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Participatory Demonstration of Maize (*Zea Mays* L.) Variety with its Full Packages in South Ethiopia

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Abstract

Participatory pre extension demonstration works of three variety (BH-546, BH-547 and BH-661) were conducted in 2016 at two FTC and 11 beneficiary farmers field by the main objective of enhancing the adoption and diffusion of the technology, to collect feedback information from the farmers and to study cost benefit analysis. All data were collected from 100 m^2 demonstration plots and the collected data were analyzed through Genstat Software, Simple descriptive statistics and matrix rankings. Farmers were evaluate the demonstration plots three times i.e. at sowing, knee height and maturity stages. Average yield performances that were obtained from farmers field were 49 Quintal/hectare, 53 Quintal/hectare and 43.5 Quintal/hectare of BH-546, BH-547 and BH-661 respectively and Yield that obtained from FTCs were 54 Quintal/hectare, 55 Quintal/hectare and 48 Quintal/hectare of BH-546, BH-547 and BH-661 respectively. BH-547 variety shows better yield performance than other variety. The net benefit that were obtained from BH-546, BH-547 and BH-661 were 23,750 ETB, 24,280 ETB and 20,400 ETB respectively. Finally, the demonstration sites were visited by organized farmer's field day and farmers select those varieties by different criteria and rank at first BH-547 by its ability to tolerate drought, earliness, resistance to pest and disease and resistance to lodging. Secondly they select as best BH-546 by criteria of good seed emergency rate, earliness, resistance to disease and pest and ability to tolerate drought. Finally it is better to scale up both BH-547 and BH-546 in larger scale to enhance adoption and diffusion of variety.

Keywords: Scale up; FTC; Farmers; Variety

Introduction

Maize (*Zea mays*) is one of the most important food crops grown world-wide. It has the highest average yield per hectare and is third after wheat and rice in area and total production in the world [1]. It is grown in most parts of the world over a wide range of environmental conditions [2]. Maize is among the most important and widely grown crops in Ethiopia [3-5]. 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 neighbouring 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. Since agricultural research innovations have no value if they are not taken by the end users, identification of the factors determining adoption of improved technologies will help improve the effectiveness of research and extension services and agricultural policy to increase productivity of traditional farmers.

The low productivity of maize is attributed to many factors like frequent occurrence of drought, declining 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 [6]. One of the major problems constraining the development of an economically successful agriculture is nutrient deficiency [7].

Different research centre releases different technologies of wheat. But farmers doesn't accept the released technology because the farmers-extension-researchers (FER) linkages are weak, fear for newly coming technologies and fear of failure. However, demonstration of these
varieties with their production package is not done widely in order to popularize the
variety in the area. So, demonstrating maize varieties on FTC and farmers field are the main tools for enhancing the adoption of technologies and to assess farmers' feedback.

Objective

To enhance rapid diffusion, adoption and dissemination of improved maize technology

To collect farmers preference and feedback information

To study cost benefit analysis of the variety

Materials and Methods

Description of study area

Melokoza is one of 17 districts in Gamo-Gofa administrative zone which is located in 6°18'117" N and 36°37'668" E with an altitude range 505-2500m.a.s.l. The district has 39 smallest administrative unit/kebele (37 rural and 2 peri-urban). According to the Melokoza office of Agriculture, the total population of the district is 152,502. There is bimodal rainfall pattern with average annual rain fall of the district is 1125 mm (minimum 750 mm and maximum 1500 mm) with minimum and maximum temperature of 15.1°C and 27.5°C,

respectively. Maize and sesame are widely grown in the area (Melokoza Woreda, office of agriculture, 2015).

Basketo special district is one of the four special districts of South nation nationality and peoples region (SNNPR) which is located in 06°28'191" N and 36°34'968" E with an altitude ranging from 780-2200 m.a.s.l. The total population of the district is 74,050. The average annual rain fall of the district is 1200 mm (minimum 1000 mm and maximum 1400 mm) with minimum and maximum temperature of 15°C and 27°C, respectively. Maize, sesame, and sorghum are widely grown in the area (Basketo special Woreda, office of agriculture, 2015) (Figure 1).

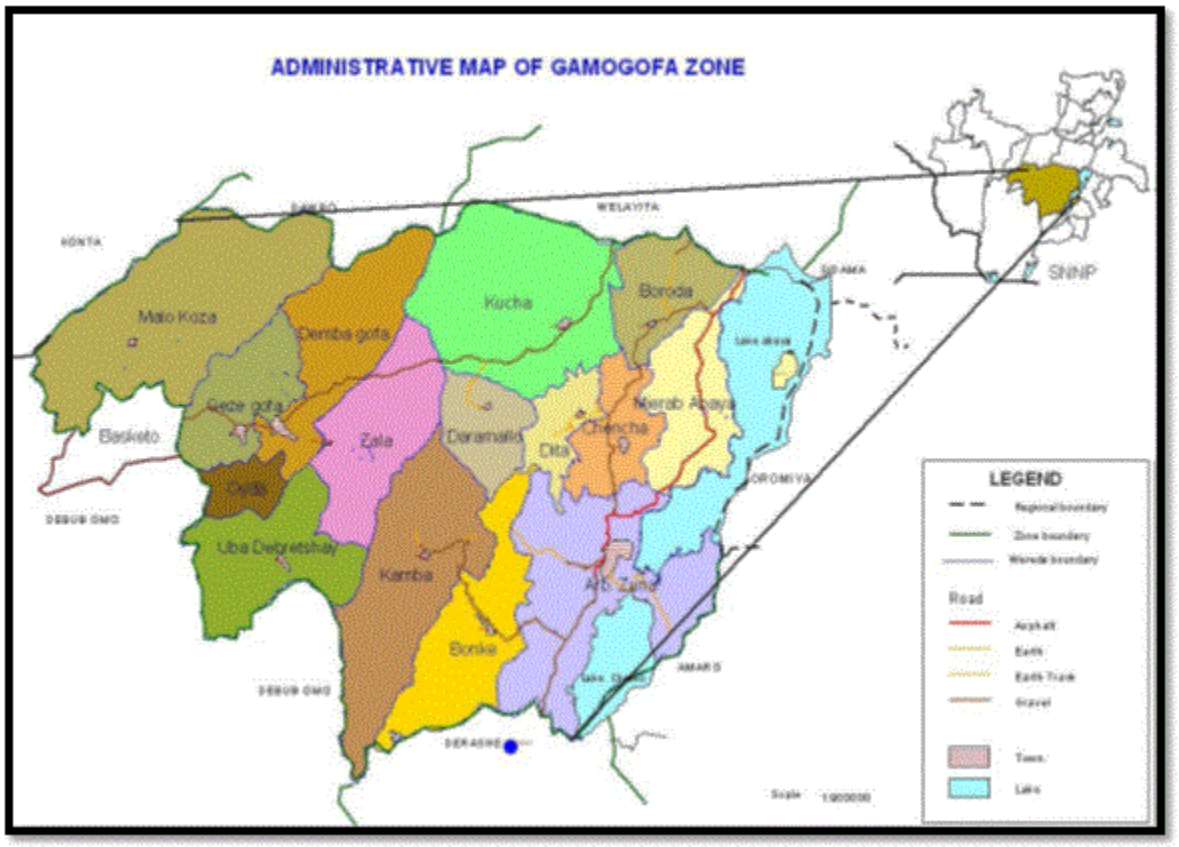

Figure 1: Administrative map of gamogofa zone.

Selection procedure

For conducting pre extension demonstration of maize technologies, two woreda (Melokoza and Basketo Special Woreda) were selected purposively. From both districts, two kebele (FTCs) and eleven host farmers (4 women headed) was selected purposively for conducting and evaluating the demonstrating plots. Beneficiary farmers were selected based on the criteria and objective of the program (Agricultural Growth Program II, which works on agricultural technology generation and diffusion) and the willingness of farmers to participate in the demonstration plots. They were selected by collaboration with kebele development agents (DAs) and the woreda office of agriculture.

Planting materials and agronomic practice

BH-546, BH-547 and BH-661 maize variety that were recently released from Bako agricultural research center were demonstrated on two farmers training center (FTC) and at eleven farmer's field. The seed rate were 25 kg/hectare, intra and inter spacing 25 cm and 75 cm respectively and fertilizer rate 100 kg NPSB and 100 kg UREA(1/3 were applied during sowing and 2/3 were applied at knee height stage) The land size that were demonstration plots applied is 10m*10m=100m^2.

Mode of implementations

Before starting implementation, farmers were organized by FRG (farmer's research group) and well trained on agronomic practice of the crops and capacitated. The group would contain 30% women and they assign the leader and secretary and they can talk together on different issues and work in close relationship with researchers. After organization of FRG, training was provided on the maize technology from production up to marketing and finally all necessary input was delivered to the farmers from Arbaminch Agricultural research centers(seeds, fertilizers, etc) and farmers sown the seeds on their fields and follow ups and essential advices from respective researchers has been taken place. Farmers were evaluated the demonstration plots three times (i.e., at sowing, knee height and maturity stages) and finally field day was organized and technologies was promoted through

different medias such as brochures, leaflets, local TVs and radio to mass who can't participate directly.

Data collection

The agronomic data were directly collected by researchers from the field. Yield data were collected at the time of maturity directly from the field and perception related data like seed emergence rate, height of the variety, resistance to disease, resistance to pest, cob size, number of cobs per plant, number of seeds per cob, resistance to lodging, ability to tolerate drought, earliness, seed size, taste and marketability data were collected through structured questionnaires.

Method of data analysis

Data that were collected from the field were analyzed through different methods. One way ANOVA, Genstat software, simple descriptive statistics such as mean, CIMMYT partial budget analysis and pair wise and matrix rankings were used to analyze farmers preferences criteria.

Results and Discussion

Yield performance

Yield performances of farmer's field: From demonstration plots, yield data were collected from eleven farmer's field from Pircha and Motikessa Kebele of Melokoza and Basketo special district respectively.

Farmers	Kebele	Yield Performance in Quintal/ha		
		BH-546	BH-547	BH-661
F1	Pircha	52	49	47
F2	Pircha	50	58	44
F3	Pircha	51	51	43
F4	Pircha	54	54.5	39
F5	Pircha	46	55	39.5
F6	Pircha	47	47	45
Mean		50	52.5	44
F7	Motikesa	53	47.5	42.5
F8	Motikesa	44	50	41
F9	Motikesa	46	59	45
F10	Motikesa	49	57	44
F11	Motikesa	48	54.5	42.5
Mean		48	53.6	43
G.mean		49	53	43.5
CV(%)		7.5		
Stdv		5.3		

Table 1: Yield Performance of farmer's field.

Table 1 shows that, the mean yield performance of farmer's field by quintal (i.e., 1 quintal=100 kg) and the mean yield of Phircha kebele were 50quintal per hectare, 52.5 quintal per hectare and 44 quintal per hectare of BH-546, BH-547 and BH-661 respectively. While the mean yield performance of farmers field of Motikessa kebele were 48 quintal per hectare, 53.6 quintal per hectare and 43 quintal per hectare of BH-546, BH-547 and BH-661 respectively. In both location BH-547 shows better yield performance than BH-546 and BH-661 variety.

Generally, the mean yield performance of BH-546 was 49 quintal per hectare, that of BH-547 was 53 quintal per hectare and BH-661 was 43.5 quintal per hectare. BH-547 variety at farmers field shows better yields than other. Also BH-546 variety gave good yield next to BH-547 variety.

Yield performance of farmers training center/FTC: The yield performance of the BH-546 and BH-547 at Phircha FTC were relatively the same i.e., 55.5 and 56 quintal per hectare. At Motikessa FTC, the variety shows differences and the average yield performance of BH-546, BH-547 and BH-661 were 54 quintal per hectare, 55 quintal per hectare and 48 quintal per hectare respectively (Table 2).

Location	Measure	Variety Name		
		BH-546	BH-547	BH-661
Phircha FTC	Qt/ha	55.5	56	50
Motikessa FTC	Qt/ha	52	54	46
Mean	Qt/ha	54	55	48
Stdv		2.5	1.4	2.8
Lsd(5%)		3.2		

Table 2: Yield performance of FTCs.

Yield advantage and yield increases

As the table 3 below shows that BH-546 variety shows 550 kg yield increase and 12.625 % yield advantage over BH-661 and BH-547 shows 1005 kg yield increase and 22 % yield advantage over BH-661 variety. Both BH-546 and BH-547 shows positive yield advantages and increase over Standard checks (BH-661 variety).

Location	Yields in Kg			Yield Increase(kg)		Yield advantage (%)	
	BH-546	BH-547	BH-661	BH-546	BH-547	BH-546	BH-547
Phircha(N=6)	5000	5250	4400	600	850	13.63	19.3
Motikessa (N=5)	4800	5360	4300	500	1060	11.62	24.65
Mean	4900	5300	4350	550	1005	12.625	22

Table 3: Yield advantage and yield increases.

Rank frequency

Pair-wise ranking matrix of farmers' selection criteria: Pair-wise ranking of farmers selection criteria were conducted through and farmers compare criteria that were set by farmers themselves and adjusted by relevant researchers and rank them in order of importance. The criteria that farmers used in identifying the suitable varieties depend on the existing constraints and opportunities farmers faced in their location. Accordingly Seed emergency(A), Height of the variety (B), Resistance to disease (C), Resistance to pest (D), Cob size (E), Number of cobs per plant (F), Number of seeds per cob (G), Resistance to lodging (H), Earliness (I), Ability to tolerate drought (J), Seed size (K), Taste (L), Marketability (M) are identified farmers criteria (Table 4).

Selection criteria	A	B	C	D	E	F	G	H	I	J	K	L	M	Points	Rank
A		A	C	D	E	F	G	H	I	J	K	A	M	1	10
B			C	D	E	F	G	H	I	J	K	B	M	1	10
C				C	C	C	C	C	C	J	C	C	C	11	2
D					D	D	D	D	I	J	D	D	D	9	4
E						F	G	H	I	J	E	L	M	3	9
F							F	H	I	J	F	F	M	6	7
G								H	I	J	G	G	M	5	8
H									I	J	H	H	H	8	5
I										J	I	I	I	10	3
J											J	J	J	12	1
K												K	M	3	9

L													M	1	10
M														7	6

Table 4: Pair-wise ranking matrix.

Farmers rank criteria as its importance. Ability to drought tolerance, Resistance to disease, Earliness, resistance to pest, resistance to lodging and marketability were the first five best selected criteria that researchers should be considered for future to develop farmer preferred variety. We have learnt that the farmers' selection criteria are beyond yield and most farmers give priority for qualitative traits. They give priority for drought tolerances, resistance to disease and pest and marketability of the variety.

Farmer's preferences: Farmers preferences criteria were conducted and they compare and rank two improved variety with standard checks (BH-546, BH-547 with BH-661) by 13 different criteria. Farmers who participated and evaluated the demonstration plots were representative to the area and having long experience in farming. Before beginning of the selection process, selected farmers from the districts were asked to set their priority selection criteria. Selection criteria of farmers in the study area were based on an extensive discussion and agreement and farmers set criteria during seed emergency, flowering, maturity and harvest stage of the crop. Seed emergency, Height of the variety, resistance to disease, resistance to pest, cob size, number of cobs per plant, number of seeds per cob, resistance to lodging, earliness, ability to tolerate drought, seed size, taste and marketability are the criteria that were set by farmers and adjusted by researchers for the sake of clarity. Farmers scored each variety for individual traits considered important by them and ranking of varieties were done on a scale of 1-4, 4 being the highest score representing very good and 1 being very poor.

Variety	Location						
	Phircha			Motikessa			
	Total Score	Mean score	Rank	Total Score	Mean score	Rank	Overall rank
BH-546	44	3.4	2	41	3.2	2	2
BH-547	47	3.6	1	48	3.7	1	1
BH-661	34	2.6	3	30	2.3	3	3

Table 5: Ranking and scoring of faba bean variety selection criteria by farmers at two locations from A-M, Seed emergency (A), Height of the variety (B), Resistance to disease (C), Resistance to pest (D), Cob size (E), Number of cobs per plant (F), Number of seeds per cob(G), Resistance to lodging(H), Earliness (I), Ability to tolerate drought (J), Seed size (K), Taste (L), Marketability (M).

According to the table 5 above ranking and scoring of maize variety, the highest score were recorded for BH-547 variety (3.6 in Phircha and 3.7 in Motikessa) and the lowest score were recorded for standard check(BH-661). BH-547 variety were recorded as best followed by BH-546 variety. The least score were recorded for standard checks (2.6 in Phircha Kebele and 2.3 in Motikessa Kebele).

Farmers selects BH-547 as best by its ability to tolerate drought, earliness , resistance to disease and pest, large cob size, number of cobs per plants, number of seeds per cobs, seed size and marketability. Secondly they select BH-546 as best next to BH-547 by criteria of high emergency rate, earliness, resistance to disease, resistance to pest, resistance to lodging, and ability to tolerate drought.

Partial budget analysis

Economic analysis (cost-benefit analysis) is the best tools for checking the technology is cost effective or not by adding each costs and gains obtained from yields and yield products. N

S.N	Items	Quantity	Unit price/cost	Variety		
				BH-546	BH-547	BH-661
1	Average yield (kg/hectare)	kg		5400	5500	4800
2	Adjusted yield (-10%)		-10%	4860	4950	4320
		Birr	6 ETB	29,160	29,700	25,920
3	Maize stalk	Ha	1000	1000	1000	1000
	Total gain in birr(A)			30,160	30,700	26,920
4	Fertilizer costs in kg	NPS	100	1250	1250	1250

		Urea	100	1100	1100	1100
		Total	200	2350	2350	2350
5	Land preparation	Ha	ETB	600	600	600
6	Labor costs per day	Sowing	2day*5person*35birr	350	350	350
		1st & 2nd Weeding	2day*10person*35birr	700	700	700
		Fertilizer application	2day*6person*35birr	420	420	420
		Harvesting	2day*10person*35birr	700	700	700
7	Transporting and threshing Cost			1300	1300	1200
	Total costs(B)			6420	6420	6520
	Net Benefit(C=A-B)			23,740	24,280	20,400

Table 6: Cost=benefit analysis of demonstration plot.

According to CIMMYT [8] the yield obtained initially were adjusted at-10% because the adjusted yield for a treatment is the average yield adjusted downward by a certain percentage to reflect the difference between the experimental yield and the yield farmers could expect from the same treatment. Experimental yields, even from on-farm experiments under representative conditions, are often higher than the yields that farmers could expect using the same treatments. Because of:-

Management. If they manage the experimental variables. researchers can often be more precise and sometimes more timely than farmers in operations such as plant spacing of the plant, weed control or fertilizer application.

Plot size: Yields estimated from small plots often overestimate the yield of an entire field because of errors in the measurement of the harvested area and because the small plots tend to be more uniform than large fields.

Harvest date: Researchers often harvest a crop at physiological maturity, whereas farmers may not harvest at the optimum time. Thus even when the yields of both researchers and farmers are adjusted to constant moisture content, the researchers' yield may be higher, because of fewer losses to insects, birds, rodents, ear rots, or shattering.

Form of harvest: In some cases farmers' harvest methods may lead to heavier losses than result from researchers' harvest methods. This might occur, for example, if farmers harvest their fields by machine and researchers carry out a more careful manual harvest.

According to the above table 6, all variety shows positive net benefits or gains. The net benefits of the varieties that were demonstrated was 23,750 ETB of BH-546, 24,280 ETB of BH-547, and 20,400 ETB of BH-661. More benefits were obtained from BH-546 varieties and least benefits obtained from BH-661.

Conclusion and Recommendation

Three varieties of Maize were demonstrated (two newly released and one standard check) with its full packages at two FTC and 11 farmers field. Field day were organized and farmers evaluate the demonstration plots three times and the yield performance were 49 quintal/hectare, 53 quintal/hectare, and 43.5 quintal/hectare of BH-546, BH-547 and BH-661 respectively. Farmers selects BH-547 and BH-546 as first and second by different criteria for further use of variety. The cost benefit analysis were conducted and recorded 22,040 Ethiopian birr(ETB), 24,200 ETB, 19,070 ETB of BH-546, BH-547 and BH-661 respectively.

It was recommended that, it is better to disseminate the preferred maize technologies to a large number of farmers through scaling up of the technologies. To enhance production and productivity, training farmers to apply technologies with its full package including agronomic practices. To enhance production and productivity of the maize, farmers need to get agricultural inputs like fertilizer, chemicals and high improved seed. Effective seed exchange mechanism (ESEM) should be designed for fast dissemination of the technology. And it is better for future to do research on disease resistant and high yielding varieties.

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