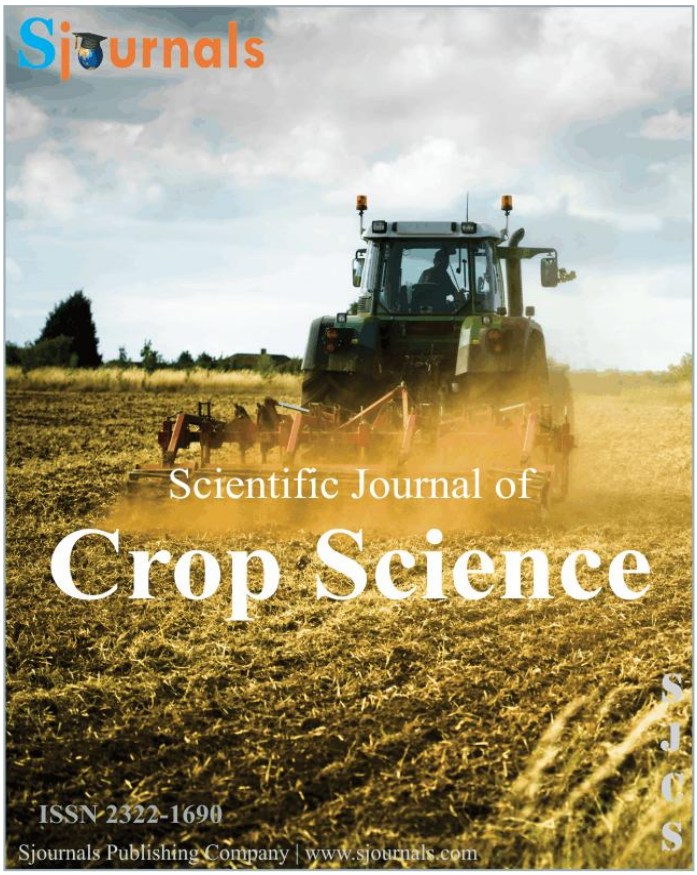
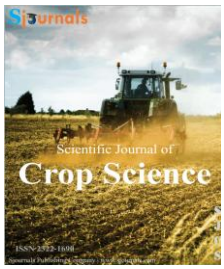


Scientific Journal of Crop Science (2016) 5(3) 90-103
ISSN 2322-1690
doi: 10.14196/sjcs.v5i3.2146



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Scientific Journal of **Crop Science**

Journal homepage: www.Sjournals.com

Original article

Participatory demonstration and evaluation of bread wheat technologies: The experience of FRG/FREG approach in Bale and West Arsi zones of Oromia national regional state, Ethiopia

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ARTICLE INFO

Article history,
Received 19 February 2016
Accepted 18 March 2016
Available online 25 March 2016
iThenticate screening 22 February 2016
English editing 15 March 2016
Quality control 21 March 2016

Keywords,
Bread wheat
Demonstration
FRGs/FREGs
Farmers' preferences
Selection criteria

ABSTRACT

The paper presents the result of participatory demonstration, evaluation and validation of recently released 4 improved bread wheat varieties (Danda'a, Huluka, Hidase and Shorima) with joint participation of farmers, agricultural experts, development agents, researchers and other stakeholders in Sinana and Agarfa districts of Bale and Dodola district of West Arsi Zones of Oromia National Regional State, Ethiopia in the year 2012/13 through the support of East African Agricultural Productivity Project (EAAPP). Generating, demonstrating, evaluating, validating, popularizing and disseminating improved bread wheat technologies to smallholder farmers are vital in facilitating adoption of these technologies. The objectives were to demonstrate, evaluate and validate the productivity of improved bread wheat technologies under farmers' condition in the target areas, to improve farmers', development agents' and agricultural experts' capacity (KSA) through training on wheat production techniques and management practices/packages, to establish FRGs/FREGs, to enhance linkage among the relevant stakeholders and to recommend the best-bet improved bread wheat varieties for further pre-scaling up activity. Three wheat growing potential kebeles were selected from each participant districts and a total of nine kebeles were selected for the study. One FRG/FREG having 20 members with the composition of men, women and youth farmers was established in each kebele. A total of 180 farmers were

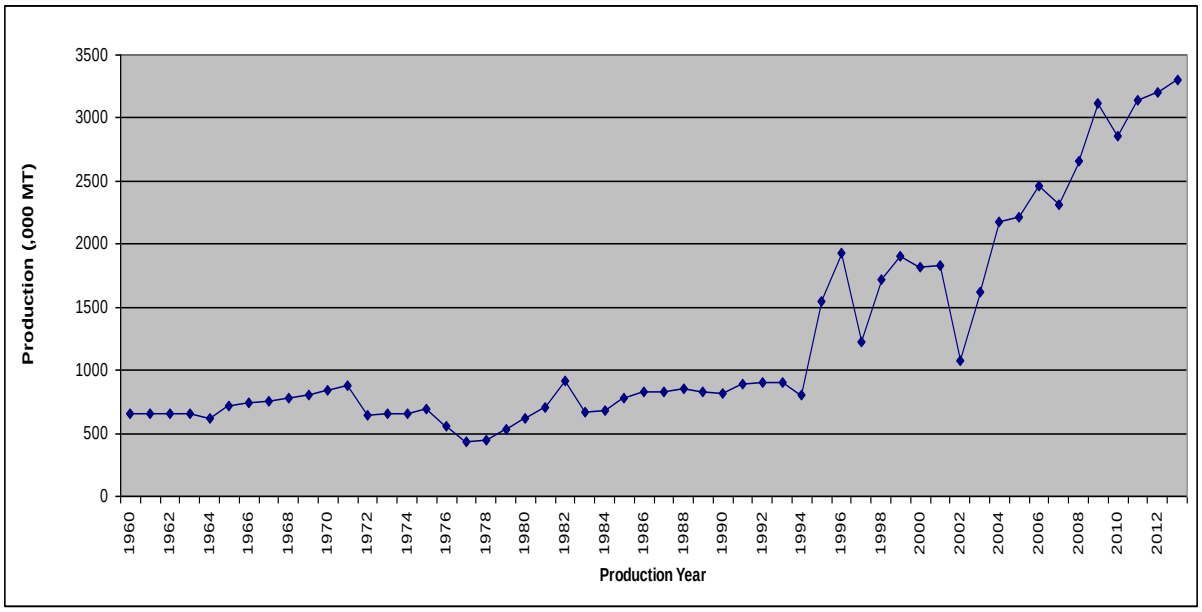
participated in the activity. Three trial farmers from FRG/FREG members were selected at each kebele (27 hosting model farmers in three districts) with the help of group members and DAs. Farmers were considered as replications. A total of 225 individuals (87.56% male and 12.44% female) from the three districts (180 farmers, 15 agricultural experts, 27 DAs & 3 supervisors) were participated on both theoretical (in-room) and practical (on-spot) training on wheat production and management packages. A total of 202.5 kg seeds of the five demonstrated varieties (40.5 kg of each variety), 67.5 kg UREA and 135 kg DAP were distributed to 27 trial farmers for demonstration purpose. One liter Pallas 45 OD herbicide was used for demonstration purpose on 1.814 ha (18144 m^2) land of 27 trial farmers. To show the performance of demonstrated varieties, mini field day was jointly organized in collaboration with other stakeholders at each district and about 300 participants were participated on this event including FRGs/FREGs members and follower farmers in the area. A total of 688 participants were participated on evaluation of the varieties. Uniformity in germination, good tillering capacity ($\geq$ 10 is preferable), disease resistant (especially yellow and stem rusts), good spike length, number of seeds per spike ($\geq$ 60 is preferable), good grain yield ($\geq$ 6 tons/ha), no irregular maturity because of late tillers, and not very late or early, ease for mechanization (medium size), good for consumption/bread making and marketable were the best criteria identified by the evaluators for selecting the best-bet variety/ies. Madda Walabu and Danda'a were selected in the first place, where as Hidase is preferred for its good yield with the availability of fungicides. In this activity, farmers were identified as reliable partners in the participatory plant breeding program. This approach will not only be resource saving in terms of preferred variety promotion/dissemination, but also time saving and fast adoption.

1. Introduction

Ethiopia is the second largest producer of wheat in Sub-Saharan Africa next to South Africa. Recently, wheat in general has become one of the most important cereal crops (strategic crop) in terms of production and food security in Ethiopia (Tolesa, 2014). It has been selected as a target crop for the strategic goal of national food self-sufficiency. Wheat (bread and durum) occupies over 1.5 million of land annually, primarily as mid-altitude and highland rain fed crops, ranks 4th in area next to teff, maize & sorghum, and 2nd in productivity among the cereals (CSA, 2013). At national level, during 2011/12 cropping season 1,553,239.89 ha of land was covered by wheat (bread and durum) and over 28,556,817.43 quintals produced from this land annually (Crop Variety Registry Book, 2012). In 2012/13 cropping season, wheat annual production in Ethiopia was 3.43 million tons cultivated on 1.63 million ha land (CSA, 2013).

The cultivation of wheat reaches far back in to history. It is number one cereals of temperate region. Also substantial amount is grown by subsistence farmers under rain fed conditions in tropical and sub-tropical environments. It is one of the major cereal crops grown within the range of 1500 to 2800masl in Bale, Arsi, West Arsi and Shewa zones, Oromia National Regional State, Ethiopia. These areas have reliable rainfall and are considered as "the wheat belt area of the country" (Bekele, 2011). Wheat is number one cereal crop grown in Bale zone both in terms of area coverage and production (CSA, 2013). It is produced by smallholder and commercial

farmers, private investors and the former state farms (now Oromia Seed Enterprise-Bale Branch) in the study zones.



Source: USDA (http://www.indexmundi.com/agriculture/?country=et&commodity=wheat&graph=production)

Smallholder farmers in Bale and West Arsi zones preferred producing wheat because of the following reasons. Conducive agro-ecology, comfortable plain farmland for wheat production & ease for mechanization, availability of improved agricultural technologies and associated packages (improved production techniques), availability of private service providers (agro-chemicals, mechanization services such as tractors, row planters, combine harvesters, etc.), increased demand for wheat (home consumption and food processors) and its comparative advantage (attractive market price).

Two wheat species are dominantly grown in the country. These two economically important wheat species are bread wheat (Triticum aestivum L.) and durum wheat (*T. turgidum* var. *durum*). For Bale zone, emmer wheat (*Triticum dicocum* L.) is also very important (SARC, 2014). Bread wheat is of recent introduction; durum wheat is indigenous to the Ethiopia, which is considered as 'the secondary center of diversity for tetraploid wheat'. Nevertheless, the on-going efforts to improve access to and use of available improved wheat technologies to smallholder farmers is below the requirements in terms of area coverage and number of beneficiaries. This is not because of government policy, our environment/agro-ecology, or not because of we do not have potential high yielding varieties, rather due to lack of well prepared plan, coordination & linkage in a sustainable way (multi-stakeholder approach). Furthermore, sustainable improvements in productivity and production depend on an efficient system of channeling demand-driven, need and interest based improved agricultural technologies to the end users.

However, the recent wheat rusts epidemics in Ethiopia is among the major wheat yield reducing factors and currently becoming the major threat for wheat production in the study zones as well as in the country. Besides, its potential productivity is limited by moisture stress (moisture stress/drought and water logging), lack of improved wheat varieties (resistant/tolerant to wheat rusts disease epidemics), low soil fertility, severe weed infestation (esp. grassy weeds), low crop management practices, diseases and insect problems. Moreover, low use of recommended full packages is also another yield limiting factor. Thus, undertaking participatory demonstration, evaluation and validation of improved wheat technologies with the participation of farmers and other stakeholders in the study zones is highly important.

1.1. Statement of the problem

Developing high yielding, disease resistant and stable varieties that can meet increasing food demand of the growing population is very important. Consequently, the research system have been making continuous and

unreserved endeavors in varietal development and seed/variety replacement to ensure the sustainability of early generation seed source for both formal and informal seed multipliers and distributors. In this endeavor, more than 60 different bread wheat varieties have been released and/or registered in Ethiopia to satisfy the growing production demands of the farmers in the country. Of these, Tusie, Madda Walabu and Sofumar are relatively resistant to diseases, commercial and in production. Among the bread wheat varieties widely grown by farmers in Bale and west Arsi zones, however, it was clearly seen from field observation that bread wheat varieties specifically Kubsa, Galama, Abola, Simba, Millenium, Pavon-76 and Digalu are losing their genetic potential due to wheat rusts disease epidemics (especially stem rust).

To tackle this problem, 4 improved bread varieties (Danda'a, Huluka, Hidase and Shorima) recently released in 2010 and 2011 with full recommended packages for production and farmers have to select the best-bet performing variety/ies by comparing with the existing commercial varieties. Farmers' low or lack of participation and failure to select the appropriate varieties is a costly mistake. Therefore, the aim of this paper is to present the result of participatory demonstration, evaluation and validation of recently released these 4 improved bread wheat varieties with joint participation of farmers, agricultural experts, development agents, researchers and other stakeholders in Sinana and Agarfa districts of Bale and Dodola district of West Arsi Zones of Oromia National Regional State, Ethiopia in the year 2012/13 through the support of East African Agricultural Productivity Project (EAAPP).

1.2. Objectives

General objective

To demonstrate and recommend the best selected variety/ies, and enhance the knowledge, skill and attitude of the end users towards the improvement of bread wheat production and productivity.

The specific objectives

- To demonstrate, evaluate and validate the productivity of improved bread wheat technologies under farmers' condition in the target areas,
- To improve farmers', development agents' and agricultural experts' capacity (KSA) through training on wheat production techniques and management practices/packages (packages approach),
- To establish FRGs/FREGs (make the farmer to be central to agricultural research and technologies dissemination),
- To enhance linkage among the relevant stakeholders and
- To recommend the best-bet improved bread wheat varieties for further pre-scaling up activity.

2. Materials and methods

2.1. Description of the study area

The research was carried out in Sinana and Agarfa districts of Bale Zone, and Dodola district of West Arsi zone of Oromia National Regional State (ONRS), Ethiopia. Bale and West Arsi zones are among the 18 administrative zones of the ONRS and located in southeastern Ethiopia.

2.1.1. Bale zone

Bale zone has eighteen (18) rural and two (2) town districts, out of which nine (9) rural districts are suitable for crop production. The other nine (9) rural districts are agro-pastoralists and pastoralists. The total area of Bale zone is about 63,555km^2 (6,355,500 hectars), which is 16.22% of ONRS. It is estimated that 88% and 22% are rural and urban dwellers, respectively. About 95% of the population is engaged in agriculture. The agro-ecological zones of the zone are extreme highland (cold) 0.04%, highland (14.93%), midland (21.5%) and lowland (63.53%). The mean annual temperature of the zone is found between 3.5^{o}c and 35^{o}c, respectively. The area receives an average annual rainfall of 1450mm where as the minimum and maximum rainfall is 400mm and 2500mm, respectively. Bale zone has bimodal rainfall patterns and two distinct seasons, namely, Belg (in Afan Oromo called 'Ganna' by referring to the harvesting time) extends from March to July and Meher (in Afan Oromo called 'Bona' by referring to the harvesting time) extends from August to January. The zone is bounded by West and East Hararghe zones in

the North, Arsi and West Arsi zones in the West, Guji zone in the South and Somali National Regional State in the East. Robe town is the capital town and administrative center of the zone (BZADO, 2014).

2.1.2. West Arsi zone

West Arsi zone has twelve (12) rural and two (2) town districts and having the total area of 12,556km^2 (1,255,600 hectars). About 95% of the population is engaged in agriculture. Geological Survey show that about 76.19% of the zone are flat plain, while about 23.81% are ragged or unutilized terrain that including valley, gorges, hills and dissected plateaus (BOFED, 2009). Most parts of the zone have elevations of ranging from 1500m to 2300m.a.s.l. The mean annual temperature of the zone is found between 10^{o}c -25^{o}c. For most of the areas, the rainy season starts in March and extends to November with the increasing concentration in June, July and August. On average, the zone gets annual mean rainfall of 1300mm. The zone is bounded by East Shewa zone in the North, South Nations, Nationalities and People National Regional State in the West, Arsi zone in the northeast, Guji zone in the South and Bale Zone in the East. Shashamanne town is the capital town and administrative center of the zone (WAZADO, 2014).

2.1.3. Sinana district

Sinana district is among the eighteen (18) districts of Bale zone, which is located at 430 km southeast of Addis Ababa. It is one of the largest and potential district of Bale zones with a total land area of 1168km^2 (116,800 hectars). It is divided into twenty (20) Kebeles and four (4) small rural towns. About 99% of the population is engaged in agriculture. Farming system of the district is characterized by mixed farming, i.e., crop-livestock mixed farming system characterizes agriculture in the district. The major crops grown by farmers in the district are wheat (bread, durum and emmer), barley (food and malt), field pea, faba bean, linseed, maize, hot pepper, potato, cabbage, banana, sugar cane, orange and papaya. Cattle, equines, sheep, goats and chickens are important livestock species reared by farmers in the district (SDADO, 2014).

The agro-ecological zones of the district are highland (90%) and midland (10%). The altitude ranges from 1650m to 3650 m.a.s.l. The annual average temperature is 16.5^{o}c where as the minimum and maximum temperature is 10^{o}c and 23^{o}c, respectively. The annual average rainfall is 1105mm where as the minimum and maximum rainfall is 1060mm and 1150mm, respectively. The dominant soil type is loamy clay and pellic vertisols. Sinana district is bounded by Agarfa district in the North, Dinsho district in the West, Barbare and Goba districts in the South, Gassara district in North-east and Goro in the East and the administrative center of the district is Robe town (SDADO, 2014).

2.1.4. Agarfa district

Agarfa district is among the eighteen (18) districts of Bale zone, which is located at 460 km southeast of Addis Ababa. It is one of the largest and potential district of Bale zones with a total land area of 1343 km^2 (134,300 hectars). It is divided into twenty (20) Kebeles and two (2) towns. More than 95% of the population is engaged in agriculture. Farming system of the district is characterized by mixed farming, i.e., crop-livestock mixed farming system characterizes agriculture in the district. The major crops grown by farmers in the district are wheat (bread, durum and emmer), barley (food and malt), field pea, faba bean, linseed, maize, hot pepper, potato, cabbage, banana, sugar cane, orange and papaya. Cattle, equines, sheep, goats and chickens are important livestock species reared by farmers in the district (ADADO, 2014).

The agro-ecological zones of the district are highland (83%), midland (11%) and lowland (6%). The altitude ranges from 1250m to 3855 m.a.s.l. The Mean Annual temperature of the district is 17.5^{o}c. The maximum and minimum temperatures are 25^{o}c and 10^{o}c, respectively. The mean annual rain fall is 800mm where as 1200mm and 400mm Maximum and Minimum annual rain fall recorded in the district, respectively. The dominant soil type is loamy clay and vertisols (ranges from well-drained fertile to waterlogged vertisols). Agarfa is bounded by Sinana and Dinsho districts in the South, Arsi zone in the North, Adaba district in the West and by Gassara district in East and the administrative center of the district is Agarfa town (ADADO, 2014).

2.1.5. Dodola district

Dodola district is among the twelve (12) districts of West Arsi zone, which is 75km far away from Shashamanne and located at 326km southeast of Addis Ababa. It is divided into twenty three (23) Kebeles and four (4) rural towns. More than 95% of the population is engaged in agriculture. Farming system of the district is

characterized by mixed farming, i.e., crop-livestock mixed farming system characterizes agriculture in the district. The major crops grown by farmers in the district are wheat (bread, durum and emmer), barley (food and malt), tef, maize, sorghum, field pea, faba bean, chickpea, linseed, lentil, enset, potato and cabbage. Cattle, equines, sheep, goats and chickens are important livestock species reared by farmers in the district (DDADO, 2014).

The agro-ecological zones of the district are Dega (91%), Woynadega (8%) and Kolla (1%). The altitude ranges from 1500m to 3655 m.a.s.l. The annual average temperature is 18.5^{o}c where as the minimum and maximum temperature is 12^{o}c and 25^{o}c respectively. The annual average rainfall is 1109.5mm where as the minimum and maximum rainfall is 800mm and 1419mm respectively. The dominant soil type is loamy clay and pellic vertisols. The district shares bounder line with Gadab Hasasa in the north, Kokosa and Kofale in the west, Adaba in the East, and Nensebo in the south and the administrative center of the district is Dodola town (DDADO, 2014).

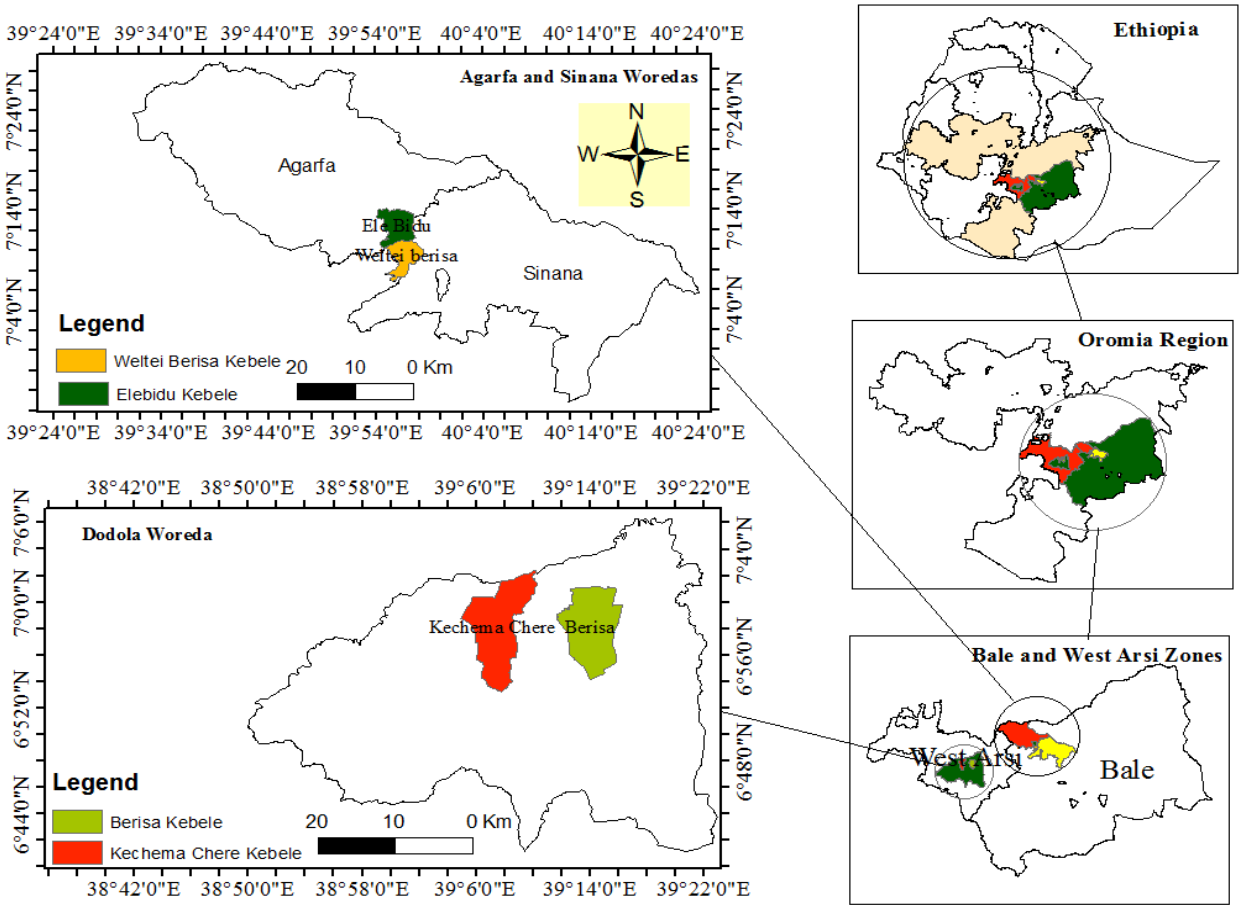


Fig. 1. Map of Sinana, Agarfa and Dodola districts.

2.2. Experimental design

As a target area, one district from West Arsi (Dodola) and two districts from Bale (Sinana and Agarfa) were selected purposively for the implementation of the activity. Three wheat growing potential kebeles were selected from each participant districts & a total of nine kebeles were selected for the study. One FRG/FREG having 20 members with the composition of men, women and youth farmers was established in each kebele. A total of 180 farmers (20 members X in 9 kebeles of 3 districts) were participated in the activity. Three trial farmers from FRG/FREG members were selected at each kebele (27 hosting model farmers in three districts) with the help of group members and DAs. Farmers were considered as replications i.e. the demonstration activity was replicated on three farmers per kebele. Trial site (farm land) was obtained through paying compensation.

A total of 720 follower farmers (1 farmer has 4 follower farmers) were participated in the activity (directly or indirectly). SARC was the source of all agricultural inputs (seed of improved varieties, fertilizers-DAP & UREA,

herbicides-Pallas 45 OD) and revolving seed system was employed. Four improved bread wheat varieties (Danda'a, Huluka, Shorima and Hidase) and one standard check (Madda Walabu) were planted on selected farmers' plot (10m X 10m) in 202/13 Meher Season (in Afan Oromo called 'Bona' by referring to the harvesting time). The varieties were treated with full recommended wheat production and management packages (agronomic recommendations and practices). The seed rate was 150 kg/ha and fertilizer rate was 50/100 kg/ha UREA/DAP with split application of *nitrogen:* 1/3 at planting time and 2/3 at tillering stage of the crop. Farm operations (planting, weeding, agro-chemical spray, harvesting, threshing) were carried out by SARC. Row planting and other crop management practices were used during the research work.

2.3. Approaches followed

Participatory and multidisciplinary approaches were used during demonstration activity.

2.3.1. Joint planning

Organizing stakeholder forum for consultation meeting with responsible and collaborative participants to have a common understanding of demonstration activities; establishing stakeholder platforms at Zone & Woreda levels and establishing FRG/FREG at each participant kebeles

2.3.2. Training on capacity building (on knowledge, skill and attitude)

For farmers, agricultural experts (zonal and woreda level) and development agents (DAs) on bread wheat production and management packages (from site selection to post harvest handling) and on roughing and seed dissemination system.

2.3.3. Packaging and distribution of wheat technologies & other agricultural inputs (fertilizers, agro-chemicals-herbicides)

2.3.4. Joint monitoring and evaluation

Regular field visit by extension agents - demonstration field will be regularly visited by extension counterparts, joint field visit and supervision at different crop stage.

Farmers (FRG/FREG members and other follower farmers) were encouraged to participate at each stage of the demonstration activity. Mini field day and demonstration were organized at crop maturity stage to popularize and create more awareness for the local communities. The variety/ies were demonstrated, evaluated and validated jointly by farmers, agricultural experts, development agents and researchers to select the best performing varieties at crop maturity stage. Discussion session and result communication forum were also organized.

2.4. Data collected

- ✓ Agronomic and yield data
- ✓ Total number of farmers participated on capacity building (training), field visit and mini-field days.
- ✓ Total number of farmers become aware the relative advantage of improved bread wheat technologies
- ✓ Change in level of knowledge and skill of farmers and DAs
- ✓ Farmers, agricultural experts and researchers assessments (preferences-likes and dislikes, which is the base for plant breeding process)
- ✓ The farmers' opinions, ideas, perceptions, interest and views that need consideration in plant breeding program.

2.5. Criteria used during assessment of the varieties at each site

Farmers' preferences and selection criteria

1. Disease resistant (particularly yellow and stem rusts)
2. Uniformity in germination
3. Tillering capacity
4. Adaptability to the local environment
5. Uniformity in heading

6. Uniformity in maturity
7. Resistant to shattering and frost
8. Resistant to sprouting (in case of unusual rain)
9. Spike length
10. Number of spikelet per spike
11. Number of seeds per Spike
12. Over all yield (estimation based on yield component parameters)
13. Stand count
14. Resistant to lodging
15. Competitiveness with weeds
16. Seed size and color
17. Seed plumpness
18. Consumption (good for bread making)
19. Threshability
20. Marketable

2.6. Rating scale

Each selection and evaluation criteria were rated using the following rating scale.

1= Very poor
2= Poor
3= Good
4= Very Good
5= Excellent

2.7. Data analysis

SPSS was used as statistical package (descriptive statistics were used to analyze the data). Pair wise ranking matrix was used to rank the varieties in order of their importance.

2.8. Communication methods used

In extension, there are no one-size-fits-all solutions. Hence, appropriate extension approaches (participatory) and all extension teaching methods (individual, group and mass contact methods) will be employed alone or in a judicious combination according to the situations during the implementation of the demonstration activity.

- Telephone (fixed and/or mobile)
- Study tour or field visit and supervision
- Workshop (for status evaluation)
- Field day
- Demonstration: method (to impart the skills) and result (to show the performance) demonstrations
- Group meeting and discussion session
- Training (in-room and on-spot or practical)
- Mass media (TV, Radio)
- Print Media (leaflets, pamphlets, flyers, posters, etc) was used for creating awareness, enhancing user knowledge and skill, changing attitude on using fully recommended packages of improved malt barley technologies.

3. Results and discussion

3.1. Training on capacity building

The effectiveness of the work is measured in terms of the changes brought about in the knowledge, skill and attitude, and adoption behavior of the people but not merely in terms of achievements of physical targets. Hence, training is very important to bring improvement on the job after filling the gap on knowledge, skill and attitude (KSA).

In this activity, training on KSA were the main approaches that used to create awareness about improved bread wheat technologies among farmers, to capacitate the farmers' and others' knowledge and skill about wheat production and management packages. To this end, multidisciplinary team consists of seven SARC researchers were organized to deliver the training in capacity building and facilitating extension efforts of bread wheat technologies. The team was composed of socio-economist, research-extensionist, breeder, pathologist, agronomist, weed scientist and seed scientist from SARC.

A total of 225 individuals (87.56% male and 12.44% female) from the three districts (180 farmers, 15 agricultural experts, 27 DAs & 3 supervisors) were participated on both theoretical (in-room) and practical (on-spot) training on wheat production and management packages. In specific, the trainings were focused on available improved bread wheat technologies (varieties, agronomic recommendations and practices/packages, etc.); input utilization (type, quantity required and application methods); weeds, diseases, insect pests and their controlling ways; agro-chemicals applications and safety precautions; the importance of crop rotation to break mono-cropping problem and quality seed production techniques and post harvest handling. The softcopy of training materials were provided in CD and flash disk to the concerned body.

Table 1
Summary of wheat training participants (2012/13).

Districts		Male	Female	Total
Sinana	Farmers	52	8	60
	Agricultural Experts	4	1	5
	DAs	6	3	9
	Supervisor	1	-	1
Agarfa	Farmers	54	6	60
	Agricultural Experts	5	-	5
	DAs	7	2	9
	Supervisor	1	-	1
Dodola	Farmers	55	5	60
	Agricultural Experts	4	1	5
	DAs	7	2	9
	Supervisor	1	-	1
	Grand Total	197	28	225

3.2. Seed and fertilizer distribution

3.2.1. Seed of improved bread wheat varieties

A total of 202.5 kg seeds of the five demonstrated varieties, namely, Danda'a, Huluka, Hidase, Shorima and Madda Walabu (40.5 kg of each variety) were distributed to 27 trial farmers for demonstration purpose.

Table 2
Amount of seed distributed for demonstration purpose.

No	Improved bread wheat varieties	Sinana district (kg)	Agarfa district (kg)	Dodola district(kg)	Total (kg)
1	Danda'a	13.5	13.5	13.5	40.5
2	Huluka	13.5	13.5	13.5	40.5
3	Hidase	13.5	13.5	13.5	40.5
4	Shorima	13.5	13.5	13.5	40.5
5	Madda Walabu	13.5	13.5	13.5	40.5
Total					202.5

3.2.2. Inorganic fertilizer

A total of 67.5 kg UREA and 135 kg DAP (inorganic fertilizers) were distributed to 27 trial farmers for demonstration purpose.

Table 3
Amount of fertilizers distributed for demonstration purpose.

No	Districts	DAP (kg)	UREA (kg)
1	Sinana (3 kebeles & 3 trial farmers at each kebele)	1kg for 1 plot at each trial farmer field and thus, 5 kg (for 5 plots) X 9 trial farmers at each district=45 kg	0.5 kg for 1 plot at each trial farmer field and thus, 2.5 kg (for 5 plots) X 9 trial farmers at each district=22.5 kg
2	Agarfa (3 kebeles & 3 trial farmers at each kebele)	1kg for 1 plot at each trial farmer field and thus, 5 kg (for 5 plots) X 9 trial farmers= 45 kg	0.5 kg for 1 plot at each trial farmer field and thus, 2.5 kg (for 5 plots) X 9 trial farmers= 22.5 kg
3	Dodola (3 kebeles & 3 trial farmers at each kebele)	1kg for 1 plot at each trial farmer field and thus, 5 kg (for 5 plots) X 9 trial farmers= 45 kg	0.5 kg for 1 plot at each trial farmer field and thus, 2.5 kg (for 5 plots) X 9 trial farmers=22.5 kg
Total		135 kg	67.5 kg

3.2.3. Agro-chemical utilization

1 liter Pallas 45 OD herbicide was used for demonstration purpose on 1.814 ha (18144 m2) land of 27 trial farmers. Area of 1 trial farmer was= 32m X21m=672m2

3.3. Supervision

The multidisciplinary team jointly conducted supervisions, monitoring and evaluation of the activities among the participating districts based on the necessities and requirements. As a result, the group had offered advice based on the practical problem observed on the spot in the project areas.

3.4. Field days

Field day is a method of motivating people to adopt new practices by showing what has already achieved under field conditions. In other words, it is to show the performance and profitability of new practices/technologies/innovation and to convince about the applicability. Besides, it is a way of facilitating people to visit new innovation for the purpose of bringing mass mobilization.

To show the performance of demonstrated varieties, mini field day was jointly organized in collaboration with other stakeholders (zone and district level agriculture development offices and participant farmers) at each district and about 300 participants were participated on this event including FRGs/FREGs members and follower farmers in the three districts.

3.5. Result of participatory assessment and evaluation

The target beneficiaries/farmers/end users of improved agricultural technologies are strongly inclined to their likes and dislikes (preferences). These preferences will cause them to give up less favored good crops/varieties for more favored ones. Therefore, before venturing/undertaking into breeding process, there is a need to consult intended beneficiaries to assess which qualities of a particular crop/variety they desire. Based on this, the breeding team (breeding program) can assess and evaluate which qualities are realistic (depending on many factors/criteria), and present their results to the beneficiaries. This will not only be resource saving in terms of preferred variety promotion/dissemination, but also time saving and fast adoption (Dan, 2012).

In the three districts (at 9 kebeles), participatory assessment and evaluation of the varieties were undertaken with agricultural experts, DAs, farmers and researchers at maturity stage of the crop. A total of 688 participants

(643 farmers, 30 DAs & supervisors and 15 experts from the three districts) & researchers were participated on evaluation of the varieties.

Table 4
Number of participants on participatory assessment and evaluation of the demonstrated varieties.

	Districts			
Participants	**Sinana**	**Agarfa**	**Dodola**	**Total**
Farmers	240	220	183	643
Agricultural Experts	5	5	5	15
DAs	9	9	9	27
Supervisors	1	1	1	3
Total	255	235	198	688

Before embarking on the actual assessment work, the evaluators were grouped in to small manageable group (one group had 10 members including one group leader and one secretary). At each district, kebele and trial site, brief orientation was given to the evaluators on how to integrate researchers' criteria and criteria set by them to evaluate and select the demonstrated varieties in order of their importance, how to carefully assess each variety by considering each criteria and using rating scale, how to organize collected data, how to make group discussion and reach on consensus in ranking the demonstrated varieties in order of their importance, and report through their group leader at the end.

The evaluators set and identified the best selection criteria for selecting of the best-bet demonstrated improved bread wheat varieties. These were uniformity in germination, has good tillering capacity (≥ 10 is preferable), disease resistant (especially yellow and stem rusts), has good spike length, number of seeds per spike (≥ 60 is preferable), good grain yield (≥ 6 tons/ha), no irregular maturity because of late tillers, and not very late or early, ease for mechanization (medium size), good for consumption/bread making and marketable. In this activity, farmers were identified as reliable partners in the participatory plant breeding program.

Consequently, suitable and widely accepted bread wheat varieties for the study areas were identified and ranked based on these criteria. So, Danda'a and Madda Walabu were selected in the first place, where as Hidase is preferred for its good yield with the availability of fungicides. This approach will not only be resource saving in terms of preferred variety promotion/dissemination, but also time saving and fast adoption.

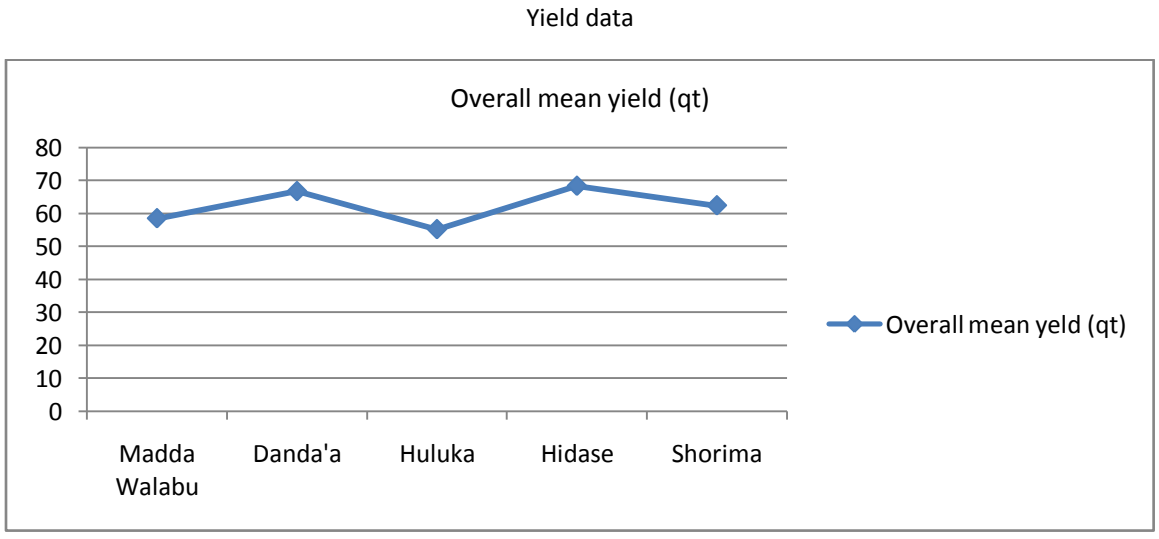


Table 5
Overall mean yield (qt) of the demonstrated varieties.

No.	Variety	Overall mean yield (qt)
1	Madda Walabu	58.5
2	Danda'a	66.7
3	Huluka	55.2
4	Hidase	68.3
5	Shorima	62.4

Table 6
Over all rank of each variety based on the evaluation criteria set by the participants at each district.

No.	Variety name	Districts			Perception of the evaluators
		Sinana Rank	Agarfa Rank	Dodola Rank	
1	Danda'a	1st	2nd	1st	High yielder, relatively disease resistant (but susceptible to yellow rust) and affected by cool weather during maturity
2	Madda Walabu	1st	1st	2nd	Relatively high yielder and disease resistant
3	Huluka	3rd	4th	3rd	Low yielder but disease resistant
4	Shorima	4th	3rd	3rd	Lacks uniformity (Different maturity level within a single plant)
5	Hidase	5th	5th	4th	High yielder with the availability (on time and price) of fungicides

3.6. Output obtained from demonstration activity

Farmers had first hand observation on the actual performance and benefit of the demonstrated varieties and Danda'a was selected for further pre-scaling up activity. Knowledge is gained, skill is acquired and attitude of the farmers is changed through intensive training especially on the importance and the dynamics of wheat rusts epidemics and on using full recommended packages (package approach). Knowledge and skill of DAs and agricultural experts also enhanced through training. Besides, farmers access to improved bread wheat technologies increased; large number of farmers was persuaded and information was disseminated to several farmers, which might pave the way for scaling–up/out. Thus, demand driven technology transfer created.

Furthermore, the activity had popularized and identified the farmers' opinions, ideas, perceptions, interest and views that need consideration in breeding program. Competitiveness among smallholders on technology (with full package) utilization increased. Information on market access provided (inputs and produce). Strong linkage among stakeholders (links to networks) is created that bridge further participatory effective bread wheat technology generation, demonstration, evaluation, validation and up-scaling/dissemination of the best technologies that fulfilling farmers' need and interest. Adoption and dissemination of improved bread wheat technologies enhanced through farmer-to-farmer learning mechanism.

4. Conclusion

To ensure the sustainability of early generation seed source for both formal and informal seed multipliers and distributors, research have been making continuous and unreserved endeavors in varietal development and seed/variety replacement. However, the prevalence of wheat rust epidemics in the country, especially in the wheat belt areas, calls for a shift from classical/conventional breeding to molecular/gene targeting breeding program. There is an opportunities to harvest high yield from commercial bread wheat variety if and only if our farmers use appropriate integrated weed/disease management practices. But, practical field observation and

assessment result indicated that, there is a knowledge gap on appropriate agro-chemicals application (utilization) by those smallholder farmers in the study zones.

Trainings (both theoretical and practical), joint supervision, field days and focus group discussions were organized at all demonstration sites as part of capacity building, technology and information diffusion mechanisms in order to make adoption rate faster. Tillering capacity, disease resistant, good spike length, number of seed per spike, yield, no irregular maturity, ease for mechanization and marketability are the best identified selection criteria for selecting of the best-bet improved bread wheat varieties. Therefore, farmers' preferences (likes and dislikes) are the base for breeding process, and thus, farmers were identified as reliable partners in the participatory breeding program. The participant farmers highly emphasized the constraint of row planter, seed supply shortage (in quantity, quality, with reasonable price and at required time), mono-cropping problem and emerging big challenge of wheat rust disease epidemics.

Recommendation:

Effective and efficient delivery of technical advices and support to farmers is highly required to improve wheat production and productivity, and bring the targeted impact. Strengthening the pre-extension demonstration, participatory evaluation and validations of newly released/registered wheat technologies under farmers' condition is important to make our research demand-driven and enhance wheat production and productivity.

Farmers' preferences should be considered and taken into consideration in breeding program in order to save resources in terms of preferred variety promotion/dissemination, time and make technology adoption faster. Recently, farmers' group is seen as the smallest unit of the farmers. Hence, establishing and strengthening FRGs/FREGs is one of the approaches, which make the farmer to be central to agricultural research and dissemination. To break mono-culture problem and emerging big challenge of wheat rust epidemics, and to stay sustainable in wheat production in the study zones, our farmers must practice appropriate integrated weed/disease management practices.

Among the four improved bread wheat varieties, Danda'a, Huluka and Hidase (with full recommended packages) were selected and recommended for pre-scaling up activity at least on ¼ hectar of land (on 50m X 50m) or 1 midde (32m X 32m) in the 2013/14 production season. Though it requires commitment & facilities, our breeding program should be tailored to molecular/gene targeting breeding program. Generally, strengthening the linkages among actors and key potential stakeholders (research-extension-farmers-private service providers as well as agro-industries/food processors) are indispensable to attain the goal.

Acknowledgements

This participatory demonstration, evaluation and validation of recently released improved bread wheat varieties were accomplished by the financial support of East African Agricultural Productivity Project (EAAPP). We also acknowledged Oromia Agricultural Research Institute, Sinana Agricultural Research Center and other collaborating stakeholders found at zone and district level for giving us all round supports during the research work.

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How to cite this article: Biftu, A., Diriba, B., Bayisa, T., Getachew, F., 2016. Participatory demonstration and evaluation of bread wheat technologies: The experience of FRG/FREG approach in Bale and West Arsi zones of Oromia national regional state, Ethiopia. Scientific Journal of Crop Science, 5(3), 90-103.