

# *In situ* conservation



**Adriana Alercia**  
**Ehsan. M. Dulloo**  
**Biodiversity International**  
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# Outline

- ❖ Introduction
- ❖ Why *in situ* conservation of crops and their wild relatives matters?
- ❖ What research is needed?

## Definition of *in situ* conservation

- ❖ It refers to the maintenance of cultivated plants (and wild relatives) in the very place where they developed their present day characteristics and where they continue to evolve.





# Why *in situ* conservation of crops matters?

- ❖ To conserve the processes of evolution and adaptation of crops to their environments
- ❖ To conserve diversity at different levels, ecosystem, species, within species
- ❖ To integrate farmers into a national PGR system
- ❖ To conserve ecosystem services critical to the functioning of the earth's life-support system
- ❖ To improve the livelihood of resource-poor farmers through economic and social development



## ***In situ* landraces ... key traits!**

- ❖ The development and utilization of genotypes that can withstand abiotic and biotic pressures are the keys for sustainable production
- ❖ Genes for such traits are often available in wild species and landraces; therefore, their genetic resources need to be collected, documented, characterized, evaluated and preserved.



## An example...

Conserving, maintaining and safe duplication of cassava using a combination of available conservation methods will facilitate:

- ❖ Availability of a source of genes for transfer of beneficial traits to farmer-preferred cassava cultivars
- ❖ Safeguard important cassava-related germplasm from loss due to environment degradation
- ❖ Availability of a germplasm pool for screening for potential important agronomic traits (i.e. disease resistance, post-harvest characteristics, nutritional qualities, etc).

# Benefits of on-farm conservation

**Table 1.1.** Some possible benefits accruing from on-farm conservation (adapted from Jarvis 1999)

	<b>Economic and sociocultural benefits</b>	<b>Ecological benefits</b>	<b>Genetic benefits</b>
<b>Farmer household</b>	<ul style="list-style-type: none"> <li>• Manage risk and uncertainty</li> <li>• Fit different budget constraints</li> <li>• Avoid or minimize labour bottlenecks</li> <li>• Fulfil rituals or forge social ties</li> <li>• Fill nutritional needs</li> </ul>	<ul style="list-style-type: none"> <li>• Minimize use of chemical inputs</li> <li>• Soil structure amelioration</li> <li>• Manage pests and diseases</li> </ul>	<ul style="list-style-type: none"> <li>• Insurance against environmental and socioeconomic change</li> </ul>
<b>Society</b>	<ul style="list-style-type: none"> <li>• Global food security</li> <li>• Empowerment of local communities</li> <li>• Social sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Reduction of chemical pollution</li> <li>• Restriction of plant diseases</li> <li>• Regulation of hydrological flows</li> </ul>	<ul style="list-style-type: none"> <li>• Insurance against environmental change, pests and diseases</li> <li>• Use for the agricultural industry</li> </ul>



# What are traditional cultivars/ landraces?

- ❖ Recognisable, distinct crop variety
- ❖ Historical origin
- ❖ Dynamic population character
- ❖ Genetically diverse
- ❖ Lack formal crop improvement
- ❖ Locally adapted
- ❖ Associated with local cultural, historical religious values and with traditional farming systems



## Landrace definition.... For debate!



- ❖ **Traditional cultivar/Landrace:**  
An early, cultivated crop form, evolved from a wild population or grown under traditional agricultural systems, which has not undergone much improvement.





# Why conserve traditional cultivars or landraces?

- ❖ Important element of farmer's livelihood
- ❖ Adaptation to marginal and specific agricultural systems and heterogenous environments (rainfall, soil types etc.)
- ❖ As an insurance against environmental risks
- ❖ For pest and disease management
- ❖ Cultural and religious needs
- ❖ Nutritional value

(source: D.I. Jarvis et. al, 2011)

# Role in ecosystem services

- ❖ Regulations and control of pest & diseases
- ❖ Sustain pollinator diversity
- ❖ Support below ground diversity
- ❖ Provides resilience & adaptability in the production system





# LR role - Global food security

## Sustainable crop production intensification strategy

- ❖ Requires a portfolio of the crop diversity including the use of local cultivars/landraces
- ❖ Intra-specific diversity in farmers' fields reduces the probability of crop loss in the future – genetic vulnerability



# Custodian farmers



- ❖ Farmers who continue to grow and maintain traditional cultivars and may be regarded as guardians of diversity
- ❖ This retention is reinforced and maintained by the traditional networks of exchange of seeds



# ***In situ* conservation of traditional farmers varieties of native R&T**

- ❖ The factors which favour the maintenance of greater genetic resource diversity are:
  - ❖ Indigenous culture
  - ❖ Traditional farming system
  - ❖ Government subsidy
  - ❖ Availability of labour
  - ❖ Self consumption

Source: Velaquez –Milla, *et al.* 2011

# What are crop wild relatives?

Broadly speaking CWR are:

***any species of the same genus as cultivated plants.*** (i.e. crop) to which they are related

Possible crop progenitors

Possible gene donors of crops





# Why conserve CWR?

- ❖ CWR are an important socio-economic resource for plant breeding and other uses
- ❖ Value as wild plant species in natural ecosystems – special role to play in ecosystem services
- ❖ CWR are threatened to extinction due to many factors.



# Landraces of cassava *in situ*

- ❖ 27,000 distinct landraces of cassava
- ❖ About 10,000 are maintained in genebanks
- ❖ A total of 15,000 varieties should be conserved *ex situ*
- ❖ *Need to* strengthen the ability of national programs to conserve cassava germplasm

Source: B.Clair H. Hershey,D.Debouck,,2010,"Backgrounon "A Global Conservation Strategy for Cassava andWild Manihot Species"

# What happens if we do nothing?

- ❖ Serious erosion of cassava genetic resources
- ❖ We lose our capacity to respond to crop failures because we lose the raw materials necessary for breeding



Photo by Debbie DeVoe/CRS



Amit, New Delhi



# Research is required to answer the following key questions..

1. What is the amount and distribution of genetic diversity maintained *in situ* by farmers over time and space?
2. What processes are used to maintain this genetic diversity on-farm?
3. What factors influence farmer decision-making to maintain diversity on-farm?
4. Who maintains this diversity on-farm (men, women, young, old, rich, poor, certain ethnic groups)?

Answering these questions will provide a scientific basis for the design of effective, long term strategies to conserve crop genetic diversity on-farm.



# Research hypothesis and questions

**Hypothesis:** *Agricultural systems rich in biodiversity are more sustainable and resilient than uniform systems that rely on external inputs*

- ❖ How would on farm management of diversity affect the socio-economic status of rural farming communities?
- ❖ How much diversity are we losing?
- ❖ How do the keepers of diversity/custodian farmers conserve diversity? What difficulties do they face?



# Information system for *in situ* conservation

No global information system or knowledge base is available for crop genetic diversity at the *in situ*/on farm level.

What elements are needed for developing an global *in situ* information system and trait information of CWR and local varieties?

Develop informatics tools for analyzing spatial changes e.g. GIS, remote sensing,

Build a system that will provide time series data for monitoring the status and trends of CWR/ traditional cultivars



# Information management

- ❖ Assess the current status of conservation and characterization of the genetic resources in all participating collections
- ❖ Provide an indication of gaps that may exist in geographical representation or phenotypic/genotypic variability inherent in the collection
- ❖ Provide an indication of duplication (including intentional security duplication) of material between collections;
- ❖ Assess the regeneration requirements at international level.

