

# Largescale Demonstration of Improved Tef (*Kora*) Variety Through Cluster Approach in Awabel District of East Gojjam Zone, Amhara Region, Ethiopia

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**Abstract:** Tef [*Eragrostis tef* (Zucc.) Trotter] is the most ancient indigenous staple food and gluten-free important cereal crop in Ethiopia. In Ethiopia, cluster farming is recently introduced as an extension approach to boost productivity and adopt agricultural mechanization solutions for different agriculture and related challenges. The main objective of this study is to demonstrate and evaluate the recently released tef [*Eragrostis tef* (Zucc.) Trotter] variety with integrated agronomic management practices through a cluster approach. Awabel district was selected randomly from the major tef producing areas of East Gojjam zone of the Amhara region. About 44 participant smallholder farmers were selected through clustering the farmers' fields. The quantitative and qualitative data were collected using participatory rural appraisal tools. The yield and yield-related data were collected from the entire participants of the cluster. The simple descriptive statistics, profitability, and breakeven analyses were deployed. The result of the demonstration revealed that the full package tef demonstration through cluster approach has 33.89% and 37.30% of yield advantage over regional and national productivity of tef, respectively. The partial budget analysis result showed that the marginal net benefit and marginal rate of return of tef production was 20,628.00 birr and 707.41%, respectively. Generally, demonstration of improved tef variety through cluster approach has yield advantage over the traditional way of tef production. Therefore, the concerned bodies need to pay due attention to sustain, strengthen, and promote a cluster approach farming system to boost productivity which in turn fills consumption demand and ensures food security status the community.

**Keywords:** Awabel District, Cluster Approach, *Kora* Variety, Largescale Demonstration, Tef

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## 1. Introduction

Agriculture is the backbone of the Ethiopian economy. The most national gross domestic product (GDP) of the country is derived from the agriculture sector [1, 2]. It is dominated by smallholder farmers who occupy the majority of land and produce crop and livestock products. Similarly, crop production is the major contributor of GDP that accounts for approximately 28% of the subsector of agriculture [3].

Cognizant the fact, the agricultural production system in Ethiopia is characterized by the limited availability of improved seeds, less profitability and efficiency of chemical

fertilizers, prevalence and occurrence of pests and diseases, limited access to improved inputs [4], low level of productivity, lack of infrastructures and market institutions [5], extremely vulnerable to rainfall and climate change [6]. Therefore, the productivity performance and profitability of the sector is unwarranted by itself to improve the overall development of the country.

Recently, the Ethiopian agricultural policy gives high priority to increasing food production and declining malnutrition problems through the promotion of improved agricultural technologies among smallholder farmers in the national extension packages. Improved agricultural technologies such as seeds, fertilizers, pesticides, and use of

improved agronomic practices have played a pivotal role in enabling smallholder farmers to increase their production as well as income [7]. Therefore; introducing, generating, and demonstrating improved agricultural technologies have been the interest of different scholars, organizations, and experts. Among these improved agricultural technologies maize, wheat, tef, sorghum, and barley are the major cereal crops that are produced in Ethiopia. They accounted for approximately 81.19% of the grain crop area [8].

Tef [*Eragrostis tef* (Zucc.) Trotter] is the most ancient indigenous staple food and an important cereal crop in the agricultural and food economy of Ethiopia [9]. It accounted for about first of the nationwide agricultural area cultivated by more than 40% of smallholder farmers in 2020 [8]. Recently, tef attracts global markets due to its nutritional value mainly it is gluten-free crops [10, 11]. Therefore, Ethiopian smallholder farmers are motivated to cultivate tef [12] because of its relative advantage over other cereal crops in terms of a better price [13], and better use for grain and straw for livestock feeds [14]. Similarly, tef is preferred by farmers due to the reduced cost of post-harvest management, sustained demand from the customers [15].

Tef is an extensively cultivated cereal crop in different parts of Ethiopia such as Amhara, Oromia, Southern nation, nationality and people (SNNP), and Tigray regions. In the Amhara region, it accounts for 30.60% and 21.82 % of cultivated area and production among cereal crops, respectively [8]. Similarly, East Gojjam has a huge potential for tef production; it covers about 41.87% of the total area and 30.70% of the production of cereal crops [8]. Despite its productivity is low due to limited access to improved varieties, poor management practices, partial application of recommended packages, low soil fertility, low seed quality, diseases, inappropriate use of pesticides are some of the major production constraints [4, 6].

Even though, many varieties of tef have been developed and released in Ethiopia, most of them were not demonstrated and popularized effectively and efficiently in different parts of the country [16]. In East Gojjam zone, smallholder farmers have used old varieties of tef for a decade. These varieties were reduced their potential due to different factors. Therefore, this demonstration activity is specifically initiated to demonstrate recently released improved tef varieties and evaluate the potential of improved tef varieties under the recommended agronomic practices in the selected area through cluster approach.

## 2. Materials and Methods

### 2.1. Description of the Study Area

This study was conducted in Awabel district which is located in the northwestern part of Amhara regional state, East Gojjam zone. It is surrounded by Gozamen district in the West, Debaye-Telategen district in the North, Basoliben district and Abbay Gorge and Oromia regional state in the South and Dejen district in the East. The town of the district

is Lumama, it far 259 Kms from Addis Ababa and 360 Kms from the state city Bahir Dar and 40 Kms from the zonal city of Debre Markos. According to CSA population projection, the district has a total population of 143,712 in 2021 of which 70,629 (49.15%) are male and 73,083 (50.85%) are female [8]. The agronomic zone of the district is *Woina-dega* (moderate hot) 60%, *Dega* (cool) (15%), and *Kolla* (hot) 25%. The district is characterized by a high potential for cereal crops and has received 1125mm the mean annual rainfall and its temperature ranges from 19-26°C. Moreover, the population's livelihood mainly consists of both crop production and livestock rearing. The district is one of the major tef growing areas of East Gojjam Zone. The total cultivated land of the district is 45,336.00 hectares and among these 26,895.00 hectares are accounted for tef production.

### 2.2. Site and Farmers Selection

Awabel district and the implementing kebele were randomly selected based on their tef production potential. Based on this, *Enebi Chifar* kebele was selected for the implementation of a large-scale demonstration (LSD) of improved tef variety through a cluster approach. The kebele was selected based on the production potential, road accessibility, and the interest of the farmers to implement improved tef variety demonstration. Correspondingly, the kebele development agents (DAs) took commitments to select the host farmers based on farmers' interests who have adjacent farm plots and willingness to manage their farms properly and use appropriate agronomic practices. A total of 44 interested farmers were selected and participated in the large-scale demonstration through a cluster approach in the study area. A cluster formed who have a chairperson, secretary, and members. Members in the cluster met together and discussed the status of the crop and management practices. The participant smallholder farmers managed the clusters and applied all the recommended agronomic practices, including land preparation, sowing, weeding, harvesting, etc., with a close follow-up and technical support of development agents of the kebeles, district experts, and researchers.

After selection of sites and farmers: a multidisciplinary team of Debre Markos Agricultural Research Center was provided training of trainers (ToT) for DAs, district and zone experts on the tef production and management techniques. The district experts and DAs had given further practical training for the participant farmers at the kebele level.

All stakeholders mainly researchers, DAs, district experts, and the committees of the clusters have made continuous monitoring and evaluation of LSD activity throughout the lifetime of the demonstration. In this regard, Agricultural Extension and Communication Research Process researchers from Debre Markos Agricultural Research Center took the lead and provide all the necessary technical support to the DAs, district experts, and the farmers in the course of implementation. Finally, a field day was organized in a selected cluster to evaluate the overall successes, challenges,

and opportunities of the intervention, share experiences, and lessons learned to other similar areas and set future directions. All concerned stakeholders, including farmers from participating and non-participating kebeles of the district and officials and experts from research, zone, and development organizations took part in the field day.

### 2.3. Input Supply Mechanisms and Utilization

Accordingly; the plot area of smallholder farmers in the cluster, the recommended rate of seed ( $25 \text{ kg ha}^{-1}$ ) of improved tef (*Kora*) variety was distributed for host farmers. The seed was delivered free of charge on a revolving basis. Farmers who received the seed were reached into an agreement to use and return an equal seed amount for the next generation seed right after harvesting to be used by other farmers in the following cropping season. Besides, access to fertilizer was facilitated for host farmers by extension offices at the district and kebele level. The chemical fertilizer was used based on the district level recommendation. Additionally, the farmers were taking farm management activities from land preparation to post-harvest handling.

### 2.4. Method of Data Collection and Analysis

Participatory rural appraisal (PRA) data collection tools such as focus group discussion (FGD), key informant interview (KII), and personal observation were used for collecting quantitative and qualitative data of the study area. The agronomic yield and yield-related data, farmers' feedbacks, and perception were collected regarding the importance of crops, variety, and the cluster extension approach. A Simple descriptive statistical analysis was deployed for quantitative data. The partial budget and breakeven analysis were used to evaluate the financial profitability of the tef large-scale demonstration through a cluster approach. The analyzed data were presented by using tables, figures, and narration.

## 3. Results and Discussion

### 3.1. Yield Performance of Kora Variety Tef

The largescale demonstration of tef yield data were collected from all participants of demonstration smallholder farmers activity. Better yield was obtained from the largescale demonstration of improved tef variety. The national and the regional productivity of tef is 1.88 and 1.93 tons per hectare, respectively [8]. However, the mean yield of cluster based tef technology demonstration was 2.54 tons per hectare.

The smallholder farmers were obtained yield with the range of 1.33 to 2.80 tons per hectare. This shows that more than 75% of participant farmers have a yield advantage over the regional and national productivity of tef. This productivity variation may occur due to the farmers limited utilization capability of the technologies, poor weed management practices, and the monocropping farming systems of the area.

### 3.2. Yield Comparison with National and Regional Productivity

It is not surprising, Awabel district is one of the major tef crops production belts among East Gojjam Zone of Amhara region. The district has been suffering from vertosol management, limited access to improved varieties, and monocropping practice problem that leads to low productivity [6]. According to the district experts, the productivity of the major crops has been decreasing gradually due to the severe newly invaded weeds, climate change, inappropriate utilization of the farmland, and the monocropping of the area.

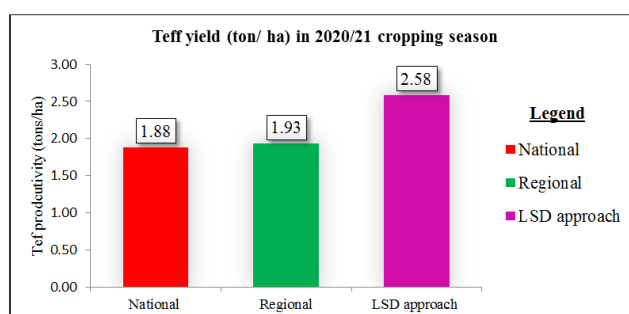


Figure 1. Comparison on LSD, National and regional productivity of tef.

The average yield data of the host smallholder farmers have a 33.89% of yield advantage over the regional productivity of tef. Besides, the comparison has been made between the LSD and national productivity; LSD productivity has a 37.30% of yield advantage. Therefore, the large-scale demonstration of tef through cluster approach has a yield advantage over the national and regional productivity.

### 3.3. Partial Budget and Breakeven Analysis

To know and evaluate the economic feasibility of using improved tef variety through cluster approach in the study area, the partial budget analysis was employed. Using improved tef variety and modern production management practices provides higher net benefit than traditional production systems in the area. Table 1 showed the net benefit and marginal benefits of producing improved tef variety obtained 65,975.50 and 20,628.00 ETB, respectively. This means that producing of tef through full package approach the farmer enables to obtain the better income is increased by 45.49% of the traditional production system.

The marginal rate of return (MRR) of using improved variety was 707.41%. The result of the marginal revenue showed that a unit invest in purchasing agricultural inputs for tef production obtained gross benefits of 7.07 ETB. Generally, using improved tef variety and applying full package agronomic management gave superior mean yield products and had obtained a higher selling price to earn a higher net return. Similarly, the breakeven analysis shows that the production of cluster-based improved tef variety with better

agronomic managements has better financial profitability than the traditional tef production system in the area.

Moreover, we can understand from the breakeven analysis, both breakeven price and yield to breakeven yield ratio of producing full package tef technology through cluster approach is more gainful. Table 1 indicates that the analysis of

the breakeven yield tons per hectare is 0.75. This implies that producing an additional 0.75 tons per hectare helps the farmers to enable to cover the total operating cost of the production of improved tef variety. Similarly, the result of the analysis of breakeven price also showed that there is a chance of purchasing tef for home consumption at a minimum price.

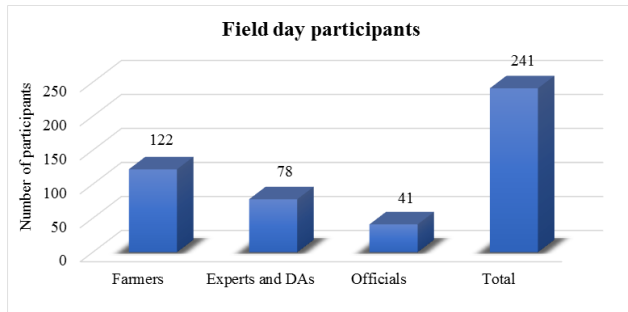
*Table 1. Partial budget analysis.*

Parameters	Local Approach	Full package demonstration
Revenue and Operating cost		
Yield per hectare	1.93	2.58
Grain yield market price (ETB/ton)	36,000.00	36,000.00
Gross benefit (ETB)	69,480.00	93,024.00
Seed cost (ETB)	1,080.00	1,836.00
Chemical fertilizer cost	5,790.00	5,790.00
Labor cost (land preparation to threshing) in ETB	17,262.50	19,422.50
Total operating cost (ETB)	24,132.50	27,048.50
Profitability analysis		
Net benefit (ETB)	45,347.50	65,975.50
Marginal cost (ETB)		2,916.00
Marginal net benefit (ETB)		20,628.00
Marginal rate of return (MRR (%))		707.41
Breakeven analysis		
Breakeven price per ton (ETB)	12,503.89	10,467.69
Breakeven yield ton per hectare (ETB)	0.67	0.75
Yield to breakeven Yield Ratio	287.91%	343.92%

Source: Own computation in 2020/21 cropping season

NB: ETB= Ethiopian Birr.

### 3.4. Demand Creation Through Field Day Events



*Figure 2. Field day participants.*

To collect feedbacks and share experience among farmers field days were organized at different stages of the technology. Figure 2 indicates that more than 241 participants have participated in the field day events. The participants are smallholder farmers, experts and development agents, and higher officials. This simply shows a total of 122 smallholder farmers were observed the performance of *kora* variety tef at the field and they gain skills and knowledge of management practices and production system of the tef. Similarly, the field day events have been made a chance to aware the farmers and other experts on how the cluster farming system is very important. The feedbacks from the participants of the field day events were positive. Participants stated that the *kora* tef variety was the new variety but they have little experience at the farmer training center fields in the areas. They also supposed that the

improved tef variety and the cluster approach are more important than the previous regular extension system in terms of ease horizontal learning between farmers, reduce the advisory efforts of experts and improving the growth and production of improved tef.

As indicated earlier, the demonstrated *kora* variety is performing better than the local as well as previously introduced improved varieties of tef. The participant farmers showed their interest to continue the use of the technologies on a larger acre of land and as business as a seed producer. The non-participating farmers of the cluster are also convinced to adopt the technology and farming practices. However, the tef straw is not comfortable for animal feed sources. Participant farmers stated that the straw of the tef is very strong and unable to use as a source of livestock feed. Therefore, the researchers should try to improve the palatability of the tef straw.

### 3.5. Benefits of Tef Cluster Farming

The benefit of cluster farming data was collected through using PRA tools. During the FDGs and KIIs, participants farmers stated that producing tef technology through cluster approach the smallholder farmers were benefited from the farming practices. Cluster farming is important to reducing advisory efforts of experts and improving the production and productivity due to use of recommended agricultural inputs. The practice also enables farmers to use farm machinery for threshing, creating horizontal positive competition among farmers, improves the input delivery mechanisms, reduce the risks of pesticide influences due to drifts, and manage their

farm properly. The experts are also providing their witnesses with the importance of cluster farming in the area. Generally, farmers asserted that cluster farming is playing a pivotal role in boosting agricultural productivity, controlling pesticides and other challenges facing the farmers collaboratively as well as sustaining the food security and gaining of income. This cluster farming approach helps to further adoption, promotion and demonstration of full package improved agricultural technologies and management practices in different locations.

## 4. Conclusion and Recommendations

Tef is the most important indigenous cereal crop in the study area. The largescale demonstration of improved tef variety (*kora*) through cluster approach was conducted at Awabel district on 44 smallholder farmers' fields. This cluster approach demonstration of *kora* variety tef has a positive impact on the adoption rate of the technology. Largescale demonstration of *kora* variety tef through a cluster approach was impressive and important for the transfer of skills and knowledge of technology and production management practices between peer groups of smallholder farmers in the area. We conclude that this approach is useful for delivering any type of pertinent information through established networks, eases of input delivery mechanism, reduces the cost of advisory service costs, enhances the adoption rate of improved technologies, and creates sustainable technology demands. The result of this study showed that using improved tef variety has nearly 1/3<sup>rd</sup> of yield advantage over national and regional productivity. Correspondingly, cluster farming is important for embracing the higher policymakers' insight and attitude which in turn national agricultural strategies and policies look likes. Therefore, concerned bodies should pay due attention to strengthening and promoting a cluster farming approach in order to fill the production and consumption gaps and ensure food security as well as increase smallholder farmers' income. Lastly, researchers should be further investigating the improvement of the palatability of the tef straw since its straw is hard to feed animals.

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