On-farm *Musa* Germplasm Diversity Status across Different Agro-ecologies in the North and South Kivu Provinces of Eastern Democratic Republic of Congo

W. Ocimati\(^1\), D. Karamura\(^1\), C. Sivirihauma\(^2\), V. Ndungo\(^2\), E. De Langhe\(^3\), J. Adheka\(^4\), B. Dheda\(^4\), J. Ntamwira\(^5\), H. Muhindo\(^6\), P. Ragama\(^7\), G. Blomme\(^1\)
Setting the scene

Eastern DR Congo is endowed with a broad diversity of banana and plantain cultivars that are grown across a wide range of altitudes and agro-ecological zones.

Zone of secondary diversification of plantains \((Musa\ AAB\ genome)\) and East African highland bananas \((Musa\ AAA-EA\ genome)\).
Objectives
Adequate knowledge on existing cultivar diversity is lacking, yet knowledge of *Musa* genetic diversity and the geographical spread of banana and plantain cultivars in DR Congo will provide valuable information to breeders and taxonomists.

In-depth knowledge of current cultivar diversity and the level of genetic erosion are urgently needed to formulate strategies for the conservation of cultivars with good/promising marketing or breeding qualities.
Assess across South and North Kivu, the on-farm diversity of *Musa* germplasm, farmers’ selection criteria that create/maintain this diversity on farm and the level of genetic erosion of *Musa* cultivars.

The information generated would provide a baseline and a precursor for a more detailed germplasm characterization study using descriptors for banana.
Diagnostic survey
An on-farm *Musa* germplasm diagnostic survey was carried out in eight representative and key banana-growing localities of North and South Kivu.

In addition to the *Musa* crop being important in these localities, there is variability in the agro-ecologies that would increase the chance of capturing a more representative measure of *Musa* cultivar diversity in the country.

The mean altitudes in North Kivu ranged from 970 to 1,730 masl. In South Kivu: 1,550 to 1,990 masl.
In each of the sampled localities, farms with at least 50 banana mats were purposely identified and of these, 30 farms per locality were randomly sampled for this study.

*Field measurements:* *Musa* cultivar diversity, socio-economic utilization options/practices that influence cultivar diversity on-farm and cultivar disappearance/genetic erosion.
Spatial analysis of the distribution/diversity of cultivars within the study sites were computed using richness (number of cultivars) and evenness (relative abundance of cultivars).

These diversity indices can help to determine which populations to target for conservation to maximize diversity.

Richness measures the number of the cultivars regardless of their frequency. It gives equal weight to the cultivars represented by very few plants as to those represented by many plants.

Evenness is a measure of the equality in distribution of the cultivars. It takes into account the number of cultivars and as well as the number of individuals of each cultivar within a community.
Results
Musa diversity

Musa cultivar diversity varied across the agro-ecologies of eastern DR Congo.

Overall: a slightly higher richness in SK (35) compared to NK (32).

However, NK sites had higher cultivar evenness (i.e. cultivar relative abundance; lower dominance) compared with SK. For example, more (close to 20) cultivars were grown widely in NK compared with 12 in SK. Long-term on-farm Musa diversity conservation will hence be easier in NK.
Forty per cent of cultivars in NK and > 60% in SK had a low evenness score (grown in small quantities and in few localities) and are thus prone to genetic erosion. Conservation ex-situ of these cultivars, especially of low cultural importance is recommended.

Figure. Spatial distribution (relative abundance/evenness) of *Musa* cultivars in four localities each in North Kivu (A) and South Kivu (B), eastern DR Congo, during a diagnostic germplasm study covering 120 farms in each province in 2007. The vertical bars are error bars with 95% Coefficient Interval.
'Nshikazi' (AAA-EA, beer) dominates (66%) the *Musa* production landscape in SK (= 7 cultivars in NK).

SK mainly has high altitude sites (1,550–1,990 masl).

**Highland AAA-EA: cooking vs. beer**

Higher elevations: AAA-EA beer types (also observed in Burundi, Rwanda and Uganda)

Closer or with good access to large markets: AAA-EA cooking types

More remote regions: AAA-EA beer types dominate (beer/wine has a longer shelf life)

Beer types often grow on poor soils and under low levels of management. The high altitude sites are hilly, soil erosion is common.
Cultivar distribution by use
The study revealed the predominance of cooking cultivars in NK followed by beer and plantains, while beer types predominate by over 70% in SK. Altitude plays a critical role in the distribution of cultivars, with beer types more prevalent at high altitudes and plantains in the humid low altitude regions.

Highland cooking and plantain types only occupy a meagre 6 and 1% in South Kivu.
Cultivar distribution by use
Cultivar selection criteria
The selection criteria used by farmers plays a critical role in the diversity of cultivars and reflects the major constraints experienced by farmers. Availability of planting materials, tolerance to low soil fertility (on slopes); resistance to pests and diseases, taste and flavour were critical for farmers in selecting cultivars, in both provinces.
Germplasm adapted to agro-ecological conditions.

Farmers select more adapted germplasm and tend to abandon the less adapted ones. 'Nshikazi' is highly adapted to higher elevations and able to produce a good number of suckers.

Availability of planting materials linked to adaptability of the cultivars.

Longer shelf life of beer also favors beer types compared to other cultivars.
Genetic erosion
Genetic erosion: 15% of respondents in NK and 35% in SK reported the disappearance of some cultivars over the last 10-20 years.

**Figure.** Frequency of farmers reporting the disappearance of *Musa* cultivars across the localities North Kivu and South Kivu, DR Congo in 2007. The vertical bars are error bars with 95% Coefficient Interval.
Diseases greatly contributed to genetic erosion and the diversity trends in the eastern DR Congo agro-ecologies. *Fusarium* wilt was mainly responsible for the loss of the AAB dessert banana and the ABB beer bananas, while *Xanthomonas* wilt has devastated numerous plantations, with ABB beer type ‘Pisang Awak’ the most affected cultivar.
Acknowledgements

THE BELGIAN
DEVELOPMENT COOPERATION

Directorate General for Development (DGD-Belgium)

UCG in North Kivu, DR Congo

INERA, South Kivu, DR Congo
Thank you

www.bioversityinternational.org