

Participatory plant breeding for on-farm conservation

Landraces are varieties developed by farmers over many generations of selection without the intervention of formal plant breeding. Numerous landraces provide food security to many people in developing countries and also act as a primary source of breeding material for modern varieties. The use of landraces contributes to stable food production and income,

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especially in marginal environments where the impact of modern varieties is limited. Therefore, the Convention on Biological Diversity (CBD) has recognised the continued maintenance of traditional varieties *in situ* as an essential component of sustainable agricultural development.

In 1995, the International Plant Genetic Resources Institute (IPGRI) together with partners in nine countries, began to explore the potential of on-farm conservation in a global project. *In situ* (on-farm) conservation is the maintenance of species populations in their natural habitats either as uncultivated plant communities or in farmers' fields as a part of existing agro-ecosystems (Jarvis et al 1997). The project intends to develop insights into how on-farm conservation can best be carried out. This includes an analysis of the ways in which sustainable partnerships between the formal and informal sectors can be developed.

Understanding

On-farm conservation is a process (Figure 1) which generates diversity. It encom-

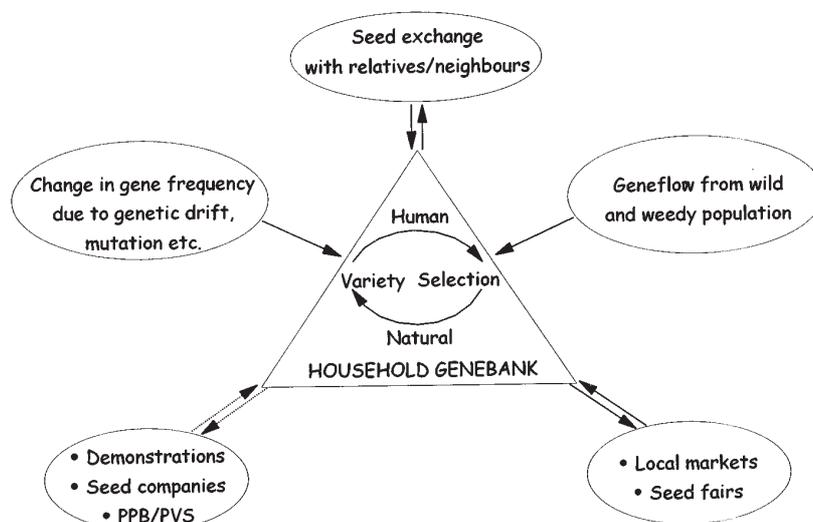


Figure 1 Informal seed supply systems in informal farming systems

passes four distinct steps:

- gene flow from wild to cultivated crops or seed flow through exchange of seeds;
- human selection of varieties;
- natural selection of varieties adapted to local conditions;
- seed storage methods for post-harvest assessment, and seed selection for next season's planting.

Traditional seed supply systems are important sources of diversity. Most farmers obtain the seeds of new varieties from informal seed sources generally within their own community. There are examples of widely diffused new varieties that

were never officially released. This indicates the importance of farmer-to-farmer seed exchange mechanisms. Migrants, marriage outside the community, and outside job opportunities play an important role in seed exchange, especially over long distances between areas isolated by geographical or cultural barriers. Seed exchange, the introduction of new diversity from informal systems and seed fairs enhance the gene flow in villages and meet farmers' immediate needs (Figure 1).

Gene flow through seed exchange between the formal/informal sectors and through local seed merchants results in a dynamic seed supply system. The number of landraces, farmers' varieties and exotic varieties grown in a given locality, their genetic differences, and the area they occupy over time are important factors for sustainable agriculture. Yield stability is an important objective for farmers and an indicator of sustainable agricultural development. Yield stability is associated with genetic diversity, which acts as a buffer against biotic stresses. Participatory plant breeding (PPB) creates new diversity and provides an opportunity for transferring new breeding skills and knowledge thus strengthening on-farm conservation (Box 1).

Threats

Farmers will continue maintaining landraces as long as they see benefits, but they may choose to replace them with modern varieties for the following reasons:

- poor yields of local landraces;
- lack of market for local varieties;
- disease and pest susceptibility;
- poor economic returns;

Table 1. Role of farmer and breeder during PPB process

Fundamental steps	Nature of participation	Farmer	Breeder
Goal setting	Consultative	<ul style="list-style-type: none"> • Opinions and views considered 	<ul style="list-style-type: none"> • Identify farmers using Farmer Network Analysis
Generating new diversity Selection	Collaborative	<ul style="list-style-type: none"> • Site selection for abiotic stress • Rejection of bulk population • Selection within and between population • Post-harvest selection • Trade off multi-traits vs. yield 	<ul style="list-style-type: none"> • Key role • Screening incoming germ plasm • Screening for biotic stresses • Selection - early generations • Training - heritability
Variety release and distribution	Collaborative or collegiate	<ul style="list-style-type: none"> • Informal seed supply system 	<ul style="list-style-type: none"> • Monitoring of spread • Prepare proposal for release

- unwanted traits such as taste;
- access to seeds of modern varieties, input and credit facilities and technical support.

We need to know why farmers grow landraces and where as well as how they maintain and use them. Figure 1 shows that farmers look for new seeds when the varieties they have do not perform well. For a farmer to maintain and use landraces, crop genetic resources must:

- be competitive with other options available to the farmer; and
- provide security and possible increase the farmer's income.

Participatory Plant Breeding (PPB)

When landraces and modern varieties are crossed and when there is a maximum selection by farmers in the target conditions at an early stage of the selection, then the breeding strategy closely resembles *in situ* genetic conservation of landraces (Witcombe et al 1996). A PPB approach using landraces as the source of genetic material for crop improvement symbolises a balance between the two goals of maintaining genetic diversity *in situ* and improving varieties according to the needs of farmers.

Table 1 illustrates four fundamental steps and roles of farmers and breeders in the PPB process. This process has been documented as an output of farmer-researcher interaction in Nepal and is being tested in the project area. The level of participation may vary with the expertise, skills and capacity of participating members. PPB needs to be used when Participatory Variety Selection (PVS) has failed to identify any suitable cultivar or if a new problem is identified in a cultivar.

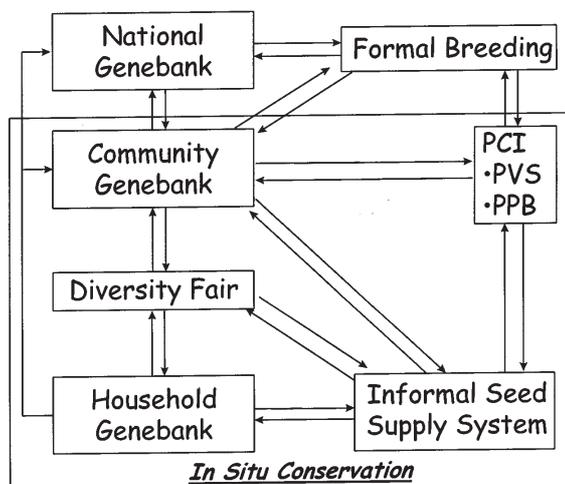
PVS and PPB cycles are inter-linked but still have their own distinct processes

Strengthening on-farm conservation

Does PPB create and conserve genetic diversity *in situ*? Does PPB enhance benefits to farmers? What is the incentive for farmers to collaborate with PPB and on-farm conservation activities? Will adding value to a particular landrace through PPB result in the spread of that variety at the expense of other varieties in the system? Six countries in the IPGRI's global project will address some of these technical questions.

Currently, on-farm conservation is under the domain of the farming community. Strengthening the capacity of farmers and local organisations will enhance on-farm conservation of crop genetic resources, thereby improving farmers' livelihoods. On-farm conservation can be strengthened through activities in the farming community, such as diversity fairs, community seed banks and PPB at grassroots (Figure 2). However, it requires more collaboration between the formal sector of plant genetic resources institutions and the informal sectors including community-based organisations (CBOs). Farmers' ability and knowledge of breeding have been generally undervalued if not ignored by plant breeders. Farmers, like plant breeders, have their own selection criteria to evaluate new cultivars.

Community participation in PPB in villages has empowered farmers. Farmers participating in PPB benefit from early access to new materials, gain recognition from the community and learn new selection techniques. In Nepal, farmers involved in PPB have successfully sold seeds of the new varieties at a higher price than the local landraces (Sthapit et al., 1996). The products of PPB remain under the control of the informal seed system. While a direct recompense to farmers is not intended in the framework of the project, it is important that the global and national investment in farmers' welfare is seen as indirect compensation in recognition of their role in on-farm crop conservation. This kind of indirect compensation may reach more farmers and thus be more equitable than a system of payment to a few farmers. PPB may, therefore, enhance community participation in managing local genetic resources making full use of farmers' knowledge and skills in crop improvement.



Acronyms:

- PCI: Participatory Crop Improvement
- PVS: Participatory Variety Selection
- PPB: Participatory Plant Breeding

Figure 2 Participatory Plant Breeding and its linkages with *in situ* and *ex situ* conservation

Box 1.

Participatory crop improvement: definitions

(Joshi & Witcombe 1996; Sthapit et al 1996; Witcombe et al 1996).

Participatory Variety Selection (PVS)

PVS is the selection of fixed lines (released, advanced lines or landraces) by farmers in their target environments using their own selection criteria

A successful PVS involves the following four steps:

- identification of farmers' needs in a cultivar;
- search for suitable materials;
- experimentation on its acceptability in farmers' field; and
- wider dissemination of farmer-preferred cultivars.

Participatory Plant Breeding (PPB)

PPB is a breeding process in which farmers and plant breeders jointly select cultivars from segregating materials under target environment.

A successful PPB has the following features:

- understanding reasons for growing diverse varieties;
- identification of expert farmers with skills in managing diversity and seed selection;
- setting up breeding goals (and roles of participants) jointly to meet farmers' needs;
- use of landraces as parent materials;
- decentralised selection of segregating lines by farmers;
- use of farmers' observation and opinions;
- farmer participation at all stages of selection and evaluation;
- transfer of skills and knowledge between breeder and farmer;
- evaluation and monitoring of varietal spread by scientists;
- use of informal seed supply systems for wider dissemination.

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