

ORIGINAL ARTICLE

## Cluster based large scale demonstration of improved food barley technology in gurage and silte zone, Southern Ethiopia

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Cluster Based Large Scale Demonstration (CBLSD) of food barley was conducted in Geta, Gumer from Gurage Zone and Alichu Woreda from Silte Zone. The Woredas were selected purposively based on the potential of food barley production. The objective of this paper was to demonstrate improved food barley technology at cluster base. From the three Woredas three food barley potential Kebeles were selected. Accordingly, Bole, Sinankoroficha and Kechemo Kebele were selected from Gumer, Geta and Alichu Woreda respectively. Farmers who have land in cluster were selected depending on their willingness. Each Woreda contains 20 hectares of land was covered in collaboration with the districts level experts and Kebele level Development Agents (DAs). One popular variety called HB1307 was demonstrated along with its full-recommended packages in the study areas. Training was given to develop awareness for a total of 52 participants (42 farmers, 4 researchers 3 DA and 3 experts) at different stage on production practice of food barley technology. To demonstrate the food barley technology, a field day was organized by inviting different stakeholders (Farmers, DAs, Experts and Researchers). Accordingly, a total of 378 participants were participated (male 287 and female 91). The variety (HB 1307) demonstrated at study districts was acceptable during field visit and field day by farmers due to its disease tolerant, well adaptation and its productivity after harvesting showed a high yield performance. Therefore, the mean grain yield of the improved food barley technology was 42.6, 37.7 and 39.2 quintal per hectare in Gumer, Geta and Alichu Woreda respectively. Therefore, based on the results shown above HB1307 is the best performed variety in the study area. So that, the woredas extensions should have extend for the community widely.

**Keywords:** HB1307, Perception, Training and Yield.

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### Introduction

Barley is the fourth most important cereal crop in the world after wheat, maize, and rice, and is among the top ten crop plants in the world (Akar et al., 2004 and Tilahun et al., 2017). Ethiopia is ranked twenty-first in the world in barley production with a share of 1.2 percent of the world's total production (USDA, 2014). It is the second-largest barley producer in Africa, next to Morocco, accounting for about 25 percent of the total barley production in the continent (FAO, 2014). Barley is an important food crop in the highland parts of Ethiopia. Food barley is the crop that matures early and an emergency crop bridging the critical food shortage occurring in September (Kemelew and Alemayehu, 2011). Traditionally, its grains are used to make "Injera" and local beers for home consumptions and during festivals. Nowadays, it passes through different value-added processes and prepared into different types of food to be eaten or drunk as bread, powder, soup, porridge, roasted grain.

From 9,974,316.28 hectares of land allocated for cereals in 2015/16 production season, barley (food and malt) covered 944,401.34 ha of land from which 18,567,042.76 quintals of grain was produced with the productivity of 19.66 quintal ha<sup>-1</sup> (CSA, 2016). Area coverage; which is 6,177.80 ha and 148,401.07 quintal in Silte Zone and 9,850.65 ha and 268,605.17 quintal in Gurage Zone is low compared to world average of 3.095 t ha<sup>-1</sup> (barley commodity strategic plan document, 2016).

Despite its enormous economic and nutritive importance its productivity is very low as compared to other cereals (1.2 ton ha<sup>-1</sup>). There are a lot of factors that contributed to the lower productivity of the crop. Among which limited demonstration improved varieties, inappropriate agronomic and low crop management practices, low soil fertility, water logging, leaf and grain diseases, pests, weed competition are the major ones (Tadesse and Derso, 2019). In addition to that, improved food barley technologies transfer activity is one of the production improvement options for smallholder farmers who had limited access for desired seeds of improved varieties in the areas of barley growing agro-ecologies (Tadesse and Derso, 2019). The transfer rate of improved technologies from research to farmers was very limited due to the scarcity of improved seed and weak linkage between research and agriculture office.

To tackle productivity problem in the study area the national and regional research systems in the country have been conducting a series of research activities on improvement of the crop and have been releasing many varieties. Due to the aforesaid facts, Worabe agricultural research center (WARC) undertaken adaptation trials and participatory varieties selection best performed and high yielding food barley variety (HB1307) in order to improve barley productivity in the midland area of target Zone, but the selected and highly performed varieties were not demonstrated widely to the farmers yet (Solomon and Muluneh, 2022).

Despite the availability of this variety most of farmers in the Zones haven't yet got access and still are using local varieties characterized by very low productivity and susceptibility to diseases. In the highland area of Gurage and Silte Zone, particularly in Gumer, Geta and Alichu woredas respectively food barley is most commonly produced and consumed by subsistence farm householders. Lack of improved varieties of seed, low level of use of improved production technologies and high infestation of rust diseases associated with both edaphic and biotic factors mainly attributed to low yields of production in the area. Farmers have limited experience of use of improved varieties of seed and other farm inputs; rather they are experienced in use of local cultivator in the existing barley production system in area. Therefore, this activity was initiated to demonstrate and popularize improved food barley technology at large and clustered farms organizing farmers in groups with its full packages in order to increase its production and productivity.

## **Objectives**

- To increase the production of improved food barley technology in the study area.
- To develop the knowledge, skills and attitude of farmers, women, experts and DAs about the technology.
- To assess farmers' perception and feedbacks about the improved food barley technology.

## **Materials and Methods**

### **Description of study area**

The research was conducted in Gumer and Geta Woreda of Gurage Zone and Alichu Woreda of the Silte Zone. Geta district is located in Gurage Zone and is 98 km away from Wolkite. It is bordered to the South by Endegan Woreda, to the East Gumer Woreda and Silte Zone, to the North by Geta Woreda, and to the West by Enor Woreda. It consists 14 rural Kebele where its altitude ranges from 2,400 to 3,200 m. Its agro-ecological zone is divided to Dega (90%) and Woina Dega (10%) with an average minimum and maximum annual rainfall of from the 1001 mm to 1400 mm and the mean annual minimum and maximum temperature from 7.5% to 20%. The district has red and brown soil types, with a total land of 16580.32ha. The main economic activity of the Woreda is agriculture. The dominant crops grown in the district are barley, wheat, bean, pea, maize and, Enset (GWAO, 2022).

Gumer district encompasses 18 rural Kebele administrations which are found in Dega agro-ecological zone. The district is located about 65 km from Wolkite. The total land area is 23,555 ha. It is bordered to the south by Geta, to the east by Silte Zone to the north by Eja Woreda and to the west by Cheha Woreda (GWFEDO, 2021). The altitude of the district range from 2700 to 3178 m. It has clay loam 85% and 15% red types of soil. Agriculture is the main economic activity in the district. The dominant crops grown in the area are barley, bean, wheat, pea, potato, and Enset (GWAO, 2022).

Alichu Wuriro is one of the Woredas in the Southern Nations, Nationalities, and Peoples' Region of Ethiopia. This Woreda is named after the sub-groups of the Silte people. Part of the Silte Zone, Alichu Wuriro is bordered on the South by Wulbareg, on the

SouthWest by Misrak Azernet Berbere, on the west and North by the Gurage Zone, and on the east by Silte. It was part of Gumer Woreda. Based on the 2007 Census conducted by the CSA, this Woreda has a total population of 92,483, of whom 42,035 are men and 50,448 women; 783 or 0.85% of its population are urban dwellers. The majority of the inhabitants were Muslim, with 99.16% of the population reporting that belief.

### **Site and farmers selection**

This research was conducted in Gumer and Geta district from Gurage Zone and Alichu district from Silte Zone. The districts were selected purposively based on their potential for food barley production and accessibility for supervision. In communication with the Woreda Agriculture and Natural Resource Office and the extension department, potential Kebeles were selected in order to conduct the demonstration activity. Three potential Kebeles from the three districts were selected based on accessibility and potentiality for food barley production. Accordingly, Bole, Sinankoroficha and Kechamo Kebeles from Gumer, Geta and Alichu Woreda were selected respectively. In each Kebele, communication was made with Kebele extension agents and selected farmers who have land in cluster from each Kebele based on their willingness and availability of land. Gender and youth balance in each farmer was strictly considered (at least 40%). Development agents, researchers and experts were collaborating in site and farmer selection. At the end a total of 20ha in each Woreda in each Kebele (a total of 60ha in three Woreda) were covered.

### **Training**

After selection of farmers, a theoretical and practical training session was arranged to farmers, DAs and experts. Multidisciplinary team of researcher from Worabe Agricultural Research Center (WARC) delivered training to a total of 52 participants: Farmers (42), DAs (3), researchers (4) and experts (3) on the following topics: participatory agricultural research and promotion, suitable agro-ecologies and weather condition for wheat production, wheat production and management packages, agronomic practices, economic and nutritive importance of wheat, post-harvest managements and storage facilities of it. The input was purchased and distributed for farmers by the coordination of Gumer, Geta and Alichu Woreda and Kebele concerning bodies on time.

### **Agronomic practices**

Every field was supervised at a fifteen (15) days interval to check the status and to identify gaps. The clusters were properly ploughed and made ready for planting ahead of the planting date. One improved HB1307 variety was Gumer, Geta and Alichu planted in Woreda. All the necessary recommended agronomic practices were applied for all demonstration sites. For food barley, the spacing of 20 cm between rows was used. The recommended seed rate of 100 kg ha<sup>-1</sup> was used by drilling in the prepared rows. Shallow planting of 2-4 cm depth was employed in the presence of ample soil moisture. The recommended fertilizer rate of UREA 100 kg ha<sup>-1</sup> and NPS 100 kg ha<sup>-1</sup> were applied. All NPS was applied at sowing/planting time while 1/2 of UREA was used at sowing/planting and the remaining 1/2 was applied at the time of tillering of the crop. For joint monitoring and evaluation, the demonstration sites were supervised at a 15 days interval to check the status and to identify gaps. Before sowing, farmers prepared their land appropriately and sowed the variety on time and the necessary management were done like weed management and chemical applying.

### **The responsibility sharing and the way of follow up**

Based in responsibility sharing all responsible bodies were participated for example the Worabe agriculture research center by facilitating the logistics and inputs; Extension researchers were participated from developing the activities up to its achievements through all stages (by giving training and creating awareness of the farmers) and finally the Woreda experts and DAs were participated by giving the potential Kebele and model farmers. After sowing, relevant follow up had been preceded appropriately and conducted in depth in communication with concerned stakeholders. Weed management, disease and pest control, data collection and other related activities conducted accordingly.

## Evaluation and monitoring

Evaluation had made with concerned bodies and farmers through its all stage of growth. Evaluation of the varieties at different stages had been conducted in participation of farmers. Especially, during germination, flowering and harvesting times, farmers and researchers took a chance to evaluate the varieties through observation.

## Data collection methods

Both qualitative and quantitative data will be collected using appropriate data collection methods such as farmers' research extension group (FREG), direct field observation and measurements. Data like grain yield will be collected a sample of (1 m × 1 m) three times from high, medium and small areas by observing at the farm. Total number of farmers participated on extension/promotional events such as training, field visits and mini field days were recorded by gender composition. Feedback assessment on farmers' perception to the demonstrated technology and farmers' perception towards the performance of the technology were also identified by using a frequency and percentages. The main traits of farmers' selection criteria used were early maturity, plant height, spike length, tillering capacity, disease resistance, and grain yield. Farmers' perception criteria were rated from scale 1 to 5: 1=Very poor, 2=Poor, 3=Good, 4=Very Good, 5=Excellent.

## Data analysis methods

The collected data were analyzed using SPSS and Descriptive statistics like Minimum, Maximum, and Mean, SD, Likert scale (average score and percentages) was used to measure farmers' perception data.

## Results and Discussion

### Training for stakeholders

Participatory training was given by multidisciplinary team of WARC researchers (Breeder, Agronomist, Pathologist, Economist and Agricultural Technology Extension Researcher) in Geta district to a total of 52 participants. Accordingly, stakeholders from district level Agriculture Office experts and DAs were invited and participated during consultation meeting and training. Multidisciplinary team of researchers from Worabe Agricultural Research Center delivered training to the participant. As indicated in (Table 1), Training were given for different stakeholders at different stage on agronomic practice of food barley, chemical applications, safety mechanisms, disease, economic, nutritive importance of food barley and post-harvest managements. Accordingly, a total of 52 participants' farmers from those, 42 farmers, 4 researchers, 3 DA and 3 experts at different stage on production practice of food barley technology (Table 1).

**Table 1.** Number of participant during trainings.

S. No	Participants	Gender		Total
		Male	Female	
1	Farmers'	34	8	42
2	Experts	3	-	3
3	DA	2	1	3
4	Researchers	4	-	4
	<b>Total</b>	43	9	52

### Field day organized

At maturity stage of the crop, a field day was organized by inviting different stakeholders such as Southern Agricultural Research Institute(SARI) management and Agricultural Technology Transfer and Communication Coordinator (ATTC) coordinator, AGP-II coordinator, SARI Human Resource managements and finance expert; Regional agricultural experts; Worabe ARC management and Agricultural Technology Transfer and Communication Researchers (ATTC) and other work process researchers, Worabe ARC Human Resource managements and finance experts, Secretary; Gurage Zone Cabine and (Gumer, Geta, Meskan and Mareko); Silte Zone Cabine and (Mesirak Azernet, Alichu and Worabe Town Admiration); DAs from above Woreda in both Zone; Asela FM, Silte

Communication Agency and the last but not the list is Malik from Silte Zone and Seed Multiplication cooperatives from Gurage and Silte Zone below (Table 2). Accordingly, Male 287, females 91 and total 378 participants were participated from different discipline and sectors (Table 2). Here is the photo during the field day session participation from different disciplines. So that, more than 87 farmers (26 female) individuals were participants of the field day (Table 2). The field day program included field visit, detail discussion on the activity, farmers and stakeholder's reflection on the performance of the variety. Moreover, future direction on seed exchange system, seed collection and marketing were settled by participants (Fig. 1).



**Fig. 1.** The field day program.

## **Feedbacks received from farmers and experts**

### **Feedbacks from farmers**

During the field day, farmers said, "The performance of the crop was interesting so that we will continue to plant this variety if we have market demand or linkage". Lack of sufficient market demand was our major problems and we tried to address market problem through cooperatives but it is not functional. They said that, before this year they did not get enough yields as they expected the reason was low production and productivity due to less availability of improved food barley variety and soil acidity were major problems. After they saw the yield of improved food barley (HB1307) they are satisfied with in its high yield. After the crop showed best performance almost on all the farmers' farm, they were very impressed and started providing thanks for Worabe Agricultural Research Center. Farmers appreciated different stakeholders those who support them during the work carried out and said that support by another crops, NRM and Livestock parts for the future. The way cluster demonstration was very effective way in order to popularize the new technology in observable way. The main farmers' feedbacks and interested thing is that doing in cluster which helps as making team spirit inn our work as well as thinking because as we are human being we have different thinking and working capacity. Due to this the cluster working helped as to help each other and learning each other at the field. As we have seen the mean grain yield of the improved variety HB1307 was high which 42 quintal per ha (Table 2).



**Table 2.** Field day participants in Gumer, Geta and Alichu Woreda.

<b>A CBLSD of improved food barley technology in Gumar, Alichu and Geta Woreda</b>					
<b>S. No</b>	<b>Participants</b>	<b>Ha and variety</b>	<b>Male</b>	<b>Female</b>	<b>Total</b>
1	SARI management and ATTC coordinator, AGP-II coordinator, SARI Human Resource mgt and finance expert	Food barley(HB1307)=60 ha	19	2	21
2	Regional agricultural experts		3		3
3	SARI drivers		4		4
4	Worabe ARC management and ATTC Researchers and other work process researchers		35	2	37
5	Worabe ARC Human Resource mgt and finance experts, Secretary		50	6	56
6	Worabe ARC drivers		4		4
7	Gurhage Zone Cabine and (gumar, geta, meskan and marako)		7	2	9
8	Silte Zone Cabine and (mesirak azernet, Alichu and Worabe town admiration)		20	7	27
9	DAs from above woreda in both zone		15	3	18
10	The Zone and Woreda drivers		8		8
11	Asela FM, Silte Communication Agency		4		4
12	Malik and Seed Multiplication cooperatives from Gurage and Silte zone		2		2
13	Number of participant farmers		135	70	205
	Total		287	91	378

#### Feedbacks from experts and administrative bodies

Experts said that, the improved variety is a high yielding variety and also the improved practice helped farmers to increase production and productivity of food barley in their locality. Early planting of food barley helped the crop to escape from frost and terminal moisture deficits. But food barley variety has low demand in their local market so that for the area creation of market linkage is very important. They also added that, they are responsible to expand the technology to other potential districts and Kebele. As they thanks Worabe Agricultural Research Center as they give the certificate to mention their excellency in their work duration 2022/23 G.C. Researchers' also advised farmers to form cooperatives to create consumer markets linkage in the study area.

#### Grain yield of the technology

The sample of yield estimation was taken from sampled farmers and calculated in order to estimate the yield of the variety. Hence, the mean grain yield was presented below the (Table 3). The descriptive statistics results show that, the mean yield of food barley was 42.5 quintal per ha, 37.7 quintal per ha and 39.2 quintal per ha in Gumer (Bole Kebele), Geta (Senankorofcha Kebele) and Alichu Woreda (Kechamo Kebele) respectively (Table 3). These results indicate the production potential of the HB 1307 variety in the study area and the yield produced in the study area was greater than the yield produced at national level. As shown below in the Table 3 the results show significance between the Woreda even between farmers. This indicates that the differences of the farmers, DAs and experts in their managements, communication, sowing and harvesting on time to reduce the post harvesting loss of the yield. So that from this, we can learn that working with strong collaboration and being active individually as well as in group can add the amount of the yield during food barley production in the study area. This means that with the same variety the Gumer Woreda grain yield is greater than from Geta and Alichu Woreda grain yields of food barley. This is due to that, in Gumer Woreda the team spirit of the DAs, Experts and farmers were very strong.

**Table 3.** Yield of the improved food barley in Gumer, Geta and Alichu Woreda in quintal per ha.

Woreda	Variety	Yield			
		Max	Min	Mean	SD
Gumer (Bole Kebele) N=21	HB1307	49.5	32	42.6	4.7
Geta (Sinankoroficha Kebele) N=28	HB1307	45	28	37.7	5.6
Alichu (Kechamo Kebele) N=39	HB1307	47	29	39.2	5.5

### Farmers' perception towards to the technology

Farmers have a broad knowledge base but they lack control treatment for comparison and statistical tools to test the hypothesis. Participants were inclined to their perception. Likert scale is rating scale which contains a series of "anchors" (displayed numerically or in words) that allows numerical measurements of an item or question. Agreement (5 points): very poor, poor, good, very good and excellent. Farmers were asked to give a rank from 1-5 on each attribute of the technology where 1=very poor 2=poor 3=good 4=very good and 5=excellent. As shown Table 4 below the majority of the participant farmers means mean score 4.2, 3.9 and 4.09 in Gumer(Bole Kebele), Geta (Sinankorofcha Kebele) and Alichu Woreda (Kechamo Kebele) respectively Table 4.

**Table 4.** Farmers' perception about food barley technology in Gumer, Geta and Alichu Woreda.

Woreda	Variety	Mean score of farmers' preferences on characteristics of wheat variety					Average Mean Score	Rank
		DR	EM	SL	PH	GY		
Gumer (Bole Kebele) N=21	HB1307	4.06	4.44	3.84	3.98	4.86	4.2	
Geta (Sinankorofcha Kebele) N=28	HB1307	3.98	4.06	3.4	3.84	4.44	3.9	
Alichu (Kechamo Kebele) N=39	HB1307	4.06	4.2	3.9	3.84	4.44	4.09	

Perception about demonstrated technology was consulted based on the desired criteria like disease tolerance, spike length, seeds per spike, plant height, early maturity and grain yield.

### Lessons learnt

Researchers transfer the scientific knowledge about the full packages of the technology and again farmers share their indigenous knowledge to the researchers. Farmers learnt that about the amount of the input used per ha and the space between the plants and rows. In addition to that, they learned that, the practices from land preparation to harvesting in general while the researchers learn about the study area planting time, harvesting time that was used by the farmers. After these procedures, lessons learnt regarding to the demonstration carried out was success by recording high yield.

### Conclusion and Recommendations

In this study, before starting the activities participatory training was given by multidisciplinary team of WARC researchers (Breeder, Agronomist, Pathologist and Agricultural Technology Extension Researcher) to farmers, experts and DAs in the study area. At maturity stage of the crop, a field day was organized by inviting different stakeholders. Food barley technology (HB1307) demonstrated at study districts was acceptable during field day by farmers, experts and DAs due to its disease tolerant, well adaptation and its productivity or high yield performance. Based on this early maturity, diseases tolerance, spike length, plant height and grain yield were the farmers' perception criteria seated by farmers. Farmers' perception ranking criteria results shows that (HB1307) variety was got a good perception by the farmers, researchers and other stakeholders who participated during the field day in Geta Woreda. The grain yield data was calculated from 1 m × 1 m from high, medium and low concentrated areas triangularly. Farmers' perception ranking criteria results shows that (HB1307) variety was got a good perception by the farmers,

researchers and other stakeholders who participated during the field day in Gumer, Geta and Alichu Woreda. Therefore, the improved variety HB1307 has high grain yield in the study area and which was confirmed by high farmers perception score in the study area. So that, the Gumer, Geta and Alichu Woreda should go further extension to reach more farmers in the area and in similar agro-ecology.

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