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Collection and *ex situ* Conservation of Coffee Landraces in Ethiopia - The Example of Harerge

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Summary

The south-western highlands of Ethiopia are recognized as the primary centre of diversity of *Coffea arabica* L. However, relatively little is known about the situation of coffee genetic resources collected and conserved *ex situ* within Ethiopia. In 2005, we started compiling an electronic database of coffee genetic resources conserved at the Jimma Agricultural Research Centre (JARC).
Since 1967, 48 campaigns of collections have been undertaken by the Ethiopian research organization, with the main objectives to capture the genetic diversity and search for genotypes tolerant to coffee berry disease.
To date (July 2006), 4731 distinct accessions are presently conserved and evaluated by JARC in field gene-banks at Jimma-Melko centre and at 9 sub-centres located in the main coffee growing areas.
In Harerge, a coffee zone in the East of the country, coffee is produced in highly diversified farming systems adapted to different ecological niches. Harerge fetches premium prices in the world market but this resource is under threat of erosion. Out of 30 Harerge *woredas* (districts) with significant coffee production, JARC has collected coffee landraces in 20 woredas. In all, a total number of 1952 Harerge accessions are conserved in JARC field gene-banks at the Jimma-Melko centre and Mechara sub-centre. They are assessed regularly for yield, disease tolerance, and quality.

Introduction

Ethiopia holds a unique position in the world as *Coffea arabica* L. has its primary centre of diversity in the south-western highlands of that country. This fact is strongly substantiated by observations of travellers and scientists [1, 2] and, more recently, by studies using DNA-based genetic markers [3, 4].

On a world scale, commercial exploitation of Arabica coffee is based on a small number of cultivars, Typica and Bourbon varieties, along with their mutants and hybrids, which makes this crop particularly vulnerable to biological and climatic risks. Consequently, collection and conservation of the wild coffee populations and landraces existing in Ethiopia have long been acknowledged as being of major interest in capturing genetic

diversity for future crop improvement [5, 6]. However, relatively little is known about the situation of coffee genetic resources collected and conserved *ex situ* within Ethiopia, despite a brief overview drawn up about ten years ago [7, 8].
In 2005, we started building up an electronic database of coffee genetic resources conserved at the Jimma Agricultural Research Centre (JARC), which is in charge of coffee research within the Ethiopian Institute of Agricultural Research (EIAR). A summary of the information generated by that database is presented here. We have chosen Harerge, a coffee zone in the East of the country, to illustrate this collection and conservation work on Ethiopian coffee landraces.

Material and methods

We used Microsoft® Access 2002 for constructing a relational database and DIVA-GIS Version 5.2.0.3 software [9] for mapping of the collection and conservation sites.

Results

Current status of coffee germplasm conserved ex situ by JARC
The collection made by ORSTOM [6] was the first one successfully established at Jimma research center in 1967 under the name of French collection. From this date, 47 other collections have been undertaken by Ethiopian researchers. The main objectives were the capture of the genetic diversity and the search of genotypes tolerant of coffee berry disease (CBD). This disease, caused by *Colletotrichum kahawae***,** a parasite unknown until 1970 in Ethiopia, provokes a significant drop in the production. A research programme to select naturally CBD-tolerant coffee landraces has been under way at JARC since 1973 [10-12].

To date (July 2006), 5109 genotypes were collected in 101 *woredas* (or districts) and 63 % of the *woredas* with more than 500 hectares planted with coffee are represented in the collections. In total, 4731 distinct accessions are conserved and evaluated by JARC in field genebanks at Jimma-Melko center and at 9 sub-centres or testing stations located in the main coffee growing areas (Fig.1).

Collection of Harerge coffee landraces
In the eastern part of Ethiopia, coffee is found in the East Harerge, West Harerge, and Arsi zones at an elevation of between 1,600 and 2,000 metres.

Local coffee landraces are well adapted to these drought-prone areas where they are grown in association with other crops in open sunlight or under a few shade trees. Farmers have developed many names - 17 in number were recorded by Bayetta [13] - to distinguish between coffee landraces according to their morphological characteristics. By segregating these landraces and using different ecological niches and farming practices, farmers have maximized the use of the genetic diversity within the species.

Harerge coffee fetches premium prices in the world market. This sun dried coffee has an overall cup taste profile displaying a typical mocha flavour, with chocolate notes, in a

medium-dense body and a mild, soft acidity with light fruitiness. Usually coffees from the East Harerge zone achieve an additional premium especially for the more distinctive golden yellow coloured long-berry beans which are also differentiated by softer tones of characteristics described above and yet still balanced in aroma and flavour. Arsi zone coffee was mixed with Harerge coffee earlier and is now further differentiated and marketed separately.

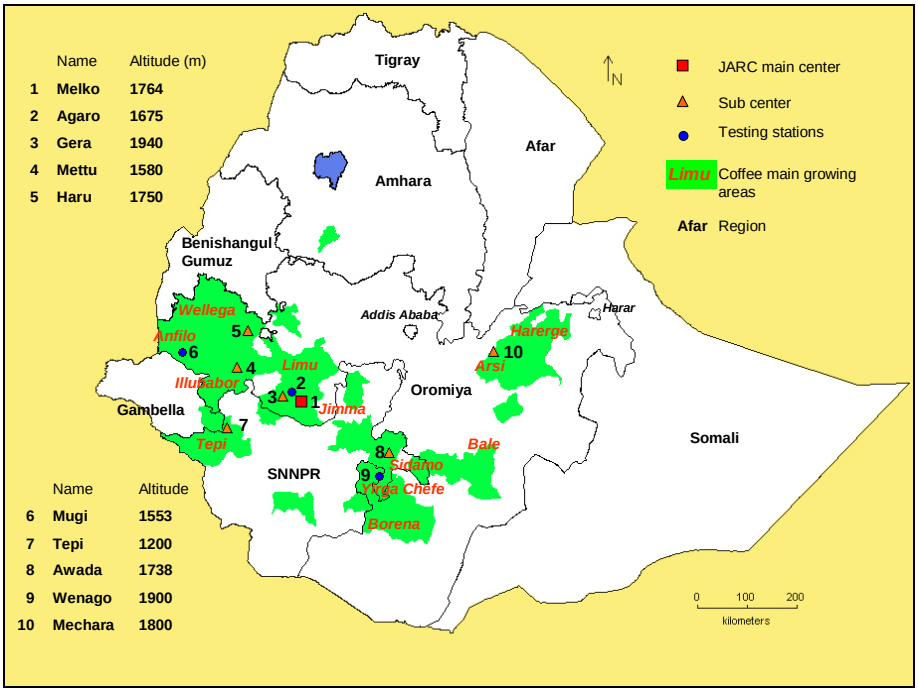

Fig.1: Sites for *ex situ* conservation and evaluation of coffee landraces in Ethiopia.

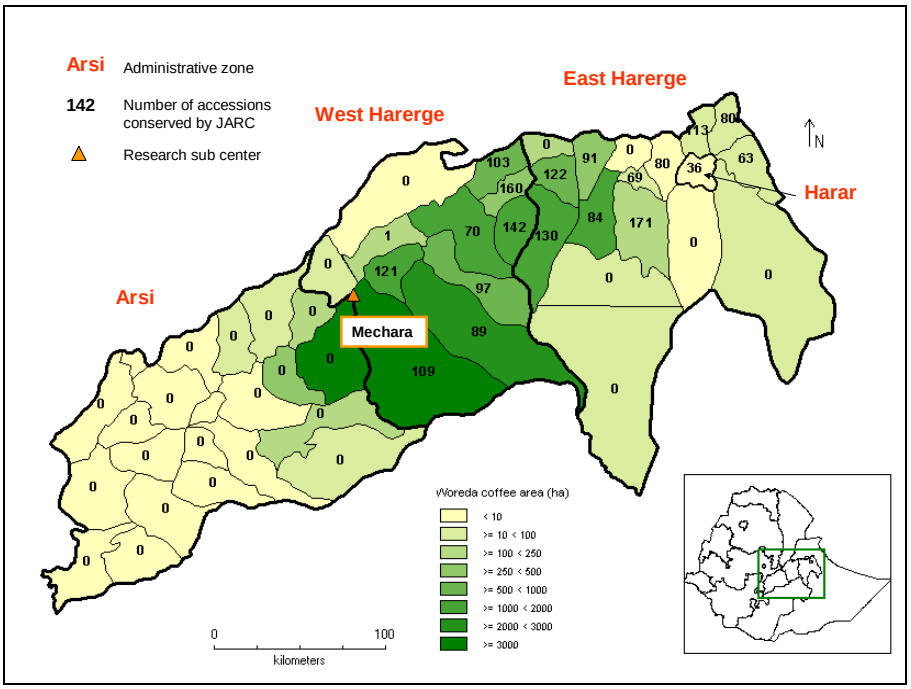

Fig. 2: Number of accessions originated from different *woredas* in Harerge and Arsi zones conserved by JARC.

However, this coffee germplasm is under threat of genetic erosion due to its high susceptibility to coffee berry disease and coffee leaf rust. Die-back frequently occurs due to poor management standards and inadequate shade. Coffee cultivation also faces competition from food crops and **chat** (*Catha edulis*), the tender leaves and shoots of which are chewed as a mild drug in the Horn of Africa.

Out of 30 *woredas* with significant coffee production, 20 have been surveyed so far (Fig. 2). In all, a total of 1952 Harerge accessions is conserved in the JARC field genebanks at the Jimma-Melko centre and Mechara sub-centre, and assessed regularly for yield, disease tolerance, and quality.
The medium-term objective of the JARC breeding programme is to supply Harerge farmers with CBD-tolerant, high-yielding landraces, suitably adapted to their ecological niches, and with the unique Harerge coffee flavour profiles.

Conclusion

By using passport data and GIS technology, collection gaps are quickly recognized. This analysis will be further refined by overlaying thematic base maps (climate, soils) combined with agricultural censuses, satellite imagery, and field work data to identify areas under imminent threat of genetic erosion. Maps can also be adapted for marketing, with clearer identification of origins and taste profiles to increase buyer awareness.

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