than the result of Yehuala *et al.* (2018) that using Rasa (N-26) returns 24.0% of yield advantage. Similarly, Dawit and Zewdie (2019) found that the estimated national average yield gap exceeds by 38.0 and 49.2% when compared to the yield achieved on farmers' fields with improved variety and recommended practices and at research stations, respectively. These yield gap figures indicate the potential of bridging the yield gaps through improved access to varieties and quality seed along with associated recommended agronomic practices and adequate extension services on providing the necessary information.

Figure 3. Taken during field day.

Market linkage and sustainability of the technology

Although the nutritional value of mung bean is high, currently it has a low level of home consumption in the household diet. This is partly because the crop is not widely known by the local people even producers do not know its nutritional content and how to use it. Therefore, in Ethiopia, specifically in the study area, mung bean is mainly grown for the market. Hence, producer farmers were sold out the whole produce immediately after harvesting. Farmers sell 75 to 80% of their marketable surplus immediately after harvesting their product (Mohammed *et al.*, 2017). However, it was observed that the market price during harvesting seasons was very low. Therefore, this market behavior creates a surplus in the market thereby pushing prices down to the lowest point. While there is a shortage, the price rises to the highest point. Since mung bean is one of the important crops among exportable agricultural products in the country (ECX, 2014), the local cooperatives and unions in the study districts have interested to collect the yield for both seed and grain purposes. Also, local traders were serving as a source of improved seed during planting seasons.

Constraints of mung bean production during the scaling up

Although improved mung bean is a profitable crop in the study areas, several constraints are constrained to its higher production. As stated by the farmers during field evaluation insect infestation specifically known as apeaon is the first and the foremost constraint for mung bean production in all the study areas. Lack of access to quality chemicals at a reasonable cost is another most important challenge for grower farmers. Moreover, farmers have no awareness on at what stage which chemicals to use and its amount. They were bought from chemical traders at a high cost and they don't know which chemical is appropriate. Farmers have also suffered from a lack of access to improved seed, low market price during harvesting and price fluctuation across traders and time, and postharvest loss due to weevils. Similarly, (Mohammed *et al.*, 2017; Yehuala *et*

al., 2018) mentioned the prevalence of pests and disease, lack of improved seed supply, lack of proper storage and handling, and inappropriate market chain (poor coordination among traders, extended market chain, lack of market information, price impulsiveness, lack of market promotion).

CONCLUSION AND RECOMMENDATIONS

Mung bean is one of the most important cash crops in the low land of the North Shewa zone. The production and productivity of mung beans were improved in the intervention areas due to the introduction of improved varieties and the provision of better extension services. Compared to the local cultivar, Rasa (N-26) improved variety had a yield advantage of 45.5%. Participation of the concerned actors involved in the mung bean seed supply chain and institutional linkage among all stakeholders are pertinent for sustainable technology scaling up and to enhance access of farmers to quality and sufficient improved seeds with affordable cost. The introduction of the improved variety Rasa (N-26) which has a large seed size, high biomass, and grain yield attracts the attention of farmers and experts and is willing to continue producing the variety. However, farmers were confronted with several factors including insect damage, lack of access to quality pesticides with affordable cost, lack of access to improved seeds, and post-harvest loss due to weevils. The result of this study suggested that developing and verifying pesticides, technical backstopping and supplying of early generation seed and also introducing post-harvest storage materials is very crucial for sustained production and productivity improvement of the crop.

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