



A General Introduction to the Maintenance of Crop Evolution in Farmers' Fields in Centers of Crop Diversity

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The value of crop diversity

- The diversity of cultivated species is the basis of our food supply and good nutrition
- This diversity has two dimensions:
 - Diversity among cultivated species
 - Diversity within a species (intraspecific diversity)
- Both based on underlying genetic diversity
- Crop genetic diversity allows farmers and breeders to adapt a crop to heterogeneous and changing conditions
- Basis for increasing crop productivity, stability and resilience

Farmers and crop diversity

- Crop genetic diversity results from the co-evolution between cultivated species and human cultures over generations.
- Until the advent of modern breeding and the development of a formal seed sector, crop diversity and its evolution have been in farmers' hands.
- This continues in many of centers of crop diversity:
e.g. Mexico and Guatemala for maize, the Andean region for potatoes
- Maintaining farmers' roles and engagement in the evolution of crop diversity **may** be central to adaptation to global changes

Questions to be addressed

- Why do farmers maintain crop infraspecific diversity?
- How do farmers maintain infraspecific diversity?
- Why do farmers abandon crop infraspecific diversity?
- How can farmers be supported in the maintenance of crop infraspecific diversity?
- How can a system be established to create global benefits from farmers' conservation of crop infraspecific diversity?

Multi-functional crops in livelihoods

- A crop that plays multiple functions or roles in farmers' livelihoods, such as a source of food, income, cultural identity, social status and as part of a safety net
- Important in areas of crop diversity among farmers whose production and consumption decisions are interrelated and who have a strong cultural attachment to the crop
- Multi-functionality reflected in the simultaneous demand for multiple production and consumption traits in a crop
- Associated with the maintenance of multiple crop varieties

Why farmers maintain crop infraspecific diversity?

- Multi-functional crop in farmer livelihoods, providing food, income, food security, social status and other cultural services
- Multi-functionality reflected in the simultaneous demand for multiple production and consumption traits in a crop
- **On farm infraspecific diversity is an outcome of different farmers trying to solve multiple problems while meeting their production needs and consumption preferences**
- Associated with the maintenance of multiple crop varieties

Maize as a multi-functional crop

Uses

- Consumption as grain
- Consumption corn-on-the-cob (elote)
- Sale of grain
- Fuel
- Animal fodder
- Sale of husk fertilizer
- Grain for animals

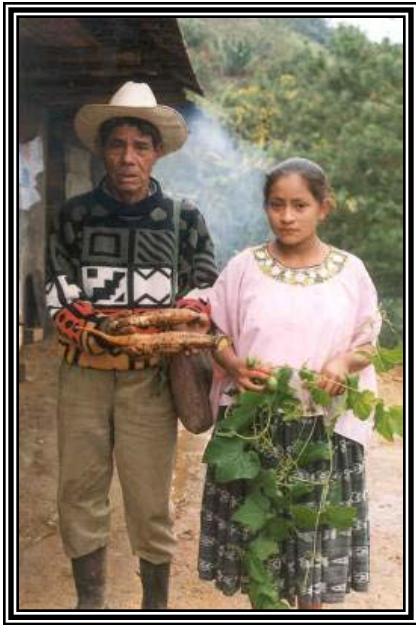
Traits

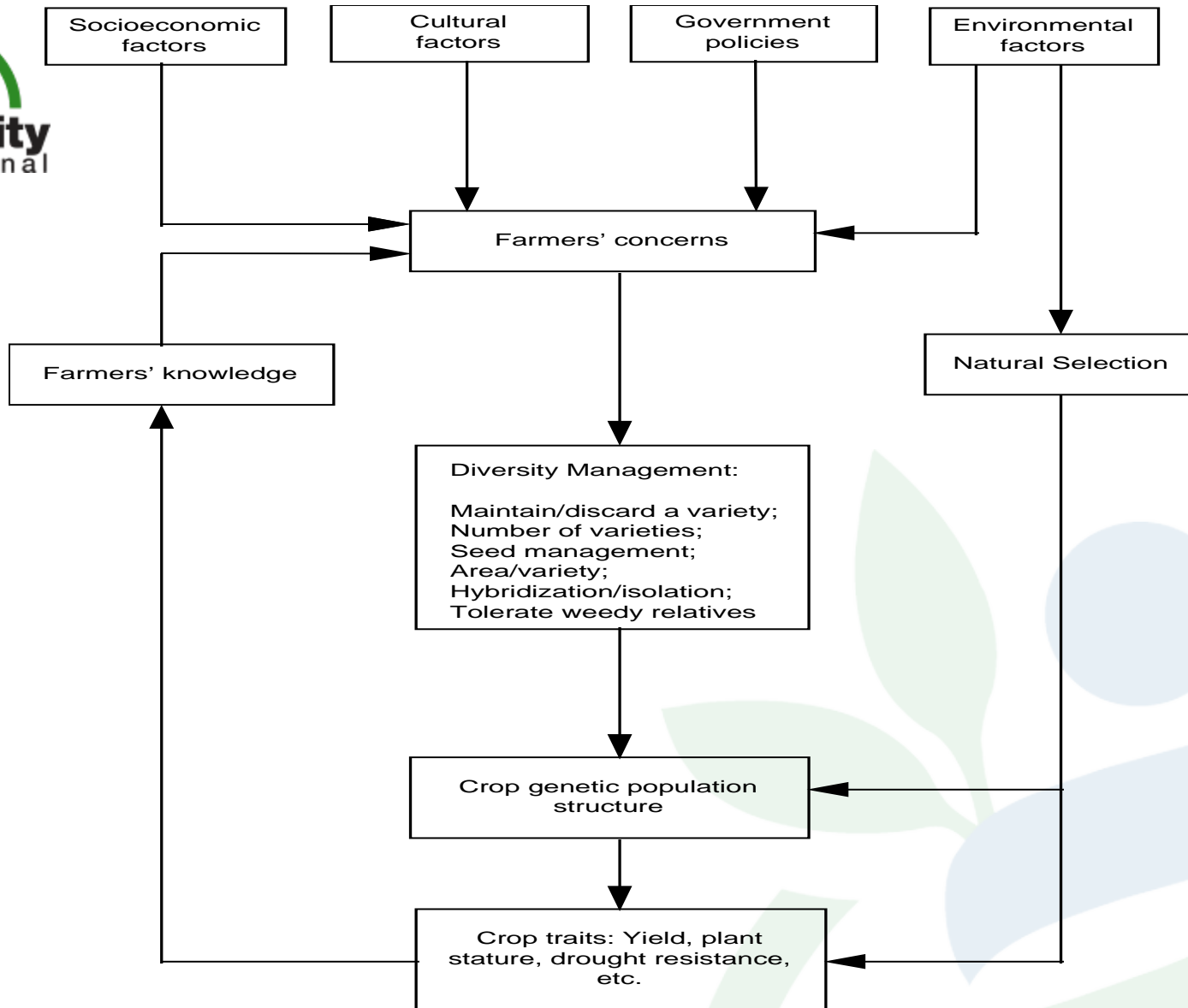
- Lodging resistance
- Drought tolerance
- Ear rot resistance
- Tolerance to excess rainfall
- Good for consumption
- Ease of shelling
- Good for nixtamal
- Storage pest resistance
- Insures food
- Good for sale
- Good for husk sale
- Yield of tortilla dough
- Yield by weight
- Yield by volume
- Yield of husk
- Good for fodder



How do farmers maintain crop infraspecific diversity?

A simple model





Farmers' management of diversity on-farm

- There are three major decisions that influence the management of crop infraspecific on-farm:
 - Variety selection (what varieties to plant?)
 - Seed sourcing (where, how and with whom to get seed for planting?)
 - temporal and spatial seed flows
 - Seed selection and storage (how seed is selected?)

Why do farmers abandon crop infraspecific diversity?

- For many years there has been a growing concern with the loss of crop diversity in farming systems, particularly those in areas of crop domestication and diversity.
- The conventional explanation for this loss is that farmers **do not want** to continue to plant a diverse set of varieties (particularly landraces) because of:
 - High yielding varieties
 - Specialization within the crop
 - Diversification to other crops
 - Non-farm labor opportunities
 - Migration



Participation in markets

- Participation in markets is probably the factor with greatest impact on changes in crop diversity
- Markets: broad social institutions of exchange of goods and services
 - Foster specialization and efficiency
 - Provide substitutes
 - Influence culture
- But culture provides the context of how problems are defined and prioritized

How do markets influence crop infraspecific diversity?



Three processes are fundamental:

1. The availability and affordability of alternative solutions to the problems that diversity of landraces addresses, i.e. the availability of substitutes for crop diversity
2. The opportunity cost of the resources employed in using and maintaining crop diversity
3. Cultural change, changes in the socially-shared notions of what is important, acceptable or desirable as they pertain to the solutions that crop diversity provides.

How to support farmers in the maintenance of crop infraspecific diversity?

- Conservation is not a moral obligation of farmers.
- Economic or cultural incentives to continue growing crop populations identified as key genetic resources
- A key criticism to on-farm conservation is that imposes costs on farmers:
 - Forces or entices them to do something they do not really want to do
 - Keeps them in poverty
 - Constrains their opportunities
- Therefore it may be morally wrong and impractical.
- However, this assumes that farmers are not interested and do not derive important net benefits from diversity.

The demand and supply of crop diversity

- The diverse set of farmer varieties of a crop planted by households in a community results from the interplay between:
 - ***Demand for diversity***: the fact that farmers value different varieties and are willing to invest resources such as labor, money, and land to plant them
 - ***Supply of diversity***: the mechanisms and transactions they depend on access to seed and information about these diverse set of varieties

Intervention: decrease the cost of accessing diversity

- Provide information:
 - Who has what?
 - How do maize types perform under different conditions?
- Gather and make seeds representing crop diversity available at low search cost to farmers
- Contribute to strengthening "traditional" social networks
- Help to create a market of seed for diverse types of maize

Intervention: increase the demand for diversity

- Increasing the value of local crop varieties for farmers who may otherwise stop growing them

- Non-market methods:

- Educational or promotional campaigns
- Increased use of local crop resources
- Farmers' participation in crop breeding and improvement programs



- Market methods:

- Develop new markets for diverse products
- Create market niches
- Re-govern market chains to be biodiversity-friendly
- Put in place legal mechanisms to capture value from diversity, e.g. certification, denomination of origin, etc.

On-farm conservation and climate change

- Climate change is a reality of global relevance.
- A key value of maintaining crop diversity on-farm is that evolutionary processes continue.
- It can contribute to adaptation of agricultural systems to climate change.
- Crop populations in those systems are the winning combinations of genes and traits that result from multiple and unpredictable interactions among a crop, the farmers that grow it and the variety of conditions and environments in which is grown.
- A diversity of winning combinations of genes and traits that are constantly responding to change should allow us to cope with and adapt better to changes.
- Not enough to have *de facto* on-farm conservation sites
- Need to link them and have monitoring and sharing of information and germplasm

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Conclusions

- Can on-farm conservation be done?
 - Yes...
 - but depends on the existence of incentives such as a strong cultural tradition binding a human population to the crop diversity they use and maintain.
- How can it be implemented?
 - A proper diagnosis of the processes behind the loss of crop diversity
 - Understanding and acting on the problems that constrain its implementation.
- Is it worth doing?
 - Yes, particularly under unpredictable conditions associated with global change.

A young child with dark skin and short hair, wearing a bright red sweater with black and white stripes on the sleeves, is the central focus. The child is looking slightly to the right with a gentle smile and is holding a silver fork with a small piece of green vegetable. They are seated at a table with white plates of food, including what appears to be a piece of bread and some green vegetables. In the background, two other children are seated at the same table, but they are out of focus. The setting is a bright, indoor dining area with a window visible on the right side.

Thank you