

Figure 2. Key players in PPV/PVS

the University of the Philippines–Los Baños (UPLB) and the Philippine Rice Research Institute (PHILRICE); and nongovernment organizations (NGOs), like the Community-Based Native Seeds Research Center (CONSERVE). The distributed genetic materials consist of stable varieties, such as traditional varieties, farmers' selections, and formal release varieties. The project also distributes segregating lines (F1-F8) collected from NGOs and formal institutions. These genetic materials are evaluated by farmers and subsequently exchanged within the community through the local exchange system.

## Methodology

The project's general approach is elaborated in a case study conducted in collaboration with the Research and Development Department of the Central Visayas State College of Agriculture, Forestry and Technology (CVSCAFT), a local institution.

Fifteen varieties of rice were distributed to 12 farmers in Zamora village in Bilar town during the second cropping season from October 1999 to March 2000 (table 1). The materials came from different sources and consisted of both white and red varieties. Boholanos are known to prefer red rice varieties. Each farmer received three varieties at 0.5 kg per variety. The farmers grew the varieties using their own management practices in combination with organic fertilization. The methods of

**Table 1. Types of Varieties Distributed to Farmer-Partners**

Set	Variety Name	Origin/Sources	Seedcoat color	No. of farmer recipients
1	MB	Farmers' selection from RC 10	Red	3
	08	Local variety	White	
	CC 13-3-4-3	NGO-bred and released to farmers at F3	White	
2	03	Local variety	White	4
	RC 28	Formal release	White	
	Los Baños	Local variety	White	
3	CFS-JR-06	Farmers' selection from Japanese variety	Red	3
	MS 1-29	NGO/farmer-bred	White	
	RC 4	Formal release	White	
4	66 Puwa	Farmers' selection from IR 66	Red	4
	MS 2-AV	NGO/farmer-bred	White	
	Japan	Local variety	White	
5	Ceres	Local variety	Red	3
	MS 13	NGO/farmer-bred	White	
	CC 13-3-4	NGO-bred and released to farmers at F3	White	

distribution and trial arrangements with farmers were based on lessons gained by the project in previous years of conducting on-farm experiments and studies.

The study documented the results of two types of farmers' evaluation of the varieties. In one evaluation, farmers who received the same set of varieties ranked the varieties in comparison with IR66, the most commonly planted variety in the village. Farmers ranked the varieties according to different parameters they themselves identified. Ranking in each parameter ranged from one to four, with four representing the highest preference by the farmers. In the other evaluation, the farmers participated in a field day to observe and evaluate all the varieties as standing crops. Farmers identified the varieties they preferred and the reasons for their preferences.

### ***Objectives of the study***

The objectives of the study were

1. to increase the genetic diversity of rice planted by farmers in Zamora village
2. to determine farmers' criteria for evaluating and selecting rice

## **Results and discussion**

### ***Farmers' preferences in a variety***

Farmers identified at least 13 specific traits they look for in a variety (table 2). Their criteria are very comprehensive, ranging from percent germination to yield. Farmers evaluated the varieties from seedling stage until harvest. Yield is one of the major criteria, as shown by the identification of related traits such as big grains, long panicles, and high tillering ability. In addition to yield, maturity also matters to farmers since early maturation allows them to maintain at least two cropping seasons per year. From the evaluation results during the farmers' field day, farmers cited one addi-

**Table 2. Sample Matrix Ranking of Varieties by Farmers Receiving Same Set**

Preferred Traits	MB	08	CC 13-3-4-3	IR 66
1. High percent (%) germination	4	1	2	3
2. Healthy and strong seedlings	4	2	1	3
3. Panicles				
a. long	4	3	4	3
b. low % of unfilled spikelets	4	4	4	3
c. low shattering	3	4	4	3
d. heavy branching	3	3	4	4
4. Big, healthy spikelets	4	4	3	3
5. High tillering	3	4	4	4
6. Early maturing	3	3	4	4
7. Strong culm	4	4	4	3
8. Resistant to pests	4	4	4	3
9. Medium height	4	4	3	3
10. High yield	4	3	4	3
Average ranking	3.7	3.3	3.5	3.2

Note: 4 = highly preferred; 1 = least preferred.

tional criterion not identified in the matrix ranking, namely, tolerance to water logging (table 3). This criterion is significant because certain areas of the village are waterlogged. This is a good example of selection by farmers for a very specific field condition. On the other hand, formal breeding programs would be unable to capture such selection because varieties released from the formal sector are generally bred for broad adaptability.

Culture, as it relates to diversity conservation and development, is also not addressed by the formal sector. For example, Bohol farmers maintain a diversity of red rice varieties, either traditional varieties or farmer-developed varieties (table 1). Boholanos are known to prefer red rice because it is generally equated with better eating quality. Farmers also claim that they can work longer in the field after eating red rice (CBDC 1996). In fact, local red rice is priced higher in the market than local white rice. Red rice is also preferred by a number of ethnic groups in Luzon and Mindanao (Borromeo, personal communication). However, the Philippine Seed Board has not released any red rice variety since it was established in the 1950s (Borromeo, personal communication).

### *Increased genetic diversity*

Seven of the 15 varieties distributed were replanted by the farmers who participated in the trial. Previous to the trial, farmers in Zamora were planting only three varieties (CBDC and CVSCAFT 1999). This represents a significant increase in the number of varieties planted in the community after one season.

The selected varieties have diverse qualities. Two are farmers' selections, three came from an NGO-farmer breeding program, one from the formal sector, and one is a locally adapted variety (table 4). The replanted varieties either ranked higher (in sets 1, 3, and 5) or slightly lower (in sets 2 and 4) in comparison to IR 66, the check variety.

**Table 3. Result of Collective Farmers' Field Evaluation of Standing Crop**

Variety name	Preferred traits	No. of farmers who preferred the variety
MS 13	Uniform hull color and absence of spots Healthy, big and many spikelets White grains Long panicle Strong culm, lodging resistant Tolerant to water logging	10
CFS-JR-06	Good panicle Healthy and big spikelets Red grains Strong culm, lodging resistant Tall	10
MS 2 – AV	Healthy and long panicles Early maturing Tolerant to leaf folder and rice bug Lodging resistant Resistant to diseases Uniform height Short height	7
MS 1-29	Healthy spikelets Many but small spikelets Uniform hull color, absence of spots Long panicle Tolerant to diseases	7
MB	Big panicles and grains Uniform hull color, absence of spots High tillering Tolerant to water logging Lodging resistant Big culm Resistant to leaf folder Tall	4
Los Baños	Many spikelets and panicles Heavy branching Tall Relatively late maturing compared to other varieties	3
66 Puwa		1

Varieties that scored high in both the field day evaluation (table 3) and the matrix ranking (table 4) had a higher rate of adoption than the other varieties with lower scores. This implies that if farmers' criteria are taken into consideration and varietal performance is evaluated in farmers' fields using farmers' practices, then varietal adoption rates could increase considerably. This could shorten the time for a material to be evaluated and adopted by farmers. Release of a new variety in

**Table 4. Summary of Matrix Ranking by Farmers According to Set**

Set	Variety name	Average ranking	No. of farmers from same set replanting the variety	No. of farmers from other sets replanting the variety
1	<b>MB</b>	3.7	1	3
	08	3.3	0	0
	<b>CC 13-3-4-3</b>	3.5	0	0
	IR 66	3.2	local check variety	—
2	03	2.8	0	0
	<b>RC 28</b>	2.8	1	0
	<b>Los Baños</b>	2.8	0	1
	IR 66	3.4	local check variety	—
3	<b>CFS-JR-06</b>	3.2	1	0
	<b>MS 1-29</b>	3.7	1	1
	RC 4	2.7	0	0
	IR 66	2.8	local check variety	—
4	66 Puwa	3.7	0	0
	<b>MS 2-AV</b>	3.5	0	1
	Japan	3.2	0	0
	IR 66	4.0	local check variety	—
5	Ceres	3.2	0	0
	<b>MS 13</b>	3.7	1	4
	CC 13-3-4	only few seeds germinated	NA	NA
	IR 66	3.2	Local check variety	—
Total no. of farmers who replanted the distributed varieties			5	10

*Note:* Varieties in bold letters were those replanted by farmer recipients: seven varieties replanted out of 15 varieties distributed (47%).

the Philippines normally takes about eight to 10 years, starting from the selection of parent materials (Borromeo, personal communication). Moreover, with farmers' participation in varietal trials, on-farm genetic diversity can be increased almost immediately. With their experience in doing PVS, farmers can later be trained to do PPB through handling of segregating generations or actual crossing of varieties. Through PPB, farmers can produce even more specifically adapted varieties that will contribute to overall local crop genetic diversity.

## Conclusions and recommendations

1. Providing diverse materials that suit farmers' criteria and conditions can enhance genetic diversity in farmers' fields.
2. PVS is a good entry point towards implementing PPB, where farmers play the central role in the development of new varieties.
3. PVS/PPB approaches should continually evolve according to local farmers' needs and conditions.
4. Feedback mechanisms between breeders and farmers should be established to ensure that appropriate materials are disseminated to farmers.

5. In providing germplasm to farmers, one should consider not only farmers' criteria but also their capacity, skills, and resources in order to determine their levels of participation.

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# Developing Local Organizational Capacity for Participatory Seed Management: Experiences from the Eastern Himalayas

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## Abstract

This paper describes the objectives and goals of a participatory seed-management initiative that is presently being conducted in the Sankhuwasabha District of eastern Nepal as part of the Gender, Ethnicity and Agrobiodiversity Management project. The long-term goal of the project is to develop local capacities to effectively manage existing genetic resources through the development of skills that enhance crop improvement. The research is based on an interactive methodology that emphasizes devolution through varying levels of farmer participation in the research process. Both men and women farmers are included in the project, with the requirement that they be involved in farming as a full-time subsistence activity. Specific problems faced by farmers in the area, such as out-migration of men looking for wage-work and a yearly period of food scarcity lasting as long as six months, are highlighted.

## Introduction

Situated in the remote mountain regions of the eastern Himalayas, the "Gender, Ethnicity and Agrobiodiversity Management" project proposes to develop the research capabilities of selected local people in four sites: eastern Nepal, Sikkim, Bhutan, and Nagaland. The immediate objective of the project is to develop a local capacity to conduct research to better understand the causal links between ethnicity and gender and how these components affect and influence decisions related to management of agro biodiversity. However, the broader, long-term goal of the project is to develop local capacities to effectively manage existing genetic resources through the development of skills that enhance crop improvement. Within this latter context, a participatory seed management initiative is currently being implemented in one site (Nepal) with the objective of broadening the experiences gained from this process to other sites in the region.

The participatory seed management project is being conducted in three adjoining "village development committees" (VDCs), which are village-level administrative units of the Sankhuwasabha District of eastern Nepal. In broader terms, the project aims to enhance and develop new technologies for seed management in marginal mountain communities that lack access to new seed sources. The following hypotheses articulate the more specific objectives of the research project:

- The development and enhancement of seed-management technologies will occur most effectively through a process of interactive learning between indigenous and formal systems of agricultural development.
- Access to improved technologies can be most effectively sustained through community action. This necessitates the enhancement of existing technical skills for seed improvement, along with the organizational capacity of community-based organizations to ensure community access to these improved technologies.

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- Finally, the success of community action to manage development processes will depend fundamentally on the community's ability to control the processes of knowledge production, design, and implementation of actions.

The practical implications of this methodology can be summarized as the need to search for ways in which participatory research can be part of an ongoing process. Inherent to the process is the acknowledgment that power relations between researchers and the *researched* is problematic and that there is a need to develop a process of critical reflection that situates the production of knowledge and action within a specific context of a negotiated process, emphasizing community action (see also Koning and Martin 1996).

## The setting

The major ethnic group inhabiting the research sites is an ethnically distinct but heterogeneous group of people known as the Rai. Together with a related group of people known as the Limbu, the Rai refer to themselves as *Kirats*, a term employed as much to unify all the various "tribes" and clans as it is a political statement employed to distinguish them from the dominant Hindu majority. Having until the recent past practiced a distinct system of communal land tenure known as *kipat*, the *Kirats* constitute one of the oldest ethnic components of the region. Yet in decades following their integration into Nepal after the "unification" in the mid-18th century, the *Kirats* have been confronted with numerous challenges to their traditional way of life. Dominant lowland influences have resulted in changes in sociocultural practices associated with traditional land-management practices and given rise to the ubiquitous rain-fed and irrigated terraces (*bari/khet*) that suit wetland paddy and other lowland crops. In the process, engineered landscapes have replaced extensive areas of forest cover where traditional swidden (slash-and-burn clearing) was practiced.

Compounding the asymmetry of historically derived center/periphery relations are constraints imposed by the harsh mountain environment. Typical of the eastern Himalayan region (see Shrestha 1989), human settlements are situated in elevations ranging from 500–2000 meters, where land-distribution patterns combine with steep slopes and shallow soil depths to severely constrain agricultural activities. The land-distribution figures of Tamku VDC (table 1), where the research sites are located, demonstrate the environmental constraints that the inhabitants are confronted with. From the total available land, only 10.6% is suitable for agriculture, and from this total arable area, 54% has slopes of 40 degrees and soil depths of not more than 20 cm (Goldsmith, 1982).

Asymmetrical center/periphery relations embedded in historical processes have contributed significantly to the present deteriorating state of local institutional capacities to negotiate and orient

**Table 1. Land Classification of Tamku VDC**

Agricultural lands	10.6%
Grazing lands	14.6%
Shrubs	7.8%
Deciduous forests	35.6%
Subtropical forests	10.8%
Rock ice	20.6%

Source: Khanal (1992).



development services to their benefit, especially to counter the period of food deficit that typically lasts for four to five months a year. Unable to support their subsistence needs through crop yields alone, many households have male family members migrating in increasing numbers to urban centers in search of employment, leaving women and children to manage and care for the farm. An additional outcome of prolonged periods of food deficit is the inability of households to save seeds from consumption in times of stress. This, along with deteriorating local knowledge about seed-management practices and the absence of organizational capacities to access external sources of improved seed technologies has profound implications for the long-term subsistence of households in the region. It also significantly determines the nature and type of research methodology to be adopted for particular sites.

## **The research process: An interactive methodology**

The objectives of the project evolved in several stages of a diagnostic process that sought devolution by emphasizing community participation in increasing stages during the research process. In order to facilitate community control and ownership, the methodology was developed from the principles of problem posing, dialogue, and reflection based on the Freirean (1972, 1973, 1978) notion that community involvement in the development process can be generated through developing a critical awareness of the causes of problems. The diagnostic process involved the following steps:

1. A survey was conducted to establish the need for a participatory seed-management initiative, based on the following research themes:
  - assessing the capacity of local community-based organizations
  - determining existing patterns of food sufficiency
  - identifying appropriate crop(s) for enhancing improved seed-management strategies
  - determining factors for farmer participation through gender-differentiated varietal assessment of identified crop(s)
  - determining the source of germplasm, either in existing local varieties or through external means
2. Analysis was done through a critical examination of baseline data to determine how the problem of food deficit is contextualized by community members. That is, are problems of food deficit linked to just economic issues of subsistence or are they affected by social dynamics of decision-making? And to what extent are these embedded in the values and cultural constructs of the community? Conceptualized problems in this way necessitates posing the following questions:
  - Do the issues deal mainly with problems of subsistence, decision-making, or values?
  - Where will action most likely come from?
  - What will most effectively motivate people?
3. Problem-posing material was prepared through the development of codes, which are representations of existing problems in the form of stories, dramatized enactments, pictures, results of participatory rural appraisal (PRA), etc. Fundamental to the preparation of codes is the need to ensure that they present a scene showing a concrete experience of the problem, which is familiar to the participants.

4. Discussion was directed through an interactive workshop whereby community members participated in defining the problem of food deficit and searching for solutions. The primary objective of this process was to develop a critical awareness of the problem of food deficit through the search for potential solutions. Additionally, the process also creates a context for the community to provide comments on the research results and to define the direction of the process. The process begins with a description of codes, followed by a first analysis, which is then related to real life and followed by a deeper analysis, ending in self-reliant action planning.

#### ***Farmer participation in the research process***

The degree and type of farmer participation depends principally on the objectives for participation, as well as the context, as determined by the particular stage of the process. Thus, the diagnostic phase, consisting of the survey, analysis, code preparation, and discussion, involved varying levels of farmer participation. In the survey, three members of the community and two project members comprised the research team. Clan elders and farmers selected on the basis their knowledge related to seed management were consulted about the relevance of the project. In addition, the executive body of community-based organizations were consulted to establish interest in developing a working partnership to conduct the project.

The survey was conducted to establish (1) a crop inventory, (2) to determine the needs and priorities of different groups, based on gender and wealth considerations, and (3) to identify crop for improving seed-management technology. At the same time, farmers were selected for consultation on the basis of their knowledge, financial status, and gender. The subsequent analysis of the data to develop appropriate codes was conducted in collaboration with local researchers and farmers.

The main objective of the workshop that followed was to present the codes to the larger community

**Table 2. Types of Farmer Participation**

	A	B	C	D
Survey		x		
Analysis		x		
Code preparation			x	
Discussion				x

*Source:* Adapted from Biggs (1989).

*Note:* A = contractual; B = consultative; C = collaborative; D = collegiate.

to understand the root causes and potential solutions to problems of food deficit in the region. The selection of community members was based on the criteria developed in prior consultation with local members of the research team. During this stage of the interface, farmers were more extensively involved in the direction of the discussion of research findings, as well as decision making to determine the level of participation in setting the agenda for future action.

## **User differentiation**

The selection of participants was determined by the following criteria:

- demonstrated instances of innovation in seed management and knowledge of causal links between problems of food scarcity and gaps in existing seed-management practices
- gender-differentiated knowledge and gendered experiences
- farming for subsistence as a full-time subsistence activity

### ***Innovation***

The participants selected for participation in the research process demonstrated varying degrees of innovation in crop management. The type of innovations ranged from pre-harvest selection practices to post-harvest storage practices. In some instances, the practices were learned from experience gained externally, as in the case of selecting for desired traits of rice during the pre-harvest period or experimenting with new strategies as in the case of post-harvest storage of maize mixed with millet to reduce pest attack.

While post-harvest selection practices were common for crops such as maize and millet, pre-harvest selection was practiced only on paddy. One farmer, selecting specifically for larger panicles, denser grain quality, and tall height in a landrace (*punche dhan*) was successful in producing a "variety" subsequently named after him (*changkhu dhan*, literally "Changkhu's rice"). This "variety" is currently widely adopted by other farmers in the community, with Changkhu presently selecting for early maturation to coincide with the planting of winter wheat.

In seed-storage technology, some innovative farmers experiment with the leaves of a locally available plant (*bojo*) to ward off pest attacks on maize seeds. Dried leaves of this plant are placed in the bottom of the seed container and alternately in several layers approximately every three to four inches, then the container is sealed by additional leaves at the top. Sealed in September or early October, the relatively airtight spaces and the toxic nature of leaves sufficiently wards off pest attacks.

In another example, one woman farmer, noticing that millet grains were free of pests that attacked maize seeds, began mixing a handful of millet grains in the container where maize seeds were stored. This relatively simple practice was based on her observation that millet seeds were free from the pests that attacked the maize seeds that were stored in close proximity to the millet.

### ***Knowledge and gendered experiences***

In varietal assessments of maize, conducted separately between women and men farmers during the initial research phase, women and men listed different categories of preferences based on their roles and experiences. Men listed four varieties of maize, mostly modern varieties that had been introduced into the community in the last several years. Women, on the other hand, listed eight varieties, mostly landraces whose use had been discontinued in the project site but existed in the women's natal villages. Women cited fodder quality, ease in grinding, and taste as the primary criteria for their preference of landraces. Men, on the other hand, cited high yields, early maturation, resistance to drought conditions, and market prices as important in their preference for modern varieties. An additional ranking of maize varieties among farmers revealed differential knowledge and preference priorities between women and men (table 3).

### ***Farming for subsistence***

That participating farmers be involved in farming as a full-time subsistence activity was an important criteria for selection for two reasons: the first was prompted by the project need for the uninterrupted involvement of participants for two production seasons (for most farmers in the area,

**Table 3. Varietal Knowledge and Preference Ranking of Maize for Men and Women**

Women	Men
1. bhote' paheli	1. manakamana-1 (MV)
2. paheli	2. dhude' seti
3. dudhe' seti	3. paheli
4. bhote' seti	
5. tamlunge' seti	
6. arun-2 (MV)	
7. manakamana-1 (MV)	
8. chepti seti	

food-scarcity periods necessitated involvement in off-farm activities for supplementing household incomes); the second was because those farmers who were involved in farming as a "full-time" activity showed a greater inclination to be relatively self-sufficient in food production, even during the scarcity period. Of the nine farmer participants in Tamku VDC who were included in the "innovative" category, all claimed sufficient food security during the year and could be counted upon by other community members for food loans during periods of food deficit.

Out-migration of men to urban centers in search of employment is one of the primary strategies employed to counter food deficits. In the past, it was common for men and women to become involved in reciprocal arrangements within the community during times of food shortage. Usually this involved providing labor for wealthier farmers in return for food provisions during times of scarcity. Increasingly, however, the present trend is for the majority of young men to migrate to urban centers to work as porters for trekking companies, perform menial jobs in restaurants and hotels, or migrate to the Middle East (*arab*) through the numerous employment agencies that have sprung up in Nepalese townships.

In addition to out-migration, people also forage for a variety of forest foods (*kandamul*), although a degree of social stigma surrounds foraging activities, principally through the perceived notion that it is part of the "primitive" past.

At the household level, food-preparation strategies also play an important role in "making it last longer." Grains are boiled with excess water, creating a porridge-like consistency to increase the quantity. "Visitors and guests" during the time of scarcity are actively discouraged from visiting, though some women participants cited visiting relatives (preferably the natal home, for married women) as an option to combat food shortages.

A seasonal calendar for food production reveals a period of severe food scarcity between the months beginning in late February and lasting till early July. The relationship between food production and out-migration, especially of males to urban centers in search of employment, is directly proportional to the increasing number of female-headed households as well as the additional, "gendered" burden of farming responsibilities that this trend implies. Moreover, there was a strong relationship between decreasing food production and poor access to seed sources and deteriorating seed-saving practices. Research suggested that the deterioration of seed saving was not necessarily related to loss of knowledge but was, rather, determined to a large extent by food scarcity and the additional burden of farm households to do "other things." Increasing trends in food scarcity over the last few generations have resulted in people consuming instead of saving seed material.

Though there were many reasons for food scarcity, research demonstrated a causal relationship between decreased crop yields and the inability to manage seed, in terms of both maintaining seed purity (*saadha biyu*) and poor seed storage practices. Moreover, access to the Agriculture Input Sector (AIC), a public-sector undertaking responsible for seed supplies was difficult, since it is situated in district headquarters a day's walk from the village and using it often proves to be a difficult bureaucratic process beyond the reach of individual farmers. The consequences of low yields, the inability to maintain seed purity, and lack of access to reliable sources of new germplasm all contribute to food scarcity in Tamku.

## Lessons learned: Reconceptualizing participation and knowledge

In order to address the objective of developing improved seed technologies in marginal mountain environments while emphasizing community control of the management of the process, it becomes important to conceptualize farmer participation in the research process as an instrument of empowerment. One principle way forward in this direction is to situate farmer participation in the context of local knowledge. In doing so, however, it becomes important to view knowledge, or indigenous technical knowledge, beyond common representations of its being produced as a rational response to environmental contingencies (e.g., Mathias-Mundy et al. 1991; Howes and Chambers 1980; Brokensha, Warren, and Werner 1980). Instead, it becomes important to situate indigenous technical knowledge within cultural categories of meaning, which can then become an empowering base for participation in the interface with more powerful external categories of knowledge.

The workshop discussions revealed how empirical experiences cannot be separated from cultural experience, especially in the way Rai farmers talk about food scarcity and place the phenomenon in a mythic context. Local discourse of food scarcity finds expression both in the dominant Nepali language as well as the various dialects of the Rai group. The words to describe food scarcity range from *anikal* (food shortage), *bhokmari* (to kill hunger), *mahamari* (the great killer), and *sisawa* (famine) in the Kulung dialect of the Rai. It also finds expression through simple expressions such as "*khana ko abab hunu*" (to be short of edibles), "*dhayrai/chitto bhok lagnu*" (to experience hunger pangs sooner and more frequently than normal), "*chasum na hunu*" (to lack prosperity), as well as more abstract expressions, such as in this lament in the Kulung dialect "*Etenay sisawa udanai lay tay ho wumche*" (dear friends and brothers, . . . how do we survive the *sisawa* [food shortage] this year?) or the more common instructional verse admonishing people to save seeds to combat food shortages "*Almal ma jiyu bachhaunu, Anikal ma biyu bachhaunu*" (save oneself in times of confusion, [but] save seeds in times of [food] shortage) or "*Chha geda sabai mero Chhaina geda sabai tendo*" (having seeds, all is mine, [not] having seeds, all is not mine [i.e., lost]).

In the indigenous schema, food scarcity is a condition of cultural "disorder" that has its genesis in the curse that one warring ancestor casts upon another for perceived treachery. In cultural terms, the condition becomes inevitable and requires annual propitiation of the ancestor through ritual appeasement. The myth, consisting of ancestral deeds that include the settling of present territories, serves as a metaphor for the sacred relationship that exists between the Rai and the delimited territory they occupy. Traditional Kirati notions of ethnicity cannot be separated from this relationship and are symbolized by an ancestor stone that is situated in every village and propitiated in annual agricultural ceremonies (*ca:ri*).

What such a view of knowledge implies is that by granting legitimacy to cultural epistemologies, indigenous explanations for empirical categories are not subjugated by rationalist scientific explanations and thereby become an empowering element for farmer participation. Within such a context, the transfer of technical skills to enhance seed technology neither diminishes nor disempowers indigenous systems of meaning.

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# Participatory Approaches to Crop Improvement at the Community Level in Vietnam

*Nguyen Ngoc De*

## Abstract

Crop improvement has been one of the strong, continuous programs in the Mekong Delta for major crops, especially rice. However, most breeding programs have been set and designed by breeders, neglecting the role of users: farmers and farming communities. Farmers have been the passive users, receiving finished breeding lines/varieties for their production. The dissemination process of "technology transfer" has been very slow and costly for both breeders and farmers.

The use of participatory approaches in crop improvement have ensured the involvement of farmers in the whole process or, at least, in the evaluation process. This has resulted in a better understanding and acceptability of new crop varieties generated through the breeding program.

Can Tho University, as the leading research institution for adapting participatory approaches to rice improvement, started on-farm breeding programs as early as 1975, after the war, by sending out their staff and students to work closely with farmers on crop-improvement programs. In 1994, with the inception of the Community-Based Biodiversity Development and Conservation (CBDC) project, participatory plant-breeding (PPB) and participatory varietal-selection (PVS) approaches were introduced as methods to develop and identify crop varieties specific to niche environments and farmers' preferences.

These participatory approaches are also being used in one of the study sites, Tra Cu, of the global in situ conservation project implemented in Vietnam in collaboration with the International Plant Genetic Resources Institute (IPGRI). The result has been very positive, with many promising crop varieties selected from these programs and used in larger-scale production. Farmers have been successful in segregating material selection and many farmers have become well known through these activities.

Participatory approaches are very important for crop improvement at the community level in Vietnam. PPB and PVS approaches are the key tool for crop improvement. Successful results from farmer selections have strongly proven that these approaches are right. This experience has been very useful for national crop-improvement programs.

## Introduction

Crop improvement has been one of the strong, continuous programs in the Mekong Delta for major crops, especially rice and beans. However, most breeding programs have been set and designed by breeders neglecting the role of users: farmers and farming communities. Breeders have set their own breeding objectives and conducted crop-improvement programs based on their own analysis of problems and on-station research findings (COWI 1999). At the end of their breeding programs, promising breeding materials are released to farmers as so-called "technology transfer." Farmers are passive users, receiving finished breeding lines/varieties for their production. In many cases, farmers, especially the poor, refuse to try new varieties because they do not want to take the risk. Resource-rich farmers are the first to try such varieties. Participation is limited to providing a piece of land to the breeders for on-farm trials. The dissemination process of "technology transfer" has been very slow and costly for both breeders and farmers. As a result, the adoption of recommended varieties, in many cases, has been very slow, doubtful, or has even failed. Local adoption of new technologies is dependent not only on technical suitability and economic viability but also on social

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acceptance. The use of participatory approaches in crop improvement assures farmers' involvement in the whole process or, at least, in the evaluation process. This has resulted in better understanding and greater acceptability of new crop varieties generated through breeding programs.

Can Tho University, as the leading research institution for adapting participatory approaches in rice improvement, started on-farm breeding programs as early as 1975, after the war, by sending out their staff and students to work closely with farmers on crop improvement programs (Xuan et al. 1993). In 1994, with the inception of the Community Biodiversity Development and Conservation (CBDC) project, participatory plant breeding (PPB) and participatory varietal selection (PVS) were introduced as methods to develop and identify crop varieties specific to niche environments and farmers' preferences (CBDC 1996, 1997).

Witcombe and Joshi (1996) defined PPB as involving farmers in selecting genotypes from genetically variable, segregating materials and PVS as involving the selection by farmers of nonsegregating materials, characterized as products from plant-breeding programs. However, they also agreed that PPB is a logical extension of PVS. In our view, PVS is only a lower level of PPB. PPB, therefore, should be understood in its broader meaning and implications as the involvement of farmers in the whole process of plant breeding, not only the selection of segregating and nonsegregating materials. Farmers can be involved at the very beginning, when strategies and objectives are set for plant breeding, in identifying parents, making crosses (of course with training from the formal sector), and selecting both segregating and nonsegregating materials. The experiences from the CBDC project in Southeast Asia have proven that point, especially in the Mekong Delta in Vietnam and in Bohol, Philippines, for rice (CBDC 1998).

These participatory approaches are also being used at one of the study sites, Tra Cu, of the global in situ conservation project implemented in Vietnam in collaboration with the International Plant Genetic Resources Institute (IPGRI).

## **Methods used in participatory crop improvement**

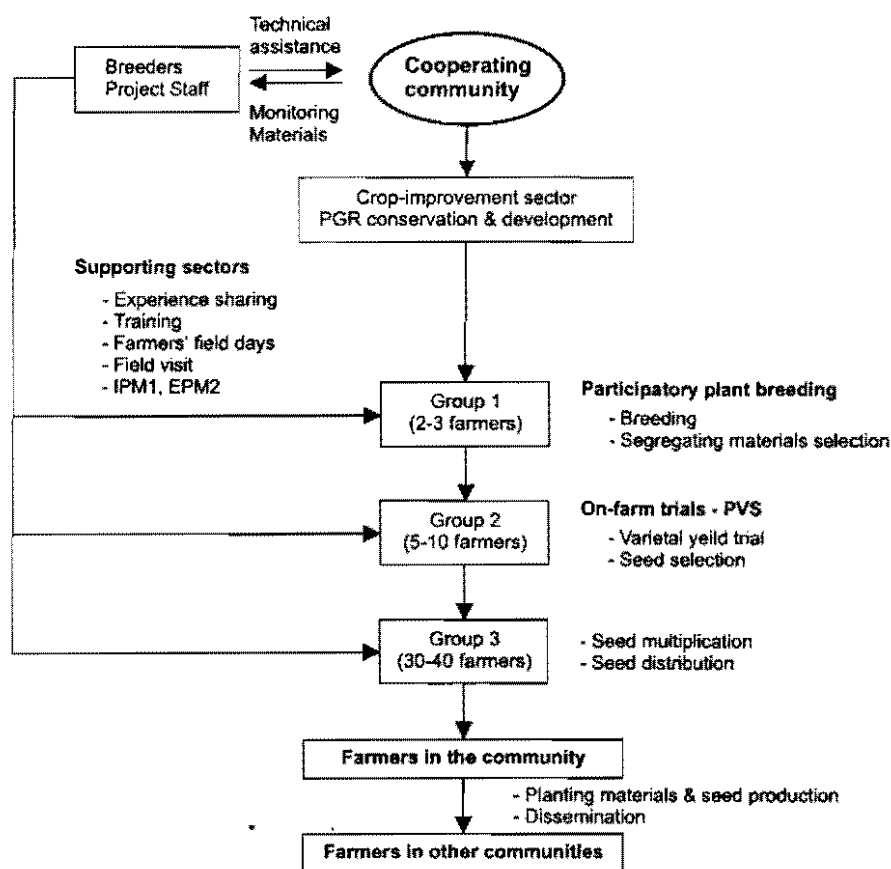
The participatory crop-improvement program uses PVS and/or PPB approaches, depending on farmers' varietal needs and their breeding knowledge and technical skills. The PVS approach has been used to improve local landraces and to evaluate the finished breeding materials, obtained from research institutions, on farmers' field. When varietal options available to farmers through PVS are limited or exhausted, PPB is initiated (CBDC 1998). Farmers with knowledge of and interest in breeding are involved in PPB activities, i.e., activities from crossing desired parent lines to selecting and evaluating the segregating genetic materials (De and Tin 1998). A flow diagram showing the methods used in participatory crop improvement is presented in figure 1. The methods used in implementing PPB and PVS are discussed below.

### ***Methods used for PPB***

Participatory plant breeding involves the following steps and activities.

**Need assessment and selection of cooperating farmers.** Community meetings are organized to identify farmers' problems and needs and to come up with suitable crop-improvement strategies and plans. A group of farmers (Group 1 farmers), with knowledge of and interest in breeding, are selected as cooperating farmers in consultation with the community. Breeding activities are then formulated and decided upon with these cooperating farmers.





*Note:* Group 1=Advanced farmers with good knowledge and skill in breeding.  
 Group 2=Farmers with good knowledge and skill in seed selection.  
 Group 3=Farmers with good knowledge and skill in seed production.  
 1. IPM=Integrated pest management.  
 2. EPM=Ecological pest management.

**Figure 1. Community-based networking diagram for PPB and PVS**

**Setting breeding objectives and identifying donor parents.** Breeders work closely with farmers to agree on breeding objectives. Farmers have been found to use both quantitative and qualitative criteria to determine these breeding objectives. Some of the examples of such criteria are high yield, short duration, resistance to major pests and diseases, stickiness of cooked rice, and so on. Based on the breeding objectives, breeders then assist farmers in searching for suitable donor parents for crossing. These donors may be found among the available genetic materials at the local level or from research institutions and are made available to the cooperating farmers.

**Making crosses and selecting segregating materials.** The Group 1 farmers are given additional training on crossing techniques and assisted in making the desired crosses. In other cases, breeders provide seeds of segregating lines at very early generations ( $F_2$ ,  $F_3$ , and  $F_4$ ) to the farmers for selection of desired lines based on their own criteria. Farmers have been found to handle segregating materials from generations as early as  $F_2$ . In the process, farmers apply their own crop-management practices. Based on breeding objectives, farmers observe, evaluate, and harvest the selected plants individually. This process is repeated until stable lines are obtained. For management reasons, the

number of individual plants selected each season is limited, depending on farmers' capacity for seed handling and the land assigned as a breeding plot. Therefore, the genetic variation in farmers' selections is usually narrow. Only Group 1 farmers are involved in the selection process, while field operations are done with the help of other farmers in the community.

**Observation test.** Pure lines selected from the segregating materials are planted in observation test plots to check for adaptation and yield, with common local varieties used as local checks. Farmers compare the performance of new varieties/lines with the local check and select promising ones for further evaluation in yield trials by Group 2 farmers.

**Monitoring.** The Group 1 cooperating farmers take close field observations with technical assistance from breeders and agricultural extensionists. These farmers also keep records on field conditions and crop performance for later analysis in determining the suitability of the new crop varieties under selection.

### ***Methods used for PVS***

Participatory varietal selection involves the following steps and activities.

**Need assessment and selection of cooperating farmers.** As in PPB, community meetings are organized to identify farmers' problems and needs in relation to their current crop varieties. Farmers may want to improve their current varieties or change for promising new varieties. A separate group of farmers (Group 2 farmers), with good knowledge of and skills in seed selection and management, are also selected as cooperating farmers in consultation with the community. PVS activities are then formulated and decided upon with the cooperating farmers from both Group 1 and Group 2.

**Provision of genetic materials and participatory selection.** Three sources of genetic materials are used to obtain seeds for participatory selection of desired crop varieties:

- **PVS with improved local landraces.** The improvement of local landraces is done through mass as well as pure-line selection. Since the mass-selection method does not require very specialized skills, Group 2 farmers, after a simple orientation, have been able to undertake this selection. On the other hand, pure-line selection for crop improvement requires specialized skills and care on the part of the farmers. For this reason, only Group 1 farmers have been used to do pure-line selection, after adequate training and with intensive monitoring. The improved local landraces are then given to a large number of farmers within the community, as PVS materials, for their own testing and selection.
- **PVS with reintroduced local landraces.** PVS also reintroduces landraces from genebanks back to the community when local materials have been destroyed by disaster. Usually the collected local varieties from different locations within and outside of the community are evaluated in the community to give farmers more choices.
- **PVS with modern crop varieties.** Modern crop varieties from research institutions and finished products from PPB are also given to the cooperating farmers for testing their suitability under farmers' own management conditions and household requirements.

**Yield trials of successful PVS varieties.** The crop varieties preferred by farmers under the PVS program are then put into varietal yield trials in the community for farmers to observe directly and make selections of their choices. Common varieties in the community are used as local checks in these trials. Farmer field days are organized just before harvesting to bring farmers in the commu-

nity to the trial plots for a joint evaluation of the tested varieties. Desirable varieties (usually two to three varieties) are then selected for seed multiplication.

**Seed multiplication.** Varieties selected by farmers from yield trials are distributed to a group of farmers (Group 3 farmers), with considerable knowledge of and interest in seed production, to multiply large quantities of seeds for use by other farmers in the community. Seed multiplication fields are closely monitored and used as final checks for large-scale production.

**Monitoring.** Field visits and farmer field days are the most appropriate tools for participatory monitoring and evaluation of PVS activities. Breeders, field staff, extension workers, and farmers participate in such activities. Data collection depends on farmers' objectives and includes common traits such as growth duration, plant height, tillering capacity, grain yield and quality, and tolerance to insects and diseases.

## Field experiences with rice

### *Participatory varietal selection (PVS)*

Rice is the major food crop in the Mekong Delta. PVS activities on rice have been undertaken in different forms in the Mekong Delta starting as early as the 1970s. The most common of these activities was varietal yield trials. The main objectives of the varietal yield trials were to generate farmer-preferred crop varieties and faster dissemination of these varieties. Can Tho University has been a leading research institution in initiating and implementing on-farm research activities. In the beginning, breeders and researchers cooperated with advanced farmers individually throughout the Mekong Delta (De 1997).

During the period 1975–1995, hundreds of promising rice varieties were tested in farmers' fields, and a number of varieties were identified and released. Some of these rice varieties are IR36 (later named NN3A), HT6 (NN6A), MTL30 (NN7A), HT19 (NN2B), IR42 (NN4B), MTL58 IR13240-108-2-2-3), and MTL87 (IR50404-57-2-2-3). These varieties have made great contributions to the improvement of rice production in the Mekong Delta. Many farmers, such as Mr. Hai Huu (Long An province); Mr. Hai Chung, Mr. Tu Tai, Mr. Ba Chuong (Tien Giang province); Mr. Ba Cung (An Giang province); Mr. Muoi Tuoc, Mr. Muoi Than Nong (Vinh Long province); and some others, were known as the "rice-selection kings." Farmers were also found to use pure-line selection to improve the formally released varieties for grain quality and adaptation to specific conditions in their areas. This process has, in fact, strengthened on-farm conservation of crop diversity.

Later, since 1994, with the inception of the Community Biodiversity Development and Conservation (CBDC) project, PPB and PVS have been included in their current form in the crop-improvement program. There has been a shift from dealing with advanced, individual farmers to farmer groups and farming communities (CBDC 1998). As a result, more farmers have been involved, the degree of participation has improved, and more work has been organized at the grass-roots level by communities themselves with help from many local authorities. Four farming communities used as pioneers are Nhut Ninh community (Tan Tru district, Long An province), My Thanh community (Ba Tri district, Ben Tre province), Ke Sach community (Ke Sach district, Soc Trang province), and Long Thanh community (Vinh Loi district, Bac Lieu province). The results of PVS activities in these communities are presented in tables 1 and 2.

**Table 1. Number of Rice Varieties Tested and Selected from PVS Activities at Four Communities in the Mekong Delta**

Year		Nhut Ninh		My Thanh		Ke Sach		Long Thanh	
		Tested	Selected	Tested	Selected	Tested	Selected	Tested	Selected
1994	TR	252	8						
	DWR	20	6						
	MR	18	4						
	HYV	5	1			5	1	22	2
1995	TR	23	3						
	HYV		1	5	4	5	3	169	16
1996	TR		1						
	MR			22	1				
	HYV	9	9	34	9	89	— <sup>1</sup>	9	1
1997	TR	222	2						
	MR	7	Lost <sup>2</sup>	32	29			25	— <sup>1</sup>
	HYV			20	9	16	8	20	3
1998	MR	11						12	
	HYV	12	6	18	8	19	9	24	5

Source: CBDC (1998).

Note: TR= Traditional rice; DWR= Deep-water rice; MR= Medium rice; HYV= High-yielding rice (early).

1. No data available at the time of writing.

2. Due to a typhoon at the last stage of the trial, no result was possible.

**Table 2. Common Varieties Selected from PVS Activities at Four Communities in the Mekong Delta**

Rice varieties	Nhut Ninh	My Thanh	Ke Sach	Long Thanh
TR	Nep Thom, Tai Nguyen, Me Huong		Tai Nguyen	
MR		MTL83, MTL124		MTL83
HYV	IR49517, IR64, MTL156, 157, MTL159, 199	IR54883, S976B, MTL138, 205	MTL99, 101, MTL142, 157, MTL164, 190, MTL199, 201, MTL202	IR64, MTL138, MTL142, 147, MTL149, 150, MTL156, 157, MTL159, 199

Source: CBDC (1998).

Note: TR= Traditional rice; DWR= Deep-water rice; MR= Medium rice; HYV= High-yielding rice (early).

### **Participatory plant breeding (PPB)**

In the 1996/97 dry season, the project decided to start providing segregating breeding materials from 63 F<sub>2</sub> populations of 12 crosses made by the Rice Research Department of Can Tho University for farmer selection in the four communities listed above (table 3). The names of these crosses are L245, L246, L247, L248, L249, L250, L251, L252, L253, L254, L255, and L256. Many farmers

**Table 3. Number of Segregating Populations Distributed and Selected by Four Communities from PPB Activities in the Mekong Delta, by Year**

Community	Number of populations selected by generation (F <sub>2</sub> , F <sub>3</sub> , F <sub>4</sub> , F <sub>5</sub> )				Farmers' selection
	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	F <sub>5</sub>	
Nhut Ninh	13	13			
My Thanh	20	8	3	1	L246-10-1-B
Ke Sach	10	4	2	1	L246-7-3-B (SiC-1) L247-1-5-B (SiC-2)
Long Thanh	20	11			
Total	63	36	5	2	

were interested in selecting individual plants from segregating populations based on their own criteria and under their own management conditions. Some of the farmer-selected varieties are now stable lines and are being tested in yield trials.

L246-7-3-B, and L247-1-5-B, the two promising farmer selections and noted by farmers as SiC-1 (Soc Trang Selection, no. 1) and SiC-2 (Soc Trang Selection, no. 2) respectively, were purified by bulk selection method after F<sub>4</sub>. Farmers in Ke Sach community (Soc Trang province) are now multiplying it for distribution among themselves. Mr. Canh is the leader of this farmers' group who has led the selection activities in this community. Similarly, L246-10-1-B, a promising line selected by farmers in My Thanh community (Ba Tri district, Ben Tre province) is also now under yield test and seed multiplication.

Besides four communities the initially selected, the PPB and PVS programs were also expanded to include other advanced, individual farmers in the Mekong Delta. One of these was Mr. Hai Triem from An Giang province, who was well-known as "farmer of the era" and was awarded the Third Labour Medal by the central government for his contribution to rice improvement.

## Problems and lessons

### Problems

- The low educational level of the farmers means they require more training and the adoption of PPB is slow.
- Few farmers are interested in working with breeding and selecting segregating materials. Farmers are more willing to multiply promising varieties than to select from segregating materials or make crosses.
- The number of farmers collaborating in PPB is limited, especially in pedigree selection and selection of segregating material because these are time-consuming activities.
- Agricultural policy is more favorable to commercial production than to conserving diversity.
- Due to the fast turnover of rice varieties by farmers (every three to four seasons), it is difficult to keep their interest and get their cooperation for the entire process of selecting segregating lines, which takes time to get results.

## **Lessons**

- Support from local authorities and organizations in term of organization, management, additional funds, and facilitation is very important.
- Cooperation with groups and communities on PPB and PVS gives better results than working only with individual farmers.
- Farmers' field schools and farmers' field days for PPB and PVS are good ways to motivate the farmers' participation at the community level.
- Farmers conserve and maintain the diversity of plant genetic resources to meet their own needs for home consumption, marketing, and adaptation to local environments and farm resources.
- Biodiversity development should be considered on a temporal and spatial basis at the level of species, crop, and agroecosystem. PPB and PVS increase plant genetic resources at the level of the gene pool and not at the level of specific varieties.
- In situ and ex situ conservation and development are complementary.
- Biodiversity in the Mekong Delta is currently under pressure but integrated farming systems and diversification of plant genetic resources could help to correct the situation.

Participatory approaches are very important for crop improvement at the community level in Vietnam and are efficient ways of achieving crop improvement at this level. PPB and PVS are the key tools for this. Successful results from farmers' selections have proven that these are the right approaches, providing a very useful lesson for national crop improvement programs.

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# Using Farmer Knowledge for Participatory Sweet-Potato Variety Selection in Garut, West Java, Indonesia

*Caecilia Afra Widyastuti and Minantyorini*

## Abstract

This paper describes trials using sweet-potato germplasm from Irian Jaya, where sweet potatoes are a staple food in the highlands. During the collection of sweet-potato germplasm, farmers' knowledge of those sweet potatoes has also been collected. Farmers' knowledge about sweet potatoes in Irian Jaya will be used as a basis for this project and includes information on yields, the use of sweet potatoes as human food or feed for livestock, and the condition of the environment.

Varieties are selected on the basis of farmers' criteria, including market orientation and table consumption: skin color, flesh color, uniformity, and other criteria. The project is also collecting information on farmers' cultivation practices, such as using high ridges in the rainy season and reducing the leaves during the growing period, as well as how to choose healthy cuttings.

## Methodology

The objective of this research is not only to get a high-yielding sweet potato that is adaptable in Garut, but also to get new variety/ies with the agronomic characteristics required by different user groups (i.e., farmers, traders, consumers).

The study was set up in the village of Desakolot, Cilawu District, Garut Regency of West Java Province in a rainfed field that had been used for brick making six years before and had remained fallow for five years. The year before the trials took place, the field was planted with yambean. One week prior to planting, 150 sacks of manure were applied in order to improve the soil. This is always done in this area, especially for land has been used for brick making. This field is typical of places where sweet potatoes are grown. The nearest field to this site is planted with corn, sweet potatoes, and ginger. This neighboring field was also used for brick making, and the vigor of the plants grown on it is good. Prior to establishing the field trials, planting materials were multiplied in Cibadak, Pacet, about 3.5 hours away from Garut, since it was very dry in Garut.

A total of 64 cultivars, including five checks (BISI83, SQ27, CIP-1, Jahe, and Keleneng) were tested (the last two of the checks are well-known local cultivars in the area). There were 36 hills per plot. The date of planting was 26 February 1998.

The experimental design is a randomized complete block with three replications. The size of individual plots is 1.6 m x 3.0 m. Spacing is 80 cm between rows and 15 cm to 18 cm between hills. Harvesting is done according to the farmers' schedules.

During the harvest, we invited farmers, traders, and extensionists to select sweet potatoes based on their criteria. By using participatory tools such as flags, they walked around the trial field and chose what they liked. After that they ranked the selected varieties based on production, skin and flesh color, uniformity, skin smoothness, and general acceptance (table 1). Figure 1 shows participants ranking the selected varieties.

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**Table 1. Selection Criteria and Rank of Sweet-Potato Varieties**

Rank of selection	Criteria of selection	Results (in order)
I	Production	Kinta, Toweko, Lemekudara, Umakmbi, Pipombi
II	Skin color	Toweko, Pipombi, Lemekudara, Umakmbi, Kinta
III	Root shape	Umakmbi, Toweko, Kinta, Pipombi, Lemekudara
IV	Flesh color	Toweko, Umakmbi, Lemekudara, Kinta, Pipombi
V	Uniformity (shape and size)	Umakmbi, Toweko, Pipombi, Lemekudara, Kinta
VI	Skin smoothness	Toweko, Pipombi, Lemekudara, Kinta, Umakmbi
VII	General acceptance	Toweko, Umakmbi, Lemekudara, Pipombi, Kinta



**Figure 1. Farmers, traders, and extensionists ranking selected sweet potatoes**

## Results and discussion

The experimental field was harvested on 22 August 1998, according to the farmers' schedule. No check varieties were select by farmers—not even Racik, the most popular local cultivar. Five new cultivars, i.e., W0139 (Toweko), W0331 (Kinta), W0111 (Umakmbi), W0113 (Lemekudara), and W0109B (Pipombi), were selected by the farmers, traders, and consumers (table 2). Toweko appears to be the most preferred cultivar in this area.

Farmers in Desakolot plant sweet potatoes for commercial purposes. They have several requirements, such as high yield, smoothness of skin, skin and flesh color, uniformity in shape and size, and root shape.

High yield is one important requirement for commercial purposes. The idea of “high yield” includes early maturation. Farmers prefer to plant sweet potatoes that with a high yield but they also require other criteria such as smooth skin, good skin and flesh color, etc. Table 2 shows that *Kinta*,



**Table 2. Farmers' Selections from the Irian Jaya Sweet-Potato Trial**

No	Accession No.	Local name	Production	Skin color	Root shape	Flesh color	Uniformity (shape and size)	Skin smoothness	General acceptance
1	W0139	Toweko	****	*****	****	*****	****	*****	*****
2	W0331	Kinta	*****	*	***	**	*	**	*
3	W0111	Umakmbi	**	**	*****	****	*****	*	****
4	W0113	Lemekuwara	***	***	*	***	**	***	***
5	W0109B	Pipombi	*	****	**	*	***	****	**

Note: Ranking is indicated on a scale from 1 to 5, where \*\*\*\*\* indicates highly acceptable and \* indicates low acceptability.

which had the highest yield was given low acceptance overall because it did not have acceptable skin color, uniformity, or skin smoothness.

Smooth skin color refers to skin that has not been damaged by weevils or nematodes and that exhibits no cracking. Skin should be thick enough to withstand peeling during transportation and to be resistant to weevils or nematodes. The smoothness of the skin has a considerable effect on the price of sweet potatoes.

Farmers always refer to good-tasting sweet potatoes as *ubi ketan* (sticky sweet potatoes) if they see a sweet potato with purple flesh. According to them, these sweet potatoes get a good price.

*Toweko* (W0139) was given eight flags because it meets the criteria of high yield, good skin color, uniformity in shape and size, good flesh color (dark yellow), and is suitable for fresh consumption and for snack food (*keremes*). According to farmers, the minimum price for *Toweko* should not be less than Rp 500. After tasting the raw *Toweko*, the farmers predicted that this cultivar would be well received in the market. The participating farmer wanted to plant *Toweko* 30% in the first season and increase it to 50% for the next season. They said they would plant 100% if the market could absorb that much. Two participating farmers, Haji Sumarna and Amin, will be responsible for multiplying this sweet potato as a source of planting material.

*Umakmbi* (W0111) was chosen with four flags because the skin is very smooth and thick, meaning it could resist weevil attacks. The flesh color is dark purple, meaning it will taste good (*ubi ketan*—sticky sweet potato), and the roots are very uniform in shape and size. With these criteria, the farmers predicted that this sweet potato would command a good price in the market. According to the farmers, they can increase the production of this variety. Farmer Unang will be responsible for multiplying this sweet potato as a source of planting material.

*Kinta* (W0331) was given six flags because of its high yield and purple flesh, meaning it will taste good (*ubi ketan*—sticky sweet potato). The skin is very smooth, with no evidence of nematode attack. Farmer Agus will be responsible for multiplying this sweet potato as a source of planting material.

*Lemekuwara* (W0113) was chosen with two flags because of its rounded shape and smooth, red skin, which mean it will be easier to sell in the market. Farmers chose this from replication III, which indicated high production. Farmer Eman will be responsible for multiplying this sweet potato as a source of planting material.

*Pipombi* (W0109B) was chosen with eight flags because the size is uniform, it has smooth skin color, and it can be sold fresh. Farmer Encek will be responsible for multiplying this sweet potato as a source of planting material.

## Conclusions

Based on our experiences with this trial, we have formed the following conclusions:

- Using farmers' knowledge about sweet potatoes from Irian Jaya will help researchers to do preliminary selections for the trial.
- The participation of farmers in the area where the trial was set up will help in selecting sweet potatoes based on farmers' criteria, such as marketability and table consumption.
- Farmers selected sweet potatoes based on their marketability and farmers' own criteria.

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**Table 3. Yield of Varieties Tested and Farmers' Ranking for Marketability**

No	Accession No	Cultivar	Yield (Ton/Ha)							
			Marketable				Not marketable			
			I	II	III	X	I	II	III	X
1	W0131	Bon	0.56	0.14	1.94	0.88	1.81	1.67	0.83	1.44
2	W0194	Yaronambiri	5.83	12.5	8.47	8.93	2.36	1.39	2.92	2.22
3	W0116	Helalekue	7.08	7.08	7.22	7.13	2.92	1.11	1.94	1.99
4	W0113	Lemekuara	2.36	7.78	9.44	6.53	1.11	1.25	2.36	4.72
5	W0323	Womin	4.44	9.17	7.36	6.99	1.94	1.53	4.03	2.50
6	W0045	Poniai	5.00	6.39	6.25	5.88	2.08	2.36	1.67	2.04
7	W0061	Tinta kuning	6.81	3.61	5.00	5.14	0.14	0.69	0.97	0.60
8	W0049	Senggol	2.92	1.39	1.67	1.99	0.28	0.56	1.39	0.74
9	W0033	Sengkerengke	5.14	8.06	3.06	5.42	1.81	1.94	3.19	2.31
10	W0350	Iloka	11.11	12.22	7.50	10.28	1.11	1.25	0.97	1.11
11	W0104	Gelakue	2.36	3.61	0.28	2.08	2.08	1.39	1.67	1.71
12	W0158	Musanaken baru	15.14	10.28	2.50	9.31	5.42	3.19	3.19	3.93
13	W0220 B	Helalekue lama B	—	—	1.11	0.37	—	—	0.69	0.23
14	W0220 A	Helalekue lama A	1.25	4.44	3.47	3.05	0.14	—	0.28	0.14
15	W0008	Esipalek	—	—	0.83	0.28	—	—	0.28	0.09
16	W0124	Naulupe	5.83	11.39	5.14	7.45	2.22	0.83	1.94	1.67
17	W0204	Korwambi	—	0.69	—	0.23	0.42	—	0.14	0.19
18	W0181	Walegein	2.50	2.36	0.83	1.90	2.50	0.69	0.97	1.39
19	W0084	Kuruparambi	3.61	4.44	1.67	3.24	2.22	0.97	0.97	1.39
20	W0187	Mugulele	3.06	4.03	2.64	3.24	1.67	3.19	3.61	2.82
21	W0048	Giniagalo	7.78	5.14	3.06	5.33	1.39	0.56	0.56	0.84
22	W0139	Toweke	12.08	8.33	10.28	10.23	2.22	2.22	2.50	2.31
23	W0130	Siknimbi	4.58	7.92	1.25	4.58	0.83	0.97	1.11	0.97
24	W0197	Mukolele	5.56	4.31	3.89	4.59	1.94	2.78	2.64	2.45
25	W0223	Umakmbi	6.25	10.00	5.56	7.27	1.94	1.53	0.97	1.48
26	W0111	Umakmbi	8.19	3.33	6.25	5.92	2.22	2.22	1.81	2.08
27	W0316	Ketfelale	5.00	5.00	9.44	6.48	0.97	1.11	2.36	1.48
28	W0018	Mailongge	17.08	10.83	12.22	13.38	0.69	1.53	0.97	1.06
29	W0300	Musan	9.03	3.75	6.53	6.44	1.53	2.22	1.94	1.90
30	W0201	Gilikue	0.56	12.22	—	4.26	0.14	—	—	0.05
31	W0331	Kinta	13.19	12.22	8.61	11.34	1.67	2.22	1.81	1.90
32	W0339	Kuning	10.97	5.69	9.17	8.61	1.53	2.78	0.97	1.76
33	W0253	Yoban	4.58	4.72	5.28	4.86	1.39	2.22	1.67	1.76
34	W0041	Pusemangken	0.42	—	1.53	0.65	0.83	—	1.39	0.74

**Table 3. Yield of Varieties Tested and Farmers' Ranking for Marketability (Continued)**

No	Accession No	Cultivar	Yield (Ton/Ha)							
			Marketable				Not marketable			
			I	II	III	X	I	II	III	X
35	W0010	Musan	2.50	—	2.22	1.57	1.67	0.56	1.94	1.39
36	W0184	Lia-lia	8.19	9.17	7.36	8.24	2.08	2.50	2.92	2.50
37	W0125	Linggoara	4.31	1.67	1.67	2.55	0.56	1.39	0.83	0.93
38	W0241	Sahoma	11.25	8.33	10.28	9.95	1.25	1.81	0.69	1.25
39	W0280	Tuwembi	8.75	8.33	9.17	8.75	1.94	2.64	2.36	2.31
40	W0014	Kentang	7.36	8.89	4.31	6.85	1.53	1.53	1.67	1.58
41	W0141	Gelakue Putih	2.92	6.53	2.22	3.89	1.94	2.22	0.97	1.71
42	W0021	Kila	1.25	1.94	—	1.06	1.53	2.92	0.28	1.58
43	W0227	Kentang	0.83	2.50	0.97	1.43	1.11	0.56	0.97	0.88
44	W0109	Pipombi	3.06	3.47	0.28	2.27	2.92	0.97	0.69	1.53
45	W0109 B	Pipombi B	1.25	4.44	3.06	2.92	0.69	1.39	2.36	1.48
46	W0220	Helalekue Lama	5.69	9.86	5.14	6.90	4.17	2.78	1.53	2.83
47	W0134	Nasimbi	1.39	2.78	4.86	3.01	1.25	1.11	3.19	1.85
48	W0156	Soepak Baru	4.17	4.31	10.28	6.25	3.61	0.56	4.03	2.73
49	W0206 B	Andelan B	4.72	0.56	0.42	1.90	1.53	0.97	1.11	1.20
50	W0206 C	Andelan C	1.67	1.25	1.25	1.39	1.11	0.42	0.69	0.74
51	W0167	Anewun	0.83	—	—	0.28	0.56	0.28	0.42	0.42
52	W0108	Tabimbi	4.03	5.69	5.28	5.00	0.83	0.14	1.11	0.69
53	W0005	Hoboak	8.19	2.22	6.53	5.65	0.97	0.83	1.25	1.02
54	W0206 D	Andelan D	3.61	1.11	2.92	2.55	0.97	0.97	2.22	1.39
55	W0260	Mikmak	7.64	8.75	14.72	10.37	1.94	1.25	2.64	1.94
56	W0055	Mikmak	4.31	7.22	7.78	6.44	1.39	0.83	1.94	1.39
57	W0002	Mikmak	6.81	0.83	10.97	6.20	1.67	0.14	0.97	0.93
58	W0017	Wortel	6.81	4.86	1.53	4.40	1.81	0.97	1.94	1.57
59	W0039	Tinta Kuning	3.33	—	1.81	1.71	0.83	0.56	1.39	0.93
60		Bis 183	12.36	13.06	13.61	13.01	4.03	0.28	4.44	2.92
61		SQ 27	5.69	10.97	10.97	9.21	1.39	0.14	2.92	1.48
62		CIP-1	8.47	9.03	7.08	8.19	1.39	2.64	2.92	2.32
63		Jahe	1.94	9.31	9.31	6.85	1.81	2.22	1.25	1.76
64		Keleneng	2.78	4.17	8.19	5.05	1.25	1.39	4.58	2.41
65		Racik	6.11	0.42	8.33	4.95	5.42	4.58	3.33	4.44

# Understanding Agroecological Domains: The Key to a Successful Participatory Plant Breeding Program

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## Abstract

Farmers have an intricate knowledge of their agroecological domains. The empirical evidences from Kachorwa (*terai*) and Begnas (mid-hill) sites in Nepal suggest that farmers distinguish domains for rice primarily on the basis of moisture and fertility. Farmers also differentiate the number, relative size, and specific characteristics of each domain within a given geographic area. Similarly, they allocate individual varieties/landraces to each domain, indicating that the competition between varieties/landraces occurs within the domain and that transgression of domain was rather limited. These deductions need to be verified at a wider level. A fuller understanding by researchers of specific agroecological domains is a prerequisite for them to contribute substantially in planning and executing effective participatory plant breeding (PPB) programs. Only with a sound knowledge of agroecological domains and the varietal distribution within domains can a program on diversity deployment and biodiversity conservation be effectively implemented. Likewise, justifying the cost-effectiveness of PPB, targeting research/extension activities, and measuring the contribution of PPB to food security demands a detailed understanding of agroecological domains. Simple and practical ways to illicit information on agroecological domains and associated varieties/landraces through farmers' group discussion at the village level have been suggested as a pre-project activity for PPB, which could enhance the success of PPB programs.

## Introduction

The importance of agroecological domains can be found in earlier work on defining and delineating recommendation domains (RDs), which is closely associated with the farming systems research of the late 1970s (Wotowiec, Poats, and Hildebrand 1986). Initial work on RDs concentrated on a few relatively easily identifiable factors (biological variables), such as land and soil types, agro ecological zones, and crop types and management (Harrington and Tripp 1985). The exercise on RD was highly complex since the process was to identify farming households, based on the similarity in their practices, rather than farms. But the delineation of agroecological domains was much less cumbersome with rice because rice is very sensitive to changes in agroecological conditions and its adaptation is limited, as compared to some other crops such as maize. Moreover, rice is the most important cereal crop in the region, so farmers have an in-depth knowledge of rice-growing environments and varieties suitable to different agroecological domains.

The current endeavor on refining the definition of agroecological domains for rice in parts of Nepal is the case of "sharpening the focus" for better targeting of participatory plant breeding (PPB) work, including diversity deployment, conservation of landraces in different domains, and planning strategic crop management research. The methodology adopted is quite simple and can be replicated in other areas for wider use by the researchers and development workers.

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## Farmers define and characterize agroecological domains

Field exercises for delineating agroecological domains have largely been influenced by the methodologies on RDs advocated by Collinson (1980), Franzel (1985), and Vaidya and Floyd (1997). They emphasized the use of secondary sources of information, followed by preliminary surveys supplemented later by a formal survey to refine the domains. However, later views on the subject hold that the refining process should take place only after researchers have a clear understanding of the variability inherent in the local farming systems (Cornick and Alberti 1985). The current study embodies the thoughts from both the methodologies for delineating domains and associated rice landraces/varieties.

In the process of delineating agroecological domains, two group meetings were organized in the Kachorwa and Begnas eco-sites. The first meeting was held with field-based staff; the second, with farmers from the project area. This was followed by a transect walk by researchers and farmer representatives to jointly validate farmers' statements. The exercise took about two days, including field visits in each site.

### *Interactions with field-based staff*

Since field-based staff are stationed in villages, it was expected that they would have a fairly good understanding of the agroecological domains and the farming systems of their respective eco-sites. Hence, the first level of group discussions was organized in field offices, with the field officer, technical assistants, and motivators participating.

After discussions, the participants were able to come up with four major agroecological domains, mainly defined on the basis of water regimes. They also broadly classified the soil type and fertility status of soils from each domain, based on scientific knowledge of soil classification and characterization. Participants were also asked to estimate the size of each domain and place different landraces/varieties in their right domains. Estimating the relative size of each domain was straightforward because the *pokhari/man* occupied only a limited area within the eco-site. But placing each landrace/variety in its right domain proved more difficult. The team could place the majority of landraces/varieties in their domains, but the number of landraces/varieties per eco-site was too large for them to remember all the names and their right environments. The process was also complicated by the fact that some of the landraces/varieties are grown in more than one domain.

The whole process was reviewed by the participants, and once they were satisfied with the steps and outputs, the field officer was asked to facilitate the same process for the farmers' group discussion.

### *Group discussion with farmers*

A group discussion was held with farmers with the specific objective of delineating agroecological domains. Field officers/site coordinators facilitated the discussion and the whole exercise was repeated with farmers' groups. Both female and male farmers participated in the discussion and put forward their opinions.

Farmers identified four agroecological domains within the eco-site (*ucha*, *samtal*, *nicha/khalar*, and *pokhari/man*), based on the major criteria of moisture regime and fertility status/gradient (tables 1 and 2). They could easily identify the relative size of each domain, but there were disagreements among about soil classification. Perhaps this reflected the variability of the soil types and soil fertility status in each domain. Placing landraces/variety in the domains initiated a lively

**Table 1. Agroecological Domains at Kachorwa Eco-Site**

Domain	Soil type	Production potential	Cultivated landraces/varieties
<b>Ucha</b> (bhadaiya rice cultivated on availability of water, good winter crops)	Balaute = sandy (ujar = whitish)	Low (III)	Mutmur, Sotwa, Soka, Saro... No modern varieties grown.
<b>Samtal</b> (Good crop of bhadaiya rice and winter crops, aaghani rice can be grown)	Domat = Loam Balaute domat = sandy loam (whitish and brown)	High (I)	Laka farm, Nakhi saro, Sathi, Bhadaiya Basmati, Khera, Aanga, Ujala faram, Sotwa, Soka, Dudhi saro, Kamod, Madhumala, Basmati, Karma ... (China 4, Philips, Jiri, TV, Chandina, Sabetri...) – Modern varieties
<b>Nicha/Khalar</b> (Good crop of aaghani rice and medium winter crops)	Matiyar = Clay? (Piyar = Yellowish)	High (II)	Basmati, Lajhi, Mansara, Karma, Batsar, Rat rani, Faram, Kamod, Madhumala (Mansula, Sabetri, Pankaj, Nat masula, Jaya, K. Mansuli...) – Modern varieties
<b>Pokhari/Man</b> (can only grow aaghani rice)	Matiyar = Clay? (kalo/kariya = black)	Low (IV)	Bhati, Megraj, Silahout... No modern varieties grown.

Source: Chaudhary (2000).

**Table 2. Agroecological Domains at Begnas Eco-Site**

Domains	Size of domain	Productivity	Cultivated landraces/varieties
<i>Mule khet/Bhale khet/Khule khet</i>	I	I	Kalo Jhinuwa, Pahento Jhinuwa, Jhinuwa, Lamcho Jhuluwa, Sato Jhinuwa, Masino Dhaba, Jhinuwa, Adhari Jhinuwa, Lahora Gurdi, Thulo Gurdi, Seto Gurdi, Sano Lahara, Kalo Gurdi, Sano Gurdi, Gurdi, Thulo Kalo Gurdi, Bayarni, Kalo Bayarni, Seto Bayarni, Gajale Bayarni, Juge Bayarni, Seto Anadi, Rato Anadi, Sano Anadi, Dudhe Anadi, Madhese Thulo Madhese, Sano Madhese, Naulo Madhese, Dhaba Jarneli, Ramani, Aapjhuta, Sano Aapjhuta, Gauwari Aakla, Sethobhudo, Rato Krishnabhog, Bhara Thapachine, Bale, Dhaba Gauwari, Masino Battisara, Kannasina, Pani Barmeli
<i>Sim/Gaire khet</i>	IV	II	Kalo Jhinuwa, Pahento Jhinuwa, Jhinuwa, Lamcho Jhinuwa, Seto Jhinuwa, Masino Jhinuwa, Tarkaya Jhinuwa, Jhugainiua, Masino Dhaba Jhinuwa, Adhari Jhinuwa, Lahara Gurdi, Thulo Gurdi, Seto Gurdi, Sano Lahara, Gajale Gurdi, Sano Gurdi, Gurdi, Thulo, Kalo Gurdi, Bayarni, Kalo Bayarni, Seto Bayarni, Gajale Bayarni, Juga Bayarni, Seto Anadi, Rato Anadi, Sano Anadi, Dudhe Anadi, Madhese Thulo Madhese, Sano Madhese, Naulo Madhese, Dhaba Jarneli, Ramni, Kartike Marsi, Pahento Marsi, Sero Marsi, Chiniya Marsi, Aapjhuta, Sano Aapjhuta, Gauwari Aakla, Naithuma Brimphul, Basmati, Chobo, Palungtare, Jyagdikhole Rato, Krishnabhog, Thapa Chine, Bale, Makikhola, Dhaba Gauwari Barmali, Zadan Masino, Battisara, Karna Jira, Pani Barmeli
<i>Tari/Kharkheri /Tapu</i>	II	III	Eida Jhinuwa, Phaka Jhinuwa, Kanta Gurdi, Pakha Jarneli, Thuda, Pakha Thuda, Pakha Gaujari, Manamuri, Rato, Bhote, Maki khola, Choto
<i>Pakho tari</i>	III	IV	Pakho Jhinuwa, Katna Gurdi, Mansara, Aagha

Source: PRA (2000).