Strength of Farmers' Knowledge and Participation in Crop Improvement and Managing Agrobiodiversity On-Farm

P. Chaudhary, S.P. Khatiwada, and K.D. Joshi

Abstract

This paper highlights the role of farmers in crop improvement and managing agrobiodiversity. The findings are mostly based on focus-group discussions and field observations. Documentation of farmers' knowledge and experiences in crop improvement and managing agrobiodiversity may serve as a reference for individual breeders or institutions involved in participatory crop improvement through different strategies like participatory plant breeding, participatory varietal selection, or participatory germplasm enhancement. The strength of participatory crop improvement is that there is multistage involvement of farmers, from parent selection through to cultivation and selection of planting materials, because farmers have a wide range of knowledge and experience, and they are the end-users as well. Since ancient times, farmers have been dependent upon the traditional seed-supply system, which still accounts for over 90% of the seed requirement in Nepal. A variety of mechanisms like varietal selection, seed selection, seed processing and storage, and the seed-flow system have contributed to crop development, creating agrobiodiversity on-farm. More recently, participatory germplasm enhancement has arisen as a new strategy to enhance the germplasm of local landraces, which will not only empower farmers in improving their landraces but also strengthen in situ conservation of such landraces on-farm. The current need is to incorporate farmers' relevant knowledge and use it in the overall crop-improvement process.

Key words: Participatory, crop improvement, agrobiodiversity, germplasm, on-farm, and knowledge

Background

In many developing countries, farmers play a pivotal role in the conservation of genetic resources, thus maintaining biodiversity, since they hold the bulk of these resources (Worede 1992). From time immemorial, farmers have experimented with naturally existing genetic variations in their own environments to produce present-day landraces (Sthapit and Joshi 1998). Farmers have grown, tested, utilized, developed, and finally, selected new varieties and crop combinations to suit particular ecosystems. The role of farmers in creating agrobiodiversity is also evident from their involvement in seed storage and seed exchange. Of course, the need and preferences of individual farm families have driven them in the selection of crop species. For this reason, they have acquired a profound knowledge about landraces and niche-specific placement.

Given the inherent advantages of traditional practices, on-farm landrace conservation and enhancement provides a valuable option for observing genetic diversity (Worede 1992). A large number of subsistence farmers still use traditional methods. Those using modern technology account for approximately 40% of global agriculture, while rest is under traditional agriculture, which provides between 15% and 20% of the world's food (Francis 1986; Sthapit and Joshi 1998). The most important factors that motivated farmers to diversify crop and livestock in the past were probably ensuring livelihood and meeting qualitative preferences and requirements (Roder 1995; Sperling and Berkowitz 1994; Sthapit and Joshi 1998). Roder (1995), has reiterated the factors motivating farmers in maintaining diversity as follows:

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- the need for high self-sufficiency due to communication problems
- reduction of risk factors
- labor considerations
- lack of availability of suitable improved varieties
- market fluctuations
- traditional food preferences
- special requirements for ceremonies and rituals

One of the commitments made in Leipzig in 1996 during the NGO conference on the access and control of agricultural biodiversity was to enable the formal sectors, through training, to recognize the value of farmers' and indigenous peoples' knowledge and practices in conserving and strengthening agricultural diversity. The following statements further stress that the documentation of farmers' knowledge and participation in crop improvement is essential.

- To be able to define precisely the objectives, limits and means for implementing in situ conservation, it is necessary to obtain a better understanding of the structure of polymorphism within farmers' varieties, ways it evolves with farmers' practices and the methods and mechanism for managing this source of diversity. (FAO 1989; Brush 1992; Louette and Smale 1996)
- Recognizing farmers' knowledge and the farmers' role in developing landraces and maintaining their genetic diversity through the partnership of farmers with formal science institutes is an important step in enhancing the maintenance of biological diversity, agricultural sustainability and food security at the farm, regional and global levels. (Teshome 1997)

This paper highlights the role of farmers in crop improvement and agrobiodiversity management. The different stages of crop development and different approaches applied to bring about current agrobiodiversity are explicated in the following chapters. The examples are mainly from one of the sites of the project "Strengthening the Scientific Basis of in situ Conservation of Agrobiodiversity On-Farm" being implemented in Nepal jointly by the Nepal Agricultural Research Council (NARC), Local Initiatives for Biodiversity Research and Development (LI-BIRD), and the International Plant Genetic Resources Institute (IPGRI).

Farmers' role in crop improvement

Crops have traveled through different stages of natural evolution and systematic crop breeding. Breeding by different groups, such as routine seed selection by farmers and formal breeding in public and private institutions, has played an important role in bringing crops and varieties to their present status. Crop species have been adapted to different agroecological conditions while evolving from a wild to a cultivated form through more refined landraces because of farmers' selections. Farmers' landraces have been extensively used to develop improved varieties through breeders' efforts and again through diffusion through formal and informal institutions. Gene flow from wild relatives to farmers' landraces and from landraces to improved cultivars is a dynamic process and should be maintained if plant breeding is to meet the growing needs of the world's population (Vaughan and Stich 1991; Sthapit and Joshi 1998). This is why the conservation of plant genetic resources in situ has very recently been widely accepted by several formal and informal institutions

worldwide. 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.

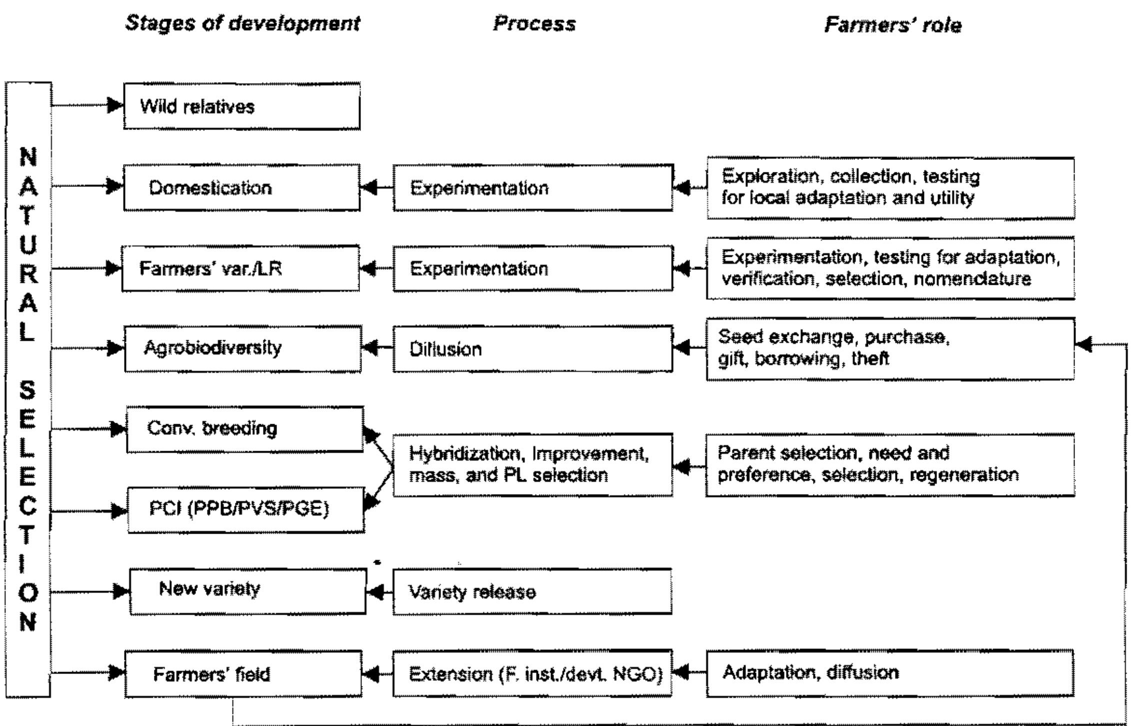

Figure 1. Farmers' roles in the crop-improvement process

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

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

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, sathi,* 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.

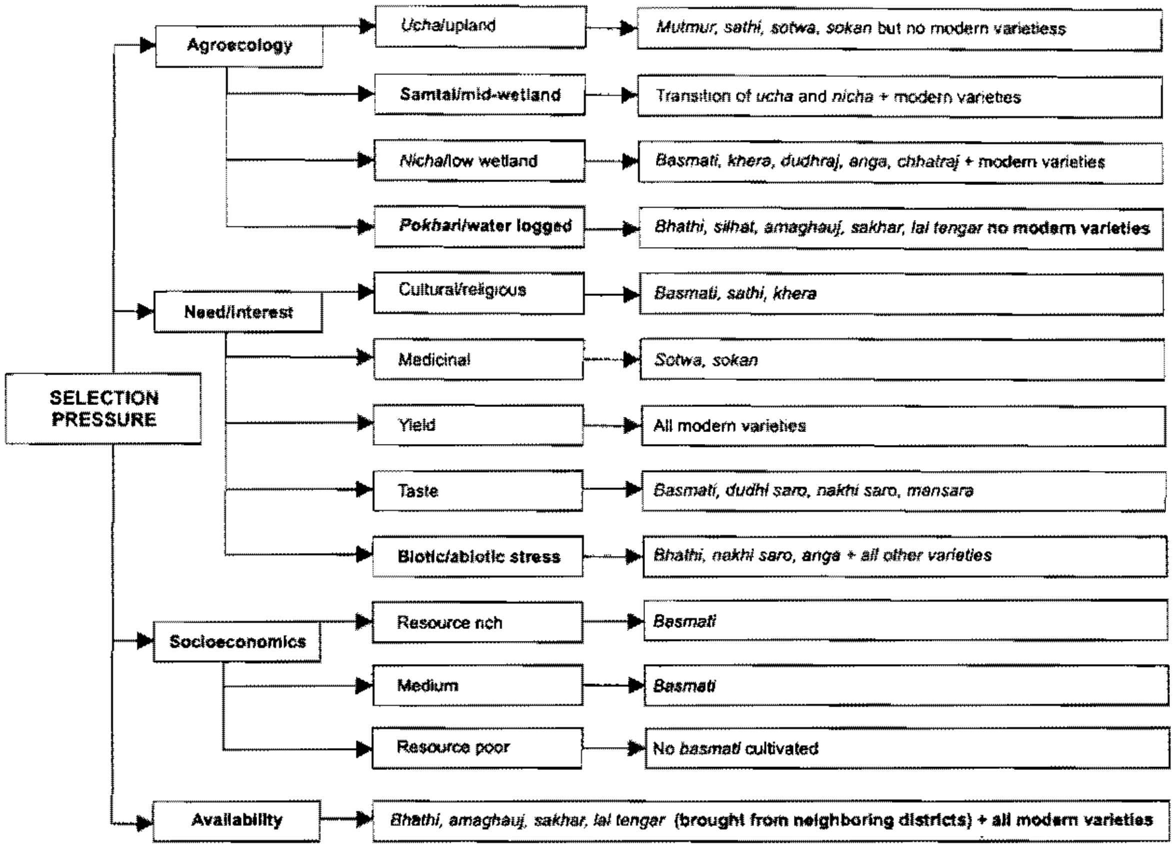

Figure 2. Agroecology and human-induced selection pressures on crop genetic resources

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-

Table 2. Level of Participation in Different PPB Processes

Citation	Modes of participation	Level of participation by farmers
Witcombe (1996)	Consultative	Researcher consults farmers to assess needs, set breeding goals, and choose testing sites, but researcher retains key decision making
	Collaborative	Expert farmers grow early, variable generations and select best plants on their own fields
McGuire, Manicad, and Sperling (1999)	Farmer-led PPB	External agents support farmers' own system of crop development
	Formal-led PPB	Farmers join in formally initiated process of crop development

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 cop 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.

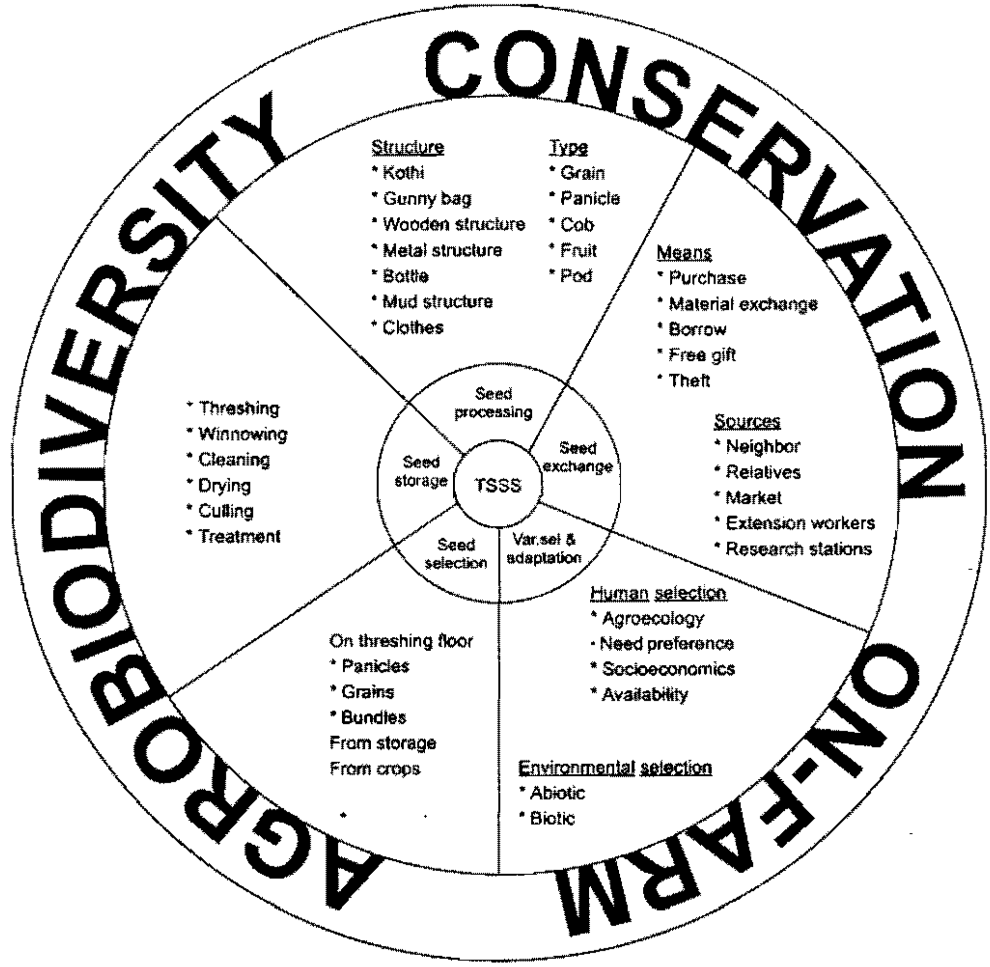

Figure 3. Farmers' role in the traditional seed-supply system

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

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

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

- *Jharan*: shattered seeds in the rice fields
- *Kheraha*: volunteer plants that emerge from jharan
- 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 monitory 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.

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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.

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The need for advocacy in PCI and PGRE

What is advocacy?

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. The co-director of the Advocacy Institute says, "To be meaningful, advocacy must be value based. It must be social, economic and political justice oriented." In most cases, government is still resisting the advocacy role being assumed by civil society.

Why advocacy?

Advocacy is not just another fad of development discourse; it is, rather, important to the sustainability of development work as well as policies. For the basic reason that for development organizations to have an effect, there needs to be a better understanding of the policies and practices of powerful development actors and how these can be changed in ways that benefit the large groups of poor farmers in their working areas. It is very important to recognize the importance of challenging deep-rooted and sustained inequality and injustice. In the age of globalization, policies are increasingly influenced by multinational and transnational corporations (MNCs/TNCs), which are not bound by rights-related laws and regulations. To have an influence at the policy level, linkages between operational work and advocacy should be developed, strengthening civil groups and alliances; lobbying decision makers directly; campaigning, promoting, and facilitating participation in research; building coalitions; and engaging the media.

Society is the common element that supports advocacy, with advocacy holding governing institutions to account on the behalf of citizens. There must be mechanisms to support nonrestrictive and robust debate on policy issues, procedures to resist harassment from authorities, and transparency in government. Civil organizations are increasingly expanding their activities beyond the provision of traditional services to include advocacy. Clear objectives, targets, methods or tactics, and allies are very basic elements of advocacy.

In the context of participatory plant breeding (PPB) and PGRE, advocacy can support communities in demanding their rights in germplasm conservation, in having an input when government is formulating policies, in making the voice of the powerless heard when plant-breeding programs/plans are developed, and in bringing the promises to the ground.

Advocacy in ActionAid Nepal

ActionAid Nepal's definition of advocacy is

> *a process, a deliberate, systematic and organised way of influencing public policy, public attitudes and policy practice in order to either change, maintain, implement or formulate new or alternative policies in favour of the poorest and most disadvantaged people.*

It is a set of coherent actions designed to introduce, influence, and change policies, practices, attitudes, and decisions for a just and equitable world. With this basic principle, ActionAid launched the International Food Rights Campaign to safeguard the right of poor people to food. The campaign aims to ensure that international agricultural trade benefits the poor and protects farmer's rights to seed and plant resources.

As biodiversity is owned by the community, there is an urgent need to include farmers in crop improvement and genetic resource enhancement. The issue of biodiversity conservation is rooted at the grass-roots level, which needs program linkage to be developed between operational work and advocacy. Therefore, ActionAid Nepal believes in strengthening the capacity of local organizations working at the grass roots to develop macro-micro linkages and, hence, to tackle the root causes of poverty, and it works to achieve this end.

Threat of the trade related intellectual property rights (TRIPs) agreement to the crop-improvement process and PGRE

The TRIPs agreement provides comprehensive rules and standards for the protection of intellectual property. Under this agreement, Article 27.3 (b) Patenting on Life Forms is a major threat for participatory plant breeding. It allows MNCs/TNCs to extend their control over the resources required to produce food in the South, as well as providing means to gain rights over many traditional plants growing in the South. This completely ignores rights of indigenous farmers to control and maintain the germplasm that fits in their lifestyles. There is a belief that TRIPs will have severe consequences for farmers in the South, that they will no longer be able to research, use, or exchange seeds and may lose ownership over traditional varieties of plants as well. Therefore, there is an urgent need to work on advocacy for participatory plant breeding, which preserves the rights of the indigenous farming community.

Where does the word *participation* fit in growing genetic engineering technology?

In the global trend of technology development, genetic engineering plays a crucial role in crop and or variety development. This kind of sophisticated technology is promoted by profit-oriented MNCs/TNCs and is limited to the laboratory. Therefore, the participation of farmers in this process is only a dream, and will remain so. If we are advocating participatory plant breeding, we must consider how we can play our role.

Case studies

The general Kiranti (Tibeto-Burman group) myth about the paddy crop invention in Khotang is that the ancestor, Khokchilipu, enjoyed a pot of rice cooked by his elder sisters, Nana Toma and Nana Khema, the cotton weavers, and he unfortunately trod on the fire-stick while dancing in the jolly mood and overturned the pot of rice. Another myth from Dhumi Rai is the story of an irritable king who had the habit of eating one *pathi* (approximately 4 kg) of rice, which had to be dehusked by nails. If this was not done properly, the cook was severely punished. These myths clearly show that the people of Khotang have grown a paddy crop since time immemorial.

In the case of Jajarkot, it is known that rice has been grown for about 110 years, and was brought from neighboring districts by the people of Jajarkot when they migrated. *Patle, mehel, kaumaro,* and *dotelo* are the main local varieties grown in the area.

Rice is grown as major crop in both Jajarkot and Khotang, especially in the less steep irrigated lowlands. It is strongly related to the eating habits of the local people.

Gender dimension

Seed choice. Seed is the basis for the next harvest. Farmers generally use seeds they have saved themselves. Family members discuss on selection of crop, seed, and land to grow it on, but the ultimate decision goes to the father or male head of the household. Women have a suggestive voice rather than an influencing one.

Nursery and plantation. For seed sowing, it is common practice in Jajarkot to soak the seeds in water for about four days and then to keep them in a bamboo basket before sowing in the nursery. In the process of preparing the nursery bed, men do the initial plowing but the rest of the job is mainly done by women.

Harvesting. Men and women are equally involve in harvesting, collecting, and carrying the paddy from field to threshing floor. Threshing is mainly the job of men with some assistance from women. After threshing, the job of mass cleaning is done by men but fine cleaning is done by women.

Seed selection. There are two main methods of seed selection.

In most cases, the paddy is harvested after it is fully ripe. Then the bunch of paddy will be threshed in the threshing floor once. The first harvest is then collected and kept for seed. The general reason is that the first harvest will have bold and healthy grains, which is good for seed. The farmers believe that "*jasto biuko ustai jiu*" (meaning, healthy seeds give healthy plants). Men perform this process, which requires more physical work. Then afterwards, the women collect the rest and finish the job.

The other method is where, after three or four years of harvest, the farmers choose the spikes in the field from healthy plants. The main reason is to get pure seeds. This method is used when the farmers realize the seed is not pure and the crops are not giving good harvests. This job is more or less done exclusively by women, who are very skillful and expert and have the patience for the tedious nature of the job. This clearly shows the relationship of power and skill with the division of labor.

The reason seed is selected by women is related to skill. There is a common saying that if the selected seed is not good enough, it means the women of that house are lazy and *allachhini* (meaning, women who have the greatest misfortune).

There is another method of seed conservation, which is very much tied up with the local culture. The farmers collect spikes that have ripened early and make a bunch, which is offered to the departed ancestors (*pitri*). This offering is not allowed for home consumption. When there is a famine and no seeds are available, the offerings can be used as seed to get the next harvest.

Postharvest storage. In most cases, all postharvest work is the exclusive job of women. They are responsible for cleaning and storing the harvest. During storage, the bold, ripe seeds are kept in local bins with *titepati* and cow urine.

Marketing

In the case of Khotang, the farmers generally keep whatever seed they need for the next season and use the seed accordingly. If there is any problem regarding the stored seed, they can exchange or barter seed with relatives or neighbors. The farmers sell paddy in the form of grain, not seed, in the market. Therefore, there is no influence from hybrid seed in the area.

In Jajarkot also, farmers are mostly dependent on internal sources of seed within the village. The Jajarkot Permaculture Program (JPP) has introduced some of rice varieties such as *machhapuchhre*

3, *chhomrong* and *badagaunle*. In addition, some of the new varieties such as the *radha* series and *mansuli*, have been introduced from district agriculture development. The JPP is working on advocacy in the promotion of indigenous seeds and technologies, and as a result, some of groups boycott the introduction of hybrid seed; they are more curious and alert about the value of local seeds and germplasm.

Cultural significance

In the Rai culture, rice must be offered to the departed ancestors. The local faith healers offer rice to chicks before sacrificing them as part of healing ceremonies. This shows the relationship between the culture and rice growing in the area.

In Jajarkot, the farmers celebrate *Harelo* on the third and fourth Sundays of Shrawan (August). During this festival, they spray cow urine by the twigs of *titepati* (*Artemisia vulgaris*) and worship the *Harelo* god with *bhojpatra* and pieces of red and white cloth.

Another interesting activity is a visit to a *Jhan* temple by pilgrims every five years during night of the full moon of *Paush* (Jan/Feb). There is a big trench below the ground where the pilgrims keep the rice grains they offered to the god. The grains replaced every five years to coincide with this celebration, so every five years there are new ones. When there is a famine and all the seeds stored in the house have been used for consumption, this store is opened and the stored grain is used for seed.

The first harvest is generally taken when there is *sait* (a good moment). The day of first consumption is considered a special day, when relatives gather and eat delicious foods. At the start of that occasion, the harvest is first offered to the god, and this offering is later used for seed if needed.

The role of intervening organizations

JPP has introduced a permaculture philosophy: making the earth live and grow on its own, with all bio-organisms surviving their full cycle. JPP has also encouraged farmers to use indigenous methods of farming and caring for nature. They have provided information on using green manure, on the use of skin-fermented water to control blast, and on patterns of crop rotation. JJP organized a farmers' level workshop on "Impact of Genetic Engineering on Indigenous Knowledge and Seeds" to raise awareness about the issues of biodiversity conservation. Now some of the women farmers' groups have dropped out of the commercial vegetable production group, which advocates the use of external inputs for agricultural production. The farmers have also boycotted the introduction of hybrid seeds in two of the village development committees. This means that farmers are able to make well-informed decisions if they have access to the right information. This will create a self-sustaining process among the farmers themselves, as well as helping to promote local biodiversity, in which they have the expertise of generations. Now Jana Sewa Samaj, a nongovernmental organization working in the Khotang district is trying to replicate the JPP model in the eastern hills of Nepal.

Conclusions

The case studies reveal that the indigenous community continues to manage plant breeding and that PGRE is most common in both case-study areas. Neither distinct formal-led nor farmer-led plant-breeding practices are common. Now such community-managed plant-breeding processes

and genetic resource management are severely threatened by globalization, especially Article 27.3 (b) of the WTO TRIPs Agreement. ActionAid Nepal believes that the food security of poor farmers and farmers' rights in seeds and plant genetic resources should be protected from such threats. To minimize the negative impact of international policies that are unfavorable to poor farmers, ActionAid Nepal has implemented a food-rights campaign. Micro-macro linkages are extremely important in influencing the policies for which the food-rights campaign is working. JPP and Jana Sewa Samaj are examples of strengthening and mobilizing local organizations to work on community-based PGRE and PPB.

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Beyond Taro Leaf Blight: A Participatory Approach for Plant Breeding and Selection for Taro Improvement in Samoa

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Abstract

The 1993 outbreak of leaf blight in Samoa resulted in the devastation of the staple taro crop and farmer's incomes from local and overseas markets. The preferred cultivars were all susceptible to the disease, and attempts to solve the problem through fungicides and changed cultural practices have had little impact. Efforts to evaluate exotic cultivars and breed taro with disease resistance commenced in 1996. Recent initiatives to facilitate the breeding program in Samoa include a university breeders' club and the Taro Improvement Project (TIP), involving university and ministry research staff, students, extension staff, and farmers. Both initiatives have been motivated by an interest in greater participation of students and farmers in the breeding process and evaluation of introduced taro cultivars. This paper reviews and evaluates experiences in Samoa with participatory approaches to plant breeding using a breeders' club and a farmers' group (TIP), highlighting the benefits of both.

Background

Samoa is a small independent Pacific Island country with two main islands (Upolu and Savaii) and five other small islands (figure 1). It has a population of about 160,000 largely involved in agriculture. Most agricultural households grow a variety of crops, including taro, bananas, breadfruit, cocoa, and coconuts. Prior to 1993, taro (*Colocasia esculenta*) was the most important export of the country, with 96% of agricultural holdings cultivating the crop. It is estimated that the area under taro at that time was 14,600 ha, of which 76% was grown as a monocrop. A single cultivar, taro Niue, dominated the cropping area because of domestic and export demand. The appearance of taro leaf blight (TLB), caused by *Phytophthora colocasiae*, in 1993 demonstrated how vulnerable the intensive production of taro had become, and production virtually ceased overnight. Since then the Ministry of Agriculture, Fisheries, Forests and Meteorology (MAFFM) has explored various approaches to overcoming the problem, including plant breeding. More recently, research staff at the University of the South Pacific (USP) have also become involved in breeding taro for resistance to the disease. There are clear signs that farmers in Samoa are slowly returning to taro again.

Taro in Samoa

Taro, an edible aroid that originated in the Indo-Malayan region, is grown as a staple or subsistence crop throughout the humid tropics but is of greatest importance in the Pacific Islands, where it accounts for about 20% of the root crop area. The corms are baked, roasted, or boiled and the leaves are eaten as *palusami*. Taro spread eastwards into the Pacific, probably reaching the Polynesian islands 2,000 years ago. There is now evidence to suggest that most cultivars found throughout the Pacific were not brought by the first settlers from the Indo-Malayan region but were domesticated from wild sources existing in the Melanesian region (Lebot 1992). There are now thought to be

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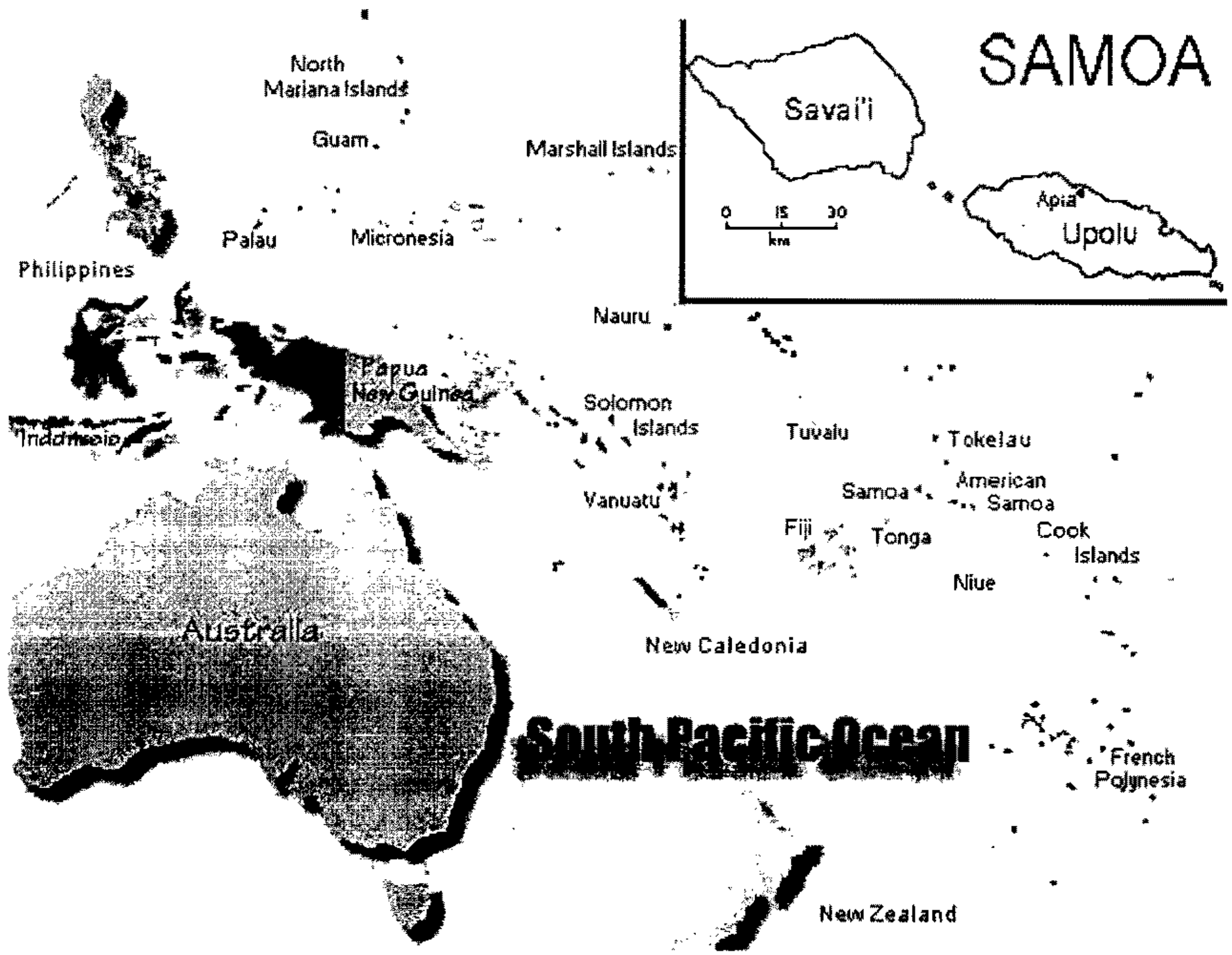

Figure 1. Samoa and its location in the South Pacific Ocean

approximately 2,000 taro cultivars in the Pacific region (Hunter, Pouono, and Semisi 1998). Prior to the arrival of TLB, farmers in the Pacific selected taro cultivars for a number of traits but not resistance to the disease. In the absence of this selection pressure, taro cultivars have reduced levels of resistance. At the turn of the century when the TLB pathogen began to spread into the region, it encountered a host plant that was genetically vulnerable.

Taro is the most important plant in Samoa, having special cultural, dietary, and economic importance. It is considered an essential component of an everyday meal. It is a plant with high prestige and great importance as a presentation on formal occasions. It is also favored for its considerable productivity in the fertile and high-rainfall environment of Samoa (Ward and Ashcroft 1998). In 1983, the returns from taro were three times higher than that from bananas and eight times higher than from coconuts (Asian Development Bank 1985).

Impact of taro leaf blight in Samoa

TLB was first observed on the island of Upolu at Aleipata and two days later from Saanapu and adjacent districts in July 1993. The disease spread rapidly throughout the country, severely affecting all local cultivars, but it was most devastating on taro Niue, the cultivar of choice for commercial production because of its quality and taste. Various factors contributed to the rapid spread of the

disease in Samoa. The area planted to taro Niue at the time was extremely large and effectively ensured a monocrop situation. There was a continuous and abundant source of taro for the disease because of the practice of farmers to interplant on old plantations and stagger their cultivation. Combined with the widespread movement of infected planting material and ideal weather conditions, the disease quickly reached epidemic proportions.

In 1992, prior to the blight, the World Bank estimated taro exports from Samoa at US$10 million, with a similar value on the domestic market. This placed taro as the dominant export and domestic market commodity. By 1995, the export value of taro had fallen to US$60,750, or less than 1% of pre-blight figures. Initial efforts by MAFFM to contain the disease, including fungicide spraying, quarantine efforts, and a public-awareness program, failed dramatically. The disease spread rapidly, and by 1996 only 200 farmers were growing taro in Samoa.

Conventional taro breeding strategies in Samoa

In 1995, MAFFM, in conjunction with the Australian government-funded Western Samoa Farming Systems Project, initiated a program to evaluate exotic cultivars. Nine exotic cultivars were evaluated against taro Niue in preliminary trials in 1995 and 1996. The cultivars Pwetepwet, Pastora and Toantal (originating from the Federated States of Micronesia) and PSB-G2 (now known locally as taro Fili and originally obtained from the Philippine Seed Board) were assessed in on-station trials for resistance to TLB. These trials indicated that all four cultivars were more resistant than Niue, the locally preferred cultivar. MAFFM further evaluated these four cultivars in on-farm trials during 1996 and 1997. Farmers involved rated Fili as the best tasting and both Fili and Pwetepwet as the most resistant to leaf blight. MAFFM began recommending and distributing Fili to growers in late 1996.

The identification of taro Fili has allowed many farmers to return to taro production, and over the last few years, the area under taro has slowly increased. However, the release of this single cultivar has not been enough to meet the needs of all growers, and a few shortcomings have been reported, including the following:

- relative susceptibility to the disease, especially in wetter areas of the country
- low yields
- poor storability, which is a problem with growers starting to export to markets in American Samoa and the United States

In addition, MAFFM imported a range of exotic taro cultivars from Palau in 1995. Field trials at the University of Hawaii had shown that some of these cultivars had good levels of resistance to TLB. To date, no Palau cultivars have been released or recommended by MAFFM.

Efforts to breed taro with resistance to TLB in Samoa commenced in 1996. Crosses were made among introduced TLB-resistant cultivars and susceptible local cultivars. This cycle-1 population has been evaluated and 10 promising clones have been selected. These clones are being further evaluated in multilocational trials in Samoa.