regarding its terminology, concepts, approaches, and methodologies. These will have to be refined over time from the experiences and the work done so far, as well as through more PPB programs and projects in the future in different production and breeding systems and in different socioeconomic and institutional settings. This also warrants more collaboration and partnerships as well as institutionalization in national agricultural research systems. Training courses and orientation programs must also be designed to develop human resources in this area of research and development.

References

Biggs, S.D. 1989. *Resource-poor farmer participation in research: A synthesis of experiences from nine national agricultural research systems.* OFCOR Comparative Study Paper No. 3. The Hague: International Service for National Agricultural Research.

Ceccarelli, S., S. Grando and R.H. Booth.1996. International breeding program and resource-poor farmers: Crop improvement in difficult environments. In *Participatory plant breeding, proceedings of a workshop, 26–29 July 1995, Wageningen, The Netherlands*, edited by P. Eyzaguirre and M. Iwanaga. Rome: International Plant Genetic Resources Institute.

DTZ Peida. 1999. An evaluation study of participatory crop improvement in Nepal: A final report. Edinburgh: DTZ Peida Consulting. *Unpublished.*

Hardon, J. 1996. The global context: Breeding and crop genetic diversity. In *Participatory plant breeding, proceedings of a workshop, 26–29 July 1995, Wageningen, The Netherlands*, edited by P. Eyzaguirre and M. Iwanaga. Rome: International Plant Genetic Resources Institute.

Hardon, J.J. and W.S. de Boef. 1993. Linking farmers and breeders in local crop development. In *Cultivating knowledge: Genetic diversity, farmer experimentation and crop research*, edited by W. de Boef, K. Amanor, K. Wellard, and A. Bebbington. London: Intermediate Technology Publications.

Joshi, A. and J.R. Witcombe. 1996. Farmer participatory crop improvement II: Participatory varietal selection, a case study in India. *Experimental Agriculture* 32:461–477.

Joshi, K.D. and B.R. Sthapit. 1990. *Informal research and development (IRD): A new approach to research and extension.* LARC Discussion Paper 1990/4. Pokhara, Nepal: Lumle Agricultural Research Centre.

Joshi, K.D., R.B. Rana, B. Gadal, and J.R. Witcombe. 1998. The success of participatory varietal selection for *chaite* rice in high potential production systems in the Nepal *terai*. In *Proceedings of the International Conference on Food Security and Crop Science, 3–6 November 1998.* Hissar, India: Hariyana Agricultural University.

Joshi, K.D., R.B. Rana, D.S. Virk, and J.R. Witcombe. 1999. *Evaluating the relevance of participatory variety selection approaches for offering varietal choice on main season rice in HPPS of Chitwan and Nawalparasi districts of Nepal (1997–1998).* Pokhara, Nepal: Local Initiatives for Biodiversity Research and Development.

Joshi, K.D., M. Subedi, R.B. Rana, K.B. Kadayat, and B.R. Sthapit. 1997. Enhancing on farm varietal diversity through participatory varietal selection: A case study for *chaite* rice in Nepal. *Experimental Agriculture* 33:335–344.

Joshi, K.D., D.K. Rijal, R.B. Rana, S.P. Khatiwada, P. Chaudhary, K.P. Shrestha, A. Mudwari, A. Subedi, and B.R. Sthapit. 2000. Participatory plant breeding, seed networks and grassroots strengthening: Adding benefits. In *Proceedings of a workshop on conserving agricultural biodiversity in situ: A scientific basis for sustainable agriculture, 5–12 July 1999, Pokhara, Nepal*, edited by D. Jarvis, B. Sthapit, and L. Sears. Rome: International Plant Genetic Resources Institute.

PRGA 1999. *Crossing perspectives: Farmers and scientists in participatory plant breeding.* Cali, Colombia: CGIAR Systemwide Program on Participatory Research and Gender Analysis, Centro Internacional de Agricultura Tropical.

Rana, R.B., K.D. Joshi, B. Gadal, D.S. Virk, and J.R. Witcombe. 1999. *Baseline report: Participatory crop improvement project of Chitwan and Nawalparasi districts of Nepal.* Pokhara, Nepal: Local Initiatives for Biodiversity Research and Development.

Sperling, L. 2000. Recent advances in participatory plant breeding. Paper presented in the First South and South East Asian PPB symposium, 1–5 May 2000, Pokhara, Nepal.

Sperling, L. and U. Scheidegger. 1996. *Results, methods, and issues in participatory selection: Case of beans in Rwanda.* IIED Gatekeeper Series No. 51. UK: International Institute for Environment and Development.

Sperling, L., M.E. Loevinsohn, and B. Ntabomvra. 1993. Rethinking the farmers' role in plant breeding: Local bean experts and on-station selection in Rwanda. *Experimental Agriculture* 29:509–519.

Sthapit, B.R. and D. Jarvis. 1999. Participatory plant breeding for on-farm conservation. *LEISA* 15(3–4):40–41.

Sthapit, B.R. and A. Subedi. 2000. Participatory approaches in plant breeding: Experiences and insights of an NGO in Nepal. In *Encouraging diversity: The conservation and development of plant genetic resources*, edited by C. Almekinders and W. de Boef. London: Intermediate Technology Publications.

Sthapit, B.R., K.D. Joshi, and J.R. Witcombe. 1996. Farmer participatory crop improvement III: Participatory plant breeding, a case study for rice in Nepal. *Experimental Agriculture* 32:479–496.

Subedi, A. and K.D. Joshi. 1998. Participatory variety selection and participatory plant breeding: Innovative approaches to enhance plant genetic resource base. Paper presented at the regional meeting to promote and facilitate the implementation of a global plan of action for the conservation and sustainable use of plant genetic resources for food and agriculture in Asia and the Pacific, 15–18 December 1998, Manila, the Philippines.

Subedi, A., R.B. Rana, and K.D. Joshi. 1997. Methodological approach to PPB: Experiences from Nepal. In *Strengthening the scientific basis of in situ conservation: Options for data collecting and analysis, proceedings of a workshop to develop tools and procedures for in situ conservation on-farm, 25–29 August 1997, Rome, Italy*, edited by D. Jarvis and T. Hodgkin. Rome: International Plant Genetic Resources Institute.

Subedi, A., K.D. Joshi, P. Shrestha, and B.R. Sthapit. 2000. Experiences in participatory approaches in crop improvement in Nepal. In *Participatory approaches to the conservation and use of plant genetic resources*, edited by E. Friis-Hansen and B.R. Sthapit. Rome: International Plant genetic Resources Institute.

Weltzein, E./Smith, M.E., L.S. Meitzner, and L. Sperling. 1999. *Technical and institutional issues in participatory plant breeding—Done from a perspective of formal plant breeding: A global analysis of issues, results and current experience.* Working Document No. 3, October 1999. Cali, Columbia: CGIAR Systemwide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation, Centro Internacional de Agricultura Tropical.

Witcombe, J.R. 1999. Do farmer-participatory methods apply more to high potential areas than to marginal ones? *Outlook on Agriculture* 28(1):43–49.

Witcombe, J.R., A. Joshi, K.D. Joshi, and B.R. Sthapit. 1996. Farmer participatory cultivar improvement I: Varietal selection and breeding methods and their impact on biodiversity. *Experimental Agriculture* 32:445–460.

Witcombe, J.R., K.D. Joshi, R.B. Rana, and D.S. Virk. 2000. Increasing genetic diversity by participatory varietal selection. *Euphytica* (in press).

Zhou, Y.Y., H.R. Chen, J.H. Fan, Y.Y. Wang, J.B. Li, J.X. Chen, S.S. Yang, L.P. Hu, H. Leung, T.W. Mew, P.S. Teng, Z.H. Wang, and C.C. Mundt. 2000. Genetic diversity and disease control in rice. *Nature* 406:718–722.

Annex A. Roles and Responsibilities Agreed between LI-BIRD, Pragatisheel Yuba Club, and Srijansheel Mothers' Group on Various Tasks in PPB Process (for High-Altitude Rice)

Tasks	Roles/Responsibilities		
	Srijansheel Mothers' Group	Pragatisheel Yuba Club	LI-BIRD
1. Preference ranking	1	1	2
2. Management of new materials			
2.1. Selection of landraces for PPB	1	1	2
2.2. Identification of MVs for PPB	2	2	1
2.3. Segregating lines	-	-	1
3. Farmers and plot selection	1	1	2
4. Interculture operations	1	1	-
5. Crop management	1	1	-
6. Field visits	2	1	3
7. Variety/plant selection	1	1	2
8. Harvesting of selected lines/plants	1	1	2
8.2. Assessment for shattering	1	1	3
8.3. Drying/storing	1	1	-
8.4. Yield estimation	1	2	-
8.5. Assessing line for milling	1	2	-
8.6. Taste assessment	1	2	-
8.7. Final selection	1	1	2
9. Monitoring spread	3	2	1
10. Record keeping of progress	2	1	3
11. Skill-transfer hands-on training	2	2	1
12. Call for meeting/consultation	1	2	3

Source: Letter of agreement between LI-BIRD and Maramche CBOs, December 1998.
Note: Roles are given in order of priority (i.e., 1 = leading role, etc.).

Annex B. Roles and Responsibilities of Farmers and Researchers on Various Tasks in PPB Processes (In Situ Crop Conservation Project), April 1999

Tasks	Participation		
	Farmer	Researcher*	Institution*
Categorization of landraces	***	**	NARC*** NARC**
Validation of landraces	***	**	LI-BIRD*** NARC**
Preference ranking for parent identification	***	**	LI-BIRD*** NARC**
Documentation of positive and negative traits	***	**	LI-BIRD*** NARC**
Matrix ranking for trait improvement	***	**	LI-BIRD*** NARC**
Goal setting with farmers (landrace parent)	***	**	LI-BIRD*** NARC**
Farmer selection	***	**	LI-BIRD*** NARC**
Creating diversity	**	***	LI-BIRD*** NARC**
Growing F_1 lines	**	***	LI-BIRD*** NARC**
Orientation to staff and participant farmer	**	***	LI-BIRD*** NARC**
Site selection	***	**	LI-BIRD*** NARC**
Screening segregating lines against abiotic stresses	***	**	LI-BIRD*** NARC**
Screening segregating lines against biotic stresses	**	***	NARC***

Source: Joshi et al. (2000).
Note: **=Subordinate role; *** = Lead responsibility.

Landrace Renaissance in the Mountains: Experiences of the *Beej Bachao Andolan* in the Garhwal Himalayan Region, India

Vir Singh and Vijay Jardhari

Abstract

The development of on-farm conservation of agrobiodiversity is of particular significance in inaccessible, fragile, and risk-ridden mountain areas, such as the Garhwal Himalayan Region in India. Having experienced the negative impact of conventional institution-led breeding programs (that neglect farmers and their knowledge systems), the farmers in the mountains of Garhwal launched the *Beej Bachao Andolan*—the Save Seed Movement. The main objectives of this movement are to save the seeds of the landraces the farmers have developed over several generations of selection and to strengthen and restore sustainable organic systems of farming.

The farmers are doing their own experimentation on the landraces in the Henwal Valley of Garhwal and comparing the results with the formal-led demonstrations of high-yielding varieties (HYVs). Many of the landraces produce more foodgrains than the HYVs do; straw-grain ratios and recovery percentages of most of the landraces are also considerably higher than those of the HYVs propagated under conventional interventions in the region. The landraces are sturdier and lees vulnerable, requiring no use of expensive external inputs, which has reduced the risks of crop failure.

The Save Seed Movement is an outstanding example of how farmers themselves can become involved in conservation of genetic resources, revive their once lost landraces, put them to sustainable use and challenge the modern systems of plant breeding. On-farm conservation of landraces and cultural practices involving farmer-led breeding programs provides a strong basis for sustainability in mountain agriculture. Mountain farmers have always been aggressive plant breeders. Their knowledge and rich experiences should be taken advantage of in evolving new programs of participatory plant breeding in the region.

Introduction

Conservation of genetic resources and species in farmers' fields (or in situ conservation) has received increased attention in recent years. National parks, zoos, and nature reserves are needed more than the current system of seed banks if sustainable agricultural systems are to be maintained (Partap 1996). On-farm conservation in farmers' fields promotes an evolutionary process of recombination of useful genes from wild relatives and cultigenes with widely grown landraces under changing conditions (Sthapit and Joshi 1996). On-farm conservation of genetic resources is of special significance for the Himalayan mountain areas, such as Garhwal in India, where there is a high degree of inaccessibility, fragility, and risks, and where farmers have little political awareness.

The traditional knowledge system of a farming community is built upon cultural practices interwoven around agroecological resources. Cultural practices include preservation, cultivation, and utilization of biodiversity. If in situ conservation practices are squeezed out of mountain agriculture and farmers are instead made dependent on germplasm developed through modern breeding techniques by public institutions and seed companies, the traditional knowledge and means of livelihood that have evolved over long periods of trial and error would be severely threatened.

Vir Singh is with GB Pant University of Agriculture & Technology, Pantnagar, India. Vijay Jardhari works with the Beej Bachao Andolan (The Save Seed Movement) Jardhargaon, Nagani, India.

In situ conservation and farmers' access to and control over germplasm go hand-in-hand. If biodiversity were the potential source of sustainability, on-farm conservation of crop species and genetic resources must be the inevitable process to realize sustainability in marginal areas like mountains. Farmers are at the center stage of agrobiodiversity management. If farmers' rights are to be safeguarded and their independence is to be ensured, on-farm conservation of germplasm must remain in the hands of farmers. In situ conservation is also a way to keep the negative effects of Green-Revolution-type agriculture at bay, including the possible extinction of valuable landraces.

Keeping in mind these deeper issues and concerns, farmers in the Henwal Valley of Garhwal Himalayas started a *Beej Bachao Andolan* (Save Seed Movement). By saving the traditional seeds and landraces, along with in situ conservation of biodiversity, this kind of initiative brings positive changes to local agricultural systems, leading to ecologically sound, self-reliant, and sustainable agriculture. It also empowers farmers with seeds, which are the most potent symbols of their power and independence. Conserving landraces and biodiversity, along with empowering farmers, are the main targets of the *Beej Bachao Andolan* (BBA). Those active in the movement are trying their best to reintroduce seeds that were lost when the so-called high-yielding varieties (HYVs) produced by institution-led research were introduced. Farmers are reviving ecologically regenerative farming practices by improving the common property resource base, mainly the forest ecosystems.

This paper attempts to present the experiences of the *Beej Bachao Andolan*, which is, in fact, a landrace renaissance in which mountain farmers are the sole motive power. This story might help to stimulate farmers and pro-farmer organizations in other areas of the world to establish this sort of conservation and development effort, with farmers at the heart of it.

A historical perspective

Garhwal is a part of the Uttarakhand Himalayan area in India, which was once a unique repository of biodiversity in its forests, grasslands, and farmlands, including a variety of unique landraces. This has been reflected in the foods and folk culture of the area. Mountain people have been relatively prosperous; unique landraces have contributed to their prosperity in a big way. Quoting Walton's findings of the 19th Century, Bahuguna (1989) writes, "The Hill man [is] indeed specially blessed by the presence in almost every jungle of fruits, vegetables, and roots to help him over a period of moderate scarcity."

The prosperity of the region in the past is also evident from oral history and written documents: "The people were well off and they used to export wheat, rice, coarse grains, oil seeds, ginger, saffron, herbs, walnut, handmade paper, copper rods, musk, honey, ghee, woolen clothes, cows, bulls, ponies, etc., in the markets of foothills and imported only *gur* (molasses) and cotton cloth" (Bahuguna 1989). Lt. Col. Pitcher, who was appointed to inquire into the conditions of the lower classes, reported in 1838, " The peasants of Garhwal and Kumaon are better off than the peasants in any parts of the world, who neither live in such well-built houses, nor are so well-dressed as the peasants of Kumaon (Bahuguna 1989).

This richness of Garhwal's agriculture was clearly evident right up to the end of the first half of the twentieth century. The picture has now reversed entirely, largely due to external development and complete neglect of local perspectives. The type of agricultural development associated with the Green Revolution began in relatively fertile irrigated valleys, leading to the management of monocultures of a few HYVs of just two cereal crops. These required liberal use of chemical inputs

(fertilizers and pesticides), for which lot of incentives and subsidies were provided to the farmers of the area. The HYVs of many crops also spread to rain-fed upland areas, which led to the reduction of the large number of landraces the region was famous for.

Beej Bachao Andolan: The genesis

The fertile valleys in Garhwal Himalayas witnessed a near genetic wipeout in agriculture. By the mid-1980s, large areas of irrigated flatlands were occupied by only two crops—wheat and rice—and only a few varieties of these crops. A considerable proportion of arable land in the upper rain-fed areas had come under cultivation of introduced white-seeded soybeans. A majority of farmers had switched over to "improved" cultivation practices using recommended chemical fertilizers and synthetic pesticides, and were heavily reliant on external "expertise." This almost completely transformed the mountain valleys, which were virtually converted into an experimental ground for government-sponsored agencies. These agencies conducted their experiments and demonstrations and distributed chemical inputs, "tested" seeds of modern varieties, and "improved" tools and implements to the farmers.

It was only a matter of time until this genetic uniformity was struck by disaster in the form of an unprecedented drought during 1987–88 and by pest epidemics in the two following years. The modern crops had a very narrow genetic base and were badly damaged; the farmers experienced the worst days in their lives.

To confront the crisis of genetic vulnerability, the farmers in the Henwal Valley of Garhwal began collecting indigenous seeds, which had almost disappeared from the accessible fertile valleys. Initially, they collected seeds of 10 local rice varieties from remote rural areas not affected by changes in technology and reintroduced them in their fields. These local varieties exhibited remarkable performances. The pest epidemic recurred during this crop season, but it hit only the modern crop cultivars. The reintroduced landraces remained undamaged.

The next year, more farmers in the Henwal Valley opted for indigenous varieties. Seeds of the landraces produced during the first year were distributed to other farmers in the valley. After strenuous efforts, 35 indigenous varieties of rice were collected during the second year and were all raised on farms. Nearly 60 percent of the total area of the valley was covered by the reintroduced landraces that year.

During the third year, a total of 110 landraces of rice were reintroduced, and the genetic diversity in rice increased dramatically. Nearly 90 percent of the cultivated area in the valley came under landraces. In the fourth year, the total number of local varieties went up to 126 and the year after, 130. Experiencing the wonderful performance of the landraces, the farmers of the valley launched the *Beej Bachao Andolan,* (BBA) which has now spread its roots throughout the whole of Garhwal.

The BBA searches, collects, reintroduces, tests, distributes, and popularizes all available local varieties of mountain crops. So far, it has reintroduced 300 genetically distinct varieties of rice, about 200 varieties of kidney beans, 12 of amaranth, and so on, in the Henwal Valley alone. The number of landraces reappearing in the once genetically transformed valleys is increasing year by year. Free exchange of seed within the community—the life-line of traditional mountain agriculture—has also been revived. BBA is witnessing a landrace renaissance in the mountains. Superb landraces, once lost to the so-called HYVs, are becoming an increasingly potent symbol of farmers' self-respect, self-reliance, and independence.