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Pre-extension Popularization of Improved Maize Varieties: In Raya-Azebo Woreda South of Tigray, Ethiopia

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Abstract
Popularization of improved maize varieties were conducted in Raya-Azebo woreda of South Tigray during 2012 and 2013 main cropping season with the objectives of popularizing best performing varieties to the agro-ecology of the woreda. The varieties used were Melkassa-2 and Melkassa-4. In 2012, the demonstration was made on 30 beneficiary farmers with plot size ranged from 0.125 to 0.25 hectare and covered a total of 7.5 hectares of land was planted with Melkassa-2 and Melkassa-4 varieties. The results indicated that both varieties were performed better than local cultivar. The average grain yield was 33.63 and 30 quintal per hectare for Melkassa-2 and Melkassa-4 respectively whereas the local cultivar gives about 16 quintal per hectare. The beneficiaries selected Melkassa-2 for its higher yield and longer stalks for feed. In the second year, participating farmers were increased by four folds. The farmers planted Melkassa-2 variety on wider area and supplemented by irrigation to fill the rain fall gaps in between the critical growth stages. As a result the productivity of Melkasa-2 was increased significantly and obtained a yield of 57.73 quintal per hectare. Therefore, it is better to scale out the varieties to wider areas of same agro-ecologies under supplementary irrigation.
Keywords: pre-extension popularization, Scaling out, varieties

1. INTRODUCTION

Maize 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. It is grown in most parts of the world over a wide range of environmental conditions (Mandefro *et al.,* 2002). Maize is among the most important and widely grown crops grown in Ethiopia. It ranks first in total production with over 7.23 million tones of produce whereas it ranks second in area coverage next to Teff. Annually maize covers about 2.11 million hectares of land (CSA, 2015). Despite the large area under maize cultivation, its national average yield is about 3.2 t/ha (CSA, 2014). This yield is by far below even the world's average yield which is about 5.21 t/ha (FAO, 2011). In addition, MoA (2014) indicated that the productivity is very low 3.4 t/ha as compared to the yield obtained by research institutions greater than 8 tones/ha in the country. The yield gap is attributed to a number of factors like frequent occurrence of drought, declining of soil fertility, poor agronomic practice, limited use of input, poor seed quality, disease, and others (CIMMYT, 2004).

Maize is widely grown in Tigray region with an area of over 64,197 ha of land with an annual production of 0.16 million tone (CSA, 2015). Melkassa-2 and Melkassa-4 varieties were some of the drought tolerant and nitrogen-use efficient maize varieties specifically adapted to the semiarid agro-ecologies of Ethiopia's Rift Valley. Therefore, there is a big room to boost the productivity of maize through use of high yielding varieties and improved management practices in the country in general and in the study area in specific. Woreda Raya-Azebo is one of the potential areas for maize production in southern zone of Tigray. However, due to many biotic and abiotic factors the productivity of the crop is low. One of the most reasonable factors was lack of access to improved varieties by farmers. Hence, as part of project intervention Alamata Agricultural Research Center and Operational Research for Technology Dissemination Project (ORTD) of Tigray Agricultural Research Institute was working to improve the productivity of the crop through demonstration and popularization of better performing maize varieties for two consecutive years.

2. OBJECTIVES

2.1. General objectives

The general objective is to improve food security of small-holder farmers through pre-extension popularization of improved maize varieties in lowland areas of Raya-Azebo woreda.

2.2. Specific objectives

- ✓ To improve the production and productivity of maize crop in the area
- ✓ To popularize the improved maize varieties to small-scale farmers
- ✓ To support the farmer-to-farmer seed exchange of the new varieties
- ✓ To understand the acceptance of the varieties by the local communities

3. RESEARCH METHODOLOGY

3.1. Location of the study

The varieties were being demonstrated and popularized in two selected kebelles (Genete and Tsigea) of the Raya-Azebo woreda. The woreda is located in the southern zone of Tigray regional state about122 km far from Mekelle to the south. It has an altitude ranging from 930 to 1800 meters above sea level. The Woreda has three climatic zones: lowland (18.6%), midland (80%) and highland (1.4%) with an average annual rainfall of 400-700 mm. The rainfall is bi-modal type: *belg* (from March to May) and the *meher* (main rainy season) from June to September. Even though the amount of rainfall is enough its erratic nature challenged crop production in general and maize production in particular. Recurrent drought and long dry spell, especially in the main season, has become a common problem. *Genet*e kebelle is located at 12º47 N and 39^{0}37E, has bimodal type of rainfall, with annual average of 500-600 mm. It has two agro-ecological zones, lowland (25%) and midland (75%) with an altitude of 900 to 1800 meters above sea level. The kebelle has a total of 2656 ha cultivated land, on which 2600 ha is area under rain fed and 65 ha is under irrigation. Sorghum, teff and maize are major crops grown in the area. In addition, wheat and barley crops are widely cultivated in the recent time in the area.

Kebelle Tsge'a, is located with an area which covers three agro ecological zones, lowland (14.6%), midland (84%) and highland (1.4%), with an elevation ranging from1800 to 1850 masl. Soils are mainly silt (60%), clay (25%) and sand (15%). Annual average rainfall of the kebelle is 500-700 mm. The area has 20 and 30 ºc minimum and maximum temperature respectively. Land use cover of the kebelle for cultivated, area closure, grazing land and bare land are 2093, 1690,160 and 199 ha respectively. In the kebelle, there are 1779 households of which 1055 are male, and 724 female-headed households (Raya-Azebo, OoARD annual report, 2013).

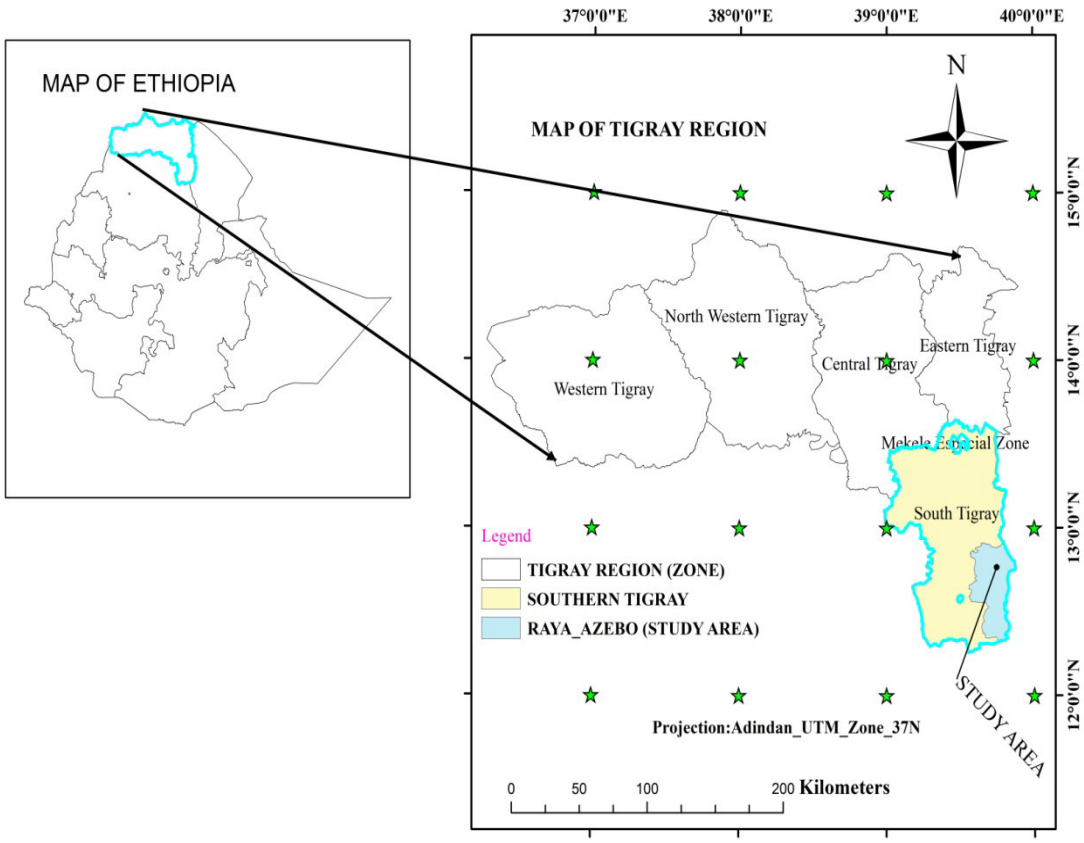

Figure 1. Map of the study area

3.2. Selection procedures and Beneficiaries

Beneficiary farmers were selected based on the criteria and objectives of the operational research for technology dissemination project and interest of farmers to participate in the demonstration trials. In addition, the safety net beneficiaries and disadvantaged households (youths and women headed household) were the main focus of the project. The participating farmers were selected by office of agriculture and rural development of respective woredas. A total of 101 beneficiary farmers were participated in improved maize (Melkassa-2 and Melkassa-4)

varieties.

3.3. Implementation procedure

The improved maize varieties (Melkassa-2 and Melkassa-4) were provided to the farmers as planting materials according to their preference. Both the varieties were first released from Melkassa Agricultural Research Center (MARC) and they were tested for their adaptation to our area by Alamata Agricultural Research Center. The seeds were supplied by the project and distributed by AARC in collaboration with the woreda experts and Development Agents of the respective kebelles. As part of the intervention activities, training on agronomic practices was given to farmers, DAs and experts. During the orientation, agreement was made with farmers to return the seed after harvesting to the farmer training center of the respective kebelles so that the seed will redistribute to other new beneficiaries in the next production season and it will be continued in the form of revolving fund.

Finally, in order to evaluate the performance and final outputs of the varieties and share the lessons with different stakeholders' field days were organized in the fields of beneficiary farmers. In the field days famers, development agents (DAs), experts, heads of agricultural and rural development office, woreda administrators, researchers from TARI (Tigray Agricultural Research Institute) and other stakeholders from all districts (Emba-Alaje, Endamekhoni, Ofla, Raya -Azebo and Raya-Alamata) of southern zone were participated.

3.4. Data collection

Both primary and secondary data were collected from various sources using different methods. The agronomic data was collected by the researchers directly from the field. The data on grain yield of the varieties in both years was taken yield assessment survey as well as quadrant of 5m * 5m ($25m^2$). The data was collected from randomly selected plots of the beneficiary farmers. In addition, the agronomic data farmers' perception related to the attributes of the varieties was collected using structured questionnaires. The perception data on the varieties attributes was grouped in to; seed size, seed uniformity, husk length, plant height, seed weight, seed color, maturity period, marketability, flour quality, dehiscing, number of cob per plant and productivity. The respondents were responding their perception level on the relative advantage of each characteristics of the variety compare to local cultivar or previously introduced varieties.

Secondary information was also collected from development agents of Genete and Tsigea kebelles, woreda experts from Office of Agriculture and Rural Development and food security office of Raya Azebo woreda.

3.5. Data analysis

The data of the two year research was analyzed descriptively using SPSS soft-ware version 16. Descriptive analysis such as mean, minimum, maximum, percentages was used and presented using tables.

4. RESULT AND DISCUSSION

4.1. Yield performance of the improved maize varieties at farmers' field

Based on the results of the popularization, mean grain yield of Melkassa-2 and Melkassa-4 varieties was 33.625 qt/ha and 30 qt/ha respectively. Both varieties had 110 and 87.5 % yield advantage over the local cultivar in the first year respectively. This is comparable with field demonstration of Melkassa II variety in 2006/07 production season showed 22.7% average yield advantage as compared to the local varieties in the rift valley area (Bedru, 2007).

The minimum and maximum yield of Melkassa-2 was 16 qt/ha and 60 qt/ha, and Melkassa-4 was 20 qt/ha and 41 qt/ha. In 2013 the mean grain yield of Melkassa-2 was 57.73 qt/ha under supplemental irrigation with minimum and maximum grain yield of 30.32 qt/ha and 89.16 qt/ha respectively. The variety had 260 % yield advantage over the local cultivar. The yield obtained among the beneficiary farmers who used same variety, was significantly different. This variation could be due to the differences in application of improved maize agronomic practices and the genetic potential of the improved varieties. Farmers used with recommended rate of fertilizer, seed and other agronomic practices properly were harvested better yield. On the other hand, farmers who used local cultivars and traditional practices harvest very low yield.

Figure 2. Researchers giving explanation to media persons (*left*) and Mr. Melaku haftu Farmer on his farm land (*Right*).

Table 1. Yield performance of improved maize (Melkassa-2 and Melkassa-4) varieties at farmers' field from 2012-2013 in Raya-Azebo woreda.

Variety	Grain yield (qt/ha)			Yield advantage over local	Year
	Mini	Max	Mean	%	
Melkassa-2	16	60	33.625	101	2012
Melkassa-4	20	41	30	87.5	
Melkassa-2	30.32	89.16	57.73	260	2013
Local	11	18	16		*

*N.B. * indicate data obtained from secondary data from the respective kebelles within the woreda.*

4.2. Direct income contributions of the varieties to beneficiaries in the area

A survey result showed that the beneficiary farmers gained on average 1275-2200 Ethiopian Birr immediate income source from direct selling of green cob at nearby markets. Most of the farmers were selling the crop when it research at a stage of matured green cob. In the local market situation, the price of a single cob of these varieties valued at 2 to 3 Birr which resulted in 250-300 Birr for 50 kg sack of a green cob at the farm gate market whereas the local cultivar is valued at 1-2 birr per single cob. Therefore, the improved varieties are very tasty, and are highly demanded in the market as compared to the local cultivar. This indicates that the improved maize varieties have better contribution to improve food security than the existing varieties in the area.

Table 2. Incomes gained from direct selling of improved green cob at Raya Azebo woreda (N=9)

Variety	Income in Birr			Year
	Mini	Maximum	Mean	
Melkassa-2	800	3600	2200	2012-13
Melkassa-4	750	1800	1275	

Source: Survey result of 2013 from project beneficiary

Case study on practical experience of innovative farmer of ORTD project beneficiary

Success story of Mr. Melaaku Haftu

Mr. Melaaku Haftu is 24 years old youth farmer in Raya Azebo woreda Genete kebelle. He completed his secondary school since 2000 E.C, currently, he engaged in agricultural practice in a total land size of 0.25 ha in which he received as gift from his parents. He had been sowing local sorghum and maize for longer times and his annual production was very low for the last three years. Lack of improved seed varieties, disease & pest, malpractices and erratic rain fall are some of the challenges he faced.

After he was selected as FRG member on popularization of improved maize varieties under this project in 2012, he was one of the farmers who had limited interest and low confidence on the new varieties and practices. After attending the training organized by the project, he immediately planted the improved maize varieties in row with full packages, and applied improved management practices in the first year. At the end of harvesting season, he has got a total income of ETB 7200 from the sale of green cob and seed. In addition to this, he also had got an extra two quintals of grain yield for his home consumption. Then after, he was interested to continue sowing those improved maize varieties for a consecutive of two seasons. As a result, his farm land grain production is increased by 80% per a quarter hectare of land. Moreover, he observed that the income gained from this crop can be increased by selling immediately to the market at the green cob /shewit/ stage than its dry seed sale.

He has got a total income of ETB 20,100 in which ETB 14,400 is from the sale of green cob. The green cob is very tasty, and is highly demanded in the market. The price of a single green cob is ranging from 2-3 Birr in the market and 250-300 Birr for 50 kg single sacks of a green cob at the farm gate market. He has got also ETB 5700 from the sale of dry seed to farmers and research center and six quintals of grain yield for his consumption in the three seasons. He also incurred a total cost of ETB 4194 for weeding and hoeing, transportation, fertilizer application and pesticide application, hence his net profit was ETB 15,906 in a three production season and he started to build assets as well as improved his livelihoods.

4.3. Farmers' perception on improved maize Melkassa-2 and Melkassa-4 varieties

As indicated in Table 3, in the first year all sampled beneficiary farmers perceived positively to all the attributes of the varieties in terms of phenotypic trait and grain quality. However, result of second year showed that more than 75% of the respondents were responded positively to all the evaluated parameters of the varieties. Majority of the respondents were responded positively on the varieties characteristics for their maturity, marketability and productivity. According to the respondents, these varieties are better yielder and early maturing, and hence can escape the early termination of rainfall. The farmers added that the varieties had bigger cob size, double cobs per plant, big seed size and higher productivity compared to the local cultivar (their own variety). Moreover, field day participants appreciated the varieties for their green cob, tasty and the market demand for both green cob and dry seed in the market than the local cultivar.

However, about 20% of respondents were reported that for the parameters green cob taste, maturity of the variety and flour quality perceived negatively in the second year. This is could be due to some farmers are not interested with sugar rich food items. In addition, it is common farmers' preference on a single parameter is different from farmers to farmers over time. Despite of the negative perception of few farmers on some parameters of the varieties all the sample respondents reported that to continue using the varieties (Table 3).

Table 3. Farmers' perception on the improved maize varieties in 2012 and 2013 in relation to local cultivar

Variety characteristics'	% response of respondents (Melkassa-2 and Melkassa-4) varieties compare to local cultivar N=9 (2012)			% response of sample respondents (Melkassa-2 variety) N=12 (2013)		
	Poor	Good	Very good	Poor	Good	Very good
Seed size	-	50	50	25	-	75
Plant Height	-	50	50	-	50	50
No of cob per plant	-	50	50	-	25	75
Husk length	-	62.5	37.5	-	41.6	58.33
Dehiscing ability	-	25	75	-	25	75
Seed uniformity	-	50	50	-	50	50
Early Maturity	-	25	75	25	25	50
Green cob (shewit) taste	-	-	100	16.7	8.3	75
Marketability	-	12.5	87.5	-	25	75
Seed color	-	-	-	8.3	33.3	58.3
Seed weight	-	-	-	8.3	33.3	58.3
Flour quality	-	50	50	16.7	8.3	75
Yield/productivity	-	37.5	62.5	-	25	75
Continuity with the varieties	Yes	100				100
	No	0				0

Source: Survey data, 2013

5. CONCLUSION AND RECOMMENDATION

Conclusion

Popularization and pre-scaling out of improved Melkassa-2 and Melkassa-4 varieties were an essential component of disseminating best technologies to farmers so as to boost production and productivity of small-scale farmers per unit area in the ORTD project sites. The recoded yield advantage of Melkassa-4 and Melkassa-2 was significantly better than the local cultivar. Moreover, farmers who participated in the project have got higher income per production season from sale of green cob and dry seed from a quarter of hectare. As to the case study conducted, participating farmers have shown significant improvement on their asset building and livelihood in general.

Recommendations

- The Office of agriculture and rural development of the woreda should further disseminate the varieties to large number of farmers and wider areas of similar agro ecologies.
- To address the problems and challenges of farmers related to improved technologies at grass root level the linkages between researches, extension agents, GOs and NGOs Should be strengthen.
- The operational research for technology dissemination project should be scaled out its best experience to development actors.

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