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Cluster-Based Demonstration and Popularization of Highland Maize (BH661) and Midland Maize (BH547) Production Technologies Packages in Selected Districts of Gedeo Zone and Sidama Region, Ethiopia

Merknehi Bekele, Zerihun Dotora, Mekonen Debara*

Southern Agricultural Research Institute, Hawassa Agricultural Research Center, Hawassa, P.O. Box 06, Ethiopia

ARTICLE INFORMATION

*Corresponding author:
Merknehi Bekele
E-mail: merknehibekele@gmail.com

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ABSTRACT

Improved maize varieties, pesticides, lime, NPSB, and urea fertilizers, as well as suggested agronomic procedures, were used as inputs for the display. Sites were selected based on the potentiality of the area to produce maize as well as their accessibility by land and road. Farmers, development agents, experts, and other stakeholders received various forms of training before implementing the demonstration. Field visits, field days, and yield harvesting events are all included as evaluation means of the demonstration. The findings show that the Gedeb and Windogenet areas produced a mean grain yield of maize of 42 qt/ha-1 and 44 qt/ha-1, respectively. The grain yield, the number of cobs per plant, disease resistance, seed color, and the well-covered seed of the varieties were preferred by the producers. The encountered challenges were the occurrence of fall armyworm; however, the worm was controlled by applying chemicals. Also, the lesson obtained from the demonstration was appropriately applying recommended maize packages is the major solution to the production and productivity problem of farmers. Extension personnel and concerned bodies need to work on the appropriate application of recommended maize technologies to improve maize productivity of farmers and interested bodywork on maize production.

INTRODUCTION

Ethiopia is the fifth largest producer of maize in Africa and smallholder farmers make up 94 % of the crop production. The country produces white maize, the preferred type of maize in neighboring markets. As the cheapest source of caloric intake in Ethiopia, providing 16.7 % of per capita calorie intake nationally, maize is an important crop for overall food security (CSA, 2015).
Maize is everything for Ethiopian maize farmers. Three fourth of the maize produced is consumed at the household level by the small-scale producers themselves (CSA, 2017). The grain is consumed in different forms of food; the Stover is used as feed, fuel, and construction material. Besides, it serves as a major source of income and means of employment for tens of millions of farming and business communities. Due to its wider significance in the country, maize is one of the strategic field crops targeted to ensure food security in Ethiopia (Keno et al. 2018).

Despite the importance of maize as a principal food crop, its average yield in Ethiopia (3.6-tons ha-1) is still lower than that of the world's average (5.6 t ha-1 in 2016) (FAO, 2017). A significant portion of this yield gap is attributable to biotic and abiotic stresses. The low productivity of maize is attributed to many factors like the frequent occurrence of drought, decline of soil fertility, poor agronomic practice, cease/limited use of fertilizer, insufficient technology generation, and adoption, lack of credit facilities, poor seed quality, disease, insect, pests, and weeds (Dhliwayo, et al. 2009). Weak research-extension linkage is also a major bottleneck for the low awareness and adoption of improved agricultural technologies. For that creating various initiatives to strengthen the research-extension-farmer linkage is an important mechanism to be able to bridge the gap and on-farm demonstration of improved maize variety with associative inputs, including farmers' pieces of training are important to facilitate change in the behavior of farmers and ultimately bring behavioral changes in favor of improved maize technology adoption and extension package (Dawit et al. 2014). Therefore, this cluster-based large-scale demonstration was conducted to improve maize productivity by creating awareness of the appropriate application of recommended maize packages and to evaluate farmers' feedback on technology thereby ultimately enhancing maize productivity improvement of smallholder farmers.

METHODOLOGIES AND USED APPROACHES

Before beginning the demonstration tasks, extension staff and relevant administrative bodies at the zone and district levels held all required discussions and communications regarding the goals and significance of carrying out the activity. After that, the district and kebele were purposefully chosen based on how well the region suited the technology (production potential and accessibility). Additionally, the farmers were chosen in consultation with district experts and development agents, taking cluster-based demonstration principles into account. The amount of area coverage that was intended to be implemented restricted the number of host farmers; therefore, the most important factor was adjacent farmland, up to the achievements of the planned hectare of land.

Training

At the starting point of implementation of the demonstration, training was given to selected farmers, DAs, and experts from the woreda farm and natural resource development office on agronomic practices, objectives, and the importance of a cluster-based demonstration approach.

All necessary inputs were collected through the collaborative contributions of both HwARC and Weareda Farm and the Natural Resource Development Office. Indeed, improved maize seed (5 quintals), fertilizers (40 quintals of NPSB and 30 quintals of urea), awareness-creation and capacity-building training, and field day ceremonies were prepared by the research center. Additionally, soil lime and chemicals have been collected under the responsibility of the woreda farm and natural resource development office. Then input distribution was done by considering the selected land size for a demonstration from each beneficiary farmer, which was accomplished by the collaborative responsibility of Kebele Das coordinators, the kebele chief adumbrative or chairman, experts from the woreda farm and natural resource development office, and respective researchers from the research center.

All necessary agronomic practices were done carefully, starting from land preparation up to yield harvesting, by applying the joint responsibility of beneficiary farmers, kebele and woreda agricultural officers, and researchers playing their respective roles. Three times (once before sowing plus once during sowing), the farming frequency was done: at the time of sowing 5 quintals ha-1, lime was applied by dressing in a row; 100 percent NPSB and 25 percent urea were applied at the sowing session; and the remaining 75 percent urea was applied 35 to 40 days after sowing as part of integrative pest and insect management (chemical and biological insect management practices were applied to control the pole worm).

Integrative continuous follow-up (inclusive of researcher-farmers-extension) was done periodically by strengthening good practices and taking corrective measures for miss field management practices by visiting each host farmer's field and having discussions, and by recommending making a frequent visit to each host farmer alone his or her demonstration field to make communication with DAs. Each demonstration task was performed by applying a participatory and shared responsibility approach, starting from the planning phase to the end, which was done by making effective communication with all stakeholders at each stage (researchers, extension personnel, administrative staff, and host farmers). This approach was done by sharing input costs, taking common field management measures, and following up by participating in multidisciplinary research teams.

ACHIEVEMENTS

Field day

At both locations (Gedeb and Wondo genet) field day was conducted with inclusive participation of all stakeholders (zone, woreda, and kebele extension personals, farmers, SARI, and HwARC researchers and management members). On-field day, media (southern radio and television) coverage was employed.

Yield performance

Two demonstrated maize varieties (BH547 and BH661) exhibited better yield performance in their respective demonstrated locations, as shown in the grain yield performance table 3. This improved yield performance was brought about by the implementation of full packages. This indicates that the main productivity potential barrier to the maize in the Gedeo and Sidama areas is the failure to implement the recommendations fully.

Table 1. Participant list of training

Location	Participant list in training												Grand Total
	Farmer			Agri- expert			Researcher			Other officers			
	M	F	Total	M	F	Total	M	F	Total	M	F	Total	
Wondo genet	15	5	20	6	2	8	6	2	8	7	2	9	45
Gedeb	10	5	15	6	1	7	6	2	8	7	2	9	39
Sub-total	25	10	35	12	1	15	12	4	16	14	4	18	84

Source: field data, 2022

Table 2. Participant list in field day

Location	**Participant lists**												**Total**
	Farmers			**Agri-experts**			**Researchers**			**Other officers**			
	male	female	total	male	female	total	male	female	total	male	female	total	
Wondo genet	57	17	74	9	2	11	7	2	9	12	2	14	**107**
Gedeb	111	16	127	12	2	14	6	2	8	16	5	21	**170**
Sub-total	168	33	201	21	4	25	13	4	17	28	7	35	**277**

Source; field data, 2022

Fig-1 Field day photo at Wondogenet and Gedeb districts, 2022

Table 3. Yield performance

District	Kebele	variety	Grain yield in quintal per hector		
			min	max	Mean
Wondo genet	Yuwe (N=12)	BH547	39.3	47	**43**
	Aroma (N=8)	BH547	40	48.6	**44.3**
Gedeb	Galcha(N =17)	BH661	39	47	**42.5**
	Gubata(N=12)	BH661	38.3	45.6	42

Source: field data, 2022

Feedbacks given

Farmers expressed that this comprehensive demonstration of the technologies and applied approaches was practically approved as a means of increasing maize production and productivity. Indeed, the majority of the maize plants on the demonstration site had two to three cobs per plant, whereas the same maize variety planted in neighboring farmers' fields and outside the demonstration field had just one cob per plant. Operationalizing the complete packages is what accounts for this productivity disparity. The excellent results of the tested maize varieties in terms of lodging resistance, grain yield, grain color, number of cobs per single crop, and well-coverage of cob tips were noted by farmers as reasons for their appreciation and acceptance. Also, according to extension staff, this cluster-based outcome demonstration opened the door for farmers to implement full-package applications to boost the productivity of maize varieties. In addition, they stated that the linkage between research, farmers, and extension is the most effective method for addressing smallholder farmers' productivity problems and issues with food security. Extension workers claimed that the proven methods and methodology for growing maize have a remarkable effect on smallholder farmers' ability to produce more maize. To maintain the results and further raise agricultural output, careful consideration must be given to this link between research, farmers, and extension. Pole worm prevalence, however, poses a significant threat to maize production, so the study center must pay careful attention to this issue.

Challenges faced

Due to their nature, agricultural activities are difficult to carry out because they are done in an open or uncontrolled environment where they are highly susceptible to unanticipated circumstances and the real conditions of farmers and other stakeholders. (technical support, agronomic practices, and conditional attitudes related to personal benefit). The effects of the aforementioned factors collectively hamper agricultural productivity and production in general, in addition to deviating from an agricultural project's intended objective.

When carrying out these demonstration tasks, there were challenges, including an outbreak of pole worms, but they were overcome without having a negative impact as a result of the use of integrative pest management techniques and collaboration with farmers, extension agents, and researchers.

Additionally, taking yield samples and determining the appropriate grain yield weight was difficult due to the heavy rain that was falling during the maturity stage. Also, extension gatekeepers' requests for periodic incentives to monitor and organize demonstration field management are growing in number as a source of grievance. However, this difficulty can be overcome by opening up channels of communication to zone and woreda extension staff so they can plan out their demonstration supervision schedule

Lessons learned

The application of this cluster-based full demonstration approach validated the effective utilization of production factors (land, labor, and technologies) to boost smallholder farmers' output and productivity. By putting farmers at the center of the research-extension relationship and fostering effective communication, smallholder farmers can readily disseminate research findings and boost agricultural productivity.

Farmers thought that utilizing recommended full packages could boost the productivity of particular agricultural technology. Farmers were also extremely motivated and believed that using the recommended full packages could boost the productivity of maize technology and, to the greatest extent possible, demonstrate the variety's potential.

CONCLUSION

The demonstrated maize varieties (BH547 and BH661) were the best performed; their average grain yields were 44 quintals ha-1 and 42 quintals ha-1, respectively. The result of the demonstration showed that using the recommended full packages for the maize technologies (BH547 and BH661) could increase the production and productivity of the varieties. Hence extending these improved maize varieties with their full packages is an important mechanism to increase the production volume and productivity of smallholder farmers up to 43 quintals per hectare in the demonstration and similar agro-ecologies. The grain yield, the number of cobs per plant, disease resistance capacity, seed color, and the well-covered seed of the varieties were preferred by the producers. Farmers were also extremely motivated and believed that using the recommended full packages could boost the productivity of maize technology and, to the greatest extent possible, demonstrate the variety's potential.

Recommendation

The demonstrated maize technologies resulted in positive change in farmers' maize productivities and showed profitable maize-producing practices, thus expanding this technology with its full package would play a great role in household-level food security and income generation for smallholder farmers and contribute to zonal and regional food security. Therefore, each concerned body needs to play its expected roles, in that manner: -

Farmers need to expand the technology as demonstrated in the packages and further refine agronomic practices (farming frequency, weed control) to maintain the productivity achieved in the demonstration as well as further improve grain yields by incorporating their indigenous knowledge, especially for the biological control of pole worm prevalence.

Also, cooperatives need to play their role in seed multiplication for the sake of seed access for farmers and other interested parties who are interested in working on this technology.

Agricultural officers need to play their role in facilitating communication among farmers, cooperatives, and researchers and giving technical support on agronomic practices (farming frequency, weed management, pest management, and rust prevention and control mechanisms). The pole worm prevalence in maize cultivars is a big production problem at demonstration locations; thus, concerned bodies need to give due attention to the solution to this problem.

Finally, all concerned parties (especially extension personnel) must pay particular attention to technical support and information accessibility for every smallholder maize producer for proper actualization of maize production packages in the area in order to maintain the demonstration's positive results and reduce the yield performance gap among farmers.

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