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PRE-EXTENSION DEMONSTRATION AND EVALUATION OF FOOD BARLEY TECHNOLOGY (*Hordeum vulgare L.*) IN WEST AND KELLEM WOLLEGA ZONES

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ABSTRACT

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Pre extension demonstration of food barley varieties was carried out during 2010/11 and 2011/12 E.C cropping season with the objective of evaluating the best performed and preferred food barley varieties under farmer's management condition. The trial was carried out selecting one kebele from each Anfilo, Hawa Gelan and Boji Dirmaji districts and selecting two kebeles from Seyo district. Three improved varieties of food barley (dinsho, abdane and biftu) with a local check were evaluated with full participation of FRG members under their management condition. The best fit variety was selected with the participants. The total of five (5) FRGs which incorporated a total of 59 male and 23 female was established. Each experimental plot had gross area of 100 m² and rows spacing of 25 cm were used. All recommended agronomic practices were equally applied to all plots. Yield of varieties were collected and analyzed using descriptive statistics. Accordingly the yield performances of varieties were 28.66 qt/ha, 26.02 qt/ha, 23.96 qt/ha and 21.15 qt/ha for Dinsho, Abdane, Biftu and local respectively. Accordingly, the yield advantage of dinsho over local is 35.5% while the yield advantage of abdane over local is 23.02% and yield advantage of biftu over local is 13.28%. Farmers were enhanced to evaluate the technology using their own criteria. Accordingly they selected dinsho variety as their first choice by its grain yield, disease resistance, finger size and abdane variety secondly by its merits of early maturity, lodging tolerance and biftu and local thirdly and fourthly respectively. Generally based on farmer's preference and objectively measured trait variety dinsho should be scaled up/out in Sayo, Hawa Galan, Anfilo and Bodji Dirmaji districts and similar agro ecology of West and Kellam wollega zones.

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INTRODUCTION

Barley (*Hordeumvulgare L.*), is a member of the grass family, a major cereal grain grown in temperate climates globally. "It is a major crop, grown worldwide and in a wide range of climatic conditions; despite its importance as a crop species, little is known about the population genetics of barley and the effects of bottlenecks, adaptation, and gene flow on genetic diversity within and between landrace populations (Leino and Jenny, 2010; Tanto et al., 2010). Ethiopia is the second largest barley producer in Africa, next to Morocco, accounting for about 25 % of the total barley production in the continent (FAO, 2014). However, there is great yield gap between national average yield (2.11 t/ha-1) (CSA, 2017) and world average yield (3.04 t/ha-1) (Foreign Agricultural Service/USDA April 2017 Office of Global Analysis). Barley has been produced in Ethiopia since ancient time. It has great importance in social and food habit of people. There are two types of barley that farmers grow in Ethiopia, food and malty barley. The majority of barley that farmers grow is food barley and it is the main ingredient for several staple dishes like Enjera (leavened bread), porridge, and bread (Yelamtesfa Firew, 2017). In Ethiopia, the national average yield of food barley was estimated to be 1.965 and 1.966 t/ha during 2014/15 and 2015/16, respectively (Abay F. and Bjørnstad A. (2009). Similarly, average grain yield of 2.228 t/ha (Oromia), 1.20 t/ha (West Wollega zone) and 1.613 t/ha (Kellem Wollega zone) was obtained (CSA, 2016), indicating below national productivity of the crop in the zones. Barley grains are commonly made into malt in a traditional and ancient method of preparation (Abegaz. 2002). During 2016/17 cropping calendar the crop holds an area 959,273.36 ha from which a total production of 20,249,216.79qts were harvested. Compared with 2015/16 there is an increment of production from 1856042.76 in 2015/16 to 20249216.76 with production difference of 1682174 (CSA, 2016/17).

Though there is food barley production potential in the study area, there is a need to enhance the production of the crop in a convincing level. As a result, adaptation trial of improved food barley varieties was made on station and sub sites by HSARC researchers for three years(2007-2009), and released the top promising and adopted varieties for west and Kellem Wollega zones. Moreover participatory on farmers' field evaluation and demonstration of the technology were done in order to taste the feasibility, relative advantage and compatibility of the technology in line with the existing local condition. This could in turn hasten the adoption rate and dissemination of the technology. Accordingly, the two way feedback between farmers and researchers is indeed vital component of high yielder and disease and pest resistant varietal development.

Objectives

- To demonstrate and evaluate the productivity of food barley technologies under farmers management conditions.
- To assess farmers' and other stakeholders' feedbacks for further technology development/improvement.
- To recommend at least one variety of food barley to be used for scaling up in the study area.

METHODOLOGY

Description of the study area

Field experiment was conducted in Seyo, Hawa Gelan and Anfilo districts of Kellem Wollega and Boji Dirmaji District of West wollega zones of Ethiopia (Figure 1), for two consecutive years (2010/11-2011/12 E.C).

Sayo district

Sayo district is located in the south western part of Kellam Wollega Zone and the zonal capital was found in it (Sayo district). Astronomically the district is located between 8° 12'-8° 44' north latitude and 34°41'-35°00' east longitude. It is bounded by Gambella Regional State in the south, Ilubabor Zone in the south east, Hawa Galan & Yemalogi Walal districts in the north and east and Anfilo district in the west and North West. The district has a total area of 127,800 km². The district generally lies within an altitudinal range of 1300-2000 m.a.s.l. The major rainy seasons in the district include spring (April-May), summer (June-August) and autumn (September- November).

Anfilo district

Anfilo district is located in the western part of Oromia regional state & the zonal capital was found in it (Mugi). Astronomically the district is located between 8°17'-8°49' north latitude and 34°13'-34°46' east longitude. The district generally lies within an altitudinal range of 500-2500 m.a.s.l. The major rainy seasons in the district include spring (April-May), summer (June-August) and autumn (September-November). The administrative center of this district is Mugi.

Hawa-Gelan district

Hawa Gelan is one of the woredas in the Oromia Region of Ethiopia. Part of the Kellam Wollega Zone, Hawa Gelan is bordered on the south and southwest by Sayo, on the north by Yemalogi Welele, on the northeast by Dale Wabera, and on the south and southeast by the Illubabor Zone. The administrative center of this woreda is Gaba-Robi. Hawagelan was separated from former Hawa Welele woreda. The 2007 national census reported a total population for this woreda of 95,976, of whom 49,312 were men and 46,664 were women; 5,562 or 5.8% of its population were urban dwellers.

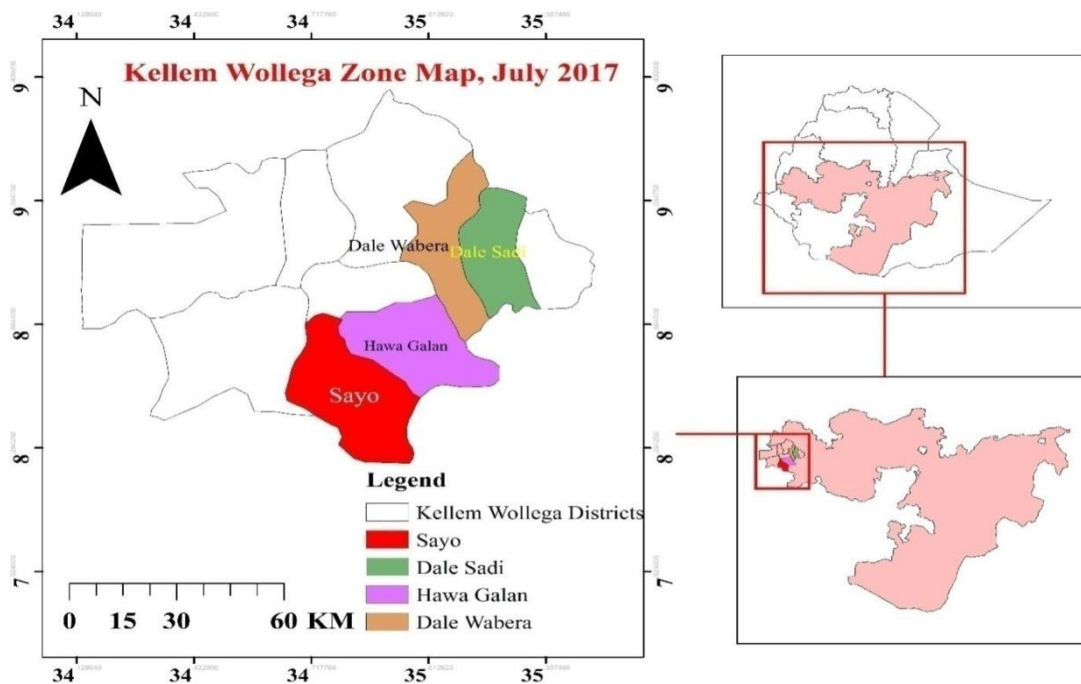


Figure 1. Map of Anfilo, Hawa Gelan and Sayo districts with in Kellam Wollega

Boji Dirmaji district

Boji Dirmaji is one of the woredas in the Oromia Region of Ethiopia. It is part of the West Wollega Zone and a part of former Boji woreda. It is bounded by Benishangul Gumuz Regional state in the north, Nedjo in the west, Boji Chokorsa in the south and Lalo Asabi in the southeast whereas Bila is the administrative center of the district.

Site and farmer selection

Four potential districts, three districts from Kellam Wollega zone and one district from West Wollega zone were selected purposively based on access to transport service, agro-ecological suitability and food barley production potential. These Districts were Anfilo, Hawa Gelan and Seyo of Kellam Wollega and Boji dirmaji district of West Wollega. From Anfilo, Hawa Gelan and Boji Dirmaji districts one each *kebeles* namely, Sudi, Hawa-mo'i Gidano-king respectively and from Seyo district two representative model *kebeles* namely, Tabor and Humbi-karo were selected based on their potential for food barley production and accessibility.

A single FRG was established in each operational *kebeles* considering their interest to cooperate within team, land ownership, gender balance (the participation of male, female and the youth group as well). Before starting the field work, selection of experimental farmers was done in collaboration with researchers, extension agents and the FRG members by taking in to consideration the farmers' interests and motivation, land ownership, and other important socio-economic aspects

Table 1. Composition of FRG member (2017/18 and 2018/19)

SL. No.	District	Kebeles	Number of FRGs	Member of FRGs		Trial farmers	
				Male	Female	Male	Female
1	Sayo	Tabor	1	12	5	4	2
		H/Karo	1	13	2	3	2
2	H/Gelan	H/Mo'i	1	11	6	2	1
3	Anfilo	Sudi	1	10	5	2	1
4	B/Dirmaji	G/King	1	13	5	2	1
Total			5	59	23	13	7
Percentage				71.9%	28.1%	65%	35%

Materials used

Three improved variety of food barley namely; Abdane, Biftu and Dinsho with Local check were demonstrated and evaluated by stakeholders. The recommended fertilizer rate of NPS 100Kg/ha and UREA 50 kg/ha was used. The spacing between rows was 20 cm and sowing was done by drilling 100 Kg of seed per hectare. Each experimental plot had 10m x 10m with a gross area of 100m².

Data type and Method of data collection and analysis

Grain yield, farmers' selection criteria and number of stakeholders participated on promotional events like training and field days were objectively measured and analyzed to see the performance of varieties under farmer's management condition. Data were collected both by the researcher and development agents of hosting peasant association. Development agents were provided with data recording sheet and orientation on how to record data since they were nearby to the trial and can frequently supervise the trial. The collected data were analyzed using simple description statistics like mean and table using SPSS software.

Technology evaluation and demonstration methods

Before starting field work training were given on role and responsibility of FRG members and important agronomic practices needed, seed and fertilizer rate and management practice. Participatory technology evaluation and selection methods were employed to demonstrate and evaluate food barley technologies. The demonstrated technology was evaluated using PRA tools like pair wise ranking, focused group discussion & direct matrix rankings.

RESULT AND DISCUSSION

Training

Before the trial establishment, orientation on roles of farmers and experts and development agent as well as importance of FRG approach and during trial establishment, practical training on very important agronomic practice such as spacing between row and plant, seed and fertilizer rate and management practice was given to 72 member farmers out of which 50 of them are male and 22 of them are female and also 6 (six) DAs were trained out of which 4 (four) of them are male and 1(one) of them are female. But training that planned to be given to farmers and other stake holders on necessary packages of food barley production, marketing and post-harvest handling was not given due to severe security problem, limited logistic and occurrence of Corona virus.

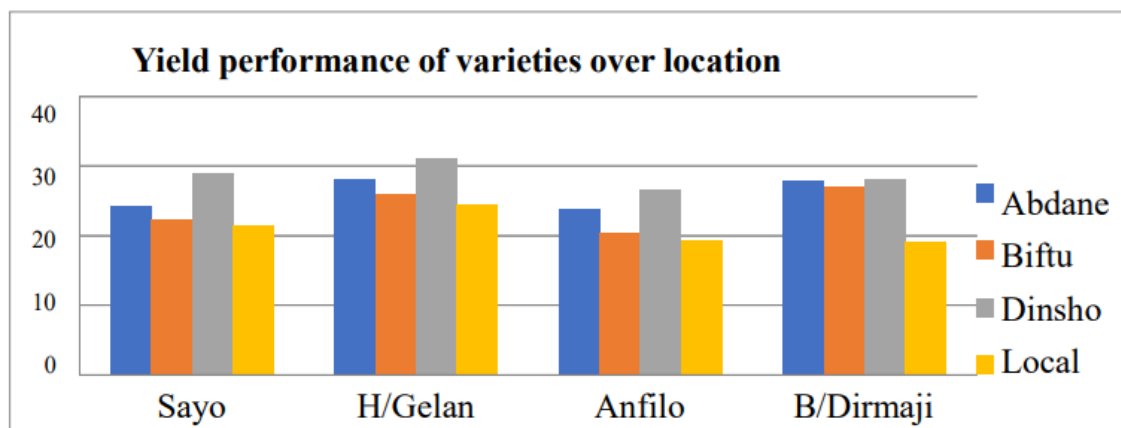


Figure 2. Yield performance over locations

Yield performance of demonstrated food barley varieties

The yield results of the demonstration manifested that Dinsho variety showed superiority over other varieties with magnitude of 28.66 qt/ha followed by Abdane, Biftu and Local with magnitude of 26.02 qt/ha, 23.96 qt/ha and 21.15qt/ha, respectively (Figure 2). The yield advantage of Dinsho variety over local was 35.5% and whereas, yield advantage of Abdane and Biftu varieties were 23.02% and 13.28%, respectively.

The study found that Abdane, Biftu and Dinsho had shown higher mean values of grain yield and yield advantage over the local check. This demonstration trial indicates that; in all the study area Dinsho variety gave the highest yield than Abdane, Biftu and local varieties of food barley and in all study area local variety of food barley gave least yield than both those demonstrated improved variety of food barley (Figure 2). Economic analysis of production was collected. However, since there is no difference in cost of production between varieties only the yield advantage was compared.

Based on this demonstration trial results, farmers get yield advantage of 35.5% when they produce Dinsho variety rather than producing the local variety and 23.02% and 13.28% yield advantage than local when produce Abdane and Biftu varieties respectively. Therefore, scaling up and popularization of the two identified varieties viz., dinsho and abdane is important to improve food barley productivity in the study areas and other similar agro-ecology of West and Kellam Wollega Zones.

Table 2. Training given for farmers, DA's and experts

Districts	Participants	Male	Female	Total
Sayo	Farmers	20	8	28
	DA'S	1	1	2
H/Gelan	Farmers	8	4	12
	DA'S	1	0	1
Anfilo	Farmers	10	5	15
	DA'S	0	1	1
B/Dirmaji	Farmers	12	5	17
	DA'S	2	0	2
Sum		54	24	78
Percentage		69.23	30.77	100

Participatory varietal selection, preference and ranking of varieties

Participatory evaluation of the technology by the farmers is another important part of this study. Hence farmers evaluated technology by setting their own criteria, and shown their own way of selecting a variety for their localities. Accordingly different stakeholders (mainly farmers, development agents, and agricultural experts) participated on participatory evaluation and selection. Thus a total of 74 (50male and 24 Female) participants participated on the process at maturity stage. During the assessment farmers were assisted to list their own selection criteria which may help them to identify best varieties that can fit their demand. These parameters include grain yield, pest tolerance, early maturity, effective tiller per plant, disease tolerance, lodging tolerance, seed color. Accordingly, farmers selected dinsho variety first based on its grain yield, disease tolerance and lodging tolerance and abdane variety selected second and biftu and local thirdly and fourthly respectively. Therefore, based on objectively measured traits and farmers' preferences, dinsho and abdane varieties of food barley were selected in the study areas.

Table 3. Pair wise ranking of varieties by farmers

Traits	GY	DT	LT	EM	PT	SC	ETP	Frequency	Rank
GY	X	GY	GY	GY	GY	GY	GY	6	1
DT		X	DT	DT	DT	DT	DT	5	2
LT			X	LT	LT	LT	LT	4	3
EM				X	EM	EM	EM	3	4
PT					X	PT	PT	2	5
SC						X	SC	1	
ETP							X	0	6

GY=Grain yield, DT=Disease Tolerance, LT=Lodging Tolerance, ETP=Effective Tiller per plant, EM=Early maturity, PT Pest Tolerance, SC= Seed Color

As shown in table-4 the most important trait among farmers criteria was grain yield, disease tolerance, lodging tolerance, early maturity, pest tolerance and effective tiller per plant of demonstrated food barley variety, respectively.

Table 4. Direct voting ranking of varieties

Criteria (N=74)	Farmers Preference and ranking of Food barley Varieties			
	Dinsho	Biftu	Abdane	Local
Grain yield	42	5	24	3
Early maturity	22	40	8	4
Disease Tolerance	35	0	39	0
Effective Tiller per plant	26	6	14	28
Pest Tolerance	40	11	19	4
Lodging Tolerance	53	10	0	11
Seed Color	33	0	38	3
Total	251	72	142	53
Percentage	48.45%	13.9%	27.41%	10.3%
Rank	1	3	2	4

As shown in the table-5 farmers preferred and selected Dinsho variety as their first choice when compiled by all criteria of their choice followed by Abdane, Biftu and Local respectively. Generally farmers preferred and ranked variety Dinsho first with the total percentage of 48.45%, Abdane second with 27.41%, Biftu and Local thirdly and fourthly with the total percentage of 13.9%, and 10.3%, respectively.

Lessons learned

It is well known that farmers do have best indigenous knowledge of their environment and farming practice. Thus demonstration of these food barley varieties gave farmers, researchers and agricultural experts considerable knowledge of food barley production in different ways. Farmers aware and identified and selected/preferred food barley varieties which suited their actual condition while researchers got farmers preference to different traits of food barley technologies which will provide the base for future technology generation.

CONCLUSION AND RECOMMENDATION

During pre-extension demonstration and evaluation of food barley varieties different stakeholders (which mainly included farmers, experts and researchers) were participated. The yield performances of the varieties were compared and the best performed varieties were identified. The yield performances of the varieties were 28.66 qt/ha, 26.02 qt/ha, 23.96 qt/ha and 21.15qt/ha for dinsho, abdane, biftu and local respectively. The yield advantages of Dinsho variety over local was 35.5% and whereas, yield advantage of Abdane and Biftu varieties were 23.02% and 13.28%, respectively. Farmers had listed important selection criteria and selected the variety that fit to their criteria. Accordingly grain yield, disease tolerance, early maturity, pest tolerance, effective tiller per plant capacity, seed color and lodging tolerance were common traits used to enable farmers to prefer demonstrated food barley varieties. Different participatory technology evaluations were used to evaluate the technologies. Among them PVES, Pair wise ranking and direct voting ranking of varieties were used. A total of 74 (20 Female and 54 male) stakeholders evaluated and selected varieties based on their selection criteria. Dinsho variety was selected first by 48.45% of participants and abdane second with total of 27.41% of participants based on the above listed criteria. The feedback collected from stakeholders and identified farmers preferences to the varieties provided a base for technology generation and fasten the rate of adoption of food barley technology.

The participated farmers have now developed a better capacity in identifying best fit varieties and management practices of food barley technology, thus they should be given the opportunity to share their experience to other farmers thereby strengthen farmers to farmers extension. This research could help regional and zone level planner to invest on food barley technology in the study area. Those identified farmers' preferences should be taken in to account for further technology development. Generally based on farmer's preference and objectively measured trait dinsho and abdane varieties were recommended to be scale up/out to address many more farmers and popularize these varieties in agro ecology of West Wollega and Kellem Wollega Zones.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

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