Impact of Participatory Varietal Selection (PVS) on Varietal Diversification and Seed Dissemination in the Tigray region, north Ethiopia: a Case of barley

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Impact of the participatory varietal selection (PVS) was studied in three villages (Habes, Mugulat and Bolenta) in the Tigray region where a PVS project had been operative. The impact of PVS was assessed on the varietal diversification, patterns of adoption of preferred varieties. A total of 97 households were randomly selected from 150 participating experimenter farmers. Twenty percent of the respondents were female-headed households. Both qualitative and quantitative data were collected using household survey, matrix ranking, and focused group discussions. In all villages, a seed fair (diversity fair) was also organized. It was observed that the project initiative greatly accelerated the varietal richness across study villages. The annual production of barley in terms of area coverage in these villages has shown steady increment. The GGE biplot analysis of the preference matrix ranking showed that Himblil, Mistrach and Dimtu varieties were positively discriminated by farmers from others due to their average yield, disease resistance and number of grains per spike. HB-42 was the least preferred variety. However the extent of land area coverage and dissemination was found to significantly vary across the study villages. The study revealed that Seed Safety through Diversity (SSD)/PVS and Local Seed Business (LSB) activities were encouraging. The Mugulat local group association operating as “Association of barley” was found to promote farmer based seed dissemination. It is recommended that PVS/PPB (participatory plant breeding) and LSB should continue and recognition be given to farmers’ group formation initiatives. To address lack of seed of preferred varieties, a continuous renewal of seed system and scaling-up of seed dissemination should be carried out by the LSB. The replacement rate of old varieties needs further investigation to design appropriate strategies of balancing development and genetic conservation.

Keywords: Participatory varietal selection, Varietal richness, Seed dissemination, Varietal diversity, Local seed business

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INTRODUCTION
Barley is one of the major food crops in the Tigray
region of Northern Ethiopia, and its consumption has
been steadily increasing. On average, barley covers
34%, 23% and 12% of the cultivated land in eastern,
southern and central zones, respectively of the Tigray
region (BoARD, 2007). However, farmers prefer to
grow their own varieties and have not adopted
improved barley varieties yet, as the varieties released
so far did not meet farmers’ criteria and were not well
adapted to the harsh growing conditions of the region.
As a consequence, the barley yield in Tigray is far
below the national average (Abay and Bjornstad,
2009). This prompted the Mekelle University (MU)
researchers to apply participatory varietal selection
(PVS) under the ‘Seed Safety through Diversity
(SSD)’ project. In PVS, farmers evaluate and adopt
varieties that suit well to the environmental conditions
and fits for their end use qualities.

The process of PVS involved four steps: the study of
farmers’ requirements in a barley variety, search of
appropriate variety, experimentation by farmers and
scaling up of varieties preferred by farmers (Witcombe
et al. 1996). Snapp (1999) proposed a “mother and
baby trial” system for agronomic trials which has been
found to be very appropriate for farmer field
experimentation in PVS. The PVS project of MU
encouraged farmers’ experimentation on new varieties
and exchange of seed and information on the most
preferred varieties. The PVS system provided an
opportunity to farmers to regain access to lost or
disappeared local varieties.

The farmers from different villages participating in
PVS were recognized as a potential pathway for the
newly initiated Local Seed Business (LSB) project in
collaboration with the Wageningen University and
funded by the Netherlands Embassy in Ethiopia. The
major objectives of this study were to study the impact
of the PVS project in terms of varietal diversification
and seed dissemination of preferred varieties.
Understanding the seed dissemination systems and
challenges of local seed supply patterns is expected to
be useful in adapting research and extension to the
needs of local seed producers, seed business
entrepreneurs and formal seed sector, and in scaling up
of dissemination and adoption of preferred varieties.

MATERIAL AND METHODS
Methodology
The PVS study was conducted on barley in three
villages: Mugulat, Bolenta and Habes, located in the
Tigray region, North Ethiopia. Of the 150 households
in the PVS villages, ninety seven (65% of households)
were interviewed to assess the impact of PVS.
Household level questionnaire, key informant
discussions and village level diversity fair were used
for collecting the data. Matrix ranking of PVS varieties
was performed. Genotype trait relationship-GGE
biplot analysis was also executed.

RESULTS
Profile of farmers
Eighty percent of the respondent households were
male headed and the remaining 20% were female
headed. The majority of the farmers were middle aged
(62%) with 27% falling in the young and 12% in the
old age categories. The findings also showed that 45% of
the farmers were literate and 55% illiterate.
However, in-depth analysis indicated that almost all of
the households had literate children. Farmer families
had up to 5 or more members; 56% had 6-10 members
and 42% had up to 5 members. From the researcher
point of view, the participating farmers could
understand the semi-technical language and printed
materials on their own or through their children.

Impact on varietal diversification
Prior to the project, farmers grew a few barley
varieties in the study area. The introduction of PVS
varieties had a positive impact on the varietal richness.
Farmers’ preference to PVS varieties varied from site
to site and they were site specific adoptions. Out of the
PVS varieties, the proportion of Himbilil (33%) was
the highest followed by Dimtu (23.4%), and Rie
(19.1%). The percentage frequency of other varieties
was less than 10% (Fig. 1). The figure shows the
richness of the varieties that has been increased in the
study areas. Out of the ten test varieties introduced
through the mother and baby trial, eight of them are
being grown by farmers in different frequencies.

The varietal dominance is also variable. The most
dominant variety is Saesa followed by Tselimo,
Embeye and Burguda. The later two are specifically
 growing in Habes and Mugulat villages. Saesa is
popular across all study villages. Across all the study
villages, the area allotted to Saesa reached about
81.9%, followed by Tselimo (42.6%), Himbilil (33%),
Embeye (31.9%), Burguda (29.8%), Dimtu (23.4%),
Gunaza and Rie (19.1%), and the rest of the varieties
have frequency percentage of less than 10.

The dominance of Saesa and Tselimo in all the villages
implies their adaptation to the local agro-ecologies and
multiple end-uses.
Apart from *Saesa* and *Tselimo*, other PVS varieties, *Himblil* and *Dimtu* have got better acceptance by the local people and this might be due to their yield potential and wide adaptation. The area allotted to *Zibna* and *Haftu-Sene* was relatively low (about 1.1%) Both varieties have rare occurrence and are specific to the Bolenta village.

**Impact on area coverage of PVS barley varieties**

Since the introduction of PVS, the land area allocated to barley has shown an increasing trend in the study villages. For example, in 2006 around 80% of the experimenter farmers were growing barley on small areas of 0.15-1 timad (timad = 0.25 ha), whereas in 2009 more than 30% of the farmers were growing barley over a half hectare (Fig. 2).

However the extent of land size allotted to each variety and dissemination is variable across the villages (Fig. 3). Of the introduced PVS varieties, farmers are growing seven of them in Habes and five in Bolenta and four in Mugulat. At Bolenta, *Sihumay* and *Himblil* had the highest area share and preferences unlike *Misrach* and *Atona*, where none of the farmers have them in their farm plots. The former is highly specific to the Bolenta area. In Mugulat, it is *Dimtu* which is favored by farmers followed by *Himblil*. The high occurrence of *Saesa* across all villages attributed to its extra earliness that enables it to fit into the drought prone areas of the region. From the PVS varieties *Himblil* had better acceptance particularly in Habes and Bolenta.
Seed dissemination of PVS varieties by location
Farmer to farmer seed dissemination was highly satisfactory, and seeds of *Himblil* and *Dimtu* reached 47% of experimenter farmers of the study villages in 2009. Seed dissemination in Mugulat and Habes villages was faster (Fig. 5). None of the experimenter farmers of Bolenta disseminated the seeds further. This might be due to availability of more varieties adapted to the Bolenta village (Abay and Bjornstad, 2008).

![Dissemination (%) of preferred/introduced barley varieties by study villages](image)

Figure 4 Dissemination (%) of preferred/introduced barley varieties by study villages

Farmers ’perceptions on yield of PVS varieties
According to the overall preference ranking by farmers, there were differences in preference of different varieties. In Atsbi, 50%, 20% and 30% of the farmers perceived introduced varieties were better, same and worst, respectively than the local varieties. Similarly in Mugulat it was 40%, 30% and 30% as better, same and worst. However in Bolenta, only 20% of them perceived as better 40% same and 30% worst than local varieties.

![The matrix ranking analysis](image)

Figure 5 Biplot analysis of farmer’s matrix ranking of PVS varieties by prioritized selection criteria

The matrix ranking analysis
The biplot explained 76% of the total variance and *Himblil*, *Misrach* and *Dimtu* were discriminated from others varieties for their higher average yield, disease resistance and number of grains but HB-42 was the least preferred variety, located in the opposite direction. *Himblil*, *Dimtu* and *Misrach* also showed similar for average maturity and better tillering capacity.
Role of women in seed dissemination
The respondent perception analysis showed that the role of women farmers in seed exchanges was more important than the men farmers. The opinions of farmers, irrespective of their sex, showed that 54% farmers wished to grow more than two varieties, especially women farmers were willing to test two or three varieties at a time.

DISCUSSION
Farmers take few years to experiment with varieties before they adopt them. This was observed in the present case as farmers started adopting new varieties after two years of informal experimentation. After initial testing and decision making phase farmers of different locations showed differential adoption of varieties because of wider choices for varietal traits and environmental conditions at different sites. For instance, farmers in Bolenta despite the allocation of the highest area to barley showed preference for fewer varieties. They preferred to grow Sihumay (one of the rare varieties) and Himblil. Their preference and expansion of the latter (Himblil) is related to the selection history of the variety Himblil, which was developed in that village by a farmer breeder named Kalsay (Abay and Bjornstad, 2008). In Mugulat, the variety Dimtu was preferred by farmers followed by Rie and Himblil. The preference of Dimtu might be associated with its high water use efficiency, an important attribute particularly during a season end drought (Sinebo, 2005). This may likely associated with a stay green trait observed in Dimtu during late season drought in Mugulat (Abay and Bjornstad, 2008).

Various author reported that the adoption rate would not reduce the area under local varieties because the preferred PVS variety may not have similar attributes that totally fit to the farmers needs. Farmers have multiple criteria to select what varieties to plant, as well as where, when and how to do it, which has been well established and that reflect their concerns (Brush et al. 1981; Lambert, 1985; Bellon 1991; Brush, 1992; Lando and Mak, 1994. These concerns can be grouped into three major types (Bellon, 1991): (a) agro ecological, which refers to the performance of a variety with respect to agro- ecological conditions, such as rainfall, temperature, soil quality, topography, etc.; (b) use, which refers to the performance of a variety with respect to the destination and uses of the output, such as production for subsistence or for the market, production of straw for fodder, taste, texture, yield, etc.; (c) technological, which refers to the performance of a variety with respect to management and inputs, such as the amount of fertilizer applied, delays in weeding, fitting with other crops, etc.

We have found that seed dissemination of farmer preferred varieties is much aided if there are linkages with research institutes. The fastest spread of seed in Mugulat and Habes villages seems to be flipped through their linkages with Mekelle University and the Local Seed Business project. As a consequence of linkages with research institutes and seed project, farmer of Habes village organized themselves as a Seed Producer Cooperative to multiply seed of the most preferred PVS varieties (mainly Himblil) and a locally endangered variety (Aresatay) (personal communication with chair of the cooperative). Therefore, seed was significantly disseminated in Habes. Similar seed dissemination patterns were observed by Abay and Bjornstad (2008), and Cromwell (1990) and Dennis (1987) who reported that seed flows can extend within a village or a region. These flows may happen as farmers exchange or market seed among themselves, purchase seed from commercial or government outlets, receive seed as a gift, or collect it from other farmers while traveling. On the other hand, dissemination of seed may be constrained by environmental factors. The end-season drought and failure of rains in the short season (belg) can result in lower seed production and exchange among farmers. This happened in Mugulat and Bolenta villages in our case. None of the experimenter farmers of Bolenta disseminated the seeds further. The non-availability of seed of preferred varieties either due to lower seed production resulting from drought or local availability caused by transport is a known constraint in scaling up of any variety. Thus it was not surprising when the majority of farmers (86%) in all villages identified it as the major constraint in the popularization of the preferred cultivars. This is in line with Witcombe et al. (1996) who experienced a great difficulty in procuring seed of several released rice cultivars for farmer participatory trials; the seed of some of them could not be obtained for several years.

Farmers prefer varieties for a number of traits that they trade off (Virk and Witcombe, 2007). Matrix ranking showed Himblil, Misrach and Dimtu were the most preferred because of their higher average yield, disease resistance and number of grains per spike, and HB-42 was the least preferred variety as was also reported by Abay and Bjornstad (2009). Quality traits and maturity time of the new varieties also are important criteria of adoption by farmers for maintaining on-farm diversity.

Farmers overall preference indicated Himblil, Dimtu and Misrach were more or less similar for average maturity and better tillering capacity. This is in accordance with the argument of Bellon (1991) that overall production is expected to increase as each
niches becomes occupied increasingly by the best-adapted variety. Farmers’ adoption of different varieties increased on-farm varietal diversity within the three cropping seasons. Unlike the main season, only one variety “Saesa” (two rowed) is known to grow under the residual moisture. The project study on genetic diversity and inheritance of barley traits and genotypes suited for residual moisture also motivated the informal experimentation by farmers.

Our results showed that the seed spread, and richness is greatly influenced by female farmers, and it is crucial to involve female farmers in PVS experiments. For example, in Habes, Azmera (a woman farmer) who has been involved in the research activities of the PVS project, using her own criteria, she selected four out of 200 PPB (participatory plant breeding) test genotypes in her village. Socially females have a network of seed exchange as they receive and give seed gifts or on sale basis to relatives and friends. The spread of new barley varieties was also discussed with farmers; seeds were mostly distributed within the village within a radius of more than 0.5 km but in some cases were carried outside village.

CONCLUSION
The MU-SSD project initiative greatly accelerated the uptake of preferred varieties across study villages. Farmers adopted new varieties and created a huge demand for improved barley seed. Farmers had the chance to regain access to endangered local varieties in PVS trials. However, lack of seed remains a major bottleneck, especially in areas, where many farmers have no access to improved barley varieties. A continuous renewal of seed and scaling-up of seed dissemination should therefore be carried out through the Local Seed Business (LSB). The local level group formation in Mugulat village as “Association of barley” are important for farmer based seed dissemination activities. It is recommended that LSB should continue to build on existing farmers’ groups for scaling up of seed activities. The replacement rate of old varieties needs to be studied in order to design appropriate strategies of balancing development and genetic conservation. It is also necessary to encourage farmers to participate in local seed conservation activities through establishing community seed conservation systems.

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