On-farm Conservation–Initiatives by NBPGR in the Western Himalayan Region

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Introduction

Large number of plant genetic resources have been collected and conserved *ex situ* in the gene banks, the world over. These genetic resources have been effectively used for breeding new crop varieties and enhancing food production. While doing so, the very important form of conservation *in situ* (on-farm), which has resulted into large *ex situ* collections, received less attention and lots of valuable materials were lost from farmer's field. On-farm conservation has been recognized as a participatory and dynamic approach involving farmers and their long established skills and knowledge on genetic resources. Being dynamic, it makes continuum in the evolutionary processes, thereby create useful genetic variability within traditional agricultural systems (Brush, 1999; Bisht *et al.*, 2006). It also supports large number of rare alleles and genotypes evolved spatially and temporally than the accessions conserved in the gene banks (Jarvis *et al*., 2008). These rare combinations of new alleles are capable to cope with wide variety of stresses and have been reviewed in detail (Oldfield and Alcorn 1987; Iwanaga 1995; Maxted *et al.*, 1997a,b; Brush and Meng 1998; Sthapit *et al*., 2008). Germplasm specialists must therefore, explore genetic variations to identify germplasm with traits for developing crops cultivars adapted to these stresses from materials conserved and cultivated on-farm as they have withstood the competition with their improved allies over the years and is testimony to their resilience to frequently changing environments. Despite these facts, changing cropping patterns, increasing interest towards cash crops, large scale migration leaving agricultural field abandoned and couple of other factors discussed later in the text are posing challenge for promoting on-farm conservation (Maikhuri *et al.*, 1996; Rana *et al*., 2001) not only in cash crops dominating regions but also in remote and marginal hill areas which by and large practice traditional farming systems. The present study was, therefore, designed to understand the dynamics of crops diversity and farmers' innovation, initiative, opportunities and limitations in the on-farm conservation of PGR.

Materials and Methods

The selection of site is a very important process to achieve the objectives of on-farm conservation and therefore, it should have ecological, socio-economic and institutional consideration (Sthapit and Jarvis, 2005). The Western Himalayan region is characterized by a complex mosaic of distinct micro-environments housing variety of climate, soil, geological, vegetation and crop growing features (Rao and Saxena 1994; Maikhuri *et al.*, 2001; Rana *et al*., 2008) and therefore, provide unique opportunity for undertaking on-farm conservation. The important indicators that we used for selecting the site were (i) number of house holds/ population structure, (ii) targeted crops, (iii) ecological, crop species and varietal diversity, (iv) cropping and land use pattern, (v) farming communities enthusiasm/ interest, (vi) potential to undertake on-farm conservation activities, (vii) imminent threat of genetic erosion, (viii) level of awareness among farmers/ farmer groups, (ix) level of technological interventions, (x) livelihood strategies/ dependence of agriculture, and access to market. In totality, we surveyed 24 sites and finally selected three which were meeting the criteria and objective laid to start on-farm conservation programme on two rice landraces, *viz.*, *Chuhatu* and *Jattu* and two crops, *viz.*, grain amaranth and finger millet (Fig. 1). Each site is a cluster of villages with overlapping boundaries and agricultural fields.

The programme mainly focused on participatory, dynamic, and farmer-based approach for the conservation, enhancement and utilization of crops and varieties of local importance. We carried out survey and collection work in 2006 and 2007 involving farmers, scientists and local extension specialists at 24 sites. After doing critical analysis three sites as mentioned above were selected to undertake the work more focused and systematic. Women farmers, in particular, were encouraged to participate because they provided more information and had greater role in seed conservation. As a first step, we collected the germplasm, evaluated, purified and given back to farmers. Germplasm comprising grain amaranth (284 accessions) and finger millet (126

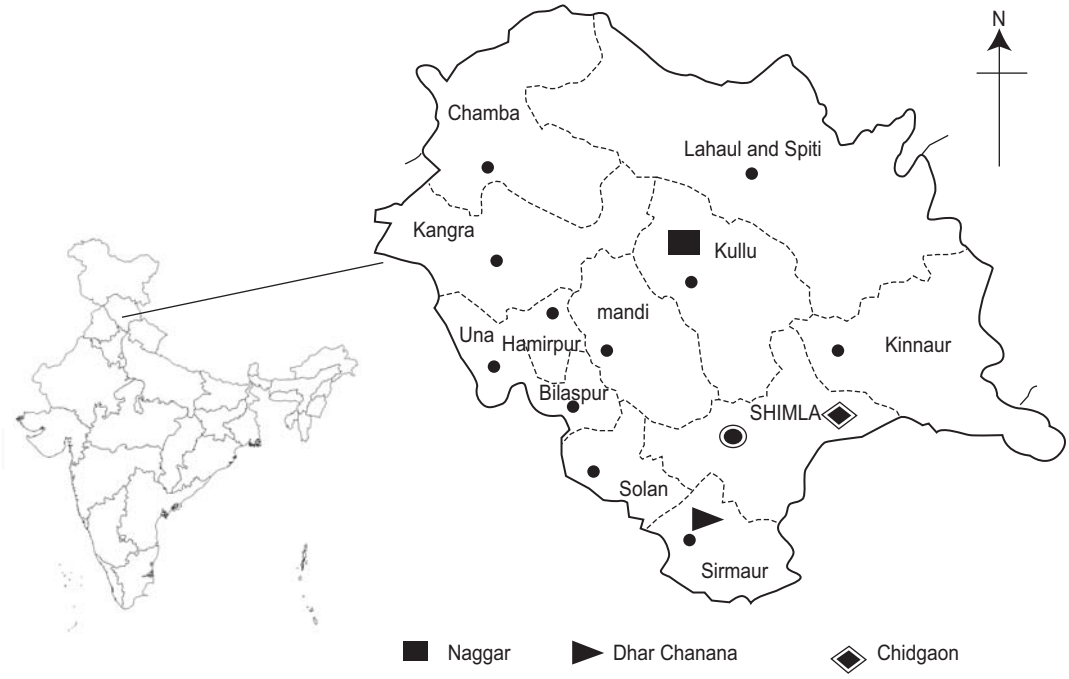

Fig. 1: Sites for on-farm conservation in Himachal Pradesh

accessions) were collected from different sites in the year 2006 and 2007. These were evaluated at NBPGR Regional Station, Shimla and elite types selected involving farmers were given back to farmers. In case of rice, 48 landraces including the two, *i.e.*, *Chuhatu* and *Jattu* were collected in the year 2008. The material is being evaluated at NBPGR Regional Station, Bhowali and Himachal Pradesh Agricultural University, Regional Station, Malan.

Results and Discussion

(i) Naggar: Geographically, It is located at an average elevation of 1875 amsl, 32º12’49"N and 77º12’02"E in Kullu district and selected for promoting cultivation of *Jattu* landrace–a cold tolerant red grained rice. It occupies around 600-800 ha area spread in Chhaki, Halanseri, Rajhan, Sarsai and Naggar villages. The landholdings varied from 0.21-6.45 ha/family while area under *Jattu* varied from 0.04-2.20 ha/family.

(ii) Chidgaon: It is located in Shimla district at an average elevation of 1750 amsl and 31º13’12"N and 77º48’25"E. It was selected for promoting a cold tolerant medicinal red grain landrace, *viz. Chuhatu* which is grown in ~1000 ha in Masli, Dadholi, Jannadee, Badhiara, Jagla, Todsa and Thana villages. The average area under *chuhatu* vary from 0.08-1.6 ha/family as compared while total landholdings were 0.24–4.40 ha/family.

(iii) Dhar Chanana: It is located in Sirmour district at an average elevation 1550 amsl and 30º52’51"N and 77º42’18"E. This site was primarily selected for grain amaranth and finger millet Two landraces of rice, *viz.*, *Bhaoj* and *Katan* which are grown since many years and now facing threat from cash crops, has been included. The area under grain amaranth and finger millet vary from 150-200 ha and 25-50 ha, respectively, in Khadah, Deuthi, Anog, Chanana, Chindi, Dhatauli Kothi villages. The area under grain amaranth varied from 0.01-0.4 ha/family while it was 0.009-0.08 ha/family for finger millet.

The amount of genetic diversity in an agricultural system is perhaps one of the important characteristic for its stability and long-term sustainability. Wide range of crops and varieties are grown in the sites both as pure and inter-cropped. Farmers in general practice low input agriculture and conserving significant amount of crop diversity which is more in Dhar Chanana than Chidgaon and Naggar. The major crops grown in *kharif* season include rice, maize, mash, rajmash, horse gram, buckwheat, amaranth, finger millet, foxtail millet, potato, tomato, *Capsicum*, apple, pear, and many other seasonal vegetables, fruits and spices while these were wheat, barley, lentil, pea, garlic and mustard in *rabi* season. The varietal composition includes landraces, locally adapted obsolete varieties (for cereals, pulses,

pseudocereals and small millets) and newly released varieties and hybrids (fruits and vegetables). The agriculture is primarily rainfed but rice is grown along the riverside/ valleys under irrigated condition for which water is obtained either from natural springs/ snow melt.

The analysis of the socio-economic surveys revealed very low level of awareness (varied from 3-18%) on the genetic resources and their management not only among farmers but also in local extension workers. Therefore, as a second step, we organized brainstorming sessions involving all the stakeholders at Shimla, Palampur and Kullu. They were sensitized on the importance of agro-biodiversity, medicinal and nutritional value of traditional crops and varieties, role of genetic resources in the land use management, against various stresses and ensuring food security. As a result, it was noticed that there was significant improvement in the awareness and attitude of farmers towards traditional crops and varieties and we could successfully promote and reintroduce these crops particularly amaranth and finger millet even in those areas from where they had disappeared, for instance, areas dominated with commercial or cash crops. They were also taken to sites of germplasm evaluation to have their inputs to identify elite types.

Studies are underway to document and build on the existing knowledge and practices relating to landraces production and management on selected sites. The data on ethnobotany and population biology, focusing on the population structure and dynamics of the traditional crops and landraces for more effective planning and management of on-farm conservation strategy is being generated. Another aspect of the programme would be to restore some selected landraces particularly of rice in areas where farmers had once planted them extensively, but now those regions are dominated by cash crops or improved varieties. We came across around 24 farmers who showed willingness to grow some of their old landraces, if seed material is made available to them. We also planned to expand on-farm conservation programme including creation of community gene banks in other crops like barley, maize and French bean and also to identify and establish strategic on-farm pockets as models.

Despite the fact that traditional crops and varieties are finding new market particularly in the emerging regimes of new tourism policies such as homestead tourism, and have better scope over their improved allies in the context of climate change and organic farming. Nevertheless, there are some concerns and/or operational difficulties which we come across during field work. For instance, gradual reduction in area of traditional crops and farmers preferences for other introduced (cash) crops is induced by the economic and socio-cultural factors. In Chidgaon and Naggar, farmers particularly the young farmers were found more interested to take up apple and off-season vegetables than rice cultivation. The reason behind was not only the economic consideration, but the amount of labour being put in for growing rice and grain amaranth. About 64% of the farmers including young were of the view that they can get more money by growing apple which needs onetime planting and less afterwards care. While talking on food security issue, they were less worried and probably owing to public distribution system where food grains were sold at much cheaper rate. It was observed that dependence of farmers for food grains on ration shop and open market was very high, *i.e.*, 40-100% in Chidgaon and Naggar than Dhar Chanana where it was 10-55% because farmers were growing more number of crops. Moreover, 58% of the farmers in Dhar Chanana had reserve stocks of amaranth and finger millet ranging from 3.0 to 25 q/ family, thus this site was found more food secured than others.

There has been a sea change in the food habits. A shift has occurred from coarse grains (maize, amaranth, buckwheat and small millets) to fine grains (wheat and rice) as the latter being considered “symbol of progress” and easy to digest. By and large, the younger generation is not keen to adoption of traditional technologies and food recipes as better substitutes are available (the views were recorded during surveys). Moreover, there is no guaranteed buyer or assured buy back system for products of on-farm conservation, be it landraces or crops. Further, there is no in-built mechanism to incentivise the farmers who are willing to adopt on-farm conservation activities. As a result, despite being aware on the loss of genetic resources, farmers are shifting to better options. Besides, there are many other associated factors leading to operational difficulties such as opting agriculture as profession is least priority, subject to natural vagaries, attack of wild animals, rural to urban migration, fixed targets to enhance seed replacement rate by the department of agriculture and agriculture universities, selling seeds of modern varieties at subsidized cost and lack of valuation/ value addition of the traditional crops and varieties.

Conclusion and Perspectives

The present programme has been systematically initiated only two years ago; it will be too early to conclude our findings. Nevertheless, on-farm conservation has potential to sustain the evolutionary systems that are responsible for generating variability and provide therefore, a valuable option for conserving crop diversity. The ability of traditional varieties and crops to survive under stress is conditioned by a broad genetic base than the more uniform new cultivars which have narrow genetic base and poor adaptability to micro-climatic niches of mountains. Though on-farm conservation has prospects, but at the same time it has challenges emerging from the changing agricultural scenario. Therefore, the complexities of on-farm conservation are required to be understood in the background of these challenges including population growth and increasing demand for food. Nevertheless, conserving biodiversity in its dynamic form should be identified as top priority in any conservation strategy.

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