

Matching Seeds to Needs

– female farmers adapt to a changing climate in Ethiopia

Between 2010 and 2012 Bioversity International worked with partners and stakeholders in Ethiopia to develop an **innovative low-cost strategy** for managing risks to agricultural systems posed by the adverse effects of climate change. The objective, which the project indeed achieved, was to **decrease vulnerability** and **enhance adaptive capacity** in smallholder farming communities by **increasing the intraspecific diversity** of important food security crops using barley and durum wheat.

Bioversity International's series of Impact Assessment Briefs aims to inform readers about the major results of evaluations carried out by the centre. The Briefs summarise conclusions and methods of more formal papers published in peer-reviewed journals.

As climate change continues to drastically affect food security around the world, many farmers are in need of new crops and crop varieties that have the adaptive traits required by changing conditions.

The project, which is part of Bioversity International's Seeds for Needs (S4N) initiative, sought to have a direct impact on development by ensuring that vulnerable farmers have access to better-adapted varieties of vital food crops to mitigate climate change risks to food security. Rather than focusing on breeding and introducing new varieties, this project focused on the opportunity to make quick wins in a cost-efficient way by using or (re)introducing a diversity of superior landraces readily available in genebanks.



The project

The pilot of the S4N project was implemented in three communities in a highly agriculturally productive and commercialized region of Ethiopia, roughly 80km from, and well-connected to, the capital city of Addis Ababa. In late 2010, 30 women farmers in one community in the lowlands (Kokka), one in the highlands (Chefe Donsa) and one in the midlands (Ejere) were selected (for their principal role as caregivers and seed custodians) to participate in an exercise of varietal assessment and selection. Farmers selected up to three highly-performing varieties based on their needs, and suitability for their agroecological conditions, farmers from these communities were given a number of three durum wheat and three barley landraces, from a total of 100 accessions. These varieties were distributed to 10 women farmers in each community, receiving up to three kilograms of seeds to sow in their fields, and agreeing as a next step to distribute in their respective communities. The same exercise was repeated in 2011 to allow for a second distribution of seeds to farmers using a subset of 25 accessions.



Bioversity International is a member of the CGIAR Consortium. CGIAR is a global research partnership for a food-secure future.

Above right: Researcher noting down farmers' preferences.

Credit: Bioversity International/C.Fadda

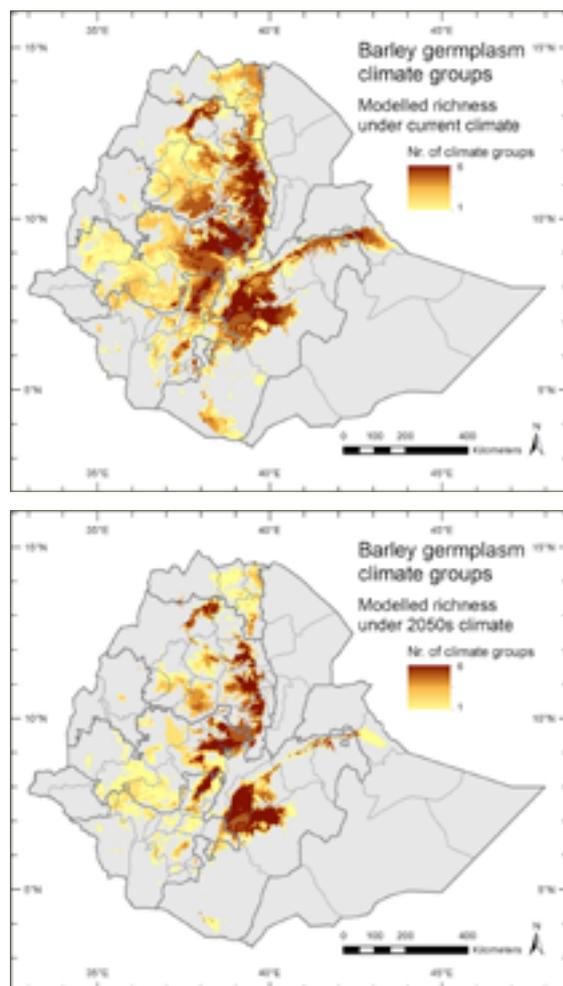


Figure 1. Suitability maps of barley at present and in 2050. It is possible to notice that suitable areas will shrink and that areas requiring very adapted group of accessions will expand.

In order to achieve its development impact, the S4N project was articulated in four main activities.

1. The project team identified promising varieties of barley and durum wheat using geographic information system (GIS), to meet the short- and long-term climate change related challenges faced by farmers in Ethiopia. Using this innovative GIS approach, 100 accessions of promising varieties were selected among those collected in areas where climatic, growing and pest and disease conditions are similar to those found in the three implementation sites. In addition, for each evaluation site, the future climate suitability was calculated on the basis of the 19 bioclimatic variables, averaging the climate in 2020 and 2050 under different greenhouse gas emission scenarios (Figure 1).¹

2. Together with participating community farmers, and especially in consultation with vulnerable women’s groups, the selected materials were planted out to evaluate and characterize the promising accessions from genebanks. During the evaluation, women and men farmers expressed their preferences based on traits that are important to them, including drought and disease tolerance.² Based on those traits, the farmers provided a thorough evaluation of the different accessions, revealing

FACTS & FIGURES

This S4N pilot project received an initial **World Bank development marketplace award of US\$200,000** over a three-year period.

Varietal diversity in wheat was increased with an average of 23% across the project sites from 2010 to 2013, showing a significant difference with non-beneficiaries in the community.

Benefits accrued from this project also include improved genetic diversity for adaptation to different environments, increased farmer knowledge on landrace marketability and insights into the role of women in handling seeds.

The promising results were shared with major partners and stakeholders in Ethiopia and elsewhere. This was done during meetings, conferences, and through the Bioversity International website.

This dissemination attracted the interest of other international funders/stakeholders and as a consequence, two other Seeds for Needs projects, using the same model and approach with other crop varieties, have been set up and implemented in other regions of Ethiopia, **for a total investment of over US\$750,000** including one supported by the FAO International Treaty Benefit-Sharing Fund, aimed at supporting the use of broader genetic diversity.

New partnerships and networking were established. The Scuola Superiore S. Anna in Italy was also keen to be part of the Project and engaged other organizations in Ethiopia, such as Mekelle University and Sirinka Agricultural Research Centre in project implementation.

As a result the project was upscaled and **an additional 400 accessions of durum wheat were fully characterized** using molecular and morphological approaches and the most preferred distributed to the farmers. An additional five sites were added to the original project.

Finally, in consideration of the significance of drought, a thorough screening for drought resistance was conducted in 2012 and 2013 at Mekelle University to identify the most tolerant varieties for subsequent planting in the project sites.

¹ A2 (business as usual) of the downscaled GCM models CCCMA2, CSIRO2, HADMC3 (available at http://ccafs-climate.org/download_sres.html).

² This includes: spike length, degree of plumpness, plant height, tillering capacity, disease resistance, leaf color, the filling stage, shattering capacity, tolerance to drought and duration of the cycle.



major differences between sites and between the two crops. For example, the ability to set seed at Kokka where the season is shorter and temperatures are high is an indication of adaptation to stressful environmental conditions of some accessions – however, farmers in Chefe Donsa and Ejere can rely on a much broader choice of accessions due to their more favorable climatic and soil conditions, thus providing indirect validation of the model shown in Figure 1 where marginal areas have and will have fewer options of suitable accessions.

3. Our aim was to identify, make available and provide access to better suited crop varieties for targeted, local communities to use in adapting to climate change. This was done through seed distribution given to women farmers during a ceremony.

4. Through the project we were able to raise awareness among local farmers and decision makers about the risks posed by climate change and share information about how the use of better adapted varieties can support vulnerable farmers to protect livelihoods and ensure food security.

The Partners

The Ethiopian Institute of Biodiversity was critical to the testing, selection and distribution of the wheat and barley varieties. Moreover, the women farmers acted both as beneficiaries and partners in the project insofar as they received, tested and distributed the landrace seeds widely in their extensive social networks and introduced them into existing conservation structures, such as the community genebanks, which were operating on two of the three initial sites.



Above: Women participating in trials. In front of them are different varieties of durum wheat and barley seeds.

Bottom left: Researcher noting down farmers' preferences.

Credit: Bioversity International/C.Fadda



Above:
Farmers evaluating durum wheat varieties in the Tigray region, Ethiopia.
Credit: Bioversity International/J.V.Gevel

Methodology

The impact assessment relied on both qualitative and quantitative data analysis. Quantitative analysis was drawn from post-intervention interviews with 428 households, which included all project beneficiaries, comparing households, wealth, social capital and production indicators for beneficiaries and non-beneficiaries. The qualitative component focused on 30 semi-structured

and a series of unstructured interviews with project beneficiaries, local actors and genebank representatives.

Results and Impact

The project results have been evaluated from a multiple viewpoint, including the increase in varieties planted by the community and the determinants of this varietal diversity, farmer perceptions on landrace marketability, empowerment of women farmers, and raised awareness of the project communities to the importance of adopting a wider range of varieties to ensure livelihood and food security.

RESULTS: VARIETIES

Wheat varietal diversity (calculated using the Shannon-Wiener and the Herfindahl-Hirschmann indices) was increased on a statistically significant level across all three project sites, with an average increase of 23%. In Kokka and Ejere, where the average number of varieties planted was lower at the household level compared to the highland site Chefe Donsa, beneficiary households significantly increased the diversity of new wheat varieties planted as a result of the project. For example, while non-beneficiaries in the mid-land site grow on average 1.43 wheat varieties, beneficiary households

Table 1. Varietal diversity in wheat in all three project sites

Communities	Wheat growing households in the area		Average number of wheat varieties grown by households cultivating wheat	Average number of wheat varieties grown in beneficiary households	Mean of Shannon-Wiener Index for varietal diversity of wheat	Mean of Herfindahl-Hirschmann Index for varietal diversity of wheat
	Number	Share				
Kokka (Lowland)	40	76.9%	1.25	1.67**	0.019	0.986
Ejere (Midland)	275	98.2%	1.43	1.8*	0.146	0.902
Chefe (Highland)	92	93.4%	2.60	2.8	0.780	0.521

Mean number of varieties grown by beneficiaries is significantly different on a 0.05 (**) or a 0.1 (*) significance level respectively

planted 1.8 varieties, with a significant increase of ca. 26% in varietal diversity (Table 1).

RESULTS: DETERMINANTS OF VARIETAL DIVERSITY

Table 1 also indicated that the three sites differ substantially in suitability for durum wheat and this in turn affects the number of farmers growing the crop and their level of varietal diversification. As a matter of fact there is a clear increase in varietal diversity across an altitudinal gradient.

Even if we control for the differences across the three sites and agro-ecologies, the S4N project still had a significantly positive effect on varietal diversity across different specifications. Only two specifications are presented in Table 2, but the significantly positive effect of the project participation holds across all the models run.

Interestingly, membership in the community genebank (CGB) is not found to be a significant factor (even when co-linear variables, such as linking social capital, are excluded) in determining level of varietal diversity (Table 2), yet it has a highly significant positive effect on overall crop diversity (results not shown). Farmers with stronger social capital tend to grow more varieties, which indicates that their decisions are influenced by neighbors, even though farmer-to-farmer seed exchanges or sales are relatively rare in these commercial production systems.

It is known from other studies that households with more land are more capable of benefitting from crop diversification, because of economies of scale. This project found that wealth is indeed significantly and positively correlated to crop diversity but that it does not matter for varietal diversity. This is an interesting finding because it indicates that the benefits of varietal diversification may be less biased to the relatively richer households than crop diversification tends to be.

KEY OBSERVATION

- The vast majority of beneficiaries (89%) describe the project’s focus on female farmers and female heads of households as an important contribution to female empowerment and gender equality in rural communities.

Top right: Wheat variety from field trial in Northern Ethiopia.
 Credit: Bioversity International/J.V.Gevel



Table 2. Determining factors of varietal diversity

	Model I: Regression with <i>Shannon-Wiener Index</i> for varietal diversity of wheat as dependent variable	Model II: Tobit regression with <i>Herfindahl- Hirschmann Index</i> for varietal diversity of wheat as dependent variable
Ejere (baseline Kokka)	0.186***	-0.668***
Chefe (baseline Kokka)	0.767***	-1.295***
Oromo (baseline Amhara)	0.023	-0.037
Total value of livestock and property	0.000	0.000
Total land cultivated (in ha)	0.026**	-0.044**
Share of wheat harvest sold	0.080	-0.116
Linking social capital	0.015	-0.022
Bonding social capital	0.032**	-0.050**
S4N Beneficiary	0.127**	-0.236**
CGB Member	0.020	0.027
Constant	-0.238***	2.227***
Number of observations	394	394
Adjusted R2/ Pseudo R2	0.46	0.32

The proportions are significantly different on a 10% (*) or a 1% (***) significance level.



Of the beneficiaries who received 2-3 kg of one or two landrace varieties, 53% plan to continue growing the distributed varieties and expand the area cultivated with the Seeds for Needs varieties.

Above:
Durum wheat variety in
community seedbank.
Credit: Bioversity
International/T.Wolday

RESULTS: FARMER PERCEPTIONS ON LANDRACE MARKETABILITY

During focus groups discussions it emerged that beneficiaries who were members of their respective community genebanks, or with previous exposure to landrace cultivation, were particularly convinced by the viability of durum wheat landraces compared to modern varieties. Moreover, they stressed that landrace grain has greater market value than improved variety grain, as a result of its limited supply, lower production cost and lower production risk. Thus, the perceived lower marketability of landrace wheat grain is a common prejudice among farmers with little exposure to landraces and it shows the potential to further strengthen the value chain for durum wheat in a broader geographic area through awareness raising.

RESULTS: WOMEN FARMER EMPOWERMENT

In the interviews, 89% of the respondents indicated that the focus on female farmers and female heads of households is an important contribution to female empowerment and gender equality their communities. "It is a kind of affirmative action. To motivate, to improve, to work against gender bias, to be able improve our lives, to research, to be able to lead better lives."

KEY OBSERVATION

- Many beneficiaries stress the superior qualities of the S4N barley varieties for cooking, especially the white varieties, compared to improved wheat varieties. While the grain is also used for staple foods like bread and *injera* (flat, soft pancakes from sourdough), it is most popular for a dish called *kinche*, for which the durum wheat is cooked, seasoned and crushed to pieces. It is also used for similar dishes based on cooked durum.

RESULTS: SUSTAINABILITY

Of the beneficiaries who received 2-3 kg of one or two landrace varieties, 53% plan to continue growing the distributed varieties and expand the area cultivated with the Seeds for Needs varieties. They want to continue growing and expanding the production of the landrace varieties they received, due to the drought tolerance, low-input requirements and high-quality of the products made from the durum wheat in particular. In Chefe Donsa, project participants have each harvested up to 60kg within one season from the 2-3kg they sowed, allowing for a quick expansion of the area grown with the introduced landraces. Some of the other benefits accrued from the adoption of the landraces are indicated in terms of better market price, the better quality of landraces for bread production, drinks, drought tolerance and diseases resistance.

Farmers also requested that their community genebank include barley in its portfolio of crops, previously disappearing from their production systems. This is a remarkable achievement in terms of crop diversification and community awareness raising.

KEY OBSERVATION

- The 'black' durum wheat varieties are especially used for malting, to produce local beer (talla) or liquor (hararke).

**Concluding remarks**

The Seeds for Needs approach in Ethiopia has proven to be a cost effective solution to climate change adaptation since it provided fast solutions to counter climate variability compared to improved varieties in use.

Given the short time that has passed between seed distribution and data collection, an impact assessment on resilience or livelihood indicators cannot yet be realistically expected or be measurable, however, it is something that Bioversity will continue to monitor over time as it continues to work with some of the communities involved in the project, and will address once these long-term benefits become apparent/have occurred.

One important lesson learnt is related to the climatic variability even within a site. It was therefore recommended to monitor changes in temperature and humidity throughout the season using small, cheap weather sensors (iButtons).

Above: Installing iButtons (weather monitoring sensor) on farmer's field in Ethiopia.
Credit: Bioversity International/J.V.Gevel

KEY RECOMMENDATIONS

Local seed systems and conservation institutions: A major barrier for sustainable impact is the limited spread of the new varieties beyond the immediate beneficiaries. The expansion and sustainability of Seeds for Needs projects relies, inter alia, on the mechanism for seed distribution, so including an analysis of the role of local seed systems and conservation institutions in seed sourcing in baseline assessments will be critical. Based on this, a crowdsourcing approach (involving distribution of seeds to a large number of farmers using a less intensive methodology) was used in the subsequent phases of the project.

Beneficiary selection: While the majority of participants viewed the focus on women farmers as beneficial to empowerment, women do not necessarily always bear the greatest responsibility for seed in rural areas of Africa, nor are women-headed households always vulnerable. Intra-household decision making elements of baseline assessments should be tested against assumptions, and the selection of women farmers should be justified via a gender empowerment rationale.

Focus on landraces and market value: The perceived lower marketability of landrace wheat grain is a common prejudice among farmers with little exposure to landraces. Training of farmers with little knowledge of landraces merits attention. Considering the high market value, more attention could equally be directed at strengthening the value chains for these varieties in a broader geographic area.

Test performance against specific climatic conditions: One important lesson learnt is related to the climatic variability even within a site. It was therefore recommended to monitor changes in temperature and humidity throughout the season using small, cheap weather sensors (iButtons). This approach was piloted in 2013 and will be tested in all the S4N sites in 2014.

Communications products

The Seeds for Needs initiative in Ethiopia has produced several policy briefs and numerous awareness raising materials that are available online.

See the Seeds for Needs page on the Bioversity International website for the complete list:

www.bioversityinternational.org/research-portfolio/adaptation-to-climate-change/seeds-for-needs/

Below:
Researchers recording
farmer preferences.
Credit: Bioversity
International/C.Fadda



POLICY BRIEFS

- Adaptation to climate change
- Atlas of crop suitability
- Participatory variety selection
- Perceptions on climate change

POSTERS

- Seeds for Needs in East Africa – Helping farming communities cope with the effects of climate change by providing access to locally adapted seeds
- Working with farmers in Ethiopia to tap the potential of durum wheat genetic diversity to adapt to climate change
- Using diversity of Ethiopian durum wheat to challenge climate change: a three pronged approach

PRESENTATION

- Seeds for Needs East Africa

VIDEOS

- Agricultural Biodiversity and Climate Change
- Halfway through the Seeds for Needs project in Ethiopia

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