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Cluster Based Large Scale Demonstration of Improved Sorghum Technology in Sofi District of Harari Region

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ABSTRACT

*Local sorghum grown in moisture stress areas, resulting in reduced yield. Large scale demonstration of improved early maturing sorghum technology was conducted in the Harari region's Sofi district to improve farmers' production and productivity to enhance their livelihoods. The activity was conducted in Kile kebele. A total of 40 Farmers were selected based on their interest, land ownership, and willingness to share experiences with other farmers and clustered according to their land adjacent to each other. Forty farmers directly benefited from the technology by keeping a gender balance. 60% and 40% were male and female farmers directly addressed with sorghum variety called Misikir. The variety was planted on a plot size of 0.25 ha per farmer, with a 12kg/ha seed rate and 75 cm*25 cm space between row and plant, respectively. Similarly, NPS and Urea fertilizer were applied at the rate of 100kg/ha. Training and field days were organized to enhance the diffusion of technologies, evaluate the variety's performance, and share the lessons with different stakeholders. The average productivity of the farmers from the improved sorghum technology in quintal per hectare was 33.94. The improved sorghum technology introduced to the study area helps farmers to reduce chronic food insecurity status in the study area. The research centre and agriculture and natural resource bureau should work on the sustainability of an improved variety of sorghum technology to boost production and productivity to improve farmers' food security in the study area.*

Keywords: *Large scale demonstration, Sorghum, Technology, Sofi district, Descriptive statistics.*

INTRODUCTION

Sorghum (*Sorghum bicolor* L.) Moench) is the fifth largest produced cereal crop in the world and one of the staples of the world's poorest, particularly in the developing countries of Africa and South Asia (FAOSTAT, 2018). Developing countries' global share in sorghum production increased from 68% in 1980 to 76% by 2016, mainly due to a doubling of production in Africa from 12 million t in 1980–1982 to 28 million t in 2014–2016. In 2018, Africa's production further increased to 29.7 (FAOSTAT, 2020).

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The largest world sorghum producers are the USA, with a total annual grain production of 8.7 million tons from 2.0 million hectares, Nigeria (6.9 million tons and 5.4 million hectares), Ethiopia (5.3 million tons and million hectares), and Sudan (3.7 million tons in 6.8 million hectares) (FAO, 2019). Nationally, the three regions, Oromia, Amhara and Tigray, have been the major producers of sorghum in the last five years (CSA, 2018). It accounts for the third largest share of cereal crop production, preceded by maize and Tef in terms of area and production volumes. Out of the total land allocated for cereal crops in the Oromia of 4.85 million ha, the sorghum is positioned fourth by covering 14.8% of the total area (CSA, 2019). The region's sorghum productivity was 28.56 qtl/ha, which is higher than the national average of 27.36 qtl/ha.

Sorghum is adjusted to different climate patterns and is forecast to sustain widespread fitness across various places of climatic zones under weather change (Christina & Jacob, 2016). It has the ability to adapt to a wide range of environments and hence can be produced in high lands, medium altitude and low land areas. Sorghum is widely produced more than any other crop in areas with moisture stress. In addition, sorghum will be the crop of the future due to the changing global climatic trends and an increase in the use of marginal lands for agriculture (Temesgen, 2021). Sorghum plays a crucial role in providing food security in the face of climate change in many developing countries (Mundia et al., 2019). It is a staple food crop in the drier parts of Africa, China, and India (Ajeigbe et al., 2018; & Mrema et al., 2020). In Ethiopia, drought and striga weed have been found to be the most important constraints in the northern and North-eastern parts of the country (Gebretsadik et al., 2014). This problem is alleviated by developing crops that are well adapted to moisture constraint areas. Improved sorghum variety is an important drought tolerant crop in such areas and is a good crop model for evaluating mechanisms of moisture stress. Low soil fertility and shortage of moisture are the major constraints in the reduction of growth and productivity of sorghum (Gebreyesus, 2012).

Most farmers grow long maturing local landraces, some of which take 7-8 months to mature, negatively affecting the yield. To solve this problem, the Fedis Agricultural Research Center (FARC) has conducted adaptation trials and evaluated different early maturing and striga resistant varieties in some districts of East Hararghe Zone. However, local sorghum varieties, which are easily affected by drought and striga infestation, are under production in the Harari region. This results in low sorghum production in the Harari region. To alleviate the problems, the evaluation of improved early maturing sorghum varieties was undertaken by FARC through AGP-II support. The variety performed better and had a yield advantage over the local variety in the natural environment. Farmers have evaluated and selected the best performed improved lowland sorghum varieties using maturity period, yield, disease tolerance, adaptability, and drought tolerance as evaluation criteria. Based on these, Misikir variety is suggested for wider promotion to benefit farmers at large. Therefore, this activity was undertaken to disseminate the Misikir variety in the study areas through large scale demonstration under AGP-II support in order to increase household income and alleviate food shortage.

Objectives

- To evaluate the productivity and profitability of the technologies under farmers' condition
- To create awareness among different development practitioners on the improved sorghum production.
- To enhance farmers’ knowledge and skills on early maturing sorghum production and management techniques.

MATERIALS AND METHODS

Description of the study area

The activity was conducted in the nationally selected Agricultural Growth Program-II implementation district of the Harari region. Harari region is located at a distance of 526 km from the national capital city, Finfinne, to the Eastern parts of the country. The Oromia region borders it and hosts the capital town of East Hararghe zone of the Oromia national regional state. The region is classified as highland, midland and lowland based on agroecology. The selected district has the potential for the program to succeed in terms of solving the practical problems of farming society. The study site is characterized by drought and the erratic nature of rainfall, which are challenging crop production in general and sorghum production in particular.

Site and farmers selection

One district from Harari region was selected. One kebele (Kile) from the Sofi district was selected. Farmers were selected based on their interest, land ownership, and willingness to share experiences with other farmers in collaboration with experts from district agriculture and natural resource offices and development agents. The selected farmers were organized into clusters according to their land adjacent, with the members taking gender issues (women and youth constitute 40% of the total participant farmers) into consideration. A total of 40 farmers were addressed within the technology.

Technology dissemination approach

Cluster approach

To promote the potential impact of the technology as well as to link farmers with different service providers, it is important to conduct cluster-based large-scale demonstration activity. Hence, participant farmers whose farms are adjacent to each other were selected to form a cluster. A cluster of farmers producing similar crops like improved sorghum was selected. Producing in clusters can enhance access to markets and information. Hence, different community groups and institutions are linked through information to work with different stakeholders to enhance technology diffusion and adoption, facilitating interaction and information exchange among farmers and other relevant stakeholders.

Implementation procedures

One improved sorghum variety called Misikir was provided to the farmers with full packages. The variety was planted on a plot size of 50mx50m/farmer, with a 12 kg/ha seed rate. The space between the row and plant was 75cm*25cm, respectively. Likewise, fertilizer (NPS and Urea) was applied at the rate of 100 kg/ha. The variety was planted on 40 farmers' land. Participant farmers managed the field with close supervision of researchers and development agents.

Capacity building and experience sharing

As part of the intervention activities, training on agronomic practices and post-harvest handling was given to farmers, DAs and experts before plantation, during harvest and post-harvesting time. The field day was organized on the fields of beneficiary farmers to evaluate the variety's performance and final outputs and share the lessons with different stakeholders. Famers, development agents, district agriculture and natural resource office experts, researchers and other relevant stakeholders attended the field day.

Data to be collected

The number of beneficiary farmers by age and sex, plot size and amount of input provided were collected using a checklist. The grain yield data was collected using a checklist from beneficiary farmers. The cost-benefit ratio was used to evaluate the profitability of the technology. The knowledge level of participant farmers concerning improved sorghum production technologies was measured before and after the implementation of the technology with developed knowledge test items.

Methods of data collection

Using a checklist, quantitative and qualitative data were collected through personal field observation, individual interviews, and Focus group discussions.

Data analysis

Quantitative data was analyzed using a statistical package for social science (SPSS). Descriptive statistics such as frequency, percentage, mean, standard deviation, minimum and maximum were presented using tables. The profitability of the technology was analyzed using cost-benefit analysis. The knowledge level of beneficiary farmers regarding improved sorghum production technologies was analyzed using a paired-sample t-test.

RESULT AND DISCUSSION

Descriptive statistics results

Farm household characteristics

Of the total 40 direct beneficiaries of the technologies, 60 %(24) of the farmers were male, while 40 %(16) were female farmers (Table 1). The mean age of the farmers who benefited from the technology was 42.13 in the year (Table 1). The maximum and minimum age of the farm household was 55 and 29 a year, respectively. The above explanation is summarized in the following table1.

Table 1: Demographic characteristics of the farmers directly benefited from the technologies

Age of farmers benefited from the technology in a year			Sex of farmers benefited from the technology			
Mean	Maximum	Minimum	Male		Female	
42.13	55	29	Frequency	Percentage	Frequency	Percentage
			24	60	16	40

Source: own calculation from own data, 2020

Descriptive result on capacity building for different stakeholders

A total of 25 farmers (15 males and 10 females), 3 development agents and 3 experts have participated in the training. Likewise, a total of 50 farmers, out of which 30 were male and 20 were female, had participated in field day. Three professional experts from the district (2 males and 1female) and 3 development agents have participated in the field day organized. The above explanation is summarized hereunder in Table 2.

Table2. Descriptive result on capacity building for different stakeholders

S.N	Participants on training	Sex of participants in training			Participants on field day organized	Sex of participants		
		Male	Female	Total		Male	Female	Total
1	Farmers	15	10	25	Farmers	30	20	50
2	DAs	2	1	3	DAs	2	1	3
3	Experts/SME	2	1	3	Experts/SME	2	1	3

Source: own computation from own data, 2020

Descriptive result for Sorghum production and productivity at Kile kebele of Sofi district

The crop used for production was a sorghum variety called Misikir. The sorghum covered a plot size of 10 hectares. The mean yield obtained per hectare was 33.94 and 15 in quintals for improved and local sorghum, respectively. The following table summarizes the above description (Table 3).

Table3. Descriptive result for Sorghum production and productivity at Sofi district

Crop	Variety	Yield in quintal per ha
Sorghum	Misikir	33.94
	local	15

Source: Own computation from own data, 2020

Table 4. Pair-wise ranking results based on a variety of traits as to their importance

No	variety traits	A	B	C	D	E	F	Total score	Rank
1	A							3	3rd
2	B	A						2	4th
3	C	A	B					0	6th
4	D	A	B	D				1	5th
5	E	E	E	E	E			4	2nd
6	F	F	F	F	F	F		5	1st

Source: own computation, 2020

A= Adaptability, B= Disease tolerant, C =Plant height, D= Early maturing, E= Drought tolerant F= Yield

Table 5.Farmers varietal selection criteria

No	Varieties	Rank	Selection criteria
1	Misikir	1	More disease tolerant ,Early maturing, more adaptable with the existing environment, more drought tolerant and high yielder
2	Local sorghum	2	Less disease tolerant, low yielder, low drought tolerant late maturing, less adaptable to the existing environment, higher plant height

Source: own computation, 2020

Results of the Knowledge Test

Knowledge test items were developed based on the contents of capacity building and production package practices or agronomic practices. Participant farmers' knowledge level regarding improved early maturing sorghum production technologies was measured before and after implementation. The score is given as 1 for the correct answer and 0 for the incorrect answer. The percentage of respondents with correct answers increased after the intervention, while the percentage of respondents with incorrect answers decreased.

Table 6 Percentage of respondents for each knowledge test item

No	Test items	Respondents percentage			
		Before technology implementation		After technology implementation	
		Correct	Incorrect	Correct	Incorrect
1	Name at least one improved sorghum variety	48	52	72	28
2	Seed rate of sorghum required per hectare?	52	48	68	32
3	What is fertilizer rate per hectare	68	32	84	16
4	recommended space between rows	40	60	64	36
5	Recommended space between plants	36	64	72	28
6	What is the Potential productivity (yield/ha) of the variety?	40	60	52	48
7	The maximum sorghum plant population per hectare	0	100	12	88
8	Yield losses due to biotic and abiotic constraints	64	36	68	32
9	yield losses due to environmental stresses	44	56	56	44
10	Actual yield losses due to misuse of recommended agronomic practices	44	56	48	52
11	Economic yield losses	28	72	64	36

Source: own computation from own data, 2020

Table7. Results of paired-sample t-test for knowledge test before and after the technology

Knowledge score	Mean	St.dev	t-value
Total score after	6.6	1.68	7.006***
Total score before	4.46	1.35	

Source: own computation from own data, 2020

Note: *** refers to significance level at 1%.

There was a significant mean difference between farmers' knowledge before and after technology intervention at a 1% significance level. This implies awareness of the farmers regarding improved sorghum production techniques after technology intervention was improved.

CONCLUSION AND RECOMMENDATIONS

The technology contributes to improving the production and productivity of farmers, which helps to enhance the living standard of farmers in the study area. Improved variety is one of the elements of input that plays a crucial role in increasing both production and productivity of the farmers. The improved sorghum technology introduced to the study area helps farmers to reduce chronic food insecurity status in the study area. The cost-benefit ratio indicated that the improved sorghum technology was greater than 1 as compared to the locally produced sorghum. The district agriculture and natural resource bureau and agricultural research centre should work on the sustainability of an improved variety of sorghum technologies to boost production and productivity to improve farmers' food security in the study area. The result of the paired-sample t-test reveals that there is an improvement in farmers' knowledge regarding the improved sorghum production technologies due to intervention done on the beneficiary farmers.

Therefore, it is better if all the concerned body focuses on capacity building to enhance the farmers' awareness and knowledge of the newly introduced improved technologies.

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