The inclusion of a landrace as one of the parents in participatory plant breeding and the involvement of farmers in several stages of its development is imperative if the needs of farmers are to be accurately met, leading to a successful conservation strategy. The figure below outlines the stages and the processes through which crops have traveled and the important role played by farmers to make the story successful.

<table>
<thead>
<tr>
<th>Stages of development</th>
<th>Process</th>
<th>Farmers' role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wild relatives</td>
<td></td>
<td>Exploration, collection, testing for local adaptation and utility</td>
</tr>
<tr>
<td>Domestication</td>
<td></td>
<td>Experimentation, testing for adaptation, verification, selection, nonendurance</td>
</tr>
<tr>
<td>Farmers' var./LR</td>
<td></td>
<td>Seed exchange, purchase, gift, borrowing, theft</td>
</tr>
<tr>
<td>Agrobiodiversity</td>
<td>Diffusion</td>
<td>Parent selection, need and preference, selection, regeneration</td>
</tr>
<tr>
<td>Conv. breeding</td>
<td></td>
<td>Hybridization, improvement, mass, and FL selection</td>
</tr>
<tr>
<td>PCI (PPB/PVS/PGE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New variety</td>
<td>Variety release</td>
<td></td>
</tr>
<tr>
<td>Farmers' field</td>
<td>Extension (F. inst./dev. NGO)</td>
<td>Adaptation, diffusion</td>
</tr>
</tbody>
</table>

Figure 1. Farmers' roles in the crop-improvement process

Nomenclature of traditional varieties

Farmers have given names to their traditional varieties of different crop species based on their identifying characteristics, which can either be external appearance or internal quality. For some of the landraces, one can easily distinguish one from another on the basis of their names. Farmers' nomenclature has a scientific basis since words that constitute the name have an important meaning that reflects the characteristics of that variety. For instance, *lal tengan* is one landrace; it has been named for its red (*lal*) lemma and palea color and a long, stout tentacle/spur (a type of fish called a *tengar* has spur like this). A few examples of the names of farmers' varieties and their meanings are presented in table 1.

On-farm varietal diversification

Varietal replacement has been taking place with the introduction of modern varieties for several years, starting from the Green Revolution in Asia during the early 1970s. In many regions of the world, farmers have economic incentives to replace the varieties that have evolved within their own ecosystems with improved, introduced varieties (Louette and Smale 1996). Landraces seem so
Table 1. Name and Meaning of a Few Selected Landraces

<table>
<thead>
<tr>
<th>S.No.</th>
<th>LR Name</th>
<th>Type</th>
<th>Name &amp; meaning</th>
<th>Easy way to identify/distinguish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nakhí sara</td>
<td>Bhadaiya</td>
<td>Nakhí=awn, Sara=bhadaiya type</td>
<td>Long awn; yellowish lemma and palea (L/P)</td>
</tr>
<tr>
<td>2</td>
<td>Bhadaiya basmati</td>
<td>*</td>
<td>Bhadaiya=early seasoned, Bas=aroma</td>
<td>Slightly range-like color; fine grained</td>
</tr>
<tr>
<td>3</td>
<td>Basmati</td>
<td>Aghani</td>
<td>Bas=aroma</td>
<td>Like B. basmati; long panicle length; fine grain; aroma; awn on a few grains</td>
</tr>
<tr>
<td>4</td>
<td>Lali tengar</td>
<td></td>
<td>Lali=red, Tengar=type of fish with stout spur</td>
<td>Reddish L/P color; bold grain with long stout awn; grown in shallow water</td>
</tr>
<tr>
<td>5</td>
<td>Amaghauj</td>
<td>*</td>
<td>Ama=guava, Ghauj=cluster</td>
<td>Yellowish grain; two to four grains originating from a single point giving cluster-like look; long and strong stalk</td>
</tr>
<tr>
<td>6</td>
<td>Dudhraj</td>
<td></td>
<td>Dudh=milk</td>
<td>Whitish L/P color; milky-white grain</td>
</tr>
<tr>
<td>7</td>
<td>Laika famar</td>
<td>*</td>
<td>Lal=red, Faram=research institution</td>
<td>Yellowish L/P color with minute reddish stripes</td>
</tr>
<tr>
<td>8</td>
<td>Harinker</td>
<td>*</td>
<td>Harin=spotted deer</td>
<td>L/P during milking and dough stage looks like spotted deer; small round grain</td>
</tr>
<tr>
<td>9</td>
<td>Parewa pankh</td>
<td>*</td>
<td>Parewa=pigeon, Pankh=feather</td>
<td>The sterile lemma is long, covering the grain from both sides</td>
</tr>
<tr>
<td>10</td>
<td>Kariya Kamodh</td>
<td>*</td>
<td>Kariya=black</td>
<td>Very fine grain; blackish in color; aromatic</td>
</tr>
</tbody>
</table>

fragile to maintain that farmers easily adopt improved varieties—they have a higher yield potentiality than farmers’ traditional varieties. As a result, the number of farmers growing local landraces and the area covered by those landraces is declining. To counteract this trend, there has been a big contribution to varietal diversification through the varietal choices made by different institutions, and on-farm varietal diversity has further been enhanced by farmer-to-farmer dissemination of new rice varieties (Joshi et al. 1997).

Figure 2 gives examples of diversity created by different factors. For instance, rice varieties grown in ucha khet (upland) are different from those in nicha khet (low wetland) and man/pokhari (water-logged areas). Similarly, basmati, sathí, and khera fulfil cultural and religious requirements, while sokan and sotwa are valued for their medicinal qualities. Bhathi is grown for its unique characteristic of adapting in deep water, and sathi, mutmur, and sokan are grown in marginal uplands where no other landraces or modern varieties can be cultivated satisfactorily. In contrast, farmers generally confine their sources of planting materials to neighbors, relatives, and whatever is available in a new environment.

Conventional breeding

The farmers’ role in conventional breeding generally starts after the variety has been released, particularly for adoption and diffusion if the released varieties are preferred by the farmers. Once a variety is released through the breeding system, it is made available to a few farmers for assessing acceptance and rejection. The farmers’ role is still as a passive partner and as an end user. Farmers’ responses about new technologies are collected through farmers’ days, farmers’ field observations, and demonstrations.
Figure 2. Agroecology and human-induced selection pressures on crop genetic resources

**Participatory plant breeding**

Participatory plant breeding (PPB) is widely used by different institutions, both government organizations and nongovernment organizations, and even by farmers. However, farmers’ participation in PPB varies. The approach and methods of PPB are described in detail by IPGRI (1996: 57–65), Sthapit, Joshi, and Witcombe (1996), and Witcombe et al. (1996). However, the stages where farmers’ involvement is most important are plant selection, germplasm enhancement, seed selection, and management (Joshi et al. 2000). Table 2 summarizes the range of farmers’ participation in the PPB process.

**Prospects for germplasm enhancement with farmers’ empowerment**

The germplasm of local landraces can be improved through pure-line or mass selection with the active participation of farmers and modest technical backstopping from formal institutions for most of the processes. This can be achieved through farmers’ active participation, with minimum costs and little effort for breeders. At the same time, the genetic potential of local landraces can be conserved by encouraging in situ conservation.

Farmers at Begnas, Kaski and Kachorwa Bara have recently taken the initiative for participatory germplasm enhancement (PGE) through pure-line selection. In these areas, farmers’ knowledge about seed selection and storage were first documented. On the basis of this information, the farm-
ers were next given an orientation on seed selection and germplasm improvement. Finally, an agreement was made to follow a pure-line selection process in which farmers' participation in the process was assured. This process was designed to help impart a selection of skills to farmers and improve their crop varieties through pure-line selection if they wished. They would also feel empowered through their own participation in the process. This process may be proven to be a holistic, less time-consuming, and more cost-effective approach to improve the quality of landraces, thus making them competitive with improved varieties and, eventually, invigorating in situ conservation on-farm.

The traditional seed-supply system

The role of farmers in crop improvement and managing agrobiodiversity can best be explained by the traditional seed-supply system (figure 3). Approximately, 60% of global agriculture is performed by subsistence farmers using traditional methods—providing between 15% to 20% of the world’s food (Francis 1986; Sthapit and Joshi 1998). Diffusion in most parts of Nepal happens through the informal seed-supply system; the contribution of the formal seed sector is less than 5% in major staple crops (Baniya et al. 2000). The traditional seed-flow system includes variety selection and adoption, seed selection, seed exchange, processing, and storage (Shrestha 1998), and all of these processes are responsible for local crop improvement and creating agrobiodiversity. A review of case studies from Bangladesh (Mazhar 1997), Indonesia (Winarto 1997), Nepal (Joshi et al. 1997; Sthapit et al. 1998), and Ethiopia (Worede 1992) shows a wide range of examples in different countries where farmers—either independently or in collaboration with formal or informal institutions—have played an important role in crop improvement through seed production and dissemination (see also figure 1).

Variety selection and adaptation

From time immemorial, farmers have been observing and selecting their crops and crop varieties, saving and maintaining the seeds for next season, and experimenting with new seeds exchanged with neighbors and relatives (Shrestha 1998). It is noteworthy that farmers have tried to select the best available portion of the harvest for growing the subsequent year and also to meet the requirements of food and tradition. Farmers introduce new varieties in their localities to suit the different needs of soil fertility, moisture, family, and society, and to spread labor and reduce risk. Hardon (1995) and Joshi et al. (1997) reported that farmers possess the ability and knowledge to select crops and species that suit their environment and meet quality and other consumer requirements.

Table 2. Level of Participation in Different PPB Processes

<table>
<thead>
<tr>
<th>Citation</th>
<th>Modes of participation</th>
<th>Level of participation by farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witcombe (1996)</td>
<td>Consultative</td>
<td>Researcher consults farmers to assess needs, set breeding goals, and choose testing sites, but researcher retains key decision making</td>
</tr>
<tr>
<td></td>
<td>Collaborative</td>
<td>Expert farmers grow early, variable generations and select best plants on their own fields</td>
</tr>
<tr>
<td>McGuire, Manicad, and Sperling (1999)</td>
<td>Farmer-led PPB</td>
<td>External agents support farmers' own system of crop development</td>
</tr>
<tr>
<td></td>
<td>Formal-led PPB</td>
<td>Farmers join in formally initiated process of crop development</td>
</tr>
</tbody>
</table>
This process has created a diversity of crops and crop species, and thus, present-day landraces are no doubt the outcome of farmers' knowledge about and activities in crop improvement. Formal breeders in the name of "PPB" have lately consolidated the role of farmers in crop improvement through regular seed selection and exchange.

There is a wide range of information about the participatory methods practiced by scientists and breeders in several countries. Informal research and development (IRD), a type of participatory varietal selection (PVS) is reported to be 43% more cost effective compared to the formal system (Joshi et al. 1996 and Joshi et al. 1997).

Seed flow

The sources and directions of seed flow are vital to creating the diversity of both landraces and improved varieties. All the means through which seeds flow from one farmer to another contribute to diversity in totality. Seed flow includes purchasing, exchanging, giving as a free gift, borrowing, and stealing. Sources of new seeds might be markets, neighbors, relatives, agriculture extension, and research stations (see figure 1). In these ways, plant genetic materials drift from one place to another, creating new diversity in each community. This creates opportunities for farmers to meet
different needs, which they could not do with a single variety (Joshi et al. 1997). In one of the studies in Begnas, Kaski, Baniya et al. (1999) reported that rich farmers generally initiate variety introduction. Most farmers (85%) change seed lots or cultivars regularly, and about 49% follow this practice every one or two years. Ex situ conservation in gene banks being unaffordable, the fate of crop diversity in many mountain areas is largely governed by the fate of the traditional seed-supply system that exists within local communities (Shrestha 1998).

**Seed selection**

For generations, farmers have been involved in seed selection, testing crop varieties to address single or multiple household needs such as food security, economic benefits, and religious and cultural requirements, as well as finding varieties that suit their land type depending upon the access or availability of planting materials (see figure 2).

The choices or preferences for varieties of a crop may, however, differ with differences in socioeconomic status. Religious and cultural considerations, level of education, and gender dimension are equally important in influencing the choices and preferences for different crops and varieties. Traditional methods of seed selection in one of the rural areas in terai region of the country are presented in box 1.

### Box 1. Traditional Methods of Seed Selection at Kachorwa, Bara

<table>
<thead>
<tr>
<th>Seed-selection practices</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>At threshing floor, off-type panicles are removing, grains are removed by beating against hard surface to get seeds</td>
<td>I</td>
</tr>
<tr>
<td>At the threshing floor, selected panicles are threshed by bullock and kept separately</td>
<td>II</td>
</tr>
<tr>
<td>Panicles are selected at the threshing floor, keeping bundle of panicles and grains separated</td>
<td>III</td>
</tr>
<tr>
<td>Seeds used directly from grain storage without prior selection</td>
<td>IV</td>
</tr>
</tbody>
</table>

*Source: Chaudhary and Joshi (1999).*

In traditional farming systems, varietal mixtures either emerge through the deliberate action of farmers, or seeds get mixed at several stages from seed sowing through harvesting, threshing, drying, and storage. Box 2 gives examples of the reasons for seed mixtures in rice, as mentioned by the farmers at Kachorwa, Bara.

**Seed processing and storage**

Farmers have developed different seed-processing and storage practices for different crops and crop species, which help the seeds stay viable. The practices that are followed by seed-storage companies and research stations today are the results of farmers’ experiments in seed storage, transferred from generation to generation. Where seed processing is concerned, farmers keep the bare seeds of some crops, such as rice and wheat, or the cobs of maize or panicles or bunches or the fruit of some crop species, especially vegetables. For some crops, grains are cleaned and then dried well after threshing, while others require no such processing. Farmers store the seeds of some vegetable crops in the kitchen, where they are exposed to a continuous flow of smoke and heat. They dry the seeds of some other crops in the sun, some others (such as potatoes) in the shade. Some are kept in...
Box 2. Traditional Methods of Seed Selection in the Terai Region of Nepal

Reasons for mixture in rice seeds

- **Jharañ**: shattered seeds in the rice fields
- **Kheraha**: volunteer plants that emerge from jharañ
- mixed in threshing floor because of a common floor used for a number of cultivars
- mixed because of using compost manure containing the seeds of other cultivars
- blown by air and getting mixed
- intermixed during planking
- mixed in seed bed because of flooding
- mixed by birds in the seed beds
- intermixed during transplanting
- careful seed selection process not performed in the mixed population by the farmer
- only a few farmers mix intentionally for monetary profit or to reduce the risk of failure

Source: Chaudhary and Joshi (1999).

Airtight conditions, and some are spread on the floor. Baniya et al. (1999) reported on the different seed-storage practices followed by farmers in Begnas, Kaski, where there is a wide range of crop diversity even today. If farmers did not save seeds under proper storage condition, we would not have the diversity in both crops and crop species that we have today.

Limitations of participatory approaches

**Participation**

In the commercial world, there may be a lack of interest in participatory methods because resource-poor farmers might not appreciate immediate benefits from participation in research. They have a restricted time for contribution and limited resources to support research. On the other hand, resource-rich farmers, especially in a high production-potential system (HPPS) are likely to migrate to urban areas, thereby discontinuing active participation after a year or more. Urbanization and commercialization might have a negative impact on the participation since absentee landlords may have less time to think about all these participatory approaches, their being capable of supporting land for research purposes. Moreover, without compensation, long-term participation of farmers can not be assured, since the time for research activities can cause conflicts with farmers’ field activities.

**Knowledge**

Confining farmers to traditional cultivation systems has made them focus on traditional selection practices; they are less aware of advances in agricultural science for seed selection and varietal selection based on agroecology. Searching and procuring seeds becomes cumbersome and time consuming for individual farmer. Traditional ways of procuring seeds without adequate information about new varieties might in some cases adversely affect the farmers’ yield. Lacking adequate knowledge about seed selection, farmers keep mixtures in their selections to ensure adequate yields, but this also creates high diversity. Furthermore, in most of the participatory approaches to crop improvement, gathering postharvest information from rich people does not provide useful
insights—they are not actually the end users, since they are likely sell a large portion of their produce in the market (Witcombe 1999).

**Farmers’ knowledge threatened**

Several areas of knowledge are associated with landraces, and with the elimination of landraces, we not only lose genetic resources from our farming system or community but also the knowledge associated with them. With the ever-increasing dependence of farmers on modern technologies, accompanied by the use of chemical fertilizers and hazardous pesticides, farmers are being handicapped in several ways, including the area of indigenous knowledge. Farmers are, therefore, not only losing benefits from plant genetic resources, but more important, they are losing the right to save, exchange, and improve their seeds (Mazhar 1997).

Despite several efforts, it has been observed that no “steady state” is possible in populations of primitive cultivars because of technological changes in the farming systems that once produced them (Frankel 1970; Brush 1995). It is, therefore, certain that genetic erosion is pervasive and may accelerate if no proper action is taken on time to check it. It is also true that gradually the habitats of the landraces will be changed, the strength of the planting materials will be weakened, development and revolutionary options for various species may be shut off in the process, diversity will be skewed, and farmers’ decision-making and indigenous knowledge systems will be diluted. The hardest hit by this will be small and marginal farmers, whose situations will be further worsened by concomitant increases in uniformity and expensive market seeds, fertilizers, insecticides, and pesticides, irrespective of their quality. As a result, food deficiency will become more widespread and the lives of people will be threatened. Thus, there is an urgent need to look for a solution that helps cope with food deficiency through the management of agrobiodiversity.

**Coping strategies**

The threat to farmers’ knowledge, as well as to agrobiodiversity, can be addressed through the following strategies.

- Research should emphasize the process of responding to farmers’ needs rather than designing fixed options in standardized trials. Research-managed on-station and on-farm trials need to be combined with trials designed and run by farmers. Researchers therefore need to expand their focus and learn about the complex adaptations made by farmers.

- Agricultural research needs to reflect farmers’ own diverse conditions. It needs to be adapted to different settings (e.g., both dry-field and wetland agriculture), to different field conditions (e.g., a variety of soil types), and to different cropping patterns (e.g., multiple and intercropping patterns), rather than focusing on standardized, uniform trial plots, so that the processes of local adaptation and the technology developed are understood and can be supported.

- Farmers can be successfully empowered through training in the process of germplasm enhancement through pure-line and mass selection of their traditional varieties (Chaudhary and Joshi 1999), enhancing in situ conservation on-farm.

- The seed-supply system can be strengthened for self-reliance and cost effectiveness through the use of farmers’ networks of information and seed exchange, involving grass-roots institutions (Joshi et al. 1997).
Conclusions

Farmers’ knowledge (skills) and routine involvement in the crop-improvement process is crucial to the management of agrobiodiversity on-farm. Farmers are key players, bringing a wild species through generations, creating diversity to suit to their different agroecologies and traditions. However, farmers’ knowledge is being eroded and plant genetic materials are being lost forever. Our current need is to document agrobiodiversity and the knowledge associated with it to use in crop improvement in the future. It is essential to have an adequate scientific explanation of farmers’ knowledge in order to better and or improve this knowledge for efficient and sustainable agriculture. This can be achieved through different strategies such as diversity fairs, community biodiversity registers, poetry journeys (Rijal, et al. 2000), censuses, and field observations or transect walks. It requires the commitment of farmers and strong linkages with formal science institutes to enhance the maintenance of biological diversity, agricultural sustainability, and food security at the farm, regional, and global level.

References


Strength of Farmers' Knowledge and Participation in Crop Improvement


Need for Advocacy for Effective Participatory Crop Improvement and Plant Genetic Resource Enhancement: Case Studies on Rice-Breeding Processes from Khotang and Jajarkot Districts, Nepal

Yamuna Ghale

Abstract

This paper deals with advocacy for effective participatory crop improvement and plant genetic resource enhancement. First, the need for advocacy is highlighted; second, cases on the community-managed process of managing plant genetic resources is discussed. Advocacy is public action directed towards wider social change. It is about changing the policies, practices, attitudes, positions or programs of governing institutions within the public and private sectors that have a negative impact. In the age of globalization, multinational/transnational corporations (MNCs/TNCs) increasingly influence policies, but these organizations are not bound by rights-related laws and regulations. The trade-related intellectual property rights (TRIPs) agreement under the World Trade Organisation (WTO) is a major threat to crop and variety development and genetic resource enhancement. Advancements in genetic engineering promoted by profit-oriented MNCs/TNCs is gradually taking over the classical research-and-development process. If we are concerned about participatory crop improvement, we have to pinpoint the issue now. We need to enforce favorable policies and effective implementation for the conservation of our genetic resources and participatory development of crops and varieties. Therefore, to have influence at the policy level, we have to develop links between operational work and advocacy. In this context, advocacy can support communities demanding their rights in germplasm conservation. It is about having an input when government is formulating relevant policies, considering the voice of the powerless in developing plant-breeding program or plans, and bringing about the realization of favorable promises or policies for the benefit of farmers. The case studies show that farmers have selected and maintained their rice crops for generations with their own experience. The role of women farmer is vital to the process of seed selection, preservation, and maintenance. However, the cases indicate that men are still ignoring the role of women in the plant-breeding process. We argue that farmers are the owners of genetic resources, and they should have right to select, develop, conserve, and multiply them as they wish. Therefore, advocacy should be one of the major activities of all development organizations if they are to have any spillover effect for challenging sustained inequality and injustice to farmers.

Introduction

This paper basically deals with two issues: the first is the issue of advocacy and the need for advocacy in participatory crop improvement (PCI) and plant genetic resource enhancement (PGRE). It also analyzes the trend of global mechanisms to develop crops and or varieties without the participation of real stakeholders and the threat to developing countries. The second part highlights the major processes of seed production and saving rice in the mid-hills of Nepal. The cases elaborate these processes along with gender dimensions and the exclusion of farmers from breeding processes. Further to this, it highlights some of the advocacy and operational work of the development organization taking place in the Jajarkot area. The cases we highlight are from Khotang, in the eastern hills of Nepal for farmer-managed seed production, and Jajarkot, in the western hills of Nepal.

Yamuna Ghale is food right campaign co-ordinator with ActionAid Nepal. This paper was prepared with the assistance of Khadga Regmi, Jajarkot Permaculture Program (JPP); Dil Bahadur Rai; Jana Sewa Samaj; Min Bahadur Rokaya, farmer, Jajarkot; and Prateeman Rai, farmer, Khotang.