

Full Length Research Paper

Pre-scaling up of improved maize variety in Highlands and Midhighlands of West Guji Zone, Oromia National Regional State, Ethiopia

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This study was conducted at Bule Hora district of West Guji zone, Southern Oromia with the objective of further disseminating the already evaluated and selected variety maize, Jibat (AMH-851) to the farming community. The district was selected purposively based on potentiality and accessibility for maize production; and two potential peasant associations (PAs), Hera Liphitu and MetiTokuma were selected. A total of 20 trial farmers, 10 from each PAs were selected. Subsequently, 86 farmers were trained by multidisiplinary team of Yabello Pastoral and Dryland Agriculture researchers (Breeder, Agronomist, Economist and Extensionist) on importance of maize production, agronomic practices and pre and post-harvest management of this variety. One variety of maize, Jibat was planted on 0.25 ha on each 20 farmers' fields. A seed rate of 25 kg/ha and 100 diammonium phosphate (DAP) kg/ha were used with a line spacing of 75 and 25 cm between plants and rows, respectively. Accordingly, in the course of implementation, a total of 20 farmers were reached, 125 kg seed was delivered and an area of 5 ha was covered. Field day was organized in representative potential PAs on which a total of 113 participants (80 farmers from trial and non-trial, 3 researcher, 18 development agents (Das) and 12 stakeholders including GOs and NGOs) attended to share experience, evaluate the performance and to communicate the progress of the activity. The overall grain yield performances of Jibat variety was 4.1 tons/ha² on farmers' field. The research intervention had contributed to improve food security, livelihood and knowledge and skill of trial farmers. Upon completion of the activity an exit strategy was designed and respective district office of agriculture and natural resources were officially invited to discuss its sustainability. Based on this study, it is evidently clear that the Jibat maize variety should be scaled up in the farming community to improve livelihood.

Key words: Pre-scaling up, multidisiplinary, Jibat, BuleHora.

INTRODUCTION

Maize is originated in Central America and was introduced to West Africa in the early 1500s by the

Portuguese traders. It was introduced to Ethiopia during the 1960s to 1970s. Today, maize is one of the most

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important food crops worldwide. It is grown in most part of the world over a wide range of environmental condition, ranging between 50° latitude north and south of equator. It also grows from sea level to over 3000 m above sea level (MoANR, 2017).

In Ethiopia, maize grows from moisture stress areas to high rainfall areas and from lowlands to the highlands. It is largely produced in Western, Central, Southern and Eastern parts of the country. In 2017 cropping season, 2,135,571.85 ha of land was covered by maize with an estimated production of 784.7 tons (CSA, 2017).

In Ethiopia, maize is produced mainly for food, especially in major maize producing regions particularly for low income groups; it is also used as staple food. Maize is consumed as “Injera,” porridge, bread and “Nefro.” It is also consumed roasted or boiled as vegetables at green stage. In additions to the aforementioned, it is used to prepare local alcoholic drinks known as “Tella” and “Arekie.” The leaf and stalk are used for animal feed and also dried stalk and cob are used for fuel. It is also used as industrial raw materials for oil and glucose production (MoANR, 2017).

Maize is the dominant cereal crop grown in Bule-hora district of West Guji zone. In 2005 and 2006 cropping season, the Yabello Pastoral and Dryland Agriculture Research Center (YPDARC) has carried out demonstration of the newly improved maize (Jibat) variety to the selected trial/participated farmers for two consecutive years (2013-2014). The results of demonstration have shown that Jibat variety was found to be early mature and high yielder variety (4.4 tons/ha) compared to local standard check which yields only 2 tons/ha (Ahimad et al., 2014). However, there is no study carried out so far in the district to further popularize and pre-scale up of Jibat maize variety in the study area. Therefore, this study was initiated to further promote and pre-scale up of this variety in the selected peasant associations (PAs) of BuleHora district.

Objective

The general objective of the study was to increase the production and productivity of maize in the study area. The specific objectives of the study were:

- (1) To increase production and productivity of participant small scale farmers in the study area.
- (2) To improve farmers' knowledge and skill of application of the improved maize technology
- (3) To develop local capacity for future scaling up of maize technology
- (4) To strengthen stakeholders linkage and collaboration

METHODOLOGY

Description of the study area

Bule Hora is found in southern Ethiopian rift valley 467 km away

from Addis Ababa. It is located at 8° 16 'N Latitude and 28° 8 'E Longitude and has an altitude ranging from 1300 to 2600 masl. Currently, the district has 43 peasant association and 5 Urban kebele of which 31 of them are under “woynadega”, 5 of them are under “Dega” and 12 of them are under “kola” agro ecology. It has two major rainy seasons namely Arfasa, which begins from March and ends on May and Ganna in which only a few cereal crops are grown beginning from September and ending in November. Arfasa is the major cropping season especially for cultivation of field crops. The average annual rain fall of the district ranges from 800 to 1500 mm and the average annual temperature from 15 to 30°C. It is bordered by Dugdadawa in the south, Malka Soda in the east, Karcha in the north and SNNP in the western direction. The woreda's economic base is agriculture and this includes cash crop and field crop production and animal rearing. The major crops produced in the woreda are maize (*Zea mays*), Teff (*Eragrostis abyssinica*), haricoat bean (*Phaseolus vulgaris*), inset, sweet potato (*Lopmoea batatas*), and chat. According to the soil map of Ethiopia (National Atlas), the district has three dominantly occurring soil types. The first two are orthic acrisols, which cover about 65% and orthic luvisols 15% of the total area of the district, while calcaric and eutric fluvisols cover about 10% of the area of the district. Dystric nitosols and chromic eutric and cambisols cover about 10% (each 5%) of the total area of the district (BHFEDO, 2017).

Site and farmers selection

The activity was carried out in Bule-hora district of West Guji Zone. Two potential maize producing PAs and 10 farmers from each PAs were selected with the collaboration of district Agricultural Offices. One improved variety, namely, Jibat was used for this activity. A 2500 m² (0.25 ha) of land was used for this activity at each selected farmers' field. Training was organized for the selected farmers and respective Development Agents. Close supervision and monitoring was undertaken through joint action of stakeholders.

Memorandum of understanding

Prior to the beginning of the activity, memorandum of understanding (MoU) was signed between Yabello Pastoral and Dryland Agriculture Research Center (YPDARC) and Bule Hora district Agricultural and Natural Resource office on their responsibility to ensure sustainable dissemination of the technology for a wider community. Close supervision and monitoring was undertaken through joint action of stakeholders.

Mechanisms/Approaches used and procedures followed to enhance technology dissemination

Research design

One variety of maize, Jibat was planted on plot size of 0.25 ha (50 m × 50 m) of land on each 20 farmer's fields for this activity. A seed rate of 25 kg/ha and 100 kg diammonium phosphate (DAP/ha) was used with a line spacing of 75 and 25 cm between plants and rows, respectively. Accordingly, a total of 20 farmers were reached, 125 kg seed was delivered and an area of 5 ha was covered.

Data collection

Appropriate data collection methods (simple survey assessment, preparing checklists, personal observation, field days, five point Likert scale) were employed to collect both qualitative and quantitative data. The types of data collected included yield data,

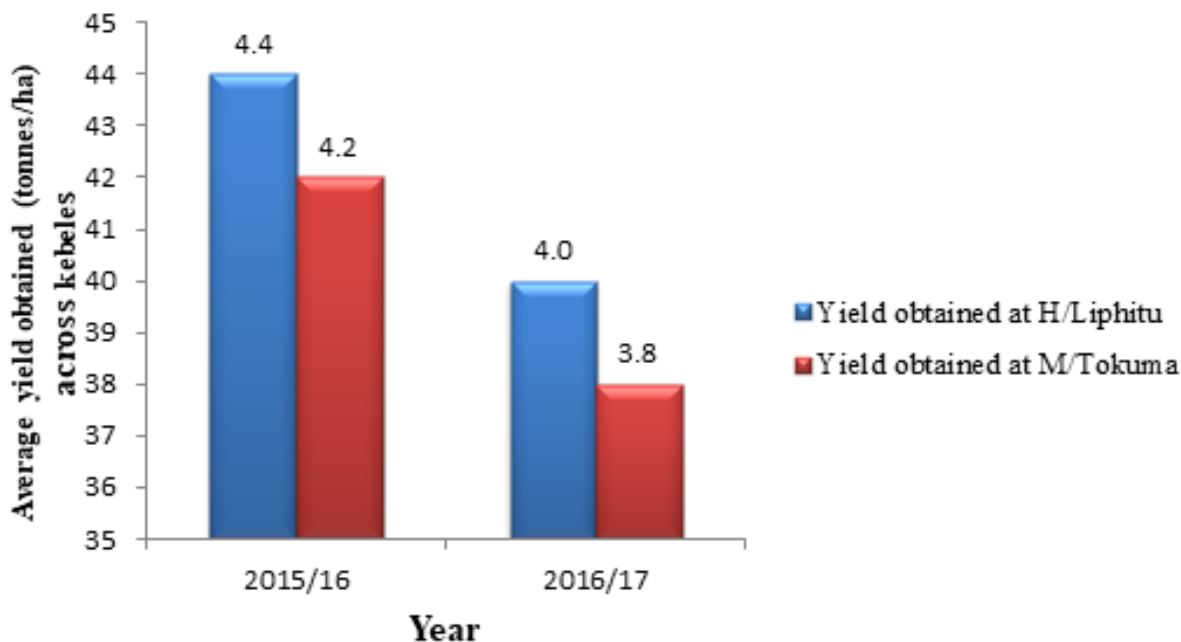


Figure 1. Yield performance of pre-scaled up of Jibat variety on selected farmers' field across district and years.

change in level of knowledge and skill of farmers and/or agro pastoralists, total number of farmers participated on extension events such as training, field visits and field days, total number of farmers adopting the technology/innovation and stakeholder's participation.

Data analysis

Farmer's preference was analysed qualitatively through narration and description and economic and agronomic data were analysed by descriptive statistics using SPSS version 20.

Method of analysis of change in level of farmers' knowledge and skill

The investigation of the immediate application of new knowledge is very important to know whether the knowledge of a particular farmer was improved after engaging in it or not. Seba et al. (2012) and Lin and Lee (2004) developed a questionnaire based survey and measured perception and knowledge using five point Likert attitude scale. For the purpose of this study, about 8 statements/items which are used as a proxy indicators of knowledge such as change in the level of knowledge and skill on application of appropriate seed rate, distance between rows and plants, sowing, weeding and other management practices, seed preference, importance of technology and changes in knowledge and skill made by the trial farmers pre and postharvest management were developed. The knowledge level and skill of the respondents were scored before and after participating in pre-scaling up of improved maize (Jibat) variety. The score was calculated by giving values to all responses used as a proxy of indicator of the level of knowledge and skill following five point Likert type attitude scale (5= Strongly agree, 4= Agree, 3= undecided 2= Disagree, 1= Strongly disagree). The total knowledge score for the participant was used to represent total score. This was used for analysis of paired sample t-test to check whether knowledge of

farmers has improved or not.

RESULTS AND DISCUSSION

Total production and productivity per unit area

The pre-scaling up of improved maize variety (Jibat AMH-851) was undertaken for two consecutive years in two PAs or kebeles of BuleHora district of West Guji Zone in the 2015/2016 and 2016/2017 cropping seasons. The variety was treated with full recommended maize production and management practices. Yabello Pastoral and Dry Agriculture Research Center was the source of all inputs (seed, fertilizer and herbicides). The result of the study revealed that the average yield of improved Jibat variety obtained in 2015/2016 cropping season was 4.4 and 4.2 tons/ha while that of 2016/2017 cropping season was 4.0 and 3.8 tons/ha at Hera Liphitu and MetiTokuma, respectively (Figure 1). Generally, the overall average grain yield of Jibat maize variety was 4.1 tons/ha. The yield obtained in 2016/2017 was lower compared to that of 2015/2016 cropping season due to erratic rainfall conditions. In spite of this, the production and productivity of maize of the trial/participated farmers has increased in the study area as compared to local maize varieties because of its early maturity and high yielder. The average yield of pre-scaled up of Jibat maize variety was almost 1.5 times higher compared to the average zonal productivity of local maize variety which was 2.7 tons/ha (CSA, 2017). The study indicates that the financial base of farmers involved in the studies has

been broadened.

Training of farmers/agro pastoralists and stakeholders

Participatory training consisting of theoretical and practical session was given by multidisciplinary team of Yabello Pastoral and Dryland Agriculture researchers (Breeder, Agronomist, Economist and Extensionist) in the selected district of BuleHora, West Guji Zone at Hera Liphitu and MetiTokuma PAs. A total of 85 participants: 67 farmers/pastoralists and 18 development agents/subject matter specialists participated on training (Table 1). The subjects of the training included the production and management practices, diseases and pest control, fertilizer application, appropriate amount of seed rate, distance between rows and plants and creating strong linkage among relevant stakeholders through multi-stakeholders approach to mitigate the problems in joint action taking immediate, short and long term measures.

Field day

At physiological maturity stage of the improved maize variety (Jibat), a mini field day was jointly organized with other relevant stakeholders such as zone and districts level agricultural development offices and participated farmers/agro pastoralists in the district to create awareness about the importance of using improved maize variety and its agronomic and management practices and boosting the dissemination of the varieties through farmers to farmers. A total of 113 participants (80 farmers from trial and non-trial, 18 development agents, 3 researchers and 12 relevant stakeholders including Government Organizations and Non-Government Organizations participated in the mini field day. The participants shared their experience and discussed the condition of improved variety with trial farmers and identified the criteria such as grain yield, early maturity, suitability for Injera and bread, market demand and resistance to diseases and pests. Based on the criteria, Jibat maize variety was selected for further scaling-up in the district (Table 2).

Change in level of knowledge and skills of participating farmers

Farmers' knowledge and skills are expected to be improved after engaging in pre-scaling up of improved varieties because of practical and theoretical training given for them on all aspects of production in relation to sowing, weeding, pest control, importance of technology, etc. The highest attitude score for knowledge and skill improvement before and after engaging in pre-scaling of

improved maize variety was 23 and 34, respectively, whilst the lowest attitude score for knowledge and skills improvement was 13 and 27, respectively (Table 3). The mean attitude score of knowledge and skills for before and after engaging in pre-scaling up of improved variety was 16.6 and 31.8, respectively, out of a potential score of 40. The result of paired sample t-test revealed that there is positive and a statistically significant mean difference ($p= 0.01$). The implication is that farmers' knowledge and skills have improved after engaging in pre-scaling up of improved maize variety.

Memorandum of understanding

Prior to the beginning of the activity, memorandum of understanding (MoU) was signed between Yabello Pastoral and Dryland Agriculture Research Center (YPDARC) and Bule Hora district Agricultural and Natural Resource office on their responsibility to ensure sustainable dissemination of the technology for a wider community. Accordingly, a strong linkage was enhanced/made among relevant stakeholders from the start to exit strategy of pre-scaling up of this variety through working collaboratively; jointly monitoring and evaluation, attending extension events such training, organizing, field visit and field days. In doing so, the local capacity for future scaling up of maize technology was developed and stakeholders' linkage and collaboration strengthened.

Exit strategy

The mandate of Yabello Pastoral and Dryland Agriculture Research Centre (YPDARC) is starting from adaptation/generation to demonstration and up to pre-scaling up stage of appropriate technologies needed for sustainable development of pastoral and agro-pastoral areas of the zone in particular and Ethiopia in general. Thus, it is important to look for an alternate option in which large number of farmers can involve in the technology promotion through strategic mechanisms. For this case, the main collaborator of YPDARC was office of Bule Hora Agricultural and Natural Resource of the district in the study area. Therefore, the wider scope of further dissemination of the technology should have remained to be implemented by respective office of Agricultural and Natural Resource district in the study area. This is to keep that the extension system linkage among that organization and to relay the continuity of technology for a wider coverage until the better new technology option developed. To achieve this goal, YPDARC and the respective districts office of Agricultural and Natural Resource have discussed on how to keep the sustainability of disseminating and wider scaling up of the technology to larger people and then agreed to own the

Table 1. Training of Farmers and other Stakeholders on maize production.

Year	Participants (N=85)						Grand total
	Experts (DA+SMS)			Farmers			
	Male	Female	Total	Male	Female	Total	
2015/2016	8	3	11	39	6	45	56
2016/2017	3	4	7	20	2	22	29
Total	11	7	18	59	8	67	85

N: Implies number, DA: development agents, SMS: subject matter specialists.

Table 2. Mini field day organized on maize production.

Year	Technology		Number of participants						Total
	Visited during field day	Location/district	Farmers/Pastoralists			Researchers	DAs	Stakeholders (GOs and NGOs)	
			Male	Female	Total				
2015/2016	Maize (Jibat)	BuleHora(H/Liphitu)	65	15	80	3	18	12	113

DA: Development agent, GO: government organization, NGOs: non-government organization.

Table 3. Change in level of knowledge and skills of farmers' on application of improved maize variety.

Variable	Farmers' knowledge and skill improvement (N=20)			t-value
	Before scaling up		After scaling up	
Mean	16.6		31.8	23.337***
Std. Deviation	2.5		1.6	-
Minimum	13		27	-
Maximum	23		34	-

N: Number of participants, ***Indicates 1% level of significance.

technology by office of Agricultural and Natural Resource of the respective districts and with the facilitation of YPDARC in technical and close supervision.

CONCLUSION AND RECOMMENDATIONS

In Ethiopia, is impossible to increase the production and productivity, insure food security and improve the livelihoods of farmers, pastoralists and agro pastoralists where conventional farming is dominant without the use improved varieties with best management practices. Thus, much is expected from stakeholders to increase the production and productivity of small scale farmers. Recognizing this, YPDARC has conducted the pre-scaling up of improved maize at BuleHora district for the two consecutive years. Generally, the result of this study revealed that improved Jibat maize variety gave higher yield, with increased income thus, leading to improvement in the standard of living in the district where the pre-scaling up study was conducted.

Participatory training consisting of theoretical and

practical sessions was given for selected farmers on the production, pre and post-harvest management of maize variety. Accordingly, many farmers built their awareness on the quality of newly introduced Jibat variety and understood that it can give a reliable yield and improve their production and productivity which in turn will improve their livelihoods and ensure food security. Moreover, knowledge and skill of Development Agent (DAs) and agricultural experts were also improved through training and exchange visits.

Better accessing of Jibat variety, improving farmers' skill, knowledge and attitude of the trial farmers on the importance and application of all recommended packages were the impacts attained during the pre-scaling up activity. Furthermore, popularization and pre-scaling up of improved Jibat variety enhanced through farmer to farmer seed dissemination mechanism.

Memorandum of understanding was signed between Yabello Pastoral and Dryland Agriculture Research Center (YPDARC) and West Guji zone Agricultural and Natural Resource office on their responsibility to ensure sustainable dissemination of the technology for a wider

community. In doing so, strong linkage among relevant stakeholders was made for the sustainability and ensuring further scaling up/out of the technology in the similar agro-ecologies. Finally, upon completion of the study, an exit strategy was designed and district office of agriculture and natural resources were officially invited and handed over ceremony was made to ensure its sustainability.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made.

Stakeholders should give due attention on enhancing farmers' capacity building (knowledge and skill) through training, strengthening linkage among all relevant stakeholders, widely extending scaling-up/out of improved Jibat maize variety in the study areas and districts with similar agro ecology in the zone for a wider community at large. This will increase production and productivity of maize in the study area in particular and West Guji Zone in general.

There should be strong linkage among relevant stakeholders: farmers, agro pastoralists, research centers, zonal and district agricultural offices so as to build the capacity for future sustainable dissemination of the maize technology for a wider community at large in the study area in particular and other similar agro ecology in general.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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