Pre-Scaling up of Improved Finger Millet Technologies: The Case of Daro Lebu and Habro Districts of West Hararghe Zone, Oromia National Regional State, Ethiopia

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Absence of hierarchy of technology dissemination is a factor that affects technology utilization and adoption by the end-users. This study investigated pre-scaling up of improved finger millet varieties in Daro Lebu and Habro districts. Enhancing productivity of improved finger millet varieties through improving knowledge and skills of farmers and creating linkage among actors was the main objective of the activity. A total of 160 farmers were addressed in four kebeles and two districts of West Hararghe zone. Site and farmers were selected purposively based on potential production of the commodity and others criteria’s. Both qualitative and quantitative data were collected and analyzed using narration and descriptive as well as inferential statistics using SPSS software. Extension services such as advisory, inputs, training and field day were delivered and organized for the farmers, extension agents and others stakeholders thereby awareness creation in media and printed extension materials. The average yield obtained from a hectare of land is accounted that 28.31 and 20.88 quintals for Boneya and Tadesse varieties, respectively. Therefore, scaling up of improved finger millet varieties for wider community over locations should be strengthen and conducted by government sectors, non-governmental organizations and others private sectors for improving productivity of the crop in a sustainable manner.

Key words: Scaling up, Improved Varieties, Technologies, Finger millet, Linkages, Awareness

INTRODUCTION

Finger millet (Eleusinecoracana (L.) Gaertn) subspecies coracana belongs to the family Poeceae (Hilu et al., 1976). It was earlier thought that cultivated E. coracana originated from E. indica, of which the distribution is quite wide, from Africa eastwards to Java. Millets are the most important cereals of the semi-arid zones of the world. For millions of people in Africa and Asia they are staple crops. Among millet crops, finger millet figures prominently; it ranks fourth in importance after sorghum, pearl millet and foxtail millet (GCDT, 2012). The global annual planting area of finger millet is estimated at around 4-4.5 million hectares, with a total production of 5 million tons of grains, of which India alone produces about 2.2 million tons and Africa about 2 million tons. The rest comes from other countries in South Asia. The important finger millet growing countries in eastern and southern Africa have been especially the sub-humid regions of Ethiopia, Kenya, Malawi, Tanzania, Uganda, Zaire, Zambia and Zimbabwe. Similarly, in South Asia the crop is largely grown in India, Nepal and, to some extent, in Bhutan and Sri Lanka. Finger millet is reported to be grown in both China and Japan to a limited extent.

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The archaeological findings of finger millet from Ethiopia date to about the third millennium BC (Hilu et al., 1979). The crop is mainly grown in the northern, northwestern and western parts of the country, especially during the main rainy season. The national annual production area of finger millet in 2016/17 cropping season is estimated at around 456,171.54 hectares, with a total production of 10.3 million quintals (CSA, 2017). Similarly, the annual finger millet area production in 2016/17 cropping season at Oromia region is estimated at 89,584.80 hectares, with a total production of 2 million quintals. A total of 45,698 farmers produced finger millet in 2016/17 cropping season at West Hararghe zone.

Finger millet cultivation is more widespread in terms of its geographical adaptation compared to other millets. It has the ability to withstand varied conditions of heat, drought, humidity and tropical weather (GCDT, 2012). Also, it has high nutritional value and excellent storage qualities. Its grain contains 9.2% protein, 1.29% fat, 76.32% carbohydrates, 2.24% minerals, 3.99% ash and 0.33% calcium. In Ethiopia, the grain is used for making native bread, injera, porridge, cake, soup, traditional breakfast called “Chachabsa” malt, local beer, and distilled spirit (Areki) alone or in mixture with tef, maize and barley (Asfaw et al., 2011; Wadajo, 2015). Finger millet can be stored for a period up to ten years or more without deterioration and weevil damage. However, its productivity is very low mainly due to shortage of improved varieties (Birhanu, 2015), weeds, insect (termite), diseases (blast), rat damage, shortage of rainfall, worm attacks, improper application of inputs (fertilizers and seed) and traditional management practices (Tefera and Adane, 2013).

Generation and dissemination of new improved varieties, training and demonstration on crop production and management are strategies revealed by different authors for improving productivity of the crop (Tefera and Adane, 2013). Under research circumstances once new technologies are released, verified and adapted, the next step is conducting pilot test/demonstration on a small number of farmer’s field. All full packages of technology are shown to the farmers in a participatory way. Then, selected technologies are settled for further popularization and scaling up to create awareness towards technologies thereby improving livelihoods and food security status of the households in mandate area.

Similarly, adaptation trial under research station and pilot test were conducted on finger millet varieties on farmer’s field. Accordingly, Boneya (27.5Qt/ha) and Tadesse (24.5Qt/ha) were outstanding varieties in resistance of drought, yield and other parameters than local cultivar. Again in 2012, popularization and promotion of Boneya variety was conducted both in Habro and Daro Lebu districts. A total of 51 farmers, seven kebeles and 4.5 hectares of land have been addressed through technology promotion and popularization programs. Scaling up of the technologies is highly required to create multiple impacts and address a large number of farmers. Therefore, the activity was initiated in order to pre-scaling improved finger millet variety in Daro Lebu and Habro districts to improve smallholder’s productivity and production of finger millet thereby strengthen linkage among actors and farmers knowledge and skill on finger millet production in the area.

MATERIALS AND METHODS

Description of the Study Area

Daro Lebu is one of the districts found under West Hararghe Zone. The capital town of the district Mechera is found at about 434 km South East of Addis Ababa. The district is situated between 7°52’10’’ and 8°42’30’’ N and 40°02’35’’ and 41°09’14’’ E. at 08°35’58” North and 40°19’114” East. The district is characterized mostly by flat and undulating land features with altitude ranging from 1350 up to 2450 m.a.s.l. Ambient temperature of the district ranges from 14°C to 26°C with average of 16°C with an average annual rainfall of 963 mm/year. The pattern of rain fall is bimodal and its distribution is mostly uneven. Generally, there are two rainy seasons: the short rainy season ‘Belg’ lasts from mid-February to April whereas the long rainy season ‘Kiremt’ is from June to September. The rainfall is erratic; onset is unpredictable, its distribution and amount are also quite irregular. Consequently, most kebeles frequently face shortage of rain; hence moisture stress is one of major production constraints in the district (DLD-Anro, 2016). The district has an estimated total population of 239,222, of whom 122,386 were males and 116,836 were females; 23,609 of its population were urban dwellers, whereas 215,613 were rural dwellers (CSA, 2013).

The district covers an area of 210, 280 hectares and divided in to 37 kebeles and 3 rural towns of which 23 kebeles in lowland and 17 kebeles are in mid-land areas. The livelihood of the people in the district is predominantly dependent on mixed farming. Crop and livestock production are the major means of livelihood of the rural community. Most commonly grown crops include maize (Zea mays), sorghum (Sorghum bicolor), groundnuts (Arachis hypogaea), coffee (Coffea arabica), khat (Cathaedulis) and haricot Bean (Phaseolus vulgaris). The major animals kept in the area are cattle, goats, sheep, donkeys, chickens and bees (DLD-Anro, 2016).

Habro district is another district in West Hararghe zone of Oromia region. The district has an altitude range from 1600-2400 m.a.s.l. The mean annual rainfall of the district is 1010 mm and the annual temperature ranges from 5-32°C (HD-Anro, 2016). The rainfall pattern in the area is uni-modal with high amount of rainfall occurring during the main rainy season between June to September (Kiremt)
and the short rainy season stretching from March to June (Belg). The highest rainfall is received in August. The agro-ecology of the district comprises highland (19%), mid-altitude (50%) and lowland (31%) areas (Mengistu et al., 2016). It occupies a total area of 725 km² i.e. about 4.2% of the zonal total area. The district has an estimated total population of 244,444; of whom 126,176 were men and 118,268 were women (CSA 2013).

Mixed crop-livestock agriculture is a common farming system in the study area. The main crops grown in the area are cereals such as teff (Eragrostis tef), maize (Zea mays), wheat (Triticum aestivum), barley (Hordeum vulgare), haricot bean (Phaseolus vulgaris) and sorghum (Sorghum bicolor) and cash crops such as coffee (Coffea arabica), chat (Catha edulis), pepper (Capsicum species) and onion (Allium cepa). The major animals kept in the area are cattle, goats, donkeys, chickens and bees (HDoANRO, 2016).

**Overview of Production of Finger Millet in Western Hararghe Zone**

Finger millet is one of the cereal crops produced other than maize, sorghum, teff and other cereals crop in the area. It is one of top six cereal crops produced next to sorghum, maize, barely, teff and wheat in the area in 2014 (CSA, 2015). The average yield obtained from the crop was accounted 14.91Qt/ha. The data obtained from the Central Statistical Authority of Ethiopia indicated that the number of producers of finger millet for the last five years has relatively increased from year to years (Figure 2). But, shortage of improved seed and drought conditions affect production and productivity of finger millet in the area.

**Site and Farmer Selection**

The study was conducted for one year in 2016 at Daro Lebu and Habro districts of West Hararghe zone. Expert meeting was undertaken for the site and farmer selection. Major finger millet producing kebeles and farmers selected in collaboration with district Agricultural and Natural Resources Office. Accordingly, two kebeles from each district were selected purposively based on finger millet production potentials. A total of 160 farmers were selected from two districts based on the selection criteria like working ability of farmer, gender balance, willingness to allocate land for scaling up, willingness to take whether the research result or risk, promise to
Finger millet producer in West Hararghe Zone for last five years.

Source: CSA, 2013-2017

manage the field and ability to cooperate and interest to the crop and agro-ecology of the area. An average of 0.125ha of land was used for the activity on each of the selected farmers.

**Finger Millet Scaling Up Process**

Finger millet adaptation study was started by the center. Based on results obtained, demonstration and evaluation were undertaken and two varieties namely Boneya and Tadesse were recommended for further studies in similar agro-ecologies. Based on result obtained from the trial, demonstration was conducted on farmers in 2009 and 2010 in Habro and Daro Lebu districts to evaluate finger millet varieties along local cultivars under farmer conditions. Based on farmer’s feedback and other parameters, both varieties were selected by the farmers for further promotion and scaling up process. Accordingly, promotion of the varieties was conducted in 2011 and 2012 by increasing number of farmers and locations to create impact on farmers improved seed production system thereby creating awareness through field days, media exposure and other mechanisms. Finally, scaling up of improved finger millet varieties was conducted on a large number of farmers and over locations to create larger impacts on the farmer views.

![Diagram](image_url)

**Figure 3:** Innovation, learning and scaling up linkages in agricultural technologies

Source: Adopted from Linn et al. (2011)
Types of Data and Methods of Data Collection

Qualitative and quantitative data were collected through close supervision and following up of the activity with joint action of the stakeholders. Data record sheet was developed to collect the data. Thus, field observation, contacting the target farmer and focus group discussion during the field visit were the data collection methods. Yield data and farmers’ preference toward the variety were collected from farmer’s field. Number of farmers participates in training and field day, number of location addressed, amount of seed distributed and number of farmers benefited from the scaling up process were major types of data collected during scaling up process.

Methods of Data Analysis

Qualitative data like farmers’ preference were analyzed using descriptive analysis and narration while quantitative data were analyzed using SPSS v.20 software.

Table 1: Traits of improved finger millet varieties

<table>
<thead>
<tr>
<th>Variety</th>
<th>Year of release</th>
<th>Area of adaptation</th>
<th>Maturity days</th>
<th>Yield (kg/ha)</th>
<th>Production Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tadesse</td>
<td>1999</td>
<td>1600-1900 ≥700</td>
<td>120-130</td>
<td>3000-4500</td>
<td>On-research field</td>
</tr>
<tr>
<td>Boneya</td>
<td>2002</td>
<td>1400-1900 1200-1300</td>
<td>145</td>
<td>2500-3000</td>
<td>On-farm field</td>
</tr>
</tbody>
</table>

Source: EARO, 2004

RESULTS AND DISCUSSIONS

Extension Services on Finger Millet Production

Improved varieties

Based on fact and figure obtained during earlier conducted demonstration and promotion experiment, both varieties showed better performance in terms of yield, drought tolerant and others parameters than local cultivars. The varieties were recommended both by farmers and researchers interest for further dissemination and multiplication in the area. Accordingly, Boneya and Tadesse varieties seed were multiplied by the center and supplied for further dissemination. A total of two kebeles and 160 farmers from both districts produced improved finger millet varieties in 20 hectares of lands (Table 2). A total of 5.6 quintals of improved varieties were delivered to the farmers, of which 2.66 quintals were Boneya and 2.94 quintals were Tadesse variety. The required amount of fertilizer rate was covered by the farmers themselves to apply cost-sharing extension approach.

Table 2: Summary of inputs procured to the farmers

<table>
<thead>
<tr>
<th>District</th>
<th>Kebeles</th>
<th>Varieties</th>
<th>Farmers</th>
<th>Amount given(Qt)</th>
<th>Area covered (Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daro Lebu</td>
<td>Kotara</td>
<td>Boneya</td>
<td>38</td>
<td>1.33</td>
<td>4.75</td>
</tr>
<tr>
<td></td>
<td>Kortu</td>
<td>Tadesse</td>
<td>37</td>
<td>1.295</td>
<td>4.625</td>
</tr>
<tr>
<td>Habro</td>
<td>Lugo</td>
<td>Tadesse</td>
<td>47</td>
<td>1.645</td>
<td>5.875</td>
</tr>
<tr>
<td></td>
<td>GarbiGoba</td>
<td>Boneya</td>
<td>38</td>
<td>1.33</td>
<td>4.75</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>160</td>
<td>5.6</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Own results, 2016

Advisory services

Advisory services are one of extension services given to the farmers through public and private extension systems. In our country, advisory service is highly dominated by public extension systems that are given through extension agents, researchers and agricultural professionals (Belay and Dawit, 2017). Farmers obtained advisory services from beginning up to the end of activity on improved finger millet varieties and practices. The advisory services are given to the farmers at different stages of productions mainly by researchers and extension agents. In this study during seed distribution, a sort of orientation on row preparation and sowing and fertilizer application was given by researchers to selected farmers for production purposes. During supervision, information on weeding practices, harvesting and overall management required for the varieties were delivered to produced farmers mainly by researchers, extension agents and experts.
All agronomic practices and packages of technologies required for the varieties were applied on farmer’s field. But, all farmers did not apply the agronomic practices required for the varieties on their field. Broadcast sowing; reduce number of seed rate and increasing and decreasing farm allocation to finger millet varieties are problems observed on some of farmer’s field.

Training

Besides advisory services, training was prepared for the farmers, extension agents and agricultural experts on finger millet agronomic practices, production and pre-harvest and post-harvest managements to improve knowledge, skills and attitudes of trainees. As indicated in Table 3, a total of 15 farmers, 9 extension agents and 7 agricultural experts had to participate in training program. Due to budget shortage, all farmers did not participate in training program. Out of 160 finger millet producer farmers, 15 model farmers were selected by different criteria’s such as role model, ability to transmit information, communicator and others. Extension agents and participant farmers were transmitted information shared from training to the non-participant farmers. Participatory training method was followed during implementation of training program for sharing knowledge’s, skills and experiences own on finger millet productions.

Table 3: Training participants on finger millet production and management

<table>
<thead>
<tr>
<th>Districts</th>
<th>Farmers</th>
<th>Development Agents</th>
<th>Experts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Total</td>
</tr>
<tr>
<td>Daro Lebu</td>
<td>7</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Habro</td>
<td>7</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>1</td>
<td>15</td>
</tr>
</tbody>
</table>

Source: Own results, 2016

Field day

Field day is one of extension services and methods used to transmit information and awareness creation for larger audience. Field day can be organized at different stages in crop production systems. It can be two or three times which the stages are at vegetative, flowering and maturity depending on crop type and nature produced (Bedru et al., 2009). Field day was used as tool to address large number of farmers, even invited farmers who did not produce improved finger millet varieties to create massive awareness and large impacts on technologies for further production and scale up on farmers field. Not only farmers but others stakeholder were also invited to participate in the program. In addition, during field day mass extension methods e.g. leaflets, banner and Radio/Television were used to reach large audience.

Accordingly, a total of 88 farmers, 8 development agents and 22 experts from district government offices and research offices participated on field day (Table 4). Besides, the field day program was transmitted on news program by Oromia Television Organization to disseminate information for wider community. A total of 120 leaflets were distributed for the participants which describes the production, agronomic practices and overall managements of improved finger millet varieties. Finally, at the end of visit during field day, group discussion was conducted to grasp farmer’s feedback on strength and weakness of improved finger millet varieties. Besides, constraints in agricultural production (weeds like Striga, wilt on chickpea and climate change); needs and interest of farmers on others improved varieties such as early maturing sorghum and chickpea and timely distribution of seeds are points were risen by the participants on the program. Accordingly, Tadesse variety was more preferred than Boneya variety due to its color, number of branches, height, drought tolerance and yield advantages.

Table 4: Participants of field day in Habro district

<table>
<thead>
<tr>
<th>Location of field day</th>
<th>Types of varieties</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Farmers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Habro district (Lugo and Garbi Gobakebeles)</td>
<td>Boneya and Tadesse varieties</td>
<td>82</td>
</tr>
</tbody>
</table>

Note: M stands for Male, F stands for Female and T stands for Total

Source: Own results, 2016
**Yield Obtained From Finger Millet Varieties**

**Mean yield of finger millet varieties**

The averages yield obtained from farmers per unit area were accounted 6.04 and 2.98 quintals for Boneya and Tadesse varieties, respectively. Similarly, the average yields obtained from a hectare of land were accounted 28.31 and 20.88 quintals for Boneya and Tadesse varieties, respectively. The independent sample t-test indicated that there was significant difference between Boneya and Tadesse varieties of finger millet crops in terms of total yield per unit area and total yield per hectare at 1% and 5% significance level, respectively (Table 5). Boneya variety gave higher yielder than Tadesse variety on farmer’s field this could be attributed to high number fingers per plants, disease and drought tolerant. But, the studies conducted in North Western Ethiopia indicated that Tadesse variety gave high yielder than Boneya variety on farmer’s field this could be suitable due to agro-ecologies, less disease effect, suitable soil character and field management (Molla, 2012).

<table>
<thead>
<tr>
<th>Yield components</th>
<th>Varieties</th>
<th>N</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield per unit area (Qt/0.125ha)</td>
<td>Boneya</td>
<td>17</td>
<td>6.04</td>
<td>3.95</td>
<td>3.019***</td>
</tr>
<tr>
<td></td>
<td>Tadesse</td>
<td>59</td>
<td>2.98</td>
<td>2.49</td>
<td></td>
</tr>
<tr>
<td>Total yield per hectare (Qt/ha)</td>
<td>Boneya</td>
<td>17</td>
<td>28.31</td>
<td>13.14</td>
<td>2.063**</td>
</tr>
<tr>
<td></td>
<td>Tadesse</td>
<td>59</td>
<td>20.88</td>
<td>13.06</td>
<td></td>
</tr>
</tbody>
</table>

*** and ** indicates significant at 1% and 5% level, respectively

**Source:** Own computation, 2017

**Yield comparison against location**

Production of crops was different from place to place due to environmental conditions, farmer’s indigenous knowledge on farming, soil characters, extension services, infrastructure and others factors. The average yields of finger millet varieties per hectare in Habro and Daro Lebu districts farmers were accounted 31.88 and 13.20 quintals, respectively (Table 6). Farmers in Habro district had more experience on finger millet production than Daro Lebu district farmers. The independent sample t-test indicated that there was significant difference between Habro and Daro Lebu districts producers of finger millet crop in terms of total yield per unit area and total yield per hectare at 1% significance level. Farmers in Habro district were producing more cereal crops than Daro Lebu district farmers due to soil character of the area suitable for cereal and other food crops whereas cash crops were mainly produced by Daro Lebu district farmers.

<table>
<thead>
<tr>
<th>Yield components</th>
<th>Districts</th>
<th>N</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield per unit area (Qt/0.125ha)</td>
<td>Habro</td>
<td>38</td>
<td>5.68</td>
<td>3.18</td>
<td>7.346***</td>
</tr>
<tr>
<td></td>
<td>Daro Lebu</td>
<td>38</td>
<td>1.65</td>
<td>1.14</td>
<td></td>
</tr>
<tr>
<td>Total yield per hectare (Qt/ha)</td>
<td>Habro</td>
<td>38</td>
<td>31.88</td>
<td>9.94</td>
<td>8.529***</td>
</tr>
<tr>
<td></td>
<td>Daro Lebu</td>
<td>38</td>
<td>13.20</td>
<td>9.14</td>
<td></td>
</tr>
</tbody>
</table>

*** indicates significant at 1% level

**Source:** Own computation, 2017
Yield comparison against earlier studies

Finger millet improved varieties trials were conducted at different stages to address large number of farmers based on their needs and interest towards technologies at different locations. Adaptation trials of finger millet varieties were conducted at Mechara research stations in 2008 by comparing four varieties. Accordingly, Boneya and Tadesse varieties were recommended for further evaluation in similar agro-ecologies due to their higher yield potentials, disease and drought tolerant compared to the other varieties. Based on result obtained during adaptation stages, demonstration and promotion have been conducted on farmer’s field at Habro and Daro Lebu districts in 2009 and 2012 to evaluate and create demand towards technologies under farmer’s contexts, respectively. The results obtained from the study indicated that Boneya variety gave high yielder than Tadesse variety on farmer’s field and on-stations.

The yields obtained during demonstration stage from Boneya and Tadesse varieties were decreased by 9 and 6.5 quintals from adaptation trials stage, respectively (Table 7). The experiments were managed on-stations during adaptation stages by researchers and other supportive staffs. Day to day monitoring and follow up, continuous management and full agronomic packages were implemented on-stations than on farmer’s field which created yield difference on similar crops between farmers and research fields. In general, yield obtained from finger millet varieties at adaptation trial stage was higher than those obtained from demonstration and scaling up stages due to above factors whereas yield obtained during demonstration and scaling up stages were comparable among the varieties due to implemented under farmers managed conditions.

<table>
<thead>
<tr>
<th>Varieties</th>
<th>Yield (Qt/ha)</th>
<th>Adaptation stage</th>
<th>Demonstration stage</th>
<th>Scaling up stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boneya</td>
<td>37</td>
<td>27.5</td>
<td>28.31</td>
<td></td>
</tr>
<tr>
<td>Tadesse</td>
<td>31</td>
<td>24.5</td>
<td>20.88</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Own computation, 2017

CONCLUSION

The number of finger millet producers in West Hararghe zone was relatively increased in recent years due to dissemination of improved agricultural technologies. Path of improved agricultural technologies in agricultural research centers started from technologies development up to impact evaluation on farmer’s livelihoods. Adaptation of improved finger millet trials was conducted in 2008 whereas demonstration was conducted in 2009 and also popularization was implemented in 2012 in Habro and Daro Lebu districts to create large impacts on farmer’s views.

Extension services such as improved finger millet varieties, advisory services during follow up, training and field day were delivered and organized jointly to the farmers, extension agents, experts from different disciplines and others stakeholders. Besides, awareness rising program such media exposure, printed extension materials and group discussion were conducted to boost technologies for large number of users.

The average yield obtained from a hectare of land was accounted 28.31 and 20.88 quintals for Boneya and Tadesse varieties, respectively. The yield difference occurred due to high number fingers per plants, disease and drought tolerant of Boneya over Tadesse varieties in the area. The independent sample t-test result indicate that there was significant difference between Boneya and Tadesse varieties as well as Habro and Daro Lebu districts in terms of yield per unit area and hectare at 1% and 5% significance level, respectively.

Yield obtained from finger millet varieties at adaptation trial stage was higher than demonstration and scaling up stages due to day to day monitoring and follow up, continuous management and full agronomic packages conducted by researchers at research fields whereas yield obtained during demonstration and scaling up stages were comparable among the varieties due to implemented under farmers managed conditions.

RECOMMENDATIONS

Based on results obtained and conclusions made, the following recommendations are given to responsible body.

- Path way of agricultural technologies dissemination and transfer should be strengthened more than current ways to address large number of farmers.
- It is advisable to apply cluster approach for technology scaling up under farmers fields to address large number of farmers and to protect quality of seed for further multiplications.
- It is better to strengthen current awareness raising program through using different communication techniques.
- It is better to reduce yield gap between research and farmers field through applying continuous management and full agronomic practices on farmer’s field.
- It is advisable to scale up improved finger millet varieties on large number of end-users through horizontal and vertical scaling up approach to create impacts on farmers’ livelihoods.
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