A crowdsourcing approach to detect farmers' preferences: A case study from Ethiopia for adapting to climate change

Carlo Fadda[4], Chiara Mancini[1,4] Dejene Kassahun Mengistu[1,2], Yosef G. Kidane[1,3,4], Matteo Dell'Acqua[1], M. Enrico Pè[1]

Contact Carlo Fadda: c.fadda@cgiar.org

Summary

Durum wheat is a strategic crop for food security and livelihood improvement of smallholder farmers in Ethiopia, yet its productivity is declining largely due to climate change. It is critical to identify accessions with adaptive traits to the changing climatic conditions. From 400 accessions of durum wheat, farmers identified the one that match their needs. We subsequently distributed a small amount of seeds of the most preferred ones using a crowdsourcing approach. From feedback received from farmers on performance under their growing conditions we were able to identify the ones with highest potential. This forms the basis of enhanced local seed systems.

Introduction

Current climate change projection models show that both temperature and precipitation are expected to increase in the Horn of Africa, and that climate uncertainty and frequency of extreme events will most likely increase the vulnerability of the rural poor in the region, Ethiopia included. One solution for long term adaptation, management of climate related risks is to enhance the level of genetic diversity available to farmers, by introducing new traits into the production system. Such strategy requires i) the characterization of the genetic resources available, ii) the understanding of the performances of accessions in different climatic conditions, and iii) to address farmers' needs.

Here we present our three-pronged approach to reach those goals.

1. Germplasm Characterization

373 accessions of durum wheat obtained from the Ethiopian Biodiversity Institute (EBI) and collected from various regions in Ethiopia and 27 improved varieties approved for cultivation in Ethiopia were genotyped using the Illumina Wheat 90K SNP platform. This platform allowed the testing of 81,588 Single Nucleotide Polymorphisms (SNP), of which 50,582 were polymorphic. The results of a Principal Component Analysis on the full set of SNPs are reported in Fig. 1. Improved cultivars mostly cluster together and are very different from the bulk of Ethiopian landraces. PCA 1 clearly separates landraces, indicating a broad genetic variation. This material was evaluated in two differently characterized agro-ecological zones of Northern Ethiopia. Several landraces outperformed improved varieties. There was a clear incentive to test the material with farmers.

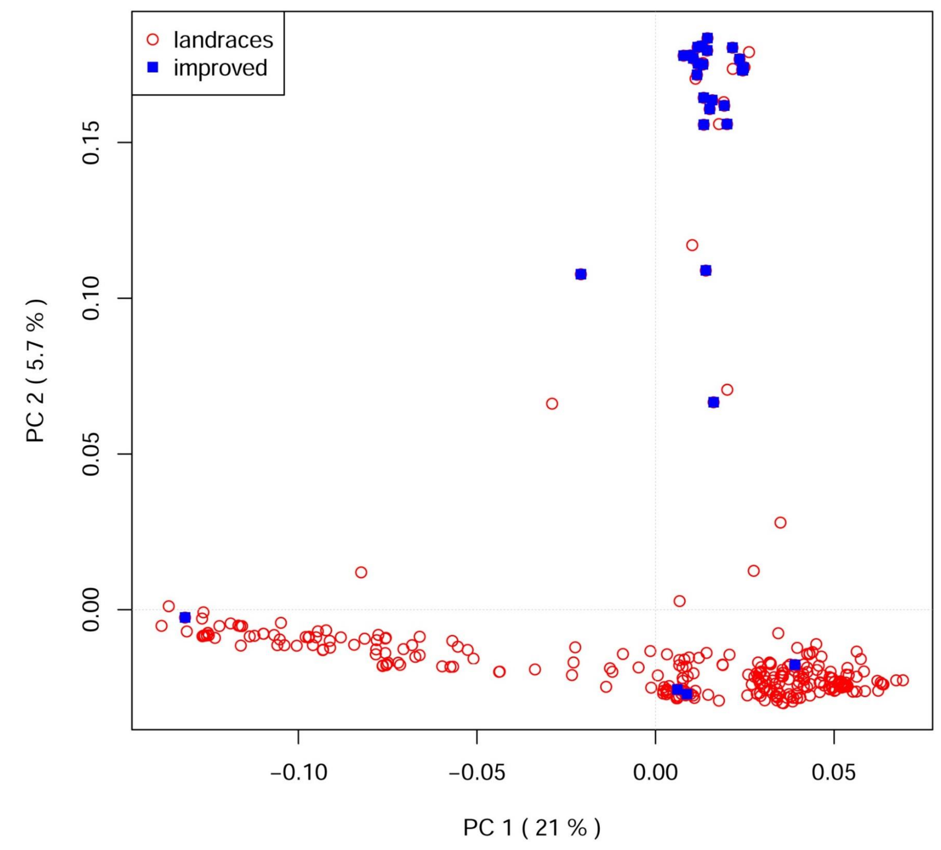

Fig. 1. Principal Component Analysis (PC 1 and 2) on the full set of SNPs. In red, Ethiopian landraces of durum wheat. Blue squares depict improved durum wheat lines cultivated in Ethiopia. The molecular diversity entailed in the landraces is much wider than that captured by the improved lines.

2. Farmers' participatory selection

All the 400 varieties were evaluated in the two locations by 30 local farmers (15 males and 15 females) for each location before harvest. Through focus group discussion (Fig. 2) with the farmers traits used by them to evaluate wheat varieties were identified and ranked. Earliness, tillering capacity, ear morphology and overall plot characteristics were evaluated, giving a score from 1 to 5 (Fig. 3). More than 200,000 data points were collected which allowed to relate farmers' preference to agro-morphological traits. Table 1 shows the correlation between farmers' rating and quantitative measurements on the same plots. Correlation coefficients indicate that farmers' preference is significantly correlated to quantitative measurements of related traits, but it is not completely captured by them. Twenty landraces in each location were selected on the basis of both metric measurements and farmers' scoring, amplified and distributed to the farmers for further analysis.

Fig. 2. A farmer focus group discussing the tested material and relevant traits.

Table 1. Correlations between farmers' rating and quantitative measurements in Hagreselam and Gere Gera field trials.

	Hagreselam				Gere Gera			
	Earliness	Tiller capacity	Spike morphology	Overall	Earliness	Tiller capacity	Spike morphology	Overall
Days to maturity	-0.734**			0.176**	-0.771**			-0.247**
Number of fertile tillers		0.268**		-0.054		0.261**		-0.03
Spike length			0.029	-0.112*			-0.05	-0.047
Number of seeds per spike			0.314**	0.331**			0.482**	0.442**
Grain yield				0.417**				0.485**
Plant height				0.359**				0.374**
Biomass yield				0.362**				0.031

Fig. 3. Field evaluation with a group of farmers. The gender bias was considered by adressing females and males separatedly.

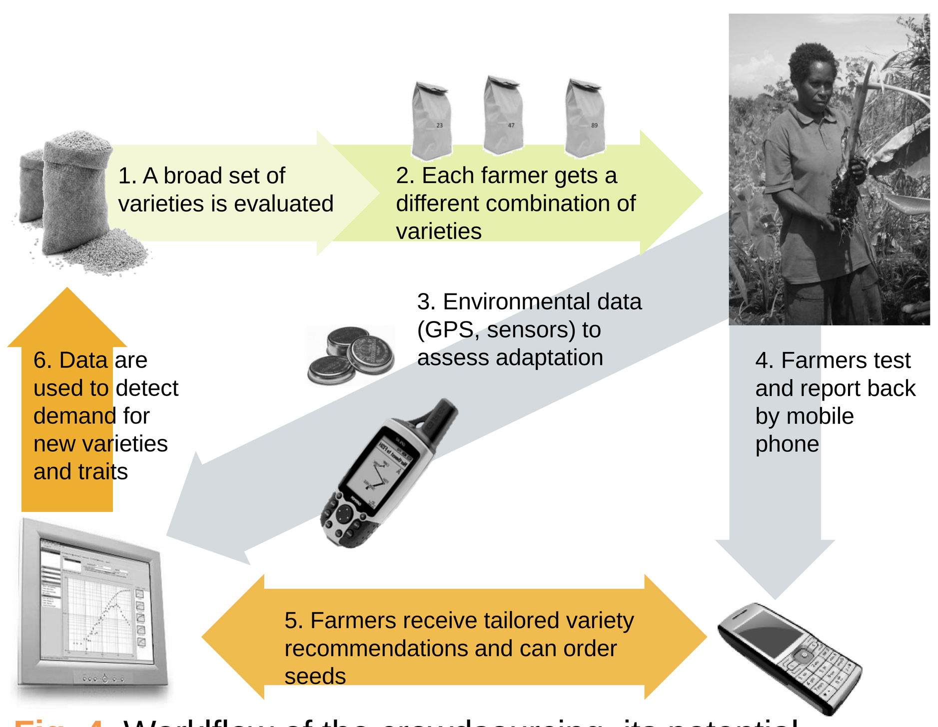

Fig. 4. Worklflow of the crowdsourcing, its potential development, and implications for seed system.

3.Crowdsourcing of selected varieties

Fig. 4 shows the process and the potential implication of the approach. In 2013 season we distributed 20 varieties among the best and as a check the improved variety Assasa to 200 farmers in 12 villages per site, covering an area of roughly 350 km2. Each farmer was given 3 varieties and the check, each receiving a different combination of accessions: each variety was equally represented in the sample. In each village we included 2 i-buttons, measuring temperature and humidity every 3 hours throughout the growing season. This allowed to analyse the data at the light of some critical climatic parameters. At each village 12 enumerators are recruited for data collection and a mobile phone is provided for all to facilitate communication. Farmers are unaware of which varieties they are given and were trained on how to conduct the experiment and to provide information. Phenotypic data were collected contextually to farmer rankings in order to estimate the performances of the selected lines in each microenvironment. The measures were standardized and compared by villages (**Fig. 5**). All the traits present a wide variation, likely contributed by microclimatic variation and field management. We are currently analyzing the data to quantify such contribution.

Fig. 5. Standardized phenotypic measures for each of the tested villages. The genotypes present a wide variation in performances overall (Pha=Plant Height; NET=Number of Effective Tillers; SPL=Spike Length; SPS=Number of Seeds/Spike; GY=Grain Yield).

In conclusion

- this process has been very effective in disseminate seeds that match farmers needs in a very short amount of time as after 2 years already several hundred farmers have the potential to use better adapted material, with a large snowball effect potential.
- It shows the potential of landraces to provide immediate option for managing climate related risks and call for broader use of material conserved in gene banks.
- It indicates the need to strengthen local seed systems in order to manage these resources in a sustainable manner.
- It indicates how farmers can provide very valuable scientific information that can be translated into research as well as development outcome also in other areas of research.

Poster presented at Tropentag 2016, Wien, Austria,18th-21st September 2016