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Pre-extension demonstration of blended fertilizer rate for maize crop production in Debub Ari Woreda, Southern Ethiopia

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The demonstration was conducted with aim to introduce new rate of blended fertilizer on maize crop and to enhance farmers' awareness toward new practice. Sites and host farmers selection were undertaken purposively by researcher jointly with agricultural experts of the corresponding woreda. The demonstration was carried out on five farmers' and one FTC's field in each kebele, and two plots per farmer's and FTC's fields were used. Totally, 105 participants were participated on training and field day events. Farmers' preference and cost data were collected using individual interview whereas sample of grain yield data was collected from each plot per farmers using weight measurement. Participatory on-field performance evaluation was conducted and feedbacks from participant farmers, agricultural experts and stakeholder were collected during field day. Farmer's preference evaluation results showed that, field performance of maize crop under new rate (100 NPSB + 260 Urea) kgha^{-1}of blended fertilizer was more preferred to the existing extension practices. Yield performance result revealed that, better grain yield of 4.78t ha^{-1} was obtained from maize crop under new practice with yield advantage of 12.47% compared to existing extension practice. So, use of new rate of blended fertilizer enhances maize productivities in the area. Therefore, conducting further scaling up and popularization of the practice is recommended in areas with similar soil type and agro-ecology.

Key words: *blended fertilizer, demonstration, extension practice, farmers' preference*

INTRODUCTION

Maize is one of the most important stable foods in terms of calorie intake for majority of smallholders in Ethiopia (Berhane et al., 2011). The crop is cultivated under diverse agro-ecologies and socio-economic conditions most commonly in Meher and Belge production seasons in midland and high land areas under rain-fed conditions in the county, specifically in South Omo zone. In the zone maize production covered 43.61% out of total arable land covered by grain crops and its average grain yield productivity was 3.97t ha^{-1} which was relatively lower than national average yield of 4.24t ha^{-1} (CSA 2020). Although, more than 124,396 farmers were engaged in maize cultivation, its production and productivities was constrained by both biotic and abiotic factors in the area. Maize production was potentially influenced mainly by soil fertility depletion, subsistence-oriented production system, limited access to improved seed, soil erosion, pests and disease, inadequate use of fertilizers both in amount and types and erratic rainfall (Bekabil, 2014; Yokamo et al., 2018, and Abate et al., 2015). Moreover frequent cultivation of crops for longer years without rotation is the foremost problem for depletion of micro-nutrients such as; zinc, boron and copper. This problem was recognized in different major crop producing area of the country. Therefore, several management options, site-specific fertilizer direction are currently increased noticeably to tackle nutrient depletion problem. After the soil fertility map which was developed by Agricultural Transformation Agency (ATA) in 2016, 8 blended fertilizers containing N, P, K, S, B, Zn and Cu have been recommended for south nation nationalities and people regional state (SNNPRS). Based on the aforementioned information, Jinka agricultural research center had conducted different rates of fertilizer with multi-nutrient blends include micronutrients for the last two years (2016-2017). Study of Tunebo et al., 2021 revealed that, Even though application of different rates of NPSB fertilizer had no significant effect on plant height and biomass yield of maize crop, the grain yield of the crop was significantly varied along with application of different rates of blended fertilizer and the highest maize grain yield of 4657.1kg ha^{-1} was obtained under application of 100kg NPSB and 260Kg urea fertilizer in the areas. Hence use of new rate of blended fertilizer for maize production is paramount important to enhance yield production in the area. Therefor this demonstration was carried out to introduce the new rate of blended fertilizer and to enhance farmers' awareness towards application of the recommended rate of fertilizer on maize crop in the areas.

MATERIALS AND METHODS

Description of study Area

Debub Ari woreda is one among eight woredas of South Omo Zone. Its mean annual rainfall of ranges between 601- 1600 mm, whereas mean annual temperature ranges between 10.1^0C and greater than 27.5^0C. The woreda consist 30%, 65% and 5% of *Dega*, *Woina Dega* and *Kolla* agro-ecologies in the same order. In general two cropping seasons called *Belg* (February to April) and *Meher* (July to September). About 90% of the crop production is carried out in *Belg* cropping season and the remaining 10% of crop products comes from the second *meher* cropping season.

Site and farmers selection

Site selection was undertaken by researchers jointly with experts from office of agricultural and natural resource management of Debub Ari woreda. Two target kebeles namely Kayisa and Kure were selected from Debub Ari woreda of the zone based on potential of the areas

for maize production and recommendation of field experiment study conducted by Atinafu et al., (2021). Totally, ten model farmers (five farmers from each kebeles) were purposively selected from the kebeles based on suitable farm land availability, willingness of farmers and volunteer to conduct field management.

Approaches followed

The demonstration of new rate of blended fertilizer application on maize crop was carried out through participatory extension approach. Prior to conduct the demonstration, one farmers research and extension group (FREG) was established in each target kebele. Linkage between researcher, development agents and FREGs were strengthened and jointly conducted frequent follow-up, technical skill support and periodic monitoring and evaluation of demonstration fields. The FREG consisting of 32 (Male = 29 and Female = 3) members and host farmers were actively participated on land preparation, plantation, field management and yield harvesting.

Training and implementation procedure

Capacity building training was offered to host farmers, member of FREGs and DAs. Training was mainly focused on awareness creation towards application of new rate of blended fertilizer application on maize crop and sustainable soil fertility management practices. The new rate of fertilizer (100 NPSB + 260 Urea) and extension practice (100 kg of each NPS and Urea) fertilizer rates were used on the demonstration. Both new and extension practices were used on the demonstration fields of 0.25 ha for each practices per host farmer's field for comparison. On both plots, BH-140 maize variety was used with spacing of 75cm between rows and 30 cm between plants. Time of planting, land preparation and field management practices were uniformly applied on both plots per farmers.

Types of data and data collection methods

Preference data towards field performances of maize crop under both new rate and farmers' practice of fertilizer application were collected from beneficiaries and field day participants using questionnaire, whereas grain yield data was collected by harvesting three randomly selected rows of each demonstration plot from all host farmers' demonstration field using data recording sheet.

Method of data analysis

A simple descriptive statistics such as mean, maximum, minimum and percentage were used to analyze quantitative data and likert scale score was used to analysis farmers' preferences towards the practices by the aid of SPSS version 20 software. The CIMMYT partial budget analysis was used compute profitability of the technology under farmers management conditions.

Thus, net benefit analysis is calculated by subtracting the total cost from the gross benefit i.e.

$$NB = TR - TC$$

Where NB=Net Benefit; TR=Total Revenue and TC=Total Cost (CIMMYT, 2004).

RESULTS AND DISCUSSION

Practically, on-farm training was given to farmers (Figure 1), members of FREGs and DAs to create awareness and improve associated skill gap on improved agronomic practices of maize production with recommended fertilizer rate. Totally 64 (M-53, F-11) farmers and Keble DAs were participated on training undertaken in the demonstration sites. The training was given on how to implement, land preparation, sawing, fertilizer application and all agronomic practices.

Figure 1. On-farm training on application of blended fertilizer application on maize crop

Field day

At physiological maturity stage of the crop, field day was organized by Jinka Agricultural Center in collaboration with office of agriculture at woreda level (Figure 2). Totally, 42 (male= 28 and female = 13) model farmers, administrators of the respective woreda and kebeles and agricultural experts from neighboring kebeles were participated on the field day. During field day, field performances of maize crop under both mew and farmers' practices of fertilizer application were visited. Discussion session was also conducted so as to enhance experience sharing among field day participants.

Figure 2. field day demonstration in kayisa kebele demonstration site

Yield performance of the demonstration

The yield result indicated in Table 1 showed the mean grain yield obtained from the new recommendation was higher than the blanket recommendation. The new recommendation gave 4.78 t/ha of maize, whereas 4.25 ton ha^{-1} was recorded from the blanket recommendation (Table 1).

Table 1. Analysis result of grain yield (ton ha^{-1}) across kebles for demonstrated technology

	Yield in tons/ha in each kebele			
	Kaysa		kure	
	New recommendation (100 NPSB + 260 Urea kg/ha)	Extension/farmer practice	New recommendation (100 NPSB + 260 Urea kg/ha)	Farmer practice
Minimum	3.31	3.20	3.73	3.60
Maximum	6.82	6.30	6.01	5.93
Mean	4.98	4.39	4.59	4.12
St. Deviation	8.79	12.79	10.18	9.55

Yield advantage

$$\text{Y. A} = \frac{\text{yield of new practice} - \text{yield of extension practice}}{\text{yield of extension practice}} \text{x}100\%$$

Where, Y.A is yield advantage

$$Y.A = \frac{4.78 - 4.25}{4.25} * 100\%$$

$$= 12.47\%$$

Farmers' preference evaluation

Field performance evaluation of maize crop under new and extension (farmers') fertilizer application practices were carried out by field day participants (model farmers, DAs and kebele level administrative bodies). Evaluation criteria were identified and highly important attributes were ranked by model farmers' group discussion lead by researcher and DAs during training session. Accordingly, early maturity, plant height, cob size, no of cobs per plant and seed holding per cob were most important farmer's preference criteria. Based on the above criteria, the mean score of farmer's preferences of the new practice is higher than farmers' practice, which implied that on-farm performances of maize crop under new rate of fertilizer application was highly preferred by farmers than the existing practices.

Table 2. Evaluation and preference of farmers

Fertilizer rate	Mean score of farmers' preferences of the technology (N=11)					Mean scores
	EM	PH	CS	No. CPP	SHPC	
New practice	3.90	4.27	4.45	4.45	4.18	4.25
Extension practice	4.54	3.63	3.18	3.18	2.9	3.48

Where*; Likert scale: 1= very poor, 2= poor, 3= fair, 4= good, 5=very good*
EM= early maturity, PH= plant height, CS= cob size, No. CPP= no of cobs per plant and SHPC= seed holding per cob

Partial budget analysis

The result of partial budget analysis showed that an average return of 25,224.2 ETB and 23,563.0 ETB were obtained at a hector of land per production season from maize crop under new rate of fertilizer application and extension practice respectively.

Table 3. Net benefit of maize product under new and existing fertilizer application practices

Item		**Unit**	**Unit price in ETB**		**Quantity on each practice ETB**	
					New practice	**Extension practice**
Average yield ha^{-1}		Ton	-		4.78	4.25
Sales in kg		Birr	8		38240	34000
Total gain					39,634	26,448
Item cost		Unit	Quantity	Unit cost	Total cost for each practice	
					New practice	Extension practice
Seed cost		Kg	25	27	675	675
Fertilizer cost	NPSB	Kg	100	16.90	1690	1690
	Urea	Kg	260	16.12	4191.2	1612
Labor cost	Land preparation	Oxen (pair)	24	100	2400	2400
	Sawing	Person	16	35	560	560
	1^{st}&2^{nd} weeding	Person	40	35	1400	1400
	Fertilizer application	Person	20	35	700	700
	Harvesting	Person	40	35	1400	1400
Total cost					**13016.2**	**10437**
Total Revenue					**38240**	**34000**
Net benefit (total gain-total cost)					**25,224.2**	**23,563.0**

CONCLUSION

Maize is one of most widely produced crops in midland and highland areas of South Omo zone. Although maize is the main source of food for majority of population living in rural as well as urban areas, its production and productivity tremendously reduced over time in the zone due to various factors. Among the most important factors that affect production and productivity of maize crop in the areas were poor soil fertility, use of insufficient fertilizers amount and types and lack of access to improved seed varieties. Based on the aforementioned reasons, new rate of blended fertilizer was identified and recommended for maize crop production in the midland and highland areas of Debub Ari woreda by Jinka Agricultural research center. Hence, demonstration of new rate of blended fertilizer on maize crop was carried out in two target kebeles of the woreda under farmer's management conditions. According to the results this demonstration, better grain yield and benefit were obtained from maize crop production under new rate of fertilizer application practice compared to the existing extension practice. Therefore, use of new rate of blended fertilizer enhances productivity as well as profitability of maize farmers, so the new rate of blended fertilizer application should be scaled out in areas with similar agro-ecology and soil type.

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AUTHOR CONTRIBUTIONS

Authors equally contributed from initial research proposal initiating to final report writing of the manuscript.

COMPETING INTERESTS

The authors have declared that no conflict of interest exists.

ETHICS APPROVAL

Not applicable

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