Adding Benefits to Local Crop Diversity as a Sustainable Means of On-Farm Conservation: A Case Study of an in Situ Project from Nepal

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Abstract

Effective management and conservation of genetic resources on-farm takes place where the genetic resources are valued and used to meet the needs of local communities. The in situ conservation project supported by the International Plant Genetic Resources Institute (IPGRI) in Nepal recognizes that farmers maintain local crop genetic resources if they remain competitive with other options or have value for special use. It has been demonstrated that community participation can be strengthened by sensitizing the farming community and consumers through public awareness, by developing markets for local products or providing market incentives, by improving the farmer's varieties and adding benefits through policy incentives. A variety of innovative and participatory initiatives to increase the value and benefits of landraces for farmers has been identified, and three strategic options in adding benefits were used in this study. Option 1—participatory plant breeding, seed networks, and grassroots strengthening—seeks to improve quality, disease resistance, high yield, better taste, and other preferred traits through technical means, including seed networks and participatory plant breeding. Option 2—non-market and non-breeding—includes creating awareness and sensitizing communities through educational means. Option 3—market methods—works through improved markets and information. Tools like diversity fairs, diversity blocks, and community biodiversity registers (CBRs) have been found effective in consolidating the roles of the farming community in the conservation process. This paper documents some processes using diversity fairs and CBRs that demonstrated how various options for adding benefits could be developed, tested, and linked with market networks.

Introduction

The goal of in situ conservation is to encourage farmers to continue to select and manage local crop populations (Brush 1999). In situ conservation aims to conserve not only genes themselves but also the farming systems and agroecosystems that produce and maintain genetic diversity (Eyzaguirre and Iwanaga 1996). Effective management and conservation of genetic resources on-farm takes place where the genetic resources are valued and used to meet the needs of local communities. The in situ conservation project supported by the International Plant Genetic Resources Institute (IPGRI) in Nepal recognizes that farmers maintain local crop genetic resources if they remain competitive with other options or if they have value for special uses. Jarvis and Hodgkin (1997, 1999), Sthapit and Jarvis (1999), and Brush (1999) suggest that one method to encourage farmers to continue to select and manage local crop populations is to increase the value of local and diverse crop populations to farmers who might otherwise stop growing them. In this paper, we concentrate on

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The in situ conservation project is implemented in partnership in Nepal between the Nepal Agriculture Research Council (NARC), Local Initiatives for Biodiversity, Research and Development (LI-BIRD), and the International Plant Genetic Resources Institute (IPGRI). The authors wish to extend their gratitude to IPGRI and the PPB symposium organizers for giving us this opportunity to share our experiences globally.

the contribution of various options to add benefits that help maintain and maximize the genetic diversity within the total crop gene pool.

The Nepal project has developed a variety of innovative and participatory methods to increase the value and benefits of landraces for farmers and society. Benefits may be sociocultural, economic, ecological, or genetic and may apply to farmers, communities, or society as a whole. This requires an in-depth understanding of the value of local crop diversity and potential ways of adding value and market networks. Brush (1999) identified three types of value in local crop diversity: direct, indirect, and optional.

This paper documents some case studies on options for adding benefit, carried out in three study sites: Jumla (2200m), Kaski (1200m), and Bara (85m) in Nepal.

Understanding the direct value of local cultivars and information sharing

Direct values refer to the harvest and uses of crop varieties as a part of a subsistence, commercial, and/or industrial process. Direct values have been considered as the basis of in situ conservation. Farmers value local crop diversity in terms of local adaptation to ecological diversity , pests, and pathogens; risk management (socioeconomic); and culture, rituals and food culture. A baseline survey, diversity fair, and focus-group discussion across three eco-sites in Nepal have documented typical examples of the direct value of local crop diversity (appendix 1).

These values may vary among farmers and are influenced by such factors as wealth, land, and labor resources; proximity to market and technological information, and government policies. No single variety can satisfy the concerns of all the farmers in a village, resulting in a complex range of crop diversity being maintained.

Evidence clearly shows a varying degree of local crop diversity in Nepal. These resources have been used and categorized broadly into ecological, socioeconomic, and cultural or religious, linked with traditional food recipes. The in situ project has the challenge of developing appropriate methods that enhance their conservation on-farm.

Strategy for adding benefits

Jarvis and Hodgkin (1999) suggested that value may be added to crop genetic resources in two main ways: (1) the materials themselves may be improved or (2) the demand for the material or some product may be created or increased. In addition, nonbreeding and non-market methods are equally important as they are linked with access to information and genetic resources and creating awareness at different levels.

How can local crop diversity be improved? It is important to understand why and where local crop populations are maintained, as well as understanding what the value of particular landraces is and what the limiting factors are and what traits are not preferred. We can appreciate the farmers, contribution to biodiversity conservation, but we need to understand why some crops and varieties are grown on a larger scale by many farmers, while at the same time, a few farmers grow a few selected varieties by themselves—often in niches. Understanding the rationale behind this will assist plant breeders in seeking technical opportunities to improve the materials. In Kaski, Nepal, *Bayerni* and

Biramphul rice is grown by a few, richer, households for its high quality. In terms of yield, these varieties are not competitive with other landraces, such as *Jetho budho* and *Pahele*. It is assumed that many households may start planting *Bayerni* and *Biramphul* if these varieties are improved in terms of yield without losing their quality traits. Table 1 shows the number of landraces selected in the study sites for adding benefits to see whether landraces, per se, can be conserved by adding value.

Table 1. Setting Breeding Goals for Adding Benefits in Selected Rice Cultivars

Site	Landrace selected	Constraint	Adding benefits—PPB
Jumla	*Jumle marshi*	Low yield, chilling injury	Increase yield by select blast- and cold-tolerant cultivars
Kaski	*Anaga*	Low yield, poor grain/panicle	increased yield
	Mansara	Low yield, less response	non-lodging
	Thulo/sano gurdi	Low yield	early maturity
	Ekle	Low yield, late	improved eating quality
	Biramphul	Lodging, low yield, late	
	Pahenle	Long straw, low yield	
	Madishe	Eating quality, low yield	
Bara	*Dudhisaro*	Low yield, lodging,	grain quality
	Nakhisaro	Lodging, low yield	non-lodging
	Rato basmati	Pest BHP, low yield, blast	pest tolerance
	Lajhi	Lodging, low yield	increased yield
	Mansara	Lodging	blast tolerance

Source: Adopted from Joshi et al. (1999) and Rijal (1999).

Adding benefits through participatory plant breeding

Participatory plant breeding (PPB) can improve the materials, but the materials can also be improved by eliminating diseases and pathogens from planting materials or clones, e.g., taro, diseases in potato and citrus. Sthapit et al. (1996) have demonstrated that *Chhomrog* rice has been enhanced because its red rice grain was replaced by a white color, while cold tolerance was improved. The project is also assessing the value of landrace enhancement for those landraces that are widely grown and preferred by farming communities. Strengthening the skill of selection and exchange of enhanced materials will also assist in the process of on-farm conservation. *Jetho budho* in Kaski, *Basmati* in Bara, and Jjumli marshi in Jumla have already been identified and preliminary work has been initiated.

The most important strategy for increasing the value of local crops is to use them for a crop-improvement program. PPB covers the full range of crop improvement activities: assessing local diversity and uses, setting breeding goals, creating variability, selecting varieties from variable populations, evaluating varieties, and scaling up through farmer-to-farmer seed networks. Joshi et al. (1999) documented the detailed process of PPB to study whether PPB can be considered a strategy to enhance on-farm conservation as well as to meet the productive needs of farmers. The roles of formal plant-breeding institutions (e.g., NARC) and NGOs (e.g., LI-BIRD) have been mutually agreed upon for each key step of the PPB process. The multidisciplinary team categorized rice landraces by their distribution and frequency, as described by Joshi et al. (1999). Breeding goals for the Bara and Kaski eco-sites were developed in a participatory manner, involving breeders, socioeconomists, and farmers, to analyze the strengths and weaknesses of the landraces. In the process of selecting parents, farmers strongly felt that the preferred traits should be maintained even if inferior traits were the targets for improvement through PPB. Thus, the breeding strategy has a role to play in improving and conserving traits and characteristics that are *not* linked specifically with social, religious, or medicinal norms and beliefs or used in local recipes.

Adding benefits through nonbreeding and non-market methods

A number of participatory approaches have been used to date to increase local awareness about the importance of agro-biodiversity and to improve the flow of seed within and between communities (Rijal et al. 1999). Diversity fairs, diversity theaters, diversity songs, poetry journeys, community biodiversity registers (CBRs), and diversity blocks are some of the popular activities carried out to increase awareness and sensitize the community.

In the context of strengthening access to germplasm and information in the farming community, diversity fairs, diversity blocks, and community biodiversity registers have been identified as powerful options, which also enhance the farmers' capacity in managing their own crop genetic resources.

The diversity fair. Here, the term *diversity fair* refers to a tool used to demonstrate or display local crops along with the associated knowledge resources of an ecology, as defined by community-based organizations (CBOs). Traditionally, local seed markets and fairs constitute an important part of the informal seed exchange system in the villages. Local markets, *haat bazaar,* and "agricultural fairs" provide a good opportunity for the exchange of seeds and knowledge. In recent years, these informal systems have been threatened by outside intervention, particularly in the seed sector. As a result, indigenous knowledge associated with local genetic resources has begun to erode.

The community-organized diversity fair focuses on indigenous landraces. In Nepal, diversity fairs have been used as an entry point to raise the level of awareness about in situ crop conservation programs before more technical aspects of the project are implemented. By organizing competitions between groups of farmers, the project promote access to farmers and encourages farmers to maintain the maximum genetic diversity. The in situ project uses diversity fairs as a participatory research and development tool in Nepal. It aims at creating competitions between farmer groups on a regular basis in order to accomplish the following:

- to recognize farmers who maintain large amounts of genetic diversity and who possess a good deal of associated knowledge, to act as a source of information for others
- to locate areas of high diversity
- to identify and locate endangered landraces
- to prepare an inventory of crop genetics, along with a knowledge resource base
- to identify the main sources of the informal seed supply within the community
- to understand the value of diverse genetic resources in terms of use, economics, culture, religion, ecology, etc.
- to empower local communities to have control over their genetic resources
- to help develop a sense of ownership in the community

There are different ways of conducting diversity fairs. The in situ project aims at strengthening CBOs that conduct on-farm conservation activities with little input from outside. Initially, when CBOs were unfamiliar with the project's activities, project staff managed the fairs in partnership with them. Over time, as they have become better oriented, they organize the fair as an annual event. Sthapit and Jarvis (1999) have documented the concept and methods used, and the steps of the fair have been described by Rijal et al. (1999). There have already been five such fairs organized in Nepal, and as a result, the process has been refined over time. The fairs organized in Nepal have been successful in terms of the following:

- documenting local landraces and associated knowledge, as well as strengthening the farmer-to-farmer seed supply system
- linking outputs with research and development work
- locating the status of diversity and the custodians
- sensitizing farmers, along with the research and policy communities, on the importance of agrobiodiversity
- strengthening CBOs in on-farm conservation processes

The fairs organized through CBOs have documented equally good information, as well as increasing sample size and the number of crops. The information includes the special characteristics associated with the landraces, i.e., *huliya,* sociocultural values, ecology, and status at the community level. These sets of information can be very useful for a number of stakeholders, including breeders, ecologists, socioeconomists, and local promoters for their varied interests. The information may be shared among the farm communities and other interested parties. A very important aspect of the fair, observed in a recent fair in Begnas, Nepal, is the development of the sense of ownership in the community for the resources they have conserved for generations. Every CBO took back samples with the knowledge that they had to maintain them for future use.

The diversity block. A diversity block is a participatory research technique designed to characterize local landraces under farmers' management conditions. Landraces to be grown in the diversity block may be selected from materials from either the diversity fair or farmers' seed stocks. The crops are monitored by both farmers and scientist-promoters, and agromorphological characteristics are recorded. The diversity block has the value of enhancing public awareness at the grassroots level and making germplasm more accessible o the local community. In Nepal, the diversity block has been used to acquire farmers' indigenous knowledge about local varieties, to identify parents for breeding, and to study the population structure.

The community biodiversity register. A community biodiversity register is a record, kept on paper or in electronic form by community members. It is a register of local crop biodiversity and associated knowledge. The information maintained in the register includes landrace names, the farmers who store the seed, associated local knowledge and uses, and traditional and nontraditional passport data like agromorphological and agroecological characteristics and cultural significance. The register functions as a decentralized community gene bank (Sthapit and Jarvis 2000). CBRs have no implications for local seed exchange and storage systems; rather, it helps to improve access to information and seeds.

Updated over time, the CBR allows communities to monitor the level of genetic diversity and prevent the extinction of rare varieties, which may then be preserved ex situ. CBRs can be a practical tool to monitor genetic diversity at the village level, and if the capacity of the farming community is strengthened with institutional support, it could be a good way of developing various options to add benefits on a local or regional scale.

Strengthening seed and information networks was one of the concerns in this project, for which different strategic tools were explored. The community gene bank adopted by a few institutions, such as UBINIG in Bangladesh, was reviewed for its strengths and limitations. It was found to require additional structures to serve communities under situations of stress and risk, and may replace the local farmer-to-farmer seed-supply systems. CBR strengthens local systems was developed through review of functions complementary to in situ conservation.

Since CBR has only recently been developed, it still requires further refinement. However, it has multiple functions and is worth the effort because of its effectiveness at the grassroots level. This was discussed with farmers and CBO representatives, and their responses are summarized below:

- CBR provides an inventory of both valuable and worst crop resources.
- It strengthens sharing of information and crop seeds by improving access.
- It is useful for strengthening market and seed networks.
- It lists the status of all known crop resources, with reasons for decrease, increase, or loss.
- It is useful to R&D workers.
- It enhances the process of developing a sense of ownership for the resources held by CBOs.
- It provides descriptions of ecology and diversity with area-specific identities.

The records maintained in the CBR assists in understanding the farmer's decision-making processes as well. Thus, the CBR implemented in Nepal has guided communities in developing a sense of ownership for their resources. Whatever significance it has depends on the way it is developed and executed locally. Therefore, the potential benefits from CBR can only be realized when it is adopted with full consideration of the importance of (1) partnership with farmers, (2) periodic up-dating, (3) local control, (4) sharing information among the users/stakeholders, and (5) caution about providing access to the information to outsiders.

Both the CBR and diversity fair can be used for a number of purposes, from developing R&D bases to strengthening at the grassroots level in terms of improving access to seeds, using information in an effective manner, and assessing diversity. CBR records could provide a very useful basis for developing conservation strategies. Endangered species or landraces, for example, may be conserved ex situ. However, we are also equally concerned with the possible misuse of information, such as intellectual and farmers' rights. The community must be made aware of this kind of danger as well.

Adding benefits through market methods

The demand for materials or processed products may be increased by market methods (box 1). There are many examples of local crops (e.g., *Basmati* and *Jetho budho* rice) that have direct market value. There are many options to which farmers are not exposed. This applies to researchers, development workers, market networks, and consumers as well. Benefits can also be added to crop diversity by better processing, packaging, storage, and marketing.

Box 1. Options for Adding Benefits through Market Incentives

Adding benefits through market incentives

- Exploiting price incentives by better processing and marketing
- Creating consumer awareness of local products
- Linking market with food culture
- Linking market with eco-tourism and local cuisine
- Developing new food products using local landraces
- Adding benefits through participatory pest management (organic agriculture, green marketing)
- Improving farmers' skills on seed production of specific valuable landraces
- Appellation of local products through development of cook book of keystone crops across ethnic cultures
- Direct sale of genetic resources using IPR or contract (e.g., seed)

Source: Sthapit and Jarvis (1999).

Identifying local promoters and then linking them with local producers and markets are crucial processes. In Begnas, Nepal, a series of consultations was carried out to identify major local products that have market potential, assessing total production, price negotiations, quality control, and marketing outlets. In Nepal, the project identified local promoters like *Gunilo* and *Bandobasta* who played a catalytic role in establishing linkages between promoters and consumers with the farming community. NGOs have been involved in the project to facilitate networking. Associations of hotel and tourism, Pokhara chambers of commerce, hostels, and hospital networks have also been sensitized to use more domestic products. The impact of such networks is yet to be seen.

The project is keen to develop markets to enhance the value of local crop diversity through direct sales. Rice landraces, *Jethobudho*, aromatic sponge gourd, *Khari* in taro, and *Samdi kodo* in finger millet, are a few examples. To succeed, this initiative must also be supported by policy reforms.

Table 2. Strategic Options Employed for Adding Benefits to Local Crop Diversity through Market Methods, Case of Begnas

Crops	Varieties	Farmers' values	Indicators of assessment
Rice	*Anadi*	*Latte*, *khatte*, and *siroula* in festivals; Medicinal value	Research base recipes developed Number of grower farmers' increased Status of nutrition known Grain demand created and area under production increased Number of growers increased
	Bayami	Fine, medicinal and high quality; High quality and price	
Taro	*Khari, Khujure, Hattipow*	*Masaura*, *tandra*, corm quality; Gava	
Sponge gourd	*Basaune ghiroula*	Aroma and excellent eating quality	Quality seed produced and marketed widely
Finger millet	*Samdi kodo*	Special gruel; Possibly suitable for pizza making	Demand created locally that motivates farmers to grow

Source: Adopted from Rijal (1999).

Discussion of strategic choices for PGR conservation

The role of local crop varieties in securing food at the household level is apparent, but diversity has also been enhanced for socioeconomic reasons (Rana et al. 1999). Nepali farmers use local rice landraces for at least six specific purposes (Rijal et al. 1997). On the one hand, these deserve special value and there is less competition, so a nonbreeding strategy is appropriate. On the other hand, breeding strategies are employed to make local crops competitive with other options, particularly those that have value and benefits in terms of ecology or physical indices like yield, disease resistance, etc. For example, the best quality of *Jethobudho* is grown with cold water, as is *Phewa* and *Kundahar* of the Pokhara valley, and always fetches a higher market price than when grown in an irrigated field. The strategies employed for adding values are presented in table 3.

In niche- or ecology-specific areas where food security is the main concern, as in Jumla, farmers always go for increased yield. Low yield is associated with rice blasts, poor response, and cold injury, for which the only way of addressing the problem is through breeding methods.

Table 3. Strategic Options for Adding Benefits to Local Crop Diversity

Values	In situ strategies employed for on-farm conservation			
	Breeding	Market	Awareness	Improved access
Ecology (e.g., JB)	✔	✔	✔	✔
Genetic (yield, height, disease, etc.)	✔	✂	✔	✔
Medicinal, cultural, religious	✂	✔	✔	✔
Traditional recipes	✂	✔	✔	✔

Conclusion

Developing an in-depth understanding of the value of landraces through appropriate methods is the prime need prior to deciding on any conservation strategies. Local crop diversity can be desegregated into broad categories by value—genetic, sociocultural, medicinal, or religious—to strengthen conservation of crops in situ by the farm community. Three broader categories include market, non-market, and policy perspectives for improving direct and indirect benefits. No single strategy is perfect for addressing the goal of conservation; a combination is required.

Of the many innovative tools available, the diversity fair and community biodiversity register have been most effective in terms of documentation and sensitizing communities of farmers, researchers, promoters, and policymakers. Furthermore, these two tools are very useful in monitoring diversity along with status. Values documented through these tools can be used for R&D purposes, where researchers, promoters, and planners may benefit. They also provide a basis for breeding work in the short term as well as the longer term.

For local crop diversity with socioreligious, cultural, or economic value, strategies that strengthen information, seed, and market networks are particularly important if CGR and their products are to be promoted *per se*. The diversity of these sets of crops will be maintained as long as the local culture associated with them continues. On the other hand, for crop diversity associated with ecological and genetic traits, the breeding strategy is the right choice. Thus, for effective conservation of

CGR on-farm, a number of strategies are essential. We argue that valuable genes can be captured and conserved only when they are utilized locally for both breeding and non-breeding purposes and when there is effective local conservation.

Bibliography

Bruce, S.B. (Ed.) 1999. *Genes in the field: On-farm conservation of crop diversity*. Boca Raton, Florida: Lewis Publishers.

IPGRI. 1999. *Diversity fair and in situ conservation on-farm.* Information Flyer Series. Rome: International Plant Genetic Resources Institute. (*in press*)

Jarvis, I.D. and T. Hodgkin (Eds.) 1997. *Proceeding of a workshop to develop tools and procedures for in situ conservation on-farm, 25–29 August 1997, Rome, Italy.*

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. 1999. In *A scientific basis for sustainable agriculture, proceedings of a workshop, 5–12 July 1999, Pokhara, Nepal*, edited by D. Jarvis, B. Sthapit, and L. Sears.

LI-BIRD. 1998. *Exploring market potentiality of agriculture produce: An attempt for action.* Pokhara, Kaski, Nepal: Local Initiatives for Biodiversity, Research and Development.

Rana, R.B., D. Gauchan, D.K. Rijal, S.P. Khatiwada, C.L. Poudel, P. Chaudhary, and P.R. Tiwari. 1999. In *A scientific basis for sustainable agriculture, proceedings of a workshop, 5–12 July 1999, Pokhara, Nepal*, edited by D. Jarvis, B. Sthapit, and L. Sears.

Rijal, D.K., B.R. Sthapit, R.B. Rana, K.D. Joshi, P.R. Tiwari, P. Chaudhary, Y.R. Pandey, C.L. Poudel, and A. Subedi. 1999. In *A scientific basis for sustainable agriculture, proceedings of a workshop, 5–12 July 1999, Pokhara, Nepal*, edited by D. Jarvis, B. Sthapit, and L. Sears.

Rijal, D.K., K.B. Kadayat, K.P. Baral, Y.R. Pandey, R.B. Rana, A. Subedi, K.D. Joshi, K.K. Sherchand, and B.R. Sthapit. 1998. Diversity fairs strengthen on-farm conservation. *IPGRI-APO Newsletter* (26) 1998.

Sthapit, B.R. and A. Subedi. 1997. Towards a synthesis between crop diversity and development. Paper presented in a workshop organized by Wageningen Agricultural University and CPRO-Dlo, 30 June–2 July 1997, Barlo, Netherlands.

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.

Appendix

Appendix 1. Comparative Value of Local Diversity of Rice, Taro, Finger Millet, and Sponge Gourds at Different Eco-Sites of Nepal

Crop/Varieties	Location/habitat	Direct value
1. Landraces with ecological benefits		
Jumli marshi in rice	Jumla (2200m)	Cold tolerance, taste, and *aadilopan*
Naltumme	Kaski (670–1400m)	Adapted to shaded areas
Mansara, Aanga, Kathe gurdi	Kaski (670–1400m)	Adapted to entirely rain-fed, low-input ecosystems
Taro: *Khari pindalu*	Kaski (670–1400m)	Compatible for intercropping with maize, etc.
Bhati, Silhat, Laltangar, Aamaghauj, Sakhar	Bara (85m)	*Dhab* (swampy land)
Nakhisaro, Rango, Sokan, Mutmur, Sotwa	Bara (85m)	*Ucha/Bhith* (upland, rain-fed)
Batsar, Lajhi	Bara (85m)	*Nicha* (low land)
2. Socioeconomic values related to specific use		
Jetho budho	Kaski (670–850m)	High quality; High price
Panhele	Kaski (670–850m)	Fine, aroma; High price
Gurdi	Kaski (670–1400m)	*Sel roti* (Nepal donut)
Anadi	Kaski (670–1100m)	Special recipe for local festivals; Not accepted for religious ceremonies
Basmati	Bara (85m)	Aroma and eating quality
3. Medicinal, cultural, food, and religious values		
Basmati, Sathi, Aanga, Lajh, Sotwa, Sokani	Bara (85m)	Religious (guest, feast, recipe)
Khera	Bara (85m)	Religious (local diets, *Karik maharaj*)
Bayarni, Anadi	Kaski (670-1900)	Medicinal (back pain, taste, recipe)
Sponge gourds: *Basaune*	Kaski (670-11200)	Aroma, taste, eating quality
Khari pindalu	Kaski (670-1400)	Special recipes: *Masaura tandra, Gava* and cormels
Dudhe	Kaski (670-1400)	Petiole for special pickle

Source: Baseline survey, PRA , diversity fair, and FGD.

Participatory Improvement of Rice Crops with Tribal Farmers in India

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Abstract

Participatory research, including participatory plant breeding (PPB), is now a recognized option for improving the livelihood security of unreached farmers. Tribal farmers in India provide an ideal group for testing the potential of participatory interventions. They live in remote areas, are intensively bound by tradition, and continue to cultivate crops using traditional practices. For instance, the sowing time of crops is often based on a particular month, with an almanac date to harvest the crop in time for its use during festive occasions. Although these traditional cultivation practices are often poorly matched with the weather, they continue because they are consonant with the habitat, soil, agroecology, and available infrastructure. Soils are relatively free from the problems of continuous chemical fertilization. Most cultivated varieties are specific landraces that carry special traits for cooking quality and taste, catering to the tribal farmers' methods of processing food. Tribal farmers live in small villages, inconveniently distant from one another, and do not have readily accessible means of producing and exchanging community seed. Traditional varieties/landraces are also not commercially competitive. Driven by poverty, the tribal farmers yield to commercial exploitation where the cultivation of landraces, local varieties, and other valuable genetic material is replaced by the cultivation of modern varieties despite the fact that they are not preferred by the tribal community. The result is a gradual erosion of precious genetic diversity, most of which is also site-specific. This situation calls urgently for preventive measures.

Jeypore tract in Orissa State is a secondary center of rice origin. Yet farmers do not realize the potential yield of the rice landraces growing there. One reason is that the traditional practices developed essentially for avoiding risks are out of tune with those needed for realizing high yields. Participatory initiatives, setting appropriate methods of cultivation based on a realistic evaluation should provide the right corrective step. This paper describes and discusses such initiatives in the Jeypore tract of Orissa.

Keywords: Tribal farmers, participatory research, rice, landraces, participatory plant breeding, India

Introduction

We describe below a situation typical of tribal farmers in India, where any option, including participatory plant breeding (PPB), has to coexist with the site constraints if it is to be feasible. Orissa state is situated in the southeast region of India between latitude 17°48' and 22°34' N and longitude 81°24' and 87°29' E. The total geographical area is approximately 156,000 km^2 and accounts for 4.74% of India's geographical area. As per the 1991 census, the state has a population of 31.66 million, of which 7.03 million (22.2%) are tribal. The tribal people consist of different ethnic groups (at least 62 were identified in a recent survey) and form three broad categories of farmers—backward, peasant-like, and semi-urbanized—based on their level of development. The backward tribes live partially in isolated pockets and practice shifting cultivation. the peasant-like farmers depend largely on sedentary cultivation, and the semi-urbanized farmers have their mainstay in settled agriculture and wage earning. But all the tribal farmers are characterized by their own traditional life-styles, ancient customs, beliefs, rituals, and sociocultural identities.

Koraput is a district in Orissa State where the economy is based predominantly on agriculture. Jeypore, previously a part of Koraput, was made a separate district in the recent past. Cultivation is carried out in Jeypore at different altitudes, ranging from 600 to 1350 feet above mean sea level.

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Usually lands situated above 900 feet are classified as upland; around 600 feet and below is lowland, and the rest is medium land.

Agricultural practices are more primitive in Jeypore than in the neighboring states. Irrigation is rarely possible, all lands are completely rain fed, and rainfall is erratic. Farmers occasionally apply farmyard manure. Rice is the most common food crop of the region. Landraces and local varieties are mostly preferred because they cater to the cooking quality and taste of the tribal people. High-yielding varieties (HYVs) are not preferred and only commercial incentives compel some farmers to grow them. Government agencies and some private organizations are the ones that encourage this. The planting and maturation of traditional varieties are timed so that their harvest coincides with the time of festivals and family rituals (table 1). The varieties are usually photosensitive and of longer duration than high-yielding varieties. A large number of farmers still practice monocropping.

Table 1. Some Valuable Land Types Cultivated by Tribal Farmers of Orissa State in India for Use in Their Religious Functions

Rice Variety	Predominant Quality	Festivals	Time of Maturity (Month)
Kalakrishna	Scented	All festivals	January
Tulsi	Scented	*Chaitra Parva*	April
Machchakanta	White slender, short grains, good taste	*Manabasa* and *Lakshmi Puja*	November
Mer	Black grains with medicinal properties	Annual ceremony of forefathers	November
Haladichudi	White slender, long grains, good taste	*Shakti Puja*	December
Deulabhoga	Bold, short grains, reddish tinge on cooking with mild scent, preferred during worship at temples	Temple deities	December

Thus we have the following basic realities in which PPB options have to be optimized:

- Tribal farmers live in villages rich in genetic diversity and occupied by one or two tribes. They are situated far away from the reach of government extension agencies.
- Farmers are highly tradition-bound socially and religiously, and would have reservations about switching to new options.
- The enhanced yields of HYVs do not attract them as much as the quality and taste of their lower-yielding landraces and local varieties, which they prefer.
- They have rich indigenous knowledge of their crop diversity but poor knowledge of modern agriculture.
- Their habitats are poorly connected by roads and are typified by poor or absent marketing facilities.
- Against this backdrop, they are vulnerable to commercial exploitation of their natural resources.
- They are ready to learn and practice profitable methods of cultivation, provided such methods can produce perceptible returns.

- Currently there is neither a feeling of strong ownership of natural resources nor any awareness of intellectual property rights.

New PPB paradigms need, therefore, to be simple and productive to promote voluntary participation. They should be cost-effective and, at best, attempt to optimize practices under existing site constraints. They should respect farmers' tastes and be consonant with their strong preferences. They should be risk-insulated and entail a low cost-benefit ratio. Complex PPB options can only be a long-term goal and should be based on short-term benefits.

The method

A number of years of work and association with farm families of several villages in the Jeypore district by the M.S. Swaminathan Research Foundation (MSSRF), based at Chennai, India, has prepared the ground for cooperative and participatory work to improve the productivity of farmer-preferred local varieties/landraces. The work plan envisaged a three-year activity module. The first year was earmarked to survey local varieties sown by farmers and to introduce organized planting of preferred varieties. The seeds of those varieties would then be distributed by MSSRF. A few farmers would be encouraged to raise the crop in their plots by their own methods. The yield data would be analyzed and a few varieties selected for further evaluation.

In the second year, the selected varieties would be grown by PPB farmers in a field design in which farmers and formal practices would be the two treatments. Data on grain yield and its components would be statistically evaluated to select the top two varieties for upland, medium land, and lowland conditions. In the third year, the selected varieties would be grown in large plots under formal technology, provided it proved superior to farmers' practices in the second year of evaluation. Varieties to be evaluated, the sites for testing their performance, and the farmers who would participate in the program would all be selected by the farmers themselves. Periodic checks on the progress of the experiments, the problems that cropped up in the execution of experiments, and related issues would be discussed in periodic PRAs with farmers, and acceptable solutions found.

Results

During the rainy season of 1998, three districts and two blocks per district were selected for upland (U), medium land (M), and lowland (L) cultivation in the Jeypore tract of Orissa State. Fourteen farmers were chosen to raise 10 upland, six medium land, and 10 lowland local races/varieties in their own plots of approximately of 80 m^2. The crop was raised using farmers' practices common in the respective areas. However, a severe cyclone at the time of crop maturity affected crop yields; the data could only be used for a relative evaluation. We devised a form to record various field activities, with which data on cost-benefits were gathered not only on the PPB plots but also on farmers' own holdings. The overall performance and characteristics of varieties were discussed in a PRA with a large number of farmers from the sites.

Only 3 U, 1 M, and 5 L varieties were selected in the PRA from the original 10 U, 6 M, and 10 L varieties tested in 1998. In consultation with the farmers, 3 U, 7 M, and 3 L varieties were added to get a total of 6 U, 8 M, and 8 L varieties for experimentation in the crop season of 1999.

To facilitate periodic visits to plots, it was decided to confine the experiment to two blocks and five villages in the Koraput district, near the MSSRF site office at Jeypore. Nine PPB farmers agreed to test the selected varieties in two test plots of 90 m^2 each. One of the test plots was divided into three replications of 30 m^2 and the selected varieties were grown in a randomized block design. The other was divided equally between varieties to be tested. They were planted unreplicated by farmers using their own traditional practices. In the replicated plots, formal methods of cultivation were introduced (box 1).

Box 1. Formal Methods Introduced to Cultivate Local Varieties and Landraces in Jeypore, India

- Preparing land and applying farmyard manure in residual moisture when the previous crop has been harvested
- Raising nursery stock in well-prepared land in rows spaced 20 cm apart with optimal moisture
- Pre-soaking seeds in water for 12 hours and selecting only those seeds that sink
- Direct seeding (in U and some M), or transplanting (in some M and L) of about 25-day-old seedlings, in rows spaced 20 cm apart, with plants at 10-cm intervals within a row
- Setting rows north-south to maximize sunlight on growing plants.

Those formal methods were developed as a result of a survey of farmer's plots grown to rice in the first year, where a number of problems were predominant (box 2).

Box 2. Problems with Rice Crops Raised under Farmers' Traditional Practices

1. Erratic rainfall, leading to the tradition of high seeding rate of about 40–60 kg/ha
2. Consequent dense plant populations that lead to yellowing and poor plant growth
3. Ill- or unprepared lands due to lack of moisture prior to the planting season, resulting in poor germination
4. Poor seedling growth, leading to severe disease and high pest incidence
5. Farmyard manure occasionally applied in small quantities during sowing, resulting in no benefit to the crop
6. Nursery plants raised in poor, most often unprepared lands with flooded rain water
7. Transplanting most often with very old seedlings, sometimes even 60 days old

Crop growth on formal and farmers' plots was evaluated in periodic PRAs with farmers. Scientists recorded data on days to flowering, number of tillers, number of panicles, number of grains per panicle, and grain and fodder yield with the help of farmers in each plot. The data were used to compute grain filling and harvest indices. Based on multivariate statistical analysis of yield and its component characteristics, the varieties were ranked on their joint performance across all traits.

The results were striking. They are summarized and shown only for the varieties common in 1998 and 1999 in table 2. The advantages of changing over to scientific methods of cultivation are obvious.

The following inferences stand out:

a. Fluctuations in the yield of varieties occurred even under traditional (farmers') methods of cultivation. For instance, the variety, *machchakanta*, was the top yielder in 1998—a year characterized by cyclonic weather and heavy rainfall. It gave low yields in 1999 under farmers' practices despite consistently good weather. In general, however, varieties responded by giving good yields under the better climatic conditions in 1999.

Table 2. Comparative Benefits of Formal Methods over Farmers' Traditional Practices of Rice Cultivation in Jeypore Tract, India

		Average Yield (k/ha)			
		1998	1999		FO/FA
Land Type	Variety		FO	FA	
Lowland	*Machchakanta*	2189	1671	1418	1.2
	Bayagunda	1755	3679	2321	1.6
	Gadakuta	13352	1524	961	1.6
	Barapanka	1643	3438	2533	1.4
	Kalachudi (*Umriachudi*)	1309	2562	2007	1.3
Medium Land	*Bodikaburi*	1261	2838	1736	1.6
Upland	*Pandakagura*	393	1188	1178	1.01
	Paradhan	562	1028	622	1.7
	Matidhan	839	1199	1133	1.06

Note: FO=Formal methods; FA=Farmers' traditional methods.

b. Yields under formal methods were consistently and significantly superior than those under farmers' methods. Lowland varieties, which gave fairly good yields under farmers' practices, responded to formal methods by giving up to 60% higher yields (table 2). One popular upland variety, *paradhan,* preferred by all farmers, had a yield advantage of 70% under formal methods. The trend of improvement was about the same for the other 13 varieties (data not shown).

c. Yield improvement using formal methods was achieved at no extra cost. Initially farmers found it difficult and time-consuming to space-plant in rows, but quite soon they saw that they could achieve higher efficiency (see d.1, below).[1]

d. Preliminary data show that the cost-benefit ratio is substantially more favorable under formal methods for the following reasons:

   1. The seeding rate is about one-fifth of that used in traditional methods (12 versus 60–65 kg/ha). Hence even row planting with uniform space between plants could become less time-consuming.
   2. Nursery seedlings produced under formal methods grew vigorously and were free from weeds, insects, and diseases.
   3. Seedlings were well and quickly established in plots because of initial seed selection and healthy nursery plants.
   4. The healthy initial stand discouraged weed competition and helped healthy crop growth without being affected by biotic stresses.
   5. Row and space planting made interculturing operations easy, where needed, and harvesting of the crop took significantly less time.
   6. The 20-cm spacing between rows proved ideal for the harvested plants to be stacked in a slanted, reinforcing standing position for the produce to dry in the sun in the field before transfer to threshing yards.

1. In a recent PRA in August 2000, farmers reported that seed placement has become more efficient and reduced the labor requirements for planting in rows.

These small but significant benefits added up to a cumulative advantage, reduced the drudgery of field operations, including weeding and harvest, and resulted in a more favorable cost-benefit ratio.

In conclusion, we learned a number of lessons, and the experiments evoked the desired response among farming families in both the experimental sites and surrounding areas.

Lessons learned

1. Situations exist which do not exactly fit a typical case for PPB. Any participatory initiative, including PPB, is a function of the target site, environment, site farmers and their traditions, practices, and social and cultural norms.
2. Participatory programs must recognize this circumscribing frame, most often rigid, within which actions must be confined.
3. Initial action plans must produce perceptible benefits in order to ensure voluntary participation.
4. When the basic constraints and opportunities for initiating participatory actions are recognized, respected, and acted upon, even farmers in difficult economic conditions will willingly participate without incentives.

Effects induced by participatory improvement initiatives

1. Farmers were clearly convinced that the traditional high seeding rate and dense planting are not the way to counter their difficult environment, harsh climate, and unpredictable yields. They have realized by their own experience the logic of the formal methods they were shown.
2. The message of formal methods of cultivation has spread so far and fast that a number of surrounding villages have started adopting the same practices, not only in rice but also in other crops, like red gram and finger millet.
3. There is a high demand from the tribal farmers for training programs in various sites to ensure proper adoption of formal methods of cultivating traditional rice varieties.
4. Farmers are willing to extend their participation to breeding productive pure lines, initiating from parents chosen from their site-specific local races and cultivars.

Thus, the experience of participatory rice improvement has been exhilarating and productive, and efforts are under way to replicate the benefits of formal methods of cultivation by initiating site-specific PPB paradigms.

CONSERVE's Experience and Work on Participatory Plant Breeding in Rice

Gilda T. Ginogaling

Abstract

In this paper CONSERVE's experiences in handling two research approaches in participatory plant breeding in rice are discussed: researcher-managed or on-station trials (OSTs) and farmer-managed trials. OSTs are done on CONSERVE's farm. CONSERVE crosses (CC) were used as materials for evaluation on-station for three filial generations before the material was given out to farmer-partners for the farmer-managed trials. All distributed segregating materials were tried in their respective fields. Activities taken on-station and in farmers' fields is assessed. Lessons on the management of on-station trials and farmer-managed trials are discussed.

Introduction

There are some organizations that conduct research on how the development of seed is improved. Some do experiments both on-station and in farmers' fields. Community-Based Native Seeds Research Center, Inc., (CONSERVE) is one of these. It was established to conduct both researcher-managed trials and on-farm field trials using rice seeds as materials. CONSERVE is an NGO established in 1992, which started as a project of the Southeast Asia Regional Institute for Community Education (SEARICE). It has a 1.7-hectare demonstration farm for field research and a space for the project office and training center. The organization is involved in the conservation and development of plant genetic resources for sustainable agriculture and food security, particularly rice and corn, in the Arakan Valley Complex that covers 35% of the total land area of the Cotabato Province in the Philippines. The Arakan Valley Complex is composed of five municipalities where farmer-partners are 60% tenant farmers and 40% landowners. The majority of them (60%) are men. Farmer-partners are organized either through people's organizations or as individual curators and indigenous people in the uplands. CONSERVE's initial activity was to collect 299 rice varieties from Cotabato and Maguindanao provinces in 1992; 389 varieties were added in 1995. Aside from rice, 42 varieties of corn, along with millet, sorghum, vegetables, and 59 varieties of unidentified cereal crops were collected. The center is maintaining local storage as a back-up of these materials.

The problems created by the Green Revolution in the 1960s through the introduction of modern varieties inspired CONSERVE to initiate a program of conservation of plant genetic resources (PGR). Over the years, farmers had mainly relied on what was being introduced by the formal system and through the local seed supply. Very few practiced seed selection from segregating materials but, many selected from mostly or almost uniform varieties. This is where the seeds for the next cropping season came from.

CONSERVE's approach to participatory plant breeding[1]

Since the project's beginning in the Arakan Valley Complex, CONSERVE has been involved in various research projects at both the center and on farmers' fields. PGR research has mostly been

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1. Participatory plant breeding (PPB) is involving farmers in the selection of genotypes from genetically variable, segregating materials (Witcombe and Joshi 1996).

linked with sustainable agriculture. Farmer-partners have taken part in the research as the evaluators and observers at the central farm's research, while at the same time, they have had their individual research projects. Program staff provide assistance and venue through training, cross visits, regular meetings, and consultations.

From this research, CONSERVE has gained experience and learned lessons, especially since it is one of the pioneering projects in the Philippines to focus on conservation and utilization of plant genetic resources. The seeds collected by CONSERVE have played a vital role in this research.

CONSERVE conducts both approaches—researcher-managed (or on-station) and farmer-managed trials—at the same time.

Researcher-managed (center-based trials)

The researcher-managed trials are conducted in the center's production farm, facilitated by program staff and later conducted by farmer-partners. Farmer-partners are invited to visit the station and identify materials that are acceptable to them, usually before harvest season.

There were 22 single crosses done by the center and coded as CONSERVE crosses (CC). Varieties crossed were mostly materials from the uplands, which were crossed with lowland rice in order to determine if the product of the cross will adapt or not. Out of these crosses, only 10 crosses survived at the first filial generation. These were planted in on-station (lowland) fields by plot, where program staff observed and evaluated the seeds. Records of the crosses and the number of selections have been kept. Distinct characteristics of the materials selected were noted, such as resistance to pests and diseases, yield (panicle length), number of tillers, height, and other agronomic characteristics. No back-up of the crossed materials has been made. After two cropping seasons, various selections were obtained and planted in the production area. Bulk selection was practiced. Program staff made the decisions involving rejecting seeds not adaptable to the center's conditions and did the selection. Before the selection at harvest time, farmers were invited to the station and took part in the evaluation of the segregating materials. Group discussions were held and criteria were obtained to provide the basis for selection. Farmer-partners also took part in the selection; they freely selected what they wanted from the segregating materials on-field. This material was simultaneously distributed to 89 farmer-partners starting in May 1995.

Breeding materials were continuously segregated and diverse characteristics were obtained. The center had difficulty managing all the materials, and the focus of the program staff was limited to keeping records of significant developments in the materials; thus, it was decided to distribute to farmer-partners. All in all, CONSERVE was able to produce 100 lines from 10 single crosses. These were distributed to increase the number of selections and to enhance participatory research by exploring the process of selection until farmers can produce a stable selection for mass production.

Lessons learned and recommendations:

- It was interesting to note that the center did not keep a back-up of those 10 crosses that might have served as good material for selection in the future. The center is maintaining short-term back-up storage of the seeds collected in the beginning of the project.
- The crosses made also provided a good learning experience—an upland variety crossed with the lowland but with the experimental plots in the lowland area. The center should have tried conducting the same experiment in the upland area to know the performance of the offspring.

- The involvement of farmer-partners in the activity was very limited since they were only involved in the later part of the research and most of the selections were done by program staff. Farmers should have been involved not only in the later part but also in the whole process so that they could learn how the research is conducted.

Farmer-managed (farmers' field trials)

Farmer-managed trials are actually conducted on an individual farmer's field. Farmers have their own way of designing the experiment, either within the farm or across farmers. The evaluation is usually informal, with their criteria providing the basis for selection.

After the segregated materials were given to the farmer-partners in the Arakan Valley Complex, project staff monitored their progress and provided assistance to them. The majority of farmers received a minimum of five breeding lines in small amounts (around 5-10 grams) to try in their respective fields. Some planted the seeds in separate plots and others planted them in a portion of their rice field. Most of the farmers who received the segregating materials were graduates of the Ecological Pest Management–Farmers' Field School (training given to farmers on a weekly basis for one cropping season of about four to five months, to give them an understanding of rice production activities using the seven dimensions of sustainable agriculture).

Farmers selected plants according to their own individual criteria. They practiced two types of selection methods: bulk and pedigree. Some farmers discarded materials, while others mass produced. As these materials expressed their characteristics under the conditions of different farmers' fields, materials were exchanged among farmers, not just within the village but to other municipalities. Selection continued even when the materials reached the mass-production stage. Farmer-breeders continuously bred, selected, and distributed their stable lines to other farmers. It happened, too, that rejected materials were passed on to other farmers, still undergoing the process of selection according to individual preference. While the flow of materials continuously moved, the process ended when the breeding lines reached the mass-production stage. The flow of genetic materials from one farmer to another is extremely fast. The farmers' efforts to explore and experiment through selection were a very good example of participatory research and how farmers can be empowered by giving them control of the seeds and the resulting exchange of seeds within the area and to other villages.

From the survey conducted by CONSERVE in 1998, a total of 19 lines out of the 57 lines originally distributed from six single crosses (CC1, CC2, CC5, CC7, CC13, and CC20) were still maintained by farmer-partners. At present, the breeding lines are widely used for mass production not only by farmer-curators but also by other farmers. CONSERVE Crosses 5 and 13 are commonly used. Selections by farmer-partners are continuously enhanced in farmers' fields, which has led to an increase in stable lines. On the other hand, it was observed that over the years, although stable lines had been identified, the number of lines has decreased as farmers continue to select and adapt the materials given to them. Their selection criteria and the adaptability of the breeding lines are based on the conditions present in their respective fields. Moreover, only a few farmers keep many selections. Usually, they only keep two to three lines, on average. Farmers who keep many selections have the capacity to manage them and lack storage facilities, leading to a diffusion of selections.

Lessons learned and recommendations:

- It was noted that farmers did not keep the original lines given to them, as the center also neglected to do. Like CONSERVE, they have lost the opportunity to go back to the mother population in order to replace the lost selections. They have kept improving the selected materials until they became stable and uniform, based on their own criteria. There are only a few farmers who have the capacity to use all of the selected materials at a time. Since labor is limiting factor, farmers have discarded those materials that are not of use to them. Storability is another factor, because of the humid conditions of the program area—seeds lose their viability in a very short time.

- Therefore, there is a need to provide farmers with support in maintaining their selections and training them how to manage their seeds to preserve longevity.

Reasons for distribution and nondistribution

In order to determine farmers' acceptance of the segregating materials distributed, the reasons for distribution and nondistribution of materials in the field were examined (table 1). In the same survey conducted by CONSERVE in 1998, it was found that 31% of the farmers distributed the segregating lines they obtained from the center to other farmers. Most of them reasoned that it was ready for mass production. Another reason was that the person who requested it was a close relative.

Table 1. Farmers' Reasons for Distribution and Nondistribution of Segregating Lines to Other Farmers, Arakan Valley Complex, Cotabato, Philippines

Distribution	Nondistribution
Relative/kin	Minimum quantity
Morpho-agronomic characteristics	Infested by rats
Ready for mass production	Tungro infested
	Not yet uniform
	Mixed
	Infested by rice bugs
	No selection done
	Milled
	Eaten by ducks
	Neighbors have the same seed

When farmer-partners did not distribute the breeding lines to other farmers, it was because they only had a minimum quantity of the material. Some said this was because of an infestation of pests, such as rats and rice bugs, that the materials were not yet uniform, that the materials were mixed, etc. Some farmers were very reluctant to distribute because of the small quantity given. In time—with further field testing, improvement, and multiplication—farmers started to appreciate and find ways to obtain, develop, and increase the quantity of good varieties.

Reasons for adoption and rejection

There are also reasons why farmers adopt or reject varieties given to them. These reasons can be agronomic, morphological, gastronomic, social/cultural, and technological (table 2). Agronomic

Table 2. Why Farmers Adopted or Rejected the Breeding Lines Distributed, Arakan Valley Complex, Cotabato, Philippines

Adoption	Rejection
Agronomic:	**Agronomic:**
• adaptable to the area	• cannot adapt to the area
• resistance to lodging	• susceptible to lodging
• resistance to pests and diseases	• susceptible to pests and diseases
• medium maturity	• maturity is not the same
• high yielding	
• early maturing	
Morphological:	**Morphological:**
• long panicle	• discouraged by the segregation
• medium height	• height (tall)
• shiny seeds	• late maturing
• thin (lemma and palea)	
• good tillering ability	
• filled grains	
Gastronomic:	**Gastronomic:**
• good eating quality	• eating quality is not good
• aromatic	
• glutinous/oily	
Social/cultural:	**Social/cultural:**
• low cost in production	• busy with other obligations
• neighbors are encouraged	
Technology:	**Technology:**
• learn selection	• laborious

reasons include resistance of the breeding lines to pest and disease, resistance to lodging, and adaptability in the area. Adaptability was measured as having good standing performance/growth under specific environmental conditions.

Morphologically, farmers adapted breeding lines according to the length of panicle, number of productive tillers, grain characteristics, and plant height. Eating quality or palatability was also considered. Other farmers mentioned the low cost of production and knowledge gained in selection techniques as reasons for adoption.

The reasons for rejection were also classified according to agronomic, morphological, gastronomic, social/cultural, and technological. Usually farmers rejected the material because of the susceptibility of the segregating lines to lodging, while others were discouraged by non-uniform maturity or because of the height and maturity of the material. Few farmers rejected the materials for poor eating quality but others were hampered by other responsibilities and said that the activities were too laborious.

It was generally learned through the farmers' evaluation that farmers discard those materials that do not fulfill their selection criteria, especially materials that are susceptible to pests and diseases. Sometimes, however, rejection can lead to success. One of the farmer respondents rejected a selection that he then gave his neighbor. The neighbor grew the variety successfully and later multiplied the seeds for other farmers.

Conclusions

The approach initiated by CONSERVE has enhanced the farmers' capacity to develop varieties from the segregating materials distributed. Farmers' direct involvement with these materials has helped to providing access to diverse genetic materials, that has led, in turn, to opportunities for them to develop what they want from the genetic materials distributed. This approach has also helped in promoting farmers' involvement in farm-based varietial-improvement activities. In general, the approach is better if farmers are involved.

Summary

1. There are two PPB approaches initiated by CONSERVE, namely, researcher-managed or on-station trials and farmer-managed trials.
2. There were 22 single crosses made between upland and lowland rice by the center, coded as CONSERVE's crosses (CC). Ten crosses survived at the first filial generation and were planted on-station for three filial generations before distribution to farmer-partners. One hundred lines were derived and distributed to 89 farmer-partners, with a minimum of five lines per partner at 5–10 grams per line.
3. All the segregating lines given to farmer-partners were grown in their own fields. Two methods of selection were practiced: bulk and pedigree.
4. Nineteen lines distributed from six single crosses (CC1, CC2, CC5, CC7, CC13, and CC20) are still maintained by the farmer-partners. CC5 and CC13 are the most common. In their fields, farmer-partners keep two to three lines, on average. Farmers who maintained many lines have a greater capacity to manage and store them, resulting in diffusion of selections.
5. Selections are continuously enhanced in farmers' fields, leading to an increase in stable lines, but as this happens, the number of lines in the farmer's fields decreases. Farmer's selection criteria and the adaptability of the segregating materials contribute to this.
6. Farmers distribute selections for reasons such as readiness of the selection for mass production and requests for materials from close relatives. Reasons for nondistribution were because of the small quantity of materials, infestation by pests and diseases, the materials were not yet uniform, they were mixed, etc.
7. Farmer-partners adapted the segregating materials distributed for resistance to pests and disease, resistance to lodging, and adaptability in the area. Some adapted length of panicle, number of productive tillers, grain characteristics, and plant height.

8. Reasons for rejecting materials were due to susceptibility of the segregating materials to lodging, non-uniformity, and maturity. Some farmers felt that the activities were laborious and conflicted with other responsibilities.

Bibliography

CONSERVE. 1996. Community-Based Native Seeds Research Center, Inc., Annual Report. Cotabato, Philippines: Community-Based Native Seeds Research Center, Inc. *Unpublished.*

CONSERVE. 1998. *Farmers' Responses to Breeding Lines Distributed to Farmer-Partners in Arakan Valley Complex, Cotabato, Philippines.* CONSERVE Technical Report No. 5. Cotabato, Philippines: Community-Based Native Seeds Research Center, Inc.

Elings, A., 1999. *Some theory and practice of participatory plant breeding and variety selection.* (First version). Wageningen, The Netherlands: Community Biodiversity Development and Conservation Program (CBDC), Centre for Genetic Resources (CGN)/CPRO-DLO.

Sthapit, B.R., K.D. Joshi, and J.R. Witcombe. 1996. Farmers participatory high altitude rice breeding in Nepal : Providing choice and utilizing farmers' expertise. In *Using diversity: Enhancing and maintaining genetic resources on farm,* edited by L. Sperling and M. Loevinsohn. Ottawa: International Development Research Centre.

Witcombe, J.R. and A. Joshi. 1996. The impact of farmer participatory research on biodiversity of crops. In *Using diversity: Enhancing and maintaining genetic resources on farm,* edited by L. Sperling and M. Loevinsohn. Ottawa: International Development Research Centre.

Enhancing Farmers' Participation in Plant Breeding: Community Biodiversity Development and Conservation Program (CBDC), Bohol Project, Philippines

Hidelisa M. de Ramos

Abstract

The Community Biodiversity Development and Conservation Program (CBDC) is a global undertaking aimed at halting or minimizing genetic erosion and strengthening the farmers' role in on-farm conservation and development of plant genetic resources (PGR). It also aims to seek ways on how the formal and informal sectors can complement each other in on-farm conservation and development. In this paper, the project's general approach is illustrated in a case study on rice, conducted in Bohol, Philippines. The objectives of the study were to increase the genetic diversity of rice planted by farmers and to determine farmers' criteria for evaluating and selecting rice. Genetic materials were distributed to farmer-partners, evaluated by farmers, and subsequently exchanged within the community through the local exchange system. Workshops were conducted every season to identify researchable areas and to design field experiments. Community workshops were also held to analyze research results and identify new problems for the next season. Farmers decided which varieties or technology to adopt after each season, based on their observations and evaluation of the on-farm research. The study documented the results of two types of farmers' evaluation of the varieties.

Introduction

Farmers have traditionally exchanged and shared seeds among themselves. Seed sharing and exchange enable farmers to evaluate and select new crop varieties that suit their needs and preferences and adapt to specific environmental conditions in their fields (Berg 1994). Farmers are therefore able to continually produce diverse crop varieties that are specifically adapted to local needs and conditions.

However, when the Green Revolution started in the 1960s, the conservation and development of crop varieties were mainly taken over by agricultural research centers (Berg 1994). For instance, the International Rice Research Institute (IRRI) developed new varieties of rice that displaced many of the traditional varieties. Formal breeding programs not only displaced local varieties but also much of the farmers' role in crop conservation and development (Salazar n.d.).

Formal breeding programs differ from farmers' methods of developing new varieties. Breeders set breeding objectives with broad rather than specific adaptability in mind (Berg 1994). This means that the new varieties are designed to adapt to a wide range of field conditions. High yield is the top consideration for breeders, while farmers consider yield along with other characteristics deemed important, such as aroma and eating quality.

Furthermore, breeders produce new varieties in very favorable environments. Varietal trials are carried out in fields that are highly fertile and highly seeded (Atlin and Frey 1989), where optimum amounts of fertilizers are applied. The new varieties, however, perform differently in farmers' fields where conditions are more variable and management practices are different.

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This project is implemented by the Southeast Asia Regional Institute for Community Education (SEARICE), a regional NGO working on issues about access and control of plant genetic resources (PGR) and farmers' rights, and currently implementing community-based PGR projects in Southeast Asia.

Ceccarelli (1989) states that direct selection of varieties in the target environment is an efficient breeding strategy since this will produce varieties that satisfy specific farmers' needs and conditions better. This calls for a decentralized and participatory breeding approach where farmers are involved in the development and selection of new varieties. Participatory breeding will generate greater crop diversity in farmers' fields that can meet the diverse needs and conditions of farmers.

Approaches and methods in on-farm research

The Community Biodiversity Development and Conservation Program (CBDC) is a global undertaking aimed at halting or minimizing genetic erosion and strengthening the farmers' role in on-farm conservation and development of plant genetic resources (PGR). It also aims to seek ways on how the formal and informal sectors can complement each other in on-farm conservation and development.

The Southeast Asia Regional Institute for Community Education (SEARICE) is implementing the CBDC project in Bohol, Philippines. It started in 1994 and focuses on conservation and development of rice, corn, and root crops, such as cassava, sweet potato, and yam (*Dioscorea alata*). The project's general approach in conducting participatory on-farm research is shown in figure 1. The project, together with farmer-partners in the community, conduct workshops every season to identify researchable areas and to design experiments to be conducted in the field. On-farm research is evaluated at three levels: by the staff, by individual farmers, and by the farmers' group. Another community workshop is conducted at the end of each season to analyze research results and to identify new research problems for the succeeding season. Farmers decide which varieties or technology to adopt after each season, based on their observation and evaluation of the on-farm research.

The key players in the project's approach participatory plant breeding (PPB) and participatory varietal selection (PVS) are shown in figure 2. The genetic materials distributed by the project to farmer-partners come mainly from three sources: local communities; formal institutions, such as

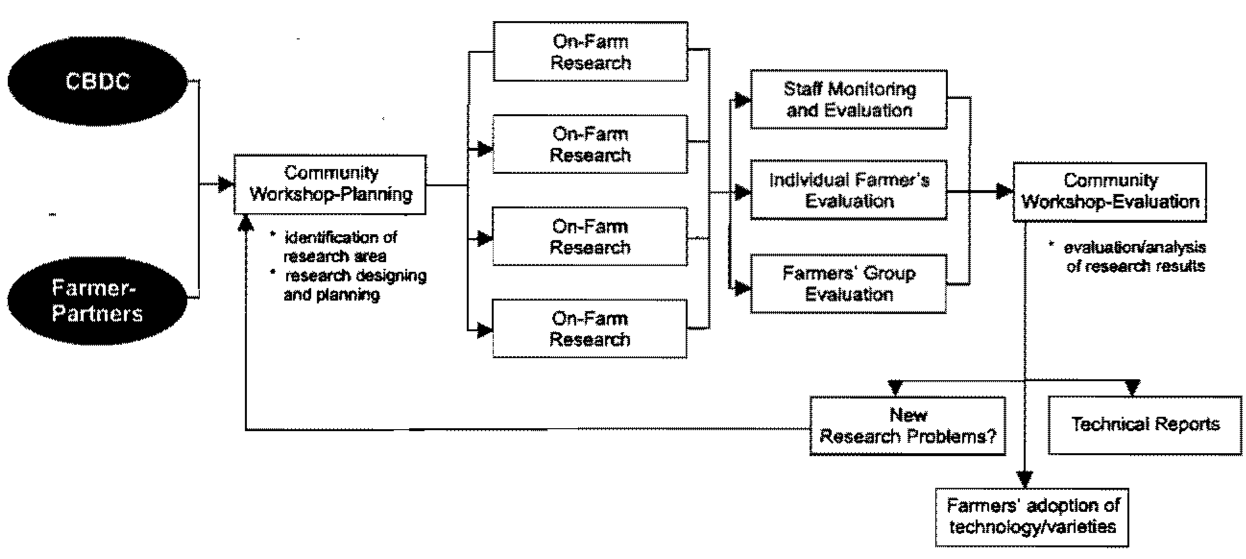

Figure 1. CBDC Bohol Project's approach in on-farm participatory research