# On-farm conservation of plant genetic resources for food and agriculture

Article · September 2004

CITATIONS
27

READS
1,110

4 authors, including:

Baldev S Dhillon
Punjab Agricultural University
143 PUBLICATIONS 2,341 CITATIONS
SEE PROFILE

Pratibha Brahmi
National Bureau of Plant Genetic Resources
31 PUBLICATIONS 197 CITATIONS
SEE PROFILE

Ishwari Bisht
Indian Council of Agricultural Research
15 PUBLICATIONS 146 CITATIONS
SEE PROFILE

# On-farm conservation of plant genetic resources for food and agriculture*

*B. S. Dhillon, R. P. Dua, Pratibha Brahmi and I. S. Bisht*

*Plant genetic resources for food and agriculture have been under threat due to various factors that have emerged as a result of overall development and food-security needs. This has also reduced the on-farm diversity. Here we present a viewpoint regarding conservation of on-farm diversity.*

Plant genetic resources for food and agriculture (PGRFA) are of critical importance to the food security of the present and future generations. They are the most fundamental of all resources on earth. They are threatened due to various factors such as (i) replacement of landraces and farmers' varieties by widely adapted improved varieties and hybrids[1], which generally have genetic homogeneity and related pedigree, (ii) habitat destruction, (iii) developmental projects, (iv) infrastructural development, (v) alien-species invasion, (vi) mechanization of agriculture, etc. Most of these threats have emerged as a result of development for overall progress and food security. In fact, erosion of genetic diversity, including that of ecosystems down to species level, started with evolution of agriculture and got enhanced with formal plant breeding and the advent of high-yielding varieties. It needs to be understood that once a cultivar is better than others, it is bound to be cultivated on a larger area. Thus, plant breeding itself adversely affects on-farm crop diversity, even though it is also a fact that genes from diverse genetic resources are combined together in improved cultivars. It has now been realized that a balance between overall progress and environmental protection and conservation and sustainable utilization of PGRFA is urgently required to ensure food security of the present generation and for the future.

There are several features unique to PGRFA, which have to be understood before their conservation issues are discussed. The most important is that PGRFA are the result of conscious and unconscious human intervention. The selection and improvement of PGRFA by farmers is going on since the origin of agriculture and the *in situ* diversity of these is concentrated in particular parts of the world. These so called 'centres of diversity' are largely located in developing countries. The association of crop species with human migration has led to the spread of many crops, varieties and genotypes to different corners of the world and they have continued to evolve both inside and away from their historic centres of diversity. Also, countries are interdependent with respect to PGRFA since most of the crops grown by them have originated/domesticated elsewhere. Further, only a small portion of these resources has been collected and used in crop improvement; and PGRFA, in general, are under-conserved and under-utilized. The activities related to conservation and utilization of PGRFA have been carried out in parallel without adequate linkage and coordination, which has resulted in overlaps as well as gaps in resource conservation and utilization[2]. Several conventions and treaties like Convention on Biological Diversity (CBD), International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and Global Plan of Action (GPA) for conservation and sustainable utilization of PGRFA at the international level, have recognized the importance of these aspects of PGRFA. The GPA was adopted at Leipzig, Germany in June 1996 during the Technical Conference on Plant Genetic Resources. It focuses attention to the importance of PGRFA for world food security, and commits countries to implement the plan. One of the major activities of GPA is '*in situ* conservation and development' that includes 'supporting on-farm conservation and improvement of PGRFA'. Here we present our viewpoint on on-farm and conservation of PGRFA, in a narrow sense, that is conservation of locally adapted cultivars and landraces.

## Conventional conservation methods

Two prevalent methods to conserve plant diversity are *in situ* and *ex situ*. In *ex situ* conservation the genetic resources are conserved outside their natural habitat in identified genebanks. These genebanks can be storage of seed (≈ 5 to – 20°C), *in vitro* storage of plantlets (≈ 4 to 25°C), cryo storage of propagules using liquid nitrogen (≈ – 150 to – 196°C) or in the form of field genebanks. Of these, seed storage is the easiest, cost-effective and most common for the species having orthodox seed (seed which can be dried to a low moisture content and stored at low temperatures without loss in viability). The vegetatively propagated species and those having recalcitrant seeds (seeds which are sensitive to desiccation) are maintained in field genebanks, which is a cumbersome option. In these species *in vitro* and cryo preservation techniques are being increasingly used. However, it may be added that in *ex situ* conservation, it may not be humanly possible to collect every distinct genotype. Further, in *ex situ* conservation methods the variability that has been collected remains static because the evolution process is not allowed to continue, as in nature.

*In situ* approach of conservation is at the level of ecosystems and natural habitats, and it includes the maintenance and recovery of viable populations of species in their natural surroundings, or, in the case of domesticated species, in the surroundings where they have developed distinctive properties. This approach involves two methods[3]. One is the genetic reserve, which is defined as the location, management and monitoring of genetic diversity of natural wild populations within defined areas for active and long-term conservation. The second is the on-farm conservation, which is sustainable management of the genetic diversity of locally

*The views expressed are of the authors, and not of National Bureau of Plant Genetic Resources or Indian Council of Agricultural Research.

developed traditional crop varieties along with associated wild and weedy species or forms within traditional agricultural, horticultural or agri-silvicultural cultivation system. *In situ* methods, including on-farm conservation, have an advantage over *ex situ* methods since they provide for a natural laboratory for evolution to continue and help in gradual build-up of traits imparting adaptation to specific eco-geographical region and those matching the requirements of local tribes, communities and populations. New and more adapted types are evolved and thus diversity gets augmented.

Keeping in view the need for on-farm conservation, some proposals are given below for conservation of locally adapted cultivars and landraces.

## Some operational considerations for on-farm conservation of PGRFA (cultivars and landraces)

The on-farm conservation of PGRFA is particularly important for a diversity-rich country like India. Small and poor farmers in India generally practice low-input farming and are dependent on, in addition to crop plants, wild and semi-wild species for food and other needs[4]. For the conservation of diversity in these species, farmers and communities need to be targeted, particularly in diversity-rich areas. However, the task of on-farm conservation is huge and complex; and its benefits are to be accrued nationally (also internationally, depending on various agreements and treaties). It needs to be taken up on a wider plane in a national network mode. This network could be difficult to operate, as it needs contribution of various diverse partners at different levels and has to be operated in an integrated manner. Also, it needs support in terms of government policy, incentives, local marketing network and also value addition, besides community awareness. Some important considerations for successful implementation of the network are presented below:

- The farmer is the pivotal partner in the network, who needs to be educated about the effect of genetic erosion and the significance of biodiversity conservation and utilization. He should be encouraged and supported through various inputs to continue cultivating or at least conserving as much plant diversity as possible. There are many examples of farmers carrying out on-farm conservation[5]. An understanding of what and why farmers do, in a two-way process would help the researchers and policy makers to help farmers effectively and extend the practice to other farmers also[6].
- Value addition in the products of landraces is an important aspect, which has not been given due attention. This would essentially encourage farmers to cultivate landraces/traditional varieties, where value addition is available and the produce can fetch higher price.
- For popularization and enhancing the consumption of food products of local varieties, food festivals need to be organized. This may help in changing the culinary habits and tastes of the urban people, thus creating more demand for local products, which would help in cultivation/conservation of landraces.
- Arranging biodiversity fairs would bring farmers together, where they can exchange views and knowledge about the importance and uses of cultivating different types of cultivars/landraces.
- The promotion of organically produced food products for export and indigenous consumption will encourage farmers to cultivate the local varieties/ landraces which require low inputs.
- The tradition of having kitchen gardens for household use and maintenance of locally used herbs should be encouraged at village level.
- Participatory variety selection programmes may be undertaken for stressed ecologies and the crop plants adapted thereto. This will facilitate selection for improved cultivars with specific adaptation.
- A liberal policy of varietal release should also be considered. Even if a variety can occupy a few thousand acres, it should be promoted in view of its specific adaptation and for enhancing on-farm diversity.
- Urgent measure must be taken to stop encroachment of government land along canals, railway lines, roads, etc. as these areas support appreciable plant diversity.
- Notwithstanding all the above measures, a farmer or community opting for on-farm conservation is contributing to the national/international cause to ensure the well-being of present and future generations. Their efforts, therefore, need to be appreciated and supported. This could be through a national policy on on-farm conservation and management encompassing the provision of monetary and non-monetary incentives to those opting for on-farm conservation.

## Partners in the proposed network

*Farmers*: The most critical partner of the network is the farmer, as discussed earlier. Besides educating the farmers and promoting their on-farm conservation efforts, it may be worth consideration to expect some obligatory contribution by farmers having large land holdings. For example, it should be made obligatory for farmers having 2 ha or more land to put about 0.5 to 1% of the area under on-farm conservation of any one landrace of that region in each crop season. The vast majority having less than 2 ha should be encouraged to reserve a small plot to conserve a landrace in each crop season.

Every such farmer may conserve a different landrace; and different crops may be assigned to a cluster of villages depending on crop diversity. In case the produce is not locally consumed or is in excess of market demand, which may be in exceptional cases, the marketing of produce should be ensured.

*Other partners*: The other partners expected to contribute to the on-farm conservation are as follows:

- The crop-based ICAR institutes, State Agricultural Universities and their regional stations should maintain the landraces, particularly those adapted to the region.
- The State Agricultural Departments have vast human and land resources. They should develop crop diversity gardens for the locally adapted crops, at least on one farm per district, and focus on awareness generation on crop diversity conservation.
- The armed forces generally have large agricultural farms. They should be encouraged to keep some area reserved for conservation of local varieties/landraces adapted to the region.
- Each block samity/municipal corporation/municipal committee/panchayat should be asked to establish at least one diversity garden of locally available crops, supported by financial assistance from the Government.
- Some *Gurukuls* and *Ashrams* are maintaining good medicinal/herbal gardens.

The Government may consider giving some incentives to promote such activities.

- Some of the civil society organizations closely associated with farming community, can play a pivotal role in on-farm conservation of crop diversity[7].

All these partners are expected to maintain locally adapted cultivars and landraces in small plots. Though it apparently seems to be *ex situ* conservation, conservation of large number of cultivars and landraces in multiple small plots is more akin to on-farm conservation.

In addition, some well-established colleges and schools either do not have biodiversity gardens or have gardens, that are not well maintained. These institutions need to be encouraged to take up such projects for maintenance/establishment of such gardens.

For effective on-farm conservation and management of PGRFA, the efforts of various partners of the proposed network (farmers, research organizations, State Departments, local self-governments, civil society and other organizations) are needed. The Biological Diversity Act, 2002 provides for Biodiversity Management Committees at the level of local self-government and State Biodiversity Board at the State level[8]. These committees and boards should plan and monitor the management of agro-biodiversity, including on-farm conservation of PGRFA. According to the Act, the Biodiversity Management Committees for each local self-government are also required to maintain 'People's Biodiversity Registers' for recording the diversity available at village level. Besides coordinating at various administrative and technical levels, linking of People's Biodiversity Registers with the national database would be required for efficient on-farm conservation of PGRFA.

1. Brush, S. B., *Econ. Bot.*, 1991, **45**, 153–165.
2. FAO, The Global Plan of Action, 1996.
3. Hawkes, J. G., Maxted, N. and Ford-Lloyd, B. V., In *The ex situ Conservation of Plant Genetic Resources*, Kluwer, The Netherlands, 2002, pp. 1–16.
4. Bellon, M. R. and Brush, S. P., *Econ. Bot*., 1994, **48**, 196–209.
5. Swaminathan, M. S. (ed.), *Gender Dimension in Biodiversity Management*, Konark Publishers Pvt Ltd, 1998, pp. 76–210.
6. Bellon, M. R., Proceedings of International Development Research Centre Workshop, New Delhi, 1995, pp. 9–22.
7. Chakrabarti, K., *India Today*, 2002, **XXVII**, p. 12.
8. Anon. Gazette Notification no. D.L. 33004/ 2002, No. 42, Ministry of Law and Justice and Company Affairs (Legislation Department), Govt. of India, New Delhi. 2002, p. 24.

*The authors are in the National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi 110 012, India.*
*e-mail: director@nbpgr.delhi.nic.in*