Pre-scaling-up of malt barley technologies in bale and west Arsi zones, Southeastern Oromia, Ethiopia: The experience of public-private partnership

Amare Biftu, Bekele Hundie, Tafa Jobie, Adamu Zeleke, Tamene Mideksa, Haile Dheressa, Firehiwot Getachew, Girma Fana, Wubishet Alemu, Mengistu Bogale, Tilahun Bayisa, Hiwot Sebsibe

Oromia Agricultural Research Institute, Sinana Agricultural Research Center, Bale-Robe, Ethiopia.
Ethiopian Institute of Agricultural Research, Kulumsa Agricultural Research Center, Asela, Ethiopia.
Oromia Agricultural Research Institute (OARI), Addis Ababa, Ethiopia.
Haramaya University, CASCAPE Project, Haramaya, Ethiopia.

*Corresponding author; Oromia Agricultural Research Institute, Sinana Agricultural Research Center, Bale-Robe, Ethiopia.

ABSTRACT

The paper presents the out-put, progress and success of pre-scaling up activities of improved malt barley technologies in Sinana, Goba, Dinsho and Gassera Districts of Bale Zone, and Adaba and Dodola Districts of West Arsi Zone of Oromia National Regional State, Ethiopia in the year 2009 to 2013 through the support of Asela Malt Factory and four breweries in multi-stakeholder approach. Generating, demonstrating, evaluating, validating, popularizing and disseminating improved malt barley technologies to smallholder farmers are vital in facilitating adoption of these technologies. The objectives were to convince the merits and increase confidence on the technologies, to strengthening on-farm seed production scheme and farmer- to-farmer seed dissemination system, increase the availability of malt barley seed for farmers and farmers’ ease access to the technologies, improve malt barley seed and grain production knowledge and skill of farmers with the standards of desired quantity and quality, organize producers, strengthening the linkage and pave the way for marketing their produce to agro-industries. A multi-stage purposive sampling technique was employed to select the participant zones, potential districts, Kebeles and farmer for the
pre-scaling up activity. Stakeholder analysis was made to select potential stakeholders to implement the activity. Thirty six (36) actors were identified, signed memorandum of understanding and participated in the activity. In capacity building and facilitating farmer-to-farmer extension effort of the technologies, about 1358 individuals (64.8% farmers, 35.2% agricultural experts, development agents and other stakeholders) were attended trainings on malt barley seed and grain production and management practices/packages. In popularizing malt barley technologies, 236.17qt (57qt Misical-21, 142.02qt Holker, 5.5qt Beka and 31.65qt Sabani) have been delivered to 880 smallholder farmers (201 in Adaba, 198 in Dodola, 150 in Dinsho, 101 in Gassara, 150 in Goba and 80 in Sinana districts) during the project period for production of seed that transferred to surrounding other farmers through farmer-to-farmer seed dissemination mechanisms. Field days and travelling workshops were organized to share the experience, evaluate the performance and to communicate the progress of the activity. A total of 450 and 120 individuals were participated on these events during the project period, respectively. Better accessing of malt barley varieties, improving farmers’ skill, knowledge and attitude on this business venture are the impacts attained during the project period. Proper site and farmers selection (lack of malt barley producing cooperatives), weak commitment of actors in implementing the project at all stages of the activity, institutional factors in seed distribution and marketing linkages, shortage of improved seed, and barley-based mono-cropping were the challenges confronted during the implementation. Strengthening linkage of key stakeholders, widely extending the scaling-up of improved malt barley technologies in well-organized and systematic approach, and mapping malt barley value chain require due considerations in order to satisfy exceedingly mounting malt barley demand in Ethiopia.

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1. Introduction

Ethiopia is the largest producer of barley in Sub-Saharan Africa. Barley is the most important cereal crops cultivated in the country. Suitable barley growing regions in Ethiopia are the highlands ranging from 2300 to 3000masl (Bayeh and Birhane, 2011). Regarding to its utilization, barley is a traditional crop and has strong tie with the society; it is deep-rooted to cultural food and local beverages; it is also used as raw material for malt (linking agriculture with agro-industries); feed for animal (straw); for making thatching roofs; serves as a relief crop (offers early crop harvest) and it is a versatile/multipurpose crop.

In Ethiopia, barley (both food and malt together) stands fifth after tef, maize, sorghum and wheat being produced on about 1 million hectares of land from which 1.90 million tons of grain is produced annually with an average national yield of 1.87 tons per hectare (CSA, 2014). Out of this, the share of malt barley is insignificant which could not exceed 5% to 10%. Yet, malt barley is among the priority commodities that have attracted the attention of malt factories, breweries and policy makers in general. Because, at the present time, it is considered as one of the cash crops and its demand by agro-industries has increased due to the increased capacity of malt barley processing in line with the expansion of the existing and establishments of new brewery plants.
Increased urbanization, population growth, and rising incomes are the driving forces that increase beer consumption levels in the country. As indicated in business sector report (2011), the market for malt barley can be estimated to grow at 15% to 20% per year in line to the beer market. Besides, the demand for malt barley grain is about 600,000 quintals per year and projected to reach 1,700,000 quintals in 2016 to produce 1.3 million qt of malt. At the end of GTP 2 (up to 2020), about 2.21 million qt of malt barley grain will be needed to produce 1.7 million qt of malt (AMF, 2015 Unpublished). However, the current local supply is only about 40% of the demand. The balance has been fulfilled through importing malt and/or malt barley grain forms, which costs the country over thirty million USD ($30,000,000.00) or six hundred million Ethiopian Birr (>600,000,000.00 Eth. Birr) per annum.

The gap between current production and consumption levels could only be closed by expansion of improved malt barley technologies through institutional innovation, making the research and extension system problem solving, demand-driven and client oriented for efficient distribution of the technologies among the end users. By doing so, the production (both in quantity and quality) and marketing system will be properly managed to ensure the linkage.

### Table 1
Current malt demand of breweries in Ethiopia.

<table>
<thead>
<tr>
<th>Breweries</th>
<th>Malt demand (Qt) in 2016</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGI Ethiopia</td>
<td>360,000</td>
<td></td>
</tr>
<tr>
<td>HEINEKEN (Bedele, Harar &amp; Klinto)</td>
<td>330,000</td>
<td>It will be doubled in the coming two years</td>
</tr>
<tr>
<td>Meta Diageo</td>
<td>130,000</td>
<td></td>
</tr>
<tr>
<td>Dashen (in Gonder &amp; in D/Birehan)</td>
<td>300,000</td>
<td></td>
</tr>
<tr>
<td>Habesha-D/Birehan</td>
<td>85,000</td>
<td></td>
</tr>
<tr>
<td>Raya – in Tigray</td>
<td>51,000</td>
<td></td>
</tr>
<tr>
<td>Zebider – in Walkite</td>
<td>45,000</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.3 million qt malt</strong></td>
<td><strong>1.7 million qt MB grain</strong></td>
</tr>
</tbody>
</table>

Source: Asela Malt Factory, 2015 (Unpublished)

However, malt barley is among crops demanded in large quantity in the country, it lacks supply in which its impact is directly connected with national economy, as beer plants import it from abroad with high hard currency. On contrary to the demand, malt barley supply in Ethiopia is characterized by continued scarcity due to low productivity attributed by low input utilization, limited availability of improved varieties, existence of pests and diseases and mono-cropping farming system. Sustained increase in agricultural production and productivity is dependent largely on the development/generation of improved varieties of crops, other associated recommended technologies, demonstration, evaluation, validation, popularization, dissemination and on an efficient system for timely supply of quality seeds to beneficiary farmers.

Extension of malt barley technologies, which improve the productivity of the crop and its production in potential areas of the country, has associated benefits for Ethiopia’s balance of trade (export-import). Besides, it has direct impact on the country’s smallholder farmers, which would supply malt factories with malt barley grain. To this end, research 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. As a result, the research system has produced substantial amount of improved agricultural technologies (variety, knowledge, information, management practices, farm equipment, tools, and machine) in the past decades. With this effort, 15 malt barley varieties were released/registered for commercial purpose.

Due to the weak linkage between research, extension, farmers and other stakeholders (in extension, multiplication and utilization), however, these technologies delayed to reach the majority of smallholder farmers particularly and the growers generally to increase production and productivity and to bring the required impact. Besides, the impacts and benefits have been limited in scope and coverage. The scenario was not different for malt barley, which serves as a bridge for agriculture-industry linkage. Coordination and cooperation among different stakeholders in agricultural development is at its low level. This is not because of government policy, our environment/agro-ecology, or not because of we do not have potential high yielding malt barley varieties, rather
due to lack of well prepared plan, coordination and linkage among stakeholders in a sustainable way (multi-stakeholder approach) for an efficient system of channeling improved agricultural technologies to farmers.

By the aim of enhancing malt barley production and productivity in the country, malt barley project (Public-Private Partnership) has been launched since 2009 by joint collaboration of Asella Malt Factory and four Breweries (BGI- Ethiopia, Meta Abo, Bedelle and Harar) to support its research and capacity through financial support and access to the smallholders in potential areas of Ethiopia. This project has planned the activity that contributes towards the improvement of its production and productivity in Arsi, West Arsi, Bale and central highlands through participatory generation, demonstration, evaluation, validation, pre-scaling up/popularization and dissemination of improved malt barley technologies developed by Ethiopian Institute of Agricultural Research (EIAR) and Regional Agricultural Research Institutes (RARIs) with the participation of farmers and other stakeholders. This project is the best example in linking agriculture with industry.

The pre-scaling up of malt barley technologies have been conducted with the aim of ensuring introduction and dissemination of improved varieties with associated technologies and availability of pure seed of the varieties to the farmers through informal seed system and thereby strength the malt barley grain supply to agro-industries. Hence, this manuscript is designed to indicate the overall progress and success of the activity, the approaches followed, challenges confronted and future direction in improving malt barley technology supply in the two zones.

1.1. Conceptual and historical background of barley production

Barley is a cool-season crop that is adapted to high altitudes. It is grown in a wide range of agro-climatic regions under several production systems. At altitudes of about 3000 masl or above, it may be the only crop grown that provides food, beverages and other necessities to many millions of people. Food barley is commonly cultivated in stressed areas where soil erosion, occasional drought or frost limits the ability to grow other crops. Malting barley, however, requires a favorable environment to produce a plump and mealy grain. Barley holds a unique place in farming in Ethiopia, and various sources agree that it has been in cultivation for at least the past 5000 years in the country (Bayeh and Birhane, 2011).

In Ethiopia, malt barley production has been started in 1975 in the highlands of Arsi. In line with the establishment of Asella Malt Factory 1984, the production area of malt barley took large coverage. In spite of the potential to produce malt barley, about 50% of the total malt barley grain produced and supplied to the factory has been rejected due to poor quality to the standard of the factory (AMF, 2015).

Barley is the major cereal crop grown in the highland areas of Arsi, West Arsi and Bale zones next to Wheat. Bale zone is the second both in barley area and production volume next to Arsi (CSA, 2013). Based on the productivity and land coverage, it is understood as it is under produced. Whereas, in Bale and W/Arsi zones the present production land allocated for barley is decreasing, while it has potential production if expanded with scientific knowledge, technologies, practices and information.

1.2. Constraints of malt barley production

The government is knee to boost production of malt barley through supporting smallholder farmers and attracting commercial farming to supply 75% from home production. To satisfy the ever-increasing demand for raw materials by the beverage industry, and to ensure dependable and higher cash returns to the smallholder farmers, expansion of the malting barley production area is very important (Minale et al., 2011). The mismatch between domestic supply and demand, and the favorable biophysical environment indicate that there is a huge opportunities and potentials exist to enhance local production and substitute import. Different experienced experts frequently raise that there is the existence of immense potential for malting barley production to meet the national demand in Ethiopia; however, its production has not expanded, and productivity at farm level has remained low. The lower productivity of malt barley in Ethiopia is attributed to various biotic and abiotic factors. Among others, limited number of quality malt barley varieties and associated technologies, weak linkage and technology transfer, poor access to market and unattractive malt barley price are identified as the main constraints.

1.3. Malt barley seed system

In Ethiopia’s context, where agriculture is the main stay of the economy, the agricultural development led industrialization policy, development strategies and plans of the country emphasizes the need to bring about rapid agricultural development through the use of improved agricultural technologies (variety/seed, knowledge,
information, management practices, farm equipment, tools, and machine) in a sustainable way as the main means of reducing poverty in the country. Seed is one of the most crucial elements in the livelihoods of agricultural communities. A farming community’s food security depends heavily on its seed security. It is the most important agricultural input and a pre-requisite for the majority of the world’s food production (Bawa et al., 2010). While access to and availability of seed has the potential to greatly improve smallholder productivity, there is currently a substantial gap between the country’s production of commercial seeds and farmers’ demand for, knowledge of, access to, and usage of these seeds.

Through the formal seed system the demand estimation, seed production and supply system is taking lengthy process and the annual supply of improved seed is only 10% to 20% (Dawit et al., 2010). Besides, the seed system of Ethiopia mainly biased towards production and multiplication of hybrid maize and wheat seeds. Ethiopia Seed Enterprise (ESE) and Regional Seed Enterprises (RSEs) give limited attention to the multiplication of seeds of other crops (barley, tef, sorghum, etc). Informal seed production (decentralized farmer-based seed multiplication and farmer-to-farmer seed dissemination mechanisms) started before 10 years after political, economic and social reforms in Ethiopia in 1991 (Minilek et al., 2012). It is a relatively good low-cost system that can maintain the provision of seed in terms of kind, quantity, quality and access (at right time, place and reasonable price) to a level satisfactory to neighboring farmers locally. Hence, the pre-scaling up program served as the main source for the majority of the malt barley varieties (seed) that are currently in production in major malt barley producing areas of the zones.

1.4. Objectives of the component

1.4.1. General objective

To ensure the dissemination of improved and newly released malt barley varieties with associated recommended technologies and availability of pure seed of the varieties to the farmers through informal seed system for the improvement of malt barley production and productivity and thereby strengthening the malt barley grain supply to agro-industries and contribute to enhance import substitution and satisfy the local demand (both in quantity and quality) of agro-industries.

1.4.2. The specific objectives

- To convince the merits and increase confidence on improved malt barley technologies, thereby to facilitate dissemination and adoption of the technologies through farmer-to-farmer extension approach,
- To strengthening on-farm seed production scheme and farmer-to-farmer seed dissemination system,
- To increase the availability of malt barley seed for farmers/malt barley growers and farmers’ ease access to the technologies,
- to enhance the capacity (knowledge, skill and attitude) of malt barley growers through training on principles of barley seed and grain production and management practices/packages with the standards of desired quantity and quality,
- To strengthen the linkage (links to networks) between the farmers, researches, improved malt barley technologies and agro-industries and
- To pave the way for marketing their produce to agro-industries.

2. Methodology

2.1. Public-Private Partnership (PPP)….. Institutional Innovation/Tool

Why do breweries and AMF fund research & Extension of malt barley? This extension approach was preferred to build capacity for research and extension activities, to ultimately increase malt barley production and productivity (both in the desired quantity and quality set by agro-industries ) and to satisfy local demand, to strengthening synergy and linkage among stakeholders (multi-stakeholder approach) and to enhance malt barley value chain in the project implementation areas.
2.2. The need for collaborative work/synergy between stakeholders to improve the livelihood of farmers (multi-stakeholder approach)

Research 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. As a result, the research system has produced substantial amount of improved agricultural technologies (variety, knowledge, information, management practices, farm equipment, tools, and machine) in the past decades. i.e. many technologies have been generated, demonstrated, evaluated, validated and popularised. However, due to the weak linkage between research, extension, farmers and other development partakers, limited access to inputs and lack of market opportunities yet, these technologies delayed to reach the majority of small scale poor farmers particularly and the growers generally to bring the required impact. Hence, in extension, multiplication and utilization still the impacts and benefits have been limited in scope and coverage. So, for the sake of enhancing efficiency and effectiveness, integration and cooperation (synergy) were institutional tools/innovations implemented for the achievements of the strategy.

2.3. Description of the study area

The research was carried out in Dinsho, Goba, Gasara and Sinana districts of Bale Zone, and Dodola and Adaba districts 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.

2.3.1. Bale zone

Bale zone has 18 rural and 2 town districts, out of which 9 rural districts are suitable for crop production. The other 9 rural districts are agro-pastoralists and pastoralists. The total area of Bale zone is about 63,555km² (6,355,500 hectares), 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°C and 35°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).
2.3.2. West Arsi zone

West Arsi zone has 12 rural and 2 town districts and having the total area of 12,556km$^2$ (1,255,600 hectares). 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 $10^\circ$C - $25^\circ$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).

2.4. Approaches followed

The inception of malt barley technology extension was started with potential malt barley growing areas identification and inventory of the best suitable technologies according to the agro-ecologies of the areas. Multidisciplinary team consists of eight researchers (Center Director/Entomologist, Breeder, Pathologist, Agronomist, Weed Scientist, Economists, Research-Extensionist and seed expert) was established at Sinana Agricultural Research Center (SARC) for the implementation the project. For the sake of enhancing efficiency and effectiveness, integration and cooperation (synergy) were institutional tools/innovations implemented for the achievements of the strategy.

Joint planning

- Organizing stakeholder forum for consultation meeting with responsible and collaborative participants to have a common understanding of scaling up activities.
- Establishing stakeholder platforms at zone and district levels.
- Signing of memorandum of understanding (document having the roles and responsibilities of each actor)
- Appointing focal persons & establishing taskforces at all levels.

Training on capacity building (in multidisciplinary approach)

- for farmers, trainers (zone and district experts, DAs) on malt barley production and management packages (from site selection to post harvest handling)
- On roughing and seed dissemination system

Packaging and distribution of Malt barley technologies

- Different improved malting barley varieties, namely, Miscal-21, Holker, Beka and Sabini distributed to selected zones, districts and farmers. The recommended seed rate and fertilizer rate for malt barley was 120 kg/ha and 100 kg/ha DAP only, respectively.

Participatory monitoring and evaluation

- Joint field visit and supervision at different crop stage
  - Field day
  - Workshop (marketing, travelling)
  - Discussion session and result communication

2.4.1. Stakeholder analysis

In enhancing malt barley production and productivity, the research center was closely working and has made frequent consultation with its respective stakeholders. Before embarking on the activity, stakeholder analysis was undertaken to identify potential stakeholders. Points such as: Who are the stakeholders? How big is their stake? How much they are closer to the project? What are their roles, duties and responsibilities in implementing the activity? End to end value chain-planning, designing, dissemination of proved technologies, seed increase, seed and grain marketing and processing. How does the synergy support the opportunities to bring the required
impact? and finally the roles, duties and responsibilities of each actor were clearly stated in implementing the activity.

Accordingly, 36 responsible and collaborative participant stakeholders/actors were identified. Namely, Sinana Agricultural Research Center (SARC), Asella Malt Factory, four Breweries (Harer, BGI, Meta and Bedelle), Bale and West Arsi zones Administration Offices, Bale and West Arsi zones Agriculture Development Offices, Bale and West Arsi zones Cooperative Promotion Offices, Bale and West Arsi zones Input Supply and Distribution Offices, Rayya Wakana Union, Sikomando Union, Dinsho, Gasara, Goba and Sinana Districts Administration Offices; Dinsho, Gasara, Goba and Sinana Districts Agriculture Development Offices; Dinsho, Gasara, Goba and Sinana Districts Cooperative Promotion Offices; Dinsho, Gasara, Goba and Sinana Districts Input Supply and Distribution Offices; Adaba and Dodola Districts Administration Offices, Adaba and Dodola Districts Agriculture Development Offices, Adaba and Dodola Districts Cooperative Promotion Offices; Adaba and Dodola Districts Input Supply and Distribution Offices.

Table 2
Stakeholder roles and responsibilities in implementing the activity.

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Roles and Responsibilities</th>
</tr>
</thead>
</table>
| Sinana Agricultural Research Center (SARC) | Coordination and facilitation  
  Provision of improved malt barley technologies  
  Provision of training in capacity building and supervision  
  Technical backstopping  
  Organize field days to share experiences and travelling workshops for monitoring and evaluations with other stakeholders |
| Asela Malt Factory (AMF)          | Financial support for malt barley research and extension, disseminate malt barley production and management packages  
  Provide training with other stakeholders in the project districts  
  Organize field days and travelling workshops in collaboration with research center, zone and district agricultural development offices |
| Four Breweries (Harer, BGI, Meta and Bedelle) | Financial support for malt barley research and extension  
  Participate on field days to share experiences and on traveling workshops for monitoring and evaluations with other stakeholders |
| Bureau of Agriculture (at zone, district and kebele level) | Assist in site and participant farmers selection  
  Provide training with other stakeholders in the project districts  
  Facilitate seed distribution and follow up farmer-to-farmer seed system  
  Follow up day to day activities from zone to kebele levels  
  Organize field days to share experiences and travelling workshops for monitoring and evaluations with other stakeholders |
| Malt barley growers/smallholder farmers | Allocate land (cost sharing) and perform required agronomic practices  
  Actively participate on the training for capacity building  
  Share skills and experiences to neighbor farmers through field visit  
  Participate on field days to share experiences and traveling workshops for monitoring and evaluations  
  Transfer produced revolving seed to other farmers in the project area and finally supply malt barley grain (in bulk production) to AMF |
| Cooperatives/Union                 | Agricultural inputs supply (seed, fertilizers, agro-chemicals, etc.)  
  Malt barley grain collection and facilitate marketing to AMF |

Besides, stakeholders’ forum was organized for consultation meeting; stakeholder platforms were established at zone and district levels; Memorandum of Understanding (MoU) was signed; focal persons were appointed and taskforces were established at all levels. Accordingly, initially at zonal level, planning and agreement was done with potential and collaborative stakeholders/partners after detail discussion was made on the
importance of the initiated project. In the course of consultation, the Sinana Agricultural Research Center (SARC) shared roles and responsibilities with the identified stakeholders by signing MoU.

### 2.5. Communication methods used

Appropriate extension approaches (project and participatory) and all extension teaching methods (individual, group and mass contact methods) were employed alone or in a judicious combination according to the situations during the implementation of the malt barley project.

- 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). To this end, multidisciplinary team was organized to deliver the training in capacity building and facilitating extension efforts of malt barely technologies. The team was composed of socio-economists, extensionists, breeders, pathologists, agronomists and seed scientists.

In capacity building and facilitating farmer-to-farmer extension effort of the technologies, theoretical (in-room) and practical (on-spot) trainings on knowledge, skill and attitude, on malt barley seed and grain production and management practices/packages (malt barley varieties quality and yield level, agronomic practices, major diseases, insect pests, weeds, etc.), on quality maintenance/roughing on malting quality parameters and post harvest handling of the seed were given to the participating farmers, development agents and agricultural experts by itinerant group of researchers (multidisciplinary team consists of eight researchers-Center Director/Entomologist, Breeder, Pathologist, Agronomist, Weed Scientist, Economists, Research-Extensionist and seed expert) from the implementing research centers. About 1358 individuals (64.8% farmers, 35.2% agricultural experts, development agents and other stakeholders) were attended this training. The softcopy of training materials were provided in CD to the concerned body.

#### 3.2. Seed distribution

The generation of new productive and disease resistant varieties of malt barley is low in Ethiopia. The possible explanation for this could be interlinked with low emphasis given to the crop. For instance, more than 12 wheat varieties have been released by wheat research program of Ethiopia since 2010 while malt barley varieties released in the country till yet are not more than 10 (Table 3). Even though the newly released varieties were few; for the sake of popularization and adoption, certain varieties were pre-scaled up among farmers in the target areas. Among malt barley varieties released, Holker, Miscal-21, Beka and Sabini have been the varieties popularized in the potential zones and districts. The recommended seed rate for malt barley was 120 kg/ha.
Fig. 2. Summary of farmers participated in pre-scaling up activity (2009-2013).

Table 3
Summary of malt barley training participants (2009-2013).

<table>
<thead>
<tr>
<th>District</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaba</td>
<td>51</td>
<td>100</td>
<td>50</td>
<td>0</td>
<td>201</td>
</tr>
<tr>
<td>Experts &amp; DAs</td>
<td>32</td>
<td>38</td>
<td>35</td>
<td>0</td>
<td>105</td>
</tr>
<tr>
<td>Dinsho</td>
<td>48</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>198</td>
</tr>
<tr>
<td>Experts &amp; DAs</td>
<td>26</td>
<td>29</td>
<td>28</td>
<td>26</td>
<td>109</td>
</tr>
<tr>
<td>Dodola</td>
<td>51</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>101</td>
</tr>
<tr>
<td>Experts &amp; DAs</td>
<td>30</td>
<td>28</td>
<td>0</td>
<td>0</td>
<td>58</td>
</tr>
<tr>
<td>Gassera</td>
<td>0</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>150</td>
</tr>
<tr>
<td>Experts &amp; DAs</td>
<td>0</td>
<td>28</td>
<td>26</td>
<td>28</td>
<td>82</td>
</tr>
<tr>
<td>Goba</td>
<td>0</td>
<td>0</td>
<td>80</td>
<td>0</td>
<td>80</td>
</tr>
<tr>
<td>Experts &amp; DAs</td>
<td>0</td>
<td>0</td>
<td>38</td>
<td>0</td>
<td>38</td>
</tr>
<tr>
<td>Sinana</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Grand Total</td>
<td>238</td>
<td>451</td>
<td>437</td>
<td>232</td>
<td>1358</td>
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</tbody>
</table>
Table 4
Released malt barley varieties.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Year of release/registered</th>
<th>Altitude (masl)</th>
<th>Yield (t/ha)</th>
<th>Protein (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beka</td>
<td>1976</td>
<td>2300-2800</td>
<td>2.5-3.8</td>
<td>10.0</td>
</tr>
<tr>
<td>Holker</td>
<td>1979</td>
<td>2500-2800</td>
<td>2.4-3.1</td>
<td>10.4</td>
</tr>
<tr>
<td>HB-120</td>
<td>1994</td>
<td>2300-2800</td>
<td>2.4-3.5</td>
<td>11.9</td>
</tr>
<tr>
<td>Misical-21</td>
<td>2006</td>
<td>Mid-highland</td>
<td>2.5-4.6</td>
<td>11.5</td>
</tr>
<tr>
<td>Sabini</td>
<td>2011</td>
<td>2000-2800</td>
<td>2.5-3.0</td>
<td>8.5</td>
</tr>
<tr>
<td>Bahati</td>
<td>2011</td>
<td>2300-3000</td>
<td>2.5-3.0</td>
<td>8.7</td>
</tr>
<tr>
<td>EH1847</td>
<td>2011</td>
<td>2300-3000</td>
<td>3.5-4.0</td>
<td>10.6</td>
</tr>
<tr>
<td>Bekoji-1</td>
<td>2010</td>
<td>2300-3000</td>
<td>3.5-4.0</td>
<td>10.5</td>
</tr>
<tr>
<td>IBON 174/03</td>
<td>2012</td>
<td>2000-2800</td>
<td>3.0-5.7</td>
<td>10.0</td>
</tr>
<tr>
<td>Grace</td>
<td>2013</td>
<td>2000-2800</td>
<td>2.4-4.5</td>
<td>10.5</td>
</tr>
<tr>
<td>Traveler</td>
<td>2013</td>
<td>2300-3000</td>
<td>2.5-4.6</td>
<td>10.3</td>
</tr>
</tbody>
</table>

Farmers/malt barley growers, development agents (DAs) and agricultural experts had their own roles towards the success of the strategy. Based on the availability of the technologies, the participant districts and farmers in pre-scaling up activity were determined each year. Selection of farmers and farm land was conducted by DAs and district agricultural experts. Then, initial investment (starter seed) is decisive to ensure the local availability of seed for farmers and thus, ‘help people to help themselves’ is the best approach. At initial stages of the project, a starter seed of 25kg of the improved malt barley varieties was given to the farmers in selected districts. In popularizing malt barley technologies, 236.17qt (57qt Misical-21, 142.02qt Holker, 5.5qt Beka and 31.65qt Sabani) have been delivered to 880 smallholder farmers (201 in Adaba, 198 in Dodola, 150 in Dinsho, 101 in Gassara, 150 in Goba and 80 in Sinana districts) and planted on 2ha during the project period for production of seed that transferred to surrounding other farmers through farmer-to-farmer seed dissemination mechanisms. This system is a relatively good low-cost system that can maintain kind, quantity, quality and access (at right time, place and reasonable price) of the seed to a level satisfactory to neighboring farmers locally.

The seed provided for the seed growers were collected by districts agriculture development office at harvesting to be re-distributed to other farmers in the project area. This seed was used as revolving seed for the project. Each year, records were made on the amount of seed produced, the attitude of the farmers towards the technologies and the adaptability of the varieties to the locations.
Fig. 3. Malt barley seed disseminated in quintal (either of the four varieties) to farmers (2009-2013).

<table>
<thead>
<tr>
<th>Year</th>
<th>Adaba</th>
<th>Dinsho</th>
<th>Dodola</th>
<th>Gasara</th>
<th>Goba</th>
<th>Sinana</th>
<th>Total</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>15.3</td>
<td>14.4</td>
<td>0</td>
<td>15.3</td>
<td>0</td>
<td>0</td>
<td>45</td>
<td>0.375</td>
</tr>
<tr>
<td>2010</td>
<td>26</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>0</td>
<td>78</td>
<td>0.65</td>
</tr>
<tr>
<td>2011</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>0</td>
<td>13</td>
<td>20.5</td>
<td>72.5</td>
<td>0.6</td>
</tr>
<tr>
<td>2012</td>
<td>0</td>
<td>13</td>
<td>15</td>
<td>0</td>
<td>12.67</td>
<td>0</td>
<td>40.67</td>
<td>0.34</td>
</tr>
<tr>
<td>Total</td>
<td>54.3</td>
<td>53.4</td>
<td>41</td>
<td>28.3</td>
<td>38.67</td>
<td>20.5</td>
<td>236.17</td>
<td>1.97</td>
</tr>
</tbody>
</table>

Fig. 4. Malt barley seed disseminated in quintal (by variety) to farmers (2009-2013).

<table>
<thead>
<tr>
<th>Year</th>
<th>Miscal 21</th>
<th>Holker</th>
<th>Beka</th>
<th>Sabani</th>
<th>Total</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>27</td>
<td>18</td>
<td>0</td>
<td>0</td>
<td>45</td>
<td>0.375</td>
</tr>
<tr>
<td>2010</td>
<td>30</td>
<td>42.5</td>
<td>5.5</td>
<td>0</td>
<td>78</td>
<td>0.65</td>
</tr>
<tr>
<td>2011</td>
<td>0</td>
<td>55.85</td>
<td>0</td>
<td>16.65</td>
<td>72.5</td>
<td>0.6</td>
</tr>
<tr>
<td>2012</td>
<td>0</td>
<td>25.67</td>
<td>0</td>
<td>15</td>
<td>40.67</td>
<td>0.34</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>142.02</td>
<td>5.5</td>
<td>31.65</td>
<td>236.17</td>
<td>1.97</td>
</tr>
</tbody>
</table>

Table 5

Malt barley seed disseminated in quintal (by variety) to each participant districts (2009-2013).

<table>
<thead>
<tr>
<th>Districts</th>
<th>Miscal 21</th>
<th>Holker</th>
<th>Beka</th>
<th>Sabani</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaba</td>
<td>21</td>
<td>26.7</td>
<td>0</td>
<td>6.5</td>
</tr>
<tr>
<td>Dinsho</td>
<td>11</td>
<td>36.75</td>
<td>2</td>
<td>3.65</td>
</tr>
<tr>
<td>Dodola</td>
<td>13</td>
<td>6.5</td>
<td>0</td>
<td>21.5</td>
</tr>
<tr>
<td>Gasara</td>
<td>10</td>
<td>16.9</td>
<td>1.5</td>
<td>0</td>
</tr>
<tr>
<td>Goba</td>
<td>2</td>
<td>34.67</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Sinana</td>
<td>0</td>
<td>20.5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>142.02</td>
<td>5.5</td>
<td>31.65</td>
</tr>
<tr>
<td>Area (ha)</td>
<td>0.475</td>
<td>1.2</td>
<td>0.05</td>
<td>0.264</td>
</tr>
</tbody>
</table>
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 and travelling workshops

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 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. Hence, it has been organized in collaboration with zone and district level agriculture and rural development offices and participant farmers to show the new innovation, to participate more farmers in the scaling-up process in seed multiplication and grain production activities and satisfy the booming need of agro-industries. Field days were organized to share the experience among seed growing farmers in October or November of the year as per required during the project period. Accordingly, about 450 participants (including farmers in the area) were participated on this event during the project period.

Travelling workshops were organized to evaluate the performance, progress, to communicate the result of the activity and pave the way forward. A total of 120 individuals/participants (Researchers, experts, DAs, farmers, officials) were participated on this event. During discussion session, it suggested that concentrating at potential districts and using produced seed efficiently is highly important to increase participant farmers’ and area coverage of malt barley in the zones.

3.5. Access to markets

Integrating smallholder farmers into markets (local, national or international) is essential if they are to innovate and increase their productivity. For farmers, market participation and technology adoption are very closely linked (Barrett, 2008). Technologies help farmers to enter the market by allowing them to produce a marketable surplus, while the availability of market opportunities provides farmers with incentives to produce more or change their patterns of production, to add value to their production and to innovate. Markets therefore strongly influence the technologies and practices adopted by farmers (FAO, 2014).

Marketing is a multi-stage process. The inclusion of small scale farmers in modern value chain could offer rural household market opportunities. For the improvement and development of marketing structure, a coordinate approach aiming at removing all the weak links of the marketing chain is essential. A package of improved marketing services in the form of regulated markets, facilities for grading, weighing, storing, transporting, handling services and marketing finance need to be made available to ensure the producer a fair return from his production efforts and a better share in the price paid by the consumer. Thus, for strong linkage between producers and agro-industries, and effective marketing system of malt barley seed and grain the following options were suggested by participants of the workshop.

**Suggested possible value chains**

1. Producers → Processor (Can farmers individually reach it?)
2. Producers → Cooperative → Processor (For sustainable grain marketing and linkage with AMF)
3. Producers → Cooperative → Union → Processor

Finally, Producers → Cooperative → Processor is the possible suggested value chain.

3.6. Harvesting and post harvest handling

Harvesting of seed crop at right time (when physiological maturity) help maintain quality and minimize damage and loss of seed. The most critical factors considered during harvesting are seed moisture content, mechanical damage and cleanliness of equipment. Besides, to protect the grain from rain damage it is better not to stay long time in the field (as it shown in the picture) and as much as possible, early threshing is recommended.
4. Achievements

4.1. Awareness was created on the importance and contribution of malt barley production as a raw material for the booming beer industries (agro-industries).

4.2. Improved on-farm seed production and seed dissemination system

The seed system of Ethiopia mainly biased towards production and multiplication of hybrid maize and improved bread wheat seeds. Ethiopian seed enterprise (ESEs) and Region seed enterprises (RSEs) give limited attention to the multiplication of seeds of other crops (barley, durum wheat, tef, sorghum, pulse and oil crops, etc). The supply of seeds of these crops to the farmers through formal seed supply is negligible. The pre-scaling program under malt barley project has contributed significant role in improving the access of improved and newly released malt barley seeds to the smallholders since 2009. It served as the main source for the majority of the malt barley varieties (seed) that are currently in production in major malt barley producing areas of Bale and West Arsi zones.

However, the shortage of malt barley varieties and seeds is the smallholders’ problem; the pre-scaling up program enabled farmers to produce malt barley seeds which informally transferred to the surrounding farmers through seed exchange, gifts, sells and borrowing. For instance, Misical-21, Holker and Sabini varieties are the main varieties that have been delivered to farmers in relation to the agro-ecology requirement. So, malt barley pre-scaling up program has increased the availability of malt barley seed for farmers in their locality.

4.3. Improved seed production skill and knowledge of farmers

The malt barley demonstration and pre-scaling up program has introduced malt barley seed and grain production for first time to new potential areas. Since the activity is accompanied by trainings, awareness creation activities like field days, frequent joint supervisions and on field advisory programs; farmers in target areas have been equipped with the skills and knowledge of malt barley seed and grain production and management practices/packages; however, the impact is hidden by occasionally existing climatic factors and vastly raising demand of malt barley grain by agro-industries.

4.4. Improved the linkage between research, extension, farmers and agro-industries (links to networks-among farmers & with private sector firms)

The synergy among different stakeholders (multi-stakeholder approach) along malt barley value chain is inevitable to satisfy the existing malt barley demand in Ethiopia as well in the region. The research system has produced substantial amount of technologies, information and knowledge since barley research commenced at DebreZeit Agricultural Research Centre in the 1950s (Bayeh and Berhane, 2012). The weak linkage and synergy among the stakeholders contributed to the unmet need of malt barley and its product in the country. Malt barley project organized by partnership of public and private institutions has bridged research, extension, farmers, Malt Factories and breweries towards attaining common goal of improving malt barley production and productivity since 2009. Towards searching solutions for malt barley scarcity, the major actors (malt barley research and development, extension, AMF and breweries) in malt barley value chain have been worked together (discussed on annual reviews, monitored and evaluated through travelling workshops and field days) in the lifespan of the project (2009-2013).

4.5. Towards searching solutions for malt barley scarcity (through PPP)

The major actors (malt barley research and development, extension, AMF and breweries) in malt barley value chain have worked together in lifespan of the project. This project is institutional innovation and taken as the best example in linking agriculture with agro-industries (taken as best practice to be scaled up).
5. Challenges and lessons learned

While performing malt barley technologies transfer in particular to varieties demonstration and pre-scaling up activities, it creates a great chance for researchers to closely work with the smallholders who further enabled to evaluate the farmers’ problems and situation in malt barley seed and grain production and management practices. Accordingly, the practical challenges in the farming communities are described as follows.

Improper site and farmer selection

In scaling-up of improved malt barley technologies, the duty of selecting proper farmers and sites belongs to agricultural experts and DAs. Sometimes, the farmers and sites selected for pre-scaling up activities were inappropriate for monitoring and evaluation, marginal lands and farmers who are not in a position to apply the required associated recommended packages for malt barley seed and grain production and management.

Mono-cropping and grass weeds

In the project areas, farmers commonly grow barley (malt and food) and wheat interchangeably for longer years. The culture of rotating barley or wheat with pulses is hardly observed. On the other hand, the monocropping farming system has created comfortable condition for grass weeds development since recent years.

Disease and insect pests

However, the level of problem varies across locations; leaf blotch and scald are major diseases attributing for malt barley yield reduction in the districts of Bale and West Arsi zones. In addition to the diseases, shoot fly is the most commonly affecting malt barley especially at early stage and the damage is sever especially in the plain areas of Bale zone.

Shortage of improved malt barley seed

The availability of malt barley seed is the bottleneck to malt barley production. According to the farmers complain, improved malt barley seed supplying agents (GOs and NGOs) are limited as compared to hybrid maize and improved bread wheat suppliers and producers. The availability of productive malt barley varieties (high yielding) was also limited in the past years. Besides, quality of improved malt barley varieties are the issue that needs due consideration.

Institutional factors (Seed distribution and market linkage)

Adequate clean and pure seed of malt barley varieties are not produced by seed enterprises (national and regional) and the produced seed are not formally distributed to farmers on time and demand bases. By the pre-scaling up activity, a large number of farmers in districts of the two zones have been introduced and engaged in malt barley production. The malt barley produced by the farmers in the project areas has been consumed in different of the intended targets. This, on the other side, discourages the farmers’ malt barley production. Traders are the main actors in malt barley marketing and they are the main beneficiary from malt barley production.
business on behalf of farmers even though the situation was improved last year in West Arsi zones. Most farmers sell malt barley at lower price in their closer markets early after production (from December to February) due to absence of market driven price setting system.

**Poor agronomic practice**

It possibly contributes for low malt barley productivity and quality stated above as a constraint to malt production that resulted in low market price. Majority of the malt barley fields are not properly prepared, fertilized, rotated with pulses or oil crops, weeded and rouged out from mixed crops and varieties even.

**Challenges in coordination and linkage of multi-stakeholder platforms as well as in making it live and sustainable**

Institutional innovation is complex and includes laws/policies, leadership, linkages and partnership, communication, attitude, social capital, incentives/markets, etc. Therefore, bringing these all key and potential collaborative stakeholders around one table for common goal require high commitment and flexible approach.

**Lack of organizing malt barley producing farmers in to cooperatives or community based seed multipliers (LSBs) and initiate contractual farming--- in Bale and West Arsi zones**

**Poor linkage between producers, cooperatives, unions and agro-industries**

6. Conclusions

By the pre-scaling of malt barley technologies (varieties) program, the majority of research outputs that was generated have been transferred to smallholders in the targeted areas in lifespan of malt barley project. Miscal-21, Holker and Sabini were the varieties popularized and transferred to the producers while Bahati, Bekoji-1, EH1847, IBON 174/03, Grace and Traveler were the new varieties that were demonstrated among farmers in different areas since 2012. The pre-scaling up of malt barley technologies require concentrated involvements of different stakeholders (multi-stakeholder approach) and other approaches including analysis of existing situation. Capacity of farmers and agriculture experts (DAs and SMSs) has been built through trainings, awareness creation, monitoring and evaluations, stakeholder meetings, field days, travelling and marketing workshop organized in 2009 to 2013.

Barley mono-cropping and grass weed development, shortage of improved productive (high yielding) malt barley varieties, institutional factors like timely distribution of improved seed and weak market linkage are the major challenges noticed in malt barley production. Improper site and farmer selection and weak commitment of actors and individuals at all stages of the pre-scaling up activities were also among challenges observed during implementation of malt barley pre-scaling up program.

**Recommendations:**

Our farmers should not only be seed receivers but also seed growers. Besides, they should not always be in the front line of problems, but also in the forefront of the solution. Thus, farmer-to-farmer seed dissemination mechanism is the best way with close supervision of DAs, agricultural experts and researchers. Moreover, establishing and strengthening community seed multipliers/malt barley producer cooperatives/LSBs can enhance the activity.

Improving institutional factors in seed distribution and strengthening market linkages (market driven price setting system), commitment of actors and individuals at all stages of the pre-scaling up activities, especially at zonal and district level is crucial. Strengthening the linkage among actors (links to networks), mapping malt barley value chain to decrease side selling of malt barley grain and widely extending the scaling up of malt barley technologies in well-organized and systematic approach requires due considerations in the future in order to satisfy exceedingly mounting/increasing malt barley demand in Ethiopia.

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