Guide to participatory varietal selection for submergence-tolerant rice

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IRRI

The Ministry
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International Rice Research Institute

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Contents

Foreword

The Green Revolution averted the threat of famine through the rapid adoption of improved rice varieties. However, despite this huge success, hundreds of millions of poor rice-farming families in rainfed areas still live in poverty and suffer from food (rice) insecurity. Despite many released improved rice varieties for rainfed conditions, farmers still use local varieties that can withstand drought and floods but have low yields or they use the same varieties for many years because of a lack of better varieties. Rainfed rice farmers are slow to adopt improved varieties because of several problems. One problem is more of extension than breeding—many farmers, particularly those living in remote rainfed areas, may not have access to or information about the seed of new varieties. Another problem is that variety testing programs are often conducted on-station, which does not represent farmers' fields. Moreover, conventional rice breeding programs usually seek farmers' input only at the very end of the process, when newly released varieties, usually one or two per year, are evaluated in on-farm demonstration trials. Often, in remote and unfavorable areas, subsistence farmers, who comprise the majority of the rural farming population in Asia, give importance to social and cultural dimensions aside from the agronomic performance of the new rice varieties. The complexities of developing acceptable varieties for variable and stressful rainfed environments require that breeders become deeply familiar with men and women farmers' needs and preferences. Since 1997, IRRI has been making efforts to improve communication among farmers, breeders, and extension workers so that men and women farmers' concerns and preferences are considered in plant breeding objectives. Participatory varietal selection (PVS) is a simple way for breeders and agronomists to learn which varieties perform well on-station and on-farm and to obtain feedback from the potential end users in the early phases of the breeding cycle. It is a means for social scientists to identify the varieties that most men and women farmers prefer, including the reasons for their preference and constraints to adoption. Based on IRRI's experience in collaboration with national agricultural research and extension system partners and farmers, PVS, which includes "researcher-managed" and "farmer-managed" trials, is an effective strategy for accelerating the dissemination of stress-tolerant varieties. PVS has also been instrumental in the fast release of stress-tolerant varieties through the formal varietal release system. This guide on PVS will complement the various training programs given by IRRI for plant breeders, agronomists, and extension workers engaged in rice varietal development and dissemination.

I compliment the authors for preparing this PVS guide and Bill Hardy for editing it. I am grateful for the assistance of the Ministry of Foreign Affairs (MOFA) of Japan and IRRI, which provided financial support to the IRRI-Japan Submergence Project for Southeast Asia from 2007 to 2009 and the NARES partners who have contributed to the development of this guide.

Robert S. Zeigler
Director General

Module

1

Introduction to participatory varietal selection

Module objectives

- Describe the need for farmer participation in plant breeding
- Describe the important features of participatory varietal selection (PVS) and its advantages over conventional plant breeding
- Describe PVS researcher-managed and farmer-managed trials, popularly called “mother-baby” trials

Rice is a very important food crop in Asia. For 50 years, IRRI has devoted its research on rice breeding to feeding millions of rice eaters in Asia. Although classical plant breeding has been successful in developing rice varieties for favorable rice environments, impact has been limited in rainfed rice environments. Productivity has not kept up with population growth. Despite many released improved rice varieties, farmers still use local varieties that can withstand abiotic stresses but have low yields or they use the same varieties for many years because of a lack of better varieties. In India, for example, varieties Mahsuri and Swarna are widely adopted. Similarly, TDK1 is the most popular in Laos. Farming households in rainfed environments are often poorer than those in irrigated areas because they produce only one rice crop per year. Because of low yields and low production, they have less marketable surplus. During times of drought or floods, they are compelled to consume or sell their seed stock saved for the next season or purchase cheaper but poorer quality rice. Farmers whose fields are prone to abiotic stress tend to apply much less fertilizer to minimize risks. The development and dissemination of improved varieties that are better than what farmers adopt in stressed environments remain a challenging task.

Rainfed rice farmers are slow to adopt improved varieties because of several problems. One problem is more of extension than breeding—that many farmers, particularly those living in remote rainfed areas, may not have access to or information about seeds of new varieties. Another problem is that variety testing programs were often conducted on-station, which does not represent farmers' fields. Moreover, conventional rice breeding programs usually seek farmer input only at the very end of the process, when newly released varieties, usually only one or two per year, are evaluated in on-farm demonstration trials. Furthermore, varietal release systems give more emphasis to grain yield whereas farmers consider other traits when selecting rice varieties (Paris et al 2002). Farmers' needs and criteria for selection do not match the varieties developed by plant breeders. Varieties selected on research stations may not outperform traditional varieties under farmer management, or else they lack a characteristic of unanticipated importance to farmers, such as palatability the day after cooking or ease of threshing. Improved varieties may not meet farmers' end-use and cooking quality requirements.

In conventional variety testing programs, researchers choose the rice lines or genotypes entering the program. The number of entries is about 20 or more and they are laid out in small plots (12–20 m^2) with replications. Most steps in the testing process are carried out at the research station and researchers decide which traits are important. The complexities of developing acceptable cultivars for variable and stressful rainfed environments require that breeders become deeply familiar with farmers' needs and preferences (Atlin 2004).

There is a need to improve communication between farmers and breeders so that farmers' concerns and preferences are incorporated earlier in the research process, research is accelerated, and the adoption rate improves (Sperling et al 1993). Farmers are not only asked for their opinion (the consultative approach) and collaboration (collaborative approach), but are actively invited to help set the research agenda (collegiate approach). By inviting farmers to make decisions in the research process, it is assumed that they will not only adopt but also, and more importantly, adapt the available technology to their own needs and environment (Ashby 1991).

IRRI had been undertaking efforts to reduce the gap between plant breeders and farmers. In 1997, the farmer participatory breeding (FPB) project "Farmers and Scientists: Building a Partnership for Improving Rainfed Rice in Eastern India" was conducted in response to the problem of low adoption rates of improved released cultivars in rainfed rice environments. The goal of this project was to enhance food security and promote biodiversity. The main research objectives were to (1) test the hypothesis that farmer participation in rainfed rice breeding can help develop suitable varieties more efficiently, and (2) identify stages in a breeding program at which farmer participation has the most impact (Courtois et al 2001). Based on lessons learned, IRRI and its collaborators under the umbrella of the Consortium for Unfavorable Rice Environments (CURE) modified FPB and institutionalized participatory varietal selection (PVS) into national agricultural research and extension systems' (NARES) rice breeding programs. Various training courses were given in-country and at IRRI to enhance the capacities of NARES partners on PVS.

PVS involves the selection by farmers of nonsegregating, characterized products from plant breeding programs. Such material includes released cultivars, varieties in advanced stages of testing, and advanced nonsegregating lines. In PVS, farmers are given near-finished or finished products to test in their fields (Maurya et al 1988, Sperling et al 1993, Joshi and Witcombe 1995).

PVS is a simple way for breeders/agronomists to learn which varieties perform well on-station and on-farm. It is a means for social scientists to identify the lines/varieties that most men and women farmers prefer, including the reasons for their preference. PVS requires information on the social, economic, and cultural dimensions in the varietal selection process. This will also introduce the participants to the many ways with which socio-cultural aspects are built into various activities to determine the most suitable variety to adopt under submerged rice conditions. PVS is conducted when conditions on-station are very different from on-farm conditions. PVS trials conducted on-farm and under the complete management of farmers provide information about the performance of new varieties under the real conditions that farmers face. Traits such as weed competitiveness and yield under low-fertility conditions can be assessed in PVS trials (Atlin et al 2002).

PVS trials include formal steps in which farmers express their opinions and preferences about the varieties under evaluation. Farmers' opinion is sought on both production and end-use traits, using tools that can emphasize the traits important to them. This input is very useful in predicting whether or not farmers are likely to adopt a variety.

PVS trials are inexpensive. The setup is deemed an effective way to expose farmers to new sources of germplasm. Farmers often spontaneously adopt varieties they observe or grow on their own farms under PVS trials. In some situations, dissemination of varieties is one of the goals of PVS trials. However, the main purpose of PVS is to provide information about variety performance and acceptability. Farmers evaluate only a few varieties under farmer-managed trials. This information can be used in assessing the quality traits that are oftentimes difficult or expensive to evaluate under conventional trials set up, for example, the milling percentage obtained when large quantities of grains are milled, cooking quality, taste, and agronomic characteristics. Also, PVS underscores the importance of enhanced partnerships among farmers and researchers (social scientists, plant breeders, agronomists, crop physiologists) and with strong support of development workers and other stakeholders. IRRI now emphasizes the importance that PVS protocols play in rice breeding programs.

PVS differs from farm testing in several ways such as (a) only farmer management is used (no package), (b) farmers' opinions about varieties being tested are systematically collected, and (c) environmental replication is extensive.

PVS takes into account farmers' opinions through the following:

- Ensures that farmers' preference data are quantified
- Captures farmers' objectives, needs, and opportunities
- Establishes contacts with potential technology users toward wide-scale adoption
- Enhances farmers' role in varietal selection
- Institutionalizes the collection of farmers' preference data
- Enhances farmers' capacity to systematize data collection and management options

PVS can be incorporated into various stages of the plant breeding cycle. These stages are Stage 1 (Setting breeding goals); Stage 2 (Evaluation of new rice lines on-station and on-farm managed by researchers); Stage 3 (Evaluation of new lines in farmers' fields managed by farmers); Stage 4 (Wide diffusion of seeds/scaling up); and Stage 5 (Assessment of benefits/impacts of PVS by both researchers and farmer-cooperators) (Fig. 1). However, this should serve as a guide and not

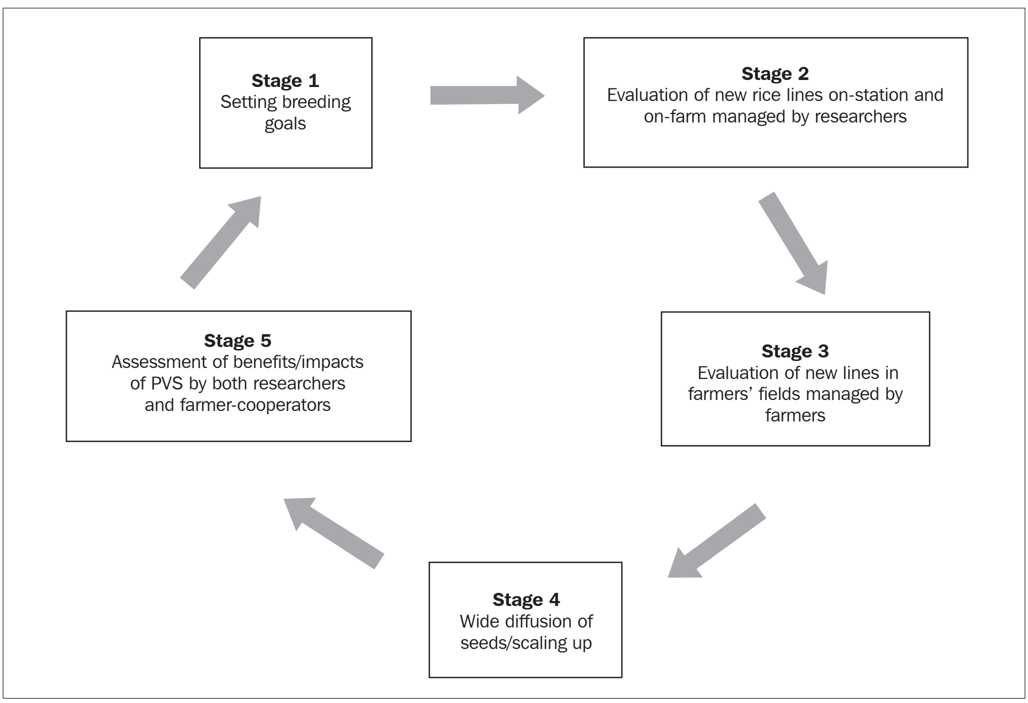

Fig. 1. Different stages of the plant breeding cycle with PVS.

be treated as a step-by-step process that should be strictly followed. It can be considered like a box of choices of various tools and methods that can be combined depending on the applicability and fit at a target site and in accordance with project objectives, for example, develop and disseminate rice varieties that are prone to stress, such as submergence.

Each of these stages will be explained in the succeeding sections of this guidebook. Stage 2 and Stage 3 involve researcher-managed (RM) and farmer-managed (FM) trials, respectively.

Researcher-managed and farmer-managed trials

The RM and FM trials are also called "mother and baby" trials. The mother and baby trial experiments originated from a study in Malawi, Africa, on participatory research to improve soil productivity. The mother and baby trial was named by one of the farmers involved in the trial. The mother trial tests many different lines/varieties while the baby trials test a subset of the lines selected from the mother trial compared with a farmer's variety (Snapp 2002). The design makes it possible to collect quantitative data from mother trials managed by researchers, and to systematically cross-check them with baby trials on a similar theme that are managed by farmers. Thus, the RM trials are referred to as mother trials while the FM trials are known as baby trials.

RM or mother trials can be conducted in several villages. Each village can have one RM or mother trial with 13 to 15 lines/varieties and several FM or baby trials with two to three lines/varieties. Both trials are compared with local checks. Figure 2 shows one mother trial with several

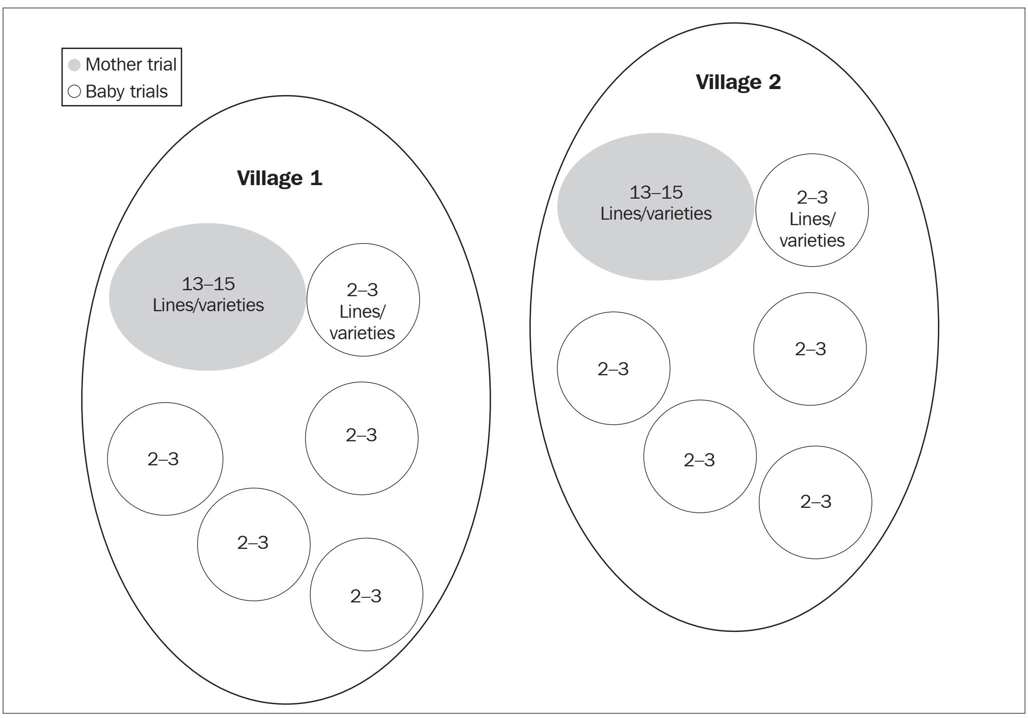

Fig. 2. Mother-baby trial design.

baby trials. One baby trial consists of two to three lines/varieties and one local check.

Researcher-managed trials/mother trials

The researcher-managed trial is a trial that consists of a set of new lines/genotypes (13–15) or introduced varieties that are compared with local checks. These trials can be conducted either on-station or on-farm. Trials conducted in farmers' fields are laid out on a bigger plot size (20–50 m^2). Farmers provide their land and labor whereas the project team lays out the design and monitors the performance of the crop. Agronomists measure yield and other important traits. Replication is within the farmers' field. A group of farmers or other stakeholders, for example, other plant breeders, and extension workers are invited to visit the RM trial. These trials are often located near the road to enable other farmers to see the performance of the lines/genotypes. These trials are similar to demonstration trials or even advanced on-station multilocation trials. Farmers' opinions through visual rating are systematically collected and used in selection decisions through a simple technique called preference analysis (PA).

Farmer-managed trials/baby trials

Through PA, farmers select lines/varieties that they observed to perform well and that can be suitable to their own conditions and needs. These trials are called farmer-managed as these lines/varieties are tested by farmers in their own fields using their resources and level of management. Farmers usually test only two to three lines/varieties in their own fields in comparison with their local checks, with initial seeds coming from the project. Trials are done on a larger farm size (500 m^2). Researchers do not lay out these trials. New lines/genotypes are fully managed by the farmers. Researchers may take crop cuts to measure yield if resources permit. Farmers' ratings, comments, and yield reports have been shown to be highly reliable and are the main outputs of baby trials. Farmers rate the varieties in comparison with their own previously grown varieties. More attention is given to postharvest quality, cooking and eating quality, grain quality, and other traits important to farmers (Atlin 2004).

This mother-baby trials approach in plant breeding is found to be an effective strategy in developing and disseminating improved crop varieties in stressed environments by many international agricultural research centers (IARCs) under the Consultative Group on International Agricultural Research (CGIAR) (Bellon and Reeves 2002).

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Module 2

Incorporating social, cultural, and economic considerations in participatory varietal selection

Module objectives

- To understand the importance of social, cultural, and economic considerations in the selection of rice varieties
- To understand the social, cultural, and economic factors that determine the adoption of improved rice varieties for stress-prone environments
- To recommend methods and tools in mainstreaming socio-cultural (focus on gender) and economic considerations in PVS
- To identify constraints faced by researchers in involving women in PVS and strategies to overcome these constraints

Hundreds of millions of poor people living in rural Asia depend on rice as a staple food and for many livelihood uses. Rice biomass and by-products are also important to subsistence farmers. Farmers will adopt new varieties and associated management practices if their needs and other livelihood uses are met and if new varieties are better than the varieties they use. Thus, the first step in participatory varietal selection (PVS) is identifying farmers' needs within their agroecological and socio-cultural environment. In Asia, where socio-cultural diversity exists, understanding the factors that determine farmer adoption of specific lines/varieties is crucial in accelerating the adoption of improved varieties in stressed environments. Thus, it is important to include social considerations, for example, ethnicity, religion, social class/caste, and gender, in PVS. These social considerations also involve the issue of equity and community empowerment. Cultural constraints and gender disparity in access to and control of resources such as improved seeds and technical information are very evident among rural poor women and the lower social class. Community empowerment and the importance of involving women are central to the PVS concept and protocol.

In the past, agricultural scientists talked to men only and ignored the women despite their active roles in farming. This is due to their assumption that the male head of the household is the only farmer, and the sole breadwinner and decision-maker in the household. It is also assumed that all household members share the same goals, have the same access to resources and outputs, and face similar constraints. Now, it is clear that, in most cases, these assumptions are incorrect. Within a household, members may have diverse roles and responsibilities, conflicts of interest, and unequal access to resources.

Social, cultural, and economic factors that determine the adoption of improved lines/varieties for stress-prone environments

a) *Adaptation to different user needs such as food, livestock fodder, thatching, and cash*. Different varieties fulfill different livelihood functions (food, livestock fodder, thatching, and cash). For example, farmers like varieties with long, fine aromatic grain because these are used as gifts for special occasions (marriage) and for religious ceremonies. Poor farmers are more interested in the quality of leftover rice that should remain tender and soft—characteristics found in traditional varieties. Similarly, traditional varieties are perceived to be better for preparing puffed rice and other rice products (Paris et al 2001a). In the uplands, farmers prefer tall varieties because they need the straw for animal fodder. Farmers also use local varieties for rice wine (IRRI 2001). Other farmers grow traditional varieties with a purple-pigmented base in drought-prone areas. This trait helps farmers distinguish weeds from rice, especially in direct-seeded fields where weeds are a major problem (Sahu et al 2001).

b) *Socioeconomic status of farmers.* Scientists may think that "all farmers are the same" or that they are working with "typical" or "representative" farmers. Farmers and their households often are not homogeneous, even within a community (Bellon 2001). Within a community, farming households belong to different socioeconomic groups and may have different resources, needs, and preferences. Thus, it is important to identify these differences. Farmers prefer different grain types according to their socioeconomic status and degree of market integration. In eastern India, farmers and field workers of lower castes with small landholdings prefer varieties with coarse grains that give them a feeling of fullness due to their slow digestibility. Higher-caste farmers with large landholdings who sell rice to the market prefer fine slender grains that command a higher price. In general, smallholder farmers from the lower castes use rice mainly for consumption, while farmers from the upper caste with more land sell their surplus (Paris et al 2001b). Farmers in the uplands prefer varieties that do not require high inputs. Farmers who depend on family labor prefer varieties with a range of maturity dates so that harvests can be staggered (IRRI 2001).

c) *Gender-specific roles.* Rice production has gender-specific roles. While men are mainly responsible for land preparation, broadcasting fertilizer, spraying pesticides, and hauling farm products, women take care of pulling and transplanting seedlings and weeding. Harvesting is jointly done by both men and women while manual threshing is relegated to female labor. Storing seed stocks and preparing rice for other products are also done by women only. Feeding large animals with rice straw is mainly women's responsibility. Based on gender-specific roles, men and women have different criteria for varietal adoption. Thus, it is important to conduct gender analysis at the initial stages of the plant breeding process. In many developing countries, women are the primary managers and users of natural resources. Poor rural women play important roles in rice-based farming systems as farm managers, unpaid family workers, hired laborers, income earners, and major caretakers of family health and nutrition. They are also responsible for natural resource management through their day-to-day productive and reproductive tasks of providing fuel, water, and food for household consumption and for sale. Annex 1 provides some notes on results of research involving social and gender analysis.

Methods in mainstreaming socio-cultural and economic dimensions in PVS

Farmers are natural experimenters. Often, all they lack is access to new technology options that have the potential to improve their farming systems and information about the potential benefits and limitations of these options (Horne and Stur 2003). Involving farmers and stakeholders in the varietal selection process enhances the likelihood that farmers will adopt the technologies, and these would have greater impact in communities. The participatory rice varietal improvement process has several stages that involve farmers and the community, such as setting breeding goals, the evaluation of new rice lines, and wide diffusion of seeds and assessment of benefits of PVS (Fig. 1). There are many ways to ensure that socioeconomic and cultural aspects are taken into consideration in the conduct of PVS. Each of the methods and tools in integrating social, economic, and cultural aspects of the varietal selection process is discussed briefly in this module.

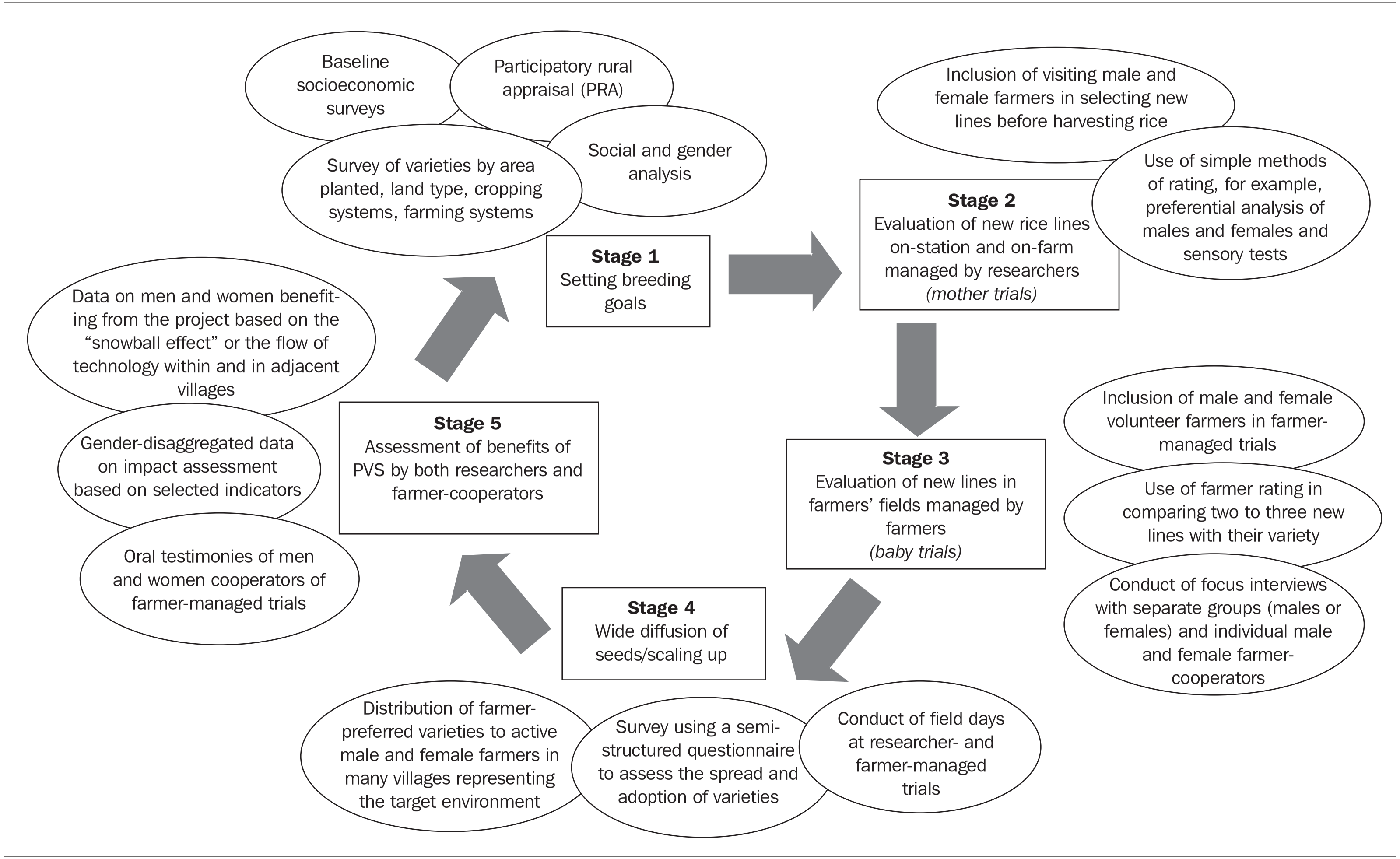

Fig. 1. Tools and methods for incorporating social, cultural, and economic considerations.

Stage 1: Setting breeding goals

1. Social and gender analysis. This will require information on social activities and culture (various ways of life, which include language, arts and sciences, thought, spirituality, and interactions). Culture also includes norms, beliefs, and perceptions that have been handed down from one generation to another. For example, gender roles and gender relations are determined by the culture of a given society.

Gender refers to the socially or culturally established roles of men and women and is governed by social norms that are accepted in specific socioeconomic and ethnic communities in all societies. On the other hand, sex refers to the biological differences between men and women. Gender roles are highly influenced by the expectations of society based on class, caste, age, ethnicity, and religion. Roles vary according to geographic location and production systems and are the result of religious, cultural, socioeconomic, and political circumstances. Gender roles are dynamic and ever-changing. For example, the husband is culturally perceived as the head of the household, breadwinner, and decision-maker. Wives assist their husbands in farm work and take care of household chores and the children. However, due to economic necessity and male out-migration, gender roles are changing. More women are increasingly becoming de facto heads of households with greater responsibilities as farm managers. Gender analysis is the discovery through systematic enquiry of gender roles in a particular place or location. The following highlights the need for gender analysis:

a. Gender is one of the most determinant socioeconomic factors that diversify roles, tasks, responsibilities, and needs among farmers.
b. Rural men and women are both food producers and food providers, and this should be taken into consideration in decision-making.
c. Rural men and women have accumulated knowledge and skills concerning their ecosystems, local crop varieties, cropping systems, and the nutritional value of various underused plants.
d. Men and women have different roles, and different perceptions and needs.

Gender analysis. This is a tool in analyzing the roles or domains of men and women as they interact in agricultural activities. This tool is partly incorporated in participatory rural appraisals (PRA), baseline surveys, and other methods of data collection. The following questions are central to gender analysis:

a. Who does what, when, and where? This covers crop-specific and livestock activities and operations, farm enterprises, and off-farm, nonfarm, and household maintenance activities that compete with or complement other tasks. Also included are crop production management and postharvest of seeds, root crops, tuber crops, other commodities, and livestock.
b. Who has access to or control over the resources? **Access** means that resources may be available but there are no choices related to the timing or amount of use, or there are conditions attached. **Control** means having decision-making authority concerning a resource.
c. Who benefits from each crop enterprise? What are the incentives and disincentives for managing or for making changes to them? The question of who benefits from

these is closely related to roles and responsibilities, equity, and issues of access and control.

Purpose of analysis. Gender analysis is done to systematically examine the roles and relationships between women and men, focusing on imbalances in access to resources, power, and workload. It is also used to examine the multiple ways in which women and men as social actors engage in strategies to transform existing roles, relationships, and processes to meet their own interests as well as the interests of others.

2. Participatory rural appraisal. Participation in breeding programs can be clearly distinguished if it is defined together with quality. Three dimensions are useful with respect to the quality of participation and these are stage of participation, degree of participation, and the actor's roles in participation.

It is usually fair to say that the earlier participation occurs in a breeding process, the more opportunity users have in influencing the objectives, breeding strategy, and final outcomes. However, the extent to which users can realize this opportunity depends on the degree of participation. The degree of participation of farmers or other users who are involved may influence decisions about the process at any given stage. Furthermore, the specific role played by researchers, farmers, and other actors is important in defining the quality of participation (Sperling et al 2001).

Farmers should be involved even at the early stage of defining the rice community's problems and opportunities. This can be realized by using participatory approaches in defining the village characteristics where the new rice lines or varieties will be tested. With the active participation of the farming community, participatory rural appraisal (PRA) tools and methods can be used to characterize the village and farming systems even at the problem identification and project planning stage.

PRA describes a growing family of approaches and methods to enable people to share, enhance, analyze, and (using their own knowledge and conditions in the farming community) to plan and to act (Chambers 1994). This is a general methodology for development research, planning, monitoring, and evaluation. It presents the link between the technical (or biophysical) and the socioeconomic information to form the basis for the community's and the stakeholders' identification and prioritization of alternatives or courses of action. Certain PRA principles should be taken into consideration when identifying a good combination of tools and methods to use. The following are some of these:

a. Reversal of learning to learn from rural people directly, on-site, and personally, gaining from local physical, technical, and social knowledge.
b. Learning rapidly and progressively with conscious exploration, flexible use of methods, iteration and cross-checking, and being adaptable in the learning process.
c. Offsetting biases by being relaxed, listening, being unimposing instead of feeling important, and seeking out poor people and women to discuss their concerns.
d. Facilitating investigation, analysis, presentation, and learning among rural people themselves, so that they present, own, and learn from the outcomes.
e. Self-critical awareness and responsibility, meaning that facilitators are continuously examining behavior to do better and accepting personal responsibility

rather than vesting it in a manual or rigid set of rules.

f. Sharing of information and ideas between rural people, between them and the facilitators, and between facilitators (Development Academy of the Philippines Course on Baseline Study Designing, CBSD).

The following are three common methods of collecting qualitative data that can be used for various aspects of the PVS and the project in general. These are used to better understand the phenomenon in the agricultural setting, particularly the social aspects for which people are the participants. The results contribute to a deeper understanding of the experience from the perspective of those concerned.

a. *Focus group discussions*
A focus group discussion is a rapid assessment and semistructured data collection method in which a purposively selected set of participants or social groups gather to discuss concerns based on a list of key themes that the researcher/facilitator has drawn up. It is a cost-effective technique for eliciting the views and opinions of farmers, who are the clients of prospective innovations. Farmers are the best informants of the problems in their own environment.

b. *Semistructured questionnaires*
This is a simple process of talking with individuals, families, or groups to discuss a specific topic in an informal setting. All present are encouraged to offer ideas and opinions. In semistructured interviews, the information that needs to be collected is predetermined by the team. Only an interview guide is developed and not a complete questionnaire. The interviewer needs to cover the whole topic and can do so through informal and relaxed discussions. The effectiveness of this method depends largely on the personal skills of the interviewer. The purpose is to gather information about a specific topic, to analyze problems and opportunities, or to discuss plans as well as elicit perceptions (e.g., on gender relations).

c. *Use of probing questions*
Probing is a tool that can be learned through constant practice. This means getting additional information and dealing with a topic or idea more deeply and logically. This is important for complex and controversial issues that need further discussion and clarification.

The following table is an example of how probing can be done.

Probing techniques (probe more when initial information is not enough)

■ It has a high/low/average yield.	■ How high is high/low/average compared to the preferred local variety?
■ It has a high market demand.	■ What qualities do consumers look for? What is the market price of this variety compared with that variety?
■ Farm laborers prefer this.	■ Why do farm laborers prefer this?
■ We are happy with the duration.	■ What is the maturity period? Why do you like short/medium/long duration?
■ It is easier to grow.	■ Why is it easier to grow? Compared with what variety?
■ It fits our cropping system.	■ How does this variety fit into the cropping system?

d. *Use of selected PRA tools and methods*
In characterizing the village, four additional major groups of PRA tools and methods will be used in the PVS protocol (Box 1). Specifically, these tools aim to (1) characterize

Box 1. PRA tools and methods.

Objectives	Specific tools	Rationale/use	Output
1. To characterize the biophysical and socioeconomic conditions of the site.	a. Village transect/transect walk	To collect information on the biophysical and social conditions of the farming communities and how these factors can support or constrain technology adoption.	Transect that shows land types, irrigation facilities, and areas affected by submergence and other stresses
	b. Resource and social mapping		Resource and social maps of the village
2. Define the cropping pattern and determine the characteristics of the abiotic stress (submergence problem).	a. Seasonal calendar (climate, cropping pattern, and period when rice is sufficient and scarce)	To understand the importance of rice and how this is affected by submergence and other stresses.	A monthly calendar showing the cropping patterns and the nature, timing, depth, intensity, and days when submergence and other stresses occur. A monthly calendar showing the months when rice supply is sufficient and scarce.
	b. Trend analysis		A trend diagram showing the incidence of submergence in the last 5 years.
3. Analyze the submergence problem in the farming community, its primary and secondary causes, and its effect on rice yield.	Problem tree analysis—causal effect link approach	To understand farmers' perception of the problem, its causes, and effects (extent of loss) on rice yield.	A diagram showing biophysical, socioeconomic, and institutional causes of the submergence problem, and the effects of such stress on the various aspects of life in the community. The resulting chart will serve as a basis for identifying intervention points for research and extension.
4. Identify resources, social capital, communication, and seed delivery system (including flow of information).	a. Venn diagrams showing the relative importance and roles of each actor. The relative importance can be shown by the size of the Venn diagrams.	To understand the relative importance of each actor in the extension and communication delivery system.	Schematic and Venn diagrams showing the interlinks between actors involved in the extension and communication delivery system.
	b. Schematic diagram of the seed delivery system, including the flow of information.	To define the inputs, information, technologies, and other requirements in the seed delivery system.	Schematic diagram showing the flow of seed delivery; room for improvement identified.

the biophysical and socioeconomic conditions at the target site; (2) determine the seasonality (climate, cropping pattern, and calendars) and the characterization of submergence stress in rice farming (nature, timing, intensity, and depth); (3) identify the problems related to rice farming in the target area using the causal link approach such as the problem tree analysis; (4) analyze the physical resources, human resources, and institutional linkages and the technology, information, and input delivery systems at the target sites; and (5) integrate all the information collected to be analyzed as a basis for identifying interventions.

The following are brief descriptions of some of the most important PRA tools and methods that can be used for Stage 1 of the PVS protocol (see Box 1). These are mainly used for the preparation of the village descriptor and baseline information.

3. Baseline socioeconomic survey. Formal baseline surveys are used to extend analysis to quantification and use of a larger sample size for extrapolation (projection into a larger picture or population). These are also used to clarify priorities in research and target expansion areas for the project. Usually, this is costly, time-consuming, and computer-intensive but is highly reliable when it has a good design from the conceptualization to the collection methods and data analysis framework. Biophysical factors can determine to a limited extent the actual land use and production potential of an area. However, socioeconomic determinants also influence farmers' decisions in land use and crop management practices as well as indicate the potential costs and benefits of a project.

The main objective of the survey, as used in the PVS protocol, is to characterize the problem, the farming conditions, and livelihood. The results serve as takeoff points to assess the economic costs and benefits and other social impacts of the project and to identify strategies under the overall framework of the wider promotion of best-fit technologies and management practices. The baseline survey provides a proper understanding of the socioeconomic conditions for the flow of technologies and information and the driving forces behind the current conditions in the community.

Socioeconomic aspects are incorporated in the different data elements to be collected, such as gender-disaggregated division of labor, responses of male/female household heads or respondents, and varietal preferences of male and female respondents, among others.

4. Key informant surveys (KIS) for varieties by area planted, land type, cropping system, farming system, and other relevant topics.
To understand farmers' crop management practices, additional information can be collected by conducting a survey with a small group of key informants. An alternative method of collecting this is through focus group discussions on specific topics, such as the following (note: a more complete list of needed information is in the module for Stage 1):

- Information on crop management practices, including male and female indigenous knowledge and opportunities for improving crop management of rice varieties.
- Farmers' criteria for varietal choice, and their constraints, needs, and opportunities to increase productivity and overcome abiotic stresses.
- Land type, varieties usually grown in each land type, varieties grown in the last 10 years, and positive

and negative traits of varieties (data disaggregated for husbands and wives).

- Access to and control of resources in the village and who benefits from information and technology.

Stage 2: Researcher-managed evaluation of new rice lines on-station and on-farm (mother trials)

- **Inclusion of visiting male and female farmers in selecting new lines before harvesting rice**. This can be done during field days or events that aim to disseminate information about new varieties or lines under trial. Farmers are invited to attend and females must be well represented. All forms or information to be collected should be gender-disaggregated to ensure that both men and women can participate and are consulted in selecting new lines in the researcher-managed trials before harvest.
- **Use of simple rating methods in the preferential analysis performed by male and female farmers.** In conducting preference analysis (PA) and sensory tests in mother trials, it is suggested that at least 30% of the participants be female. This would allow the collection of reliable information that can be subjected to both qualitative and quantitative analysis of data and information. The design of the PA and sensory tests already incorporates the disaggregation of data for male and female cooperators/participants.

Stage 3: Farmer-managed evaluation of new lines in farmers' fields (baby trials)

- **Inclusion of male and female volunteer farmers in farmer-managed trials.** The baby trials involve the participation of men and women in growing, testing, and selecting new rice lines in farmer-managed trials under their own farm conditions.
- **Use of farmer ratings in comparing two to three new lines with their variety.** PVS makes use of farmer ratings in comparing two to three new lines with their local/traditional variety. On the second visit for monitoring and data collection (2 weeks before harvest), each farmer-managed trial is observed. Husbands and wives are asked to rate each variety for yield, tillering ability, plant height, tolerance of pests and diseases, tolerance of unfavorable conditions, and for their overall opinion about the variety. On the third visit (postharvest), a meeting of participating farmers should be held in the community. Husbands and wives will rate the varieties again for their yield, postharvest quality, and overall performance. Ratings for eating and cooking quality can also be obtained.
- **Conduct of focus interviews with separate groups (males or females) and individual male and female farmers.** The baby trial should contain a group discussion on the performance of the varieties and farmers should be asked to talk about the good and bad (positive and negative) characteristics of the varieties. For each variety, farmers are asked if they plan to grow the variety in the following year. These ratings and information about the condition of the trial should be recorded on a form (provided in Stage 3) that clearly summarizes farmers' opinions and preferences. Separate focus interviews can be done for male and female farmer-cooperators.

Stage 4: Wide diffusion of seeds/ scaling up

- **Distribution of farmer-preferred varieties to active male and female farmers in villages that represent the target environment.** The project aims for the wide adoption of technologies and associated management practices and goes beyond adoption by the project's direct cooperators and beneficiaries. With this objective, the project distributes the seeds to target male and female farmers to ensure that new rice varieties tolerant of submergence in rice environments are tested on experiment stations and in farmers' fields with their strong participation. Technology improvements should include the development of varieties based on preferences and the impacts on male and female farmers. The project should ensure that the number of women and men involved is proportional to how they are already involved in their respective activities. The basis for this could come from the result of the village description.
- **Survey using a semistructured questionnaire for the "snowball effect" to assess the spread and adoption of varieties.** Snowball sampling uses an informant as a source for locating other people from whom data can be generated (in this case, the spread of technology or variety), who then can refer the researcher to other people, and so on. The names accumulate over time and this system can easily and efficiently build a sample from the social network in and outside the village.

  Using the snowball system, a simple semistructured survey can be conducted on women and men who participate in seed distribution and adoption of varieties and associated technologies, field days, farmer field schools, extension groups, or other dissemination activities to determine how they participated and can potentially benefit from the project. This information could be linked with the Stage 5 information on impact/benefit assessment. Information on how men and women have contributed to the spread of the technologies can also be collected. In addition, the simple survey can include information on how the technologies and inputs were made available where women can access them, and if they were affordable.
- **Conduct of field days at researcher- and farmer-managed trials.** For both the RM-PVS (researcher-managed PVS) and the FM-PVS (farmer-managed PVS), male and female farmers should be invited and given equal opportunity to participate, be heard, and take part in the decision-making process of the activities. This scheme should also eliminate any social barriers against women and their organization or interaction with male development/extension workers and other stakeholders. Farmers can have first-hand information to evaluate the advantages and disadvantages of the technologies.

Stage 5: Assessment of benefits of PVS by both researchers and farmer-cooperators

- **Oral testimonies of men and women cooperators for farmer-managed trials.** To assess the initial benefits accruing to the direct beneficiaries of the project, oral testimonies from one or two men and women cooperators can be gathered and presented in a simple case study, feature article, or information clip. The oral testimony can include information on how the technologies and management practices have changed their lives in terms of agricultural production, income, and mechanism for coping with stress occurrence, among others. The testimonies can reflect, if any, differences in the impact of the project on men and women farmers.

- **Data on women benefiting from the project based on the "snowball effect" or the flow of technology within or in adjacent villages.** Information in the village easily spreads, especially if the technology is creating a significant impact on farmers' lives. This analysis can include the assessment of communication flow within the community that would give equal access to and control of information for men and women. It is important to assess how this knowledge might be used to create opportunities for women. Included here is the assessment of whether the project has considered the participation of women in informal seed systems and if opportunities to promote greater acceptance of technical packages and activities were given to both male and female farmers.
- **Gender-disaggregated data on impact assessment based on selected indicators.** The impact assessment to be conducted should have, when possible, gender disaggregation of data and information.

Involving women farmers in PVS is not easy and straightforward based on experience. There are constraints to their participation but these constraints can be overcome. Some of these constraints to women's participation in breeding programs and how they can be overcome are listed in Table 1. These can be classified into social and cultural constraints, logistical problems, and institutional constraints.

Some positive outcomes of social and gender analysis in rice varietal improvement

The incorporation of intended beneficiaries, both men and women, in the innovation process can affect the efficiency of the process itself. The interaction with researchers may affect the beneficiaries as well, at both the individual and community levels, by building social and human capital (Johnson et al 2000). Below are some positive outcomes of including women in the rice varietal improvement process.

- Plant breeders have a clearer understanding of farmers' selection criteria, including social (gender roles) and cultural differences, which were considered in breeding objectives.
- Poor women are included as visiting farmers in the evaluation of the performance of new lines in researcher-managed trials (mother-trial design).
- Farmers are exposed to many varieties or new lines and have many to choose from.
- Active poor women farmers are included as project cooperators in farmer-managed trials.
- Both men and women farmer-cooperators are able to make a more objective evaluation of the new genotypes using their resources.
- Farmers' rights are promoted.
- There is a faster uptake of new varieties in rainfed areas.
- Men and women have better access to seeds and new knowledge.
- Varieties are approved from PVS by formal release systems, which consider both yields and other traits for poor subsistence-oriented farmers.

Table 1. Constraints that researchers face in involving women and other disadvantaged groups in participatory rice varietal improvement projects and the strategies to overcome them.

Constraints/problems	Strategies used to overcome these constraints
Logistical problems	
■ Drudgery of female farmer-cooperators increased in harvesting and threshing small quantities.	■ Varieties to be grown and managed by farmers are reduced to 2 to 3.
■ There are too many lines to rank in researcher-managed trials.	■ Rating instead of ranking is used in evaluating new rice lines.
■ Limited seeds of new lines restricted the number of cooperators, especially the women.	■ Seeds are brought by the farmers and multiplied on experimental farms.
■ Women farmers mixed the seeds of different lines. ■ Farmers with marginal holdings were afraid to risk testing seeds in anticipation of drought or submergence.	■ Men and women can be trained on seed health improvement, particularly in maintaining the purity of seeds from the seedbed to planting until harvesting. In past experiences, many followed the improved practice. New seeds were provided accordingly (2–4 kg) so they have fewer chances to mix them. Sometimes, if seedlings are not sufficient for their plot (small/big), they transplant other varieties to fill the gaps and the remaining area.
■ Marginal farmers hesitate to test too many lines since the size of their plots is small and marginal.	■ Number of lines to be tested is reduced to 2 to 3.
Social and cultural constraints	
■ It is difficult to convince marginal and lower-caste farmers to try new seeds.	■ The researchers explained the goals and objectives of the project. FGDs and farm visits can be conducted to create awareness and better understanding of the project.
■ Farmers do not trust and are suspicious of scientists who ask too many questions during surveys.	■ Social scientists and biologists visit the villages frequently.
■ Rainfed farmers were worried that they would have to pay for the losses of new seeds because of drought.	■ Researchers assured farmers that they would not pay for the losses incurred due to biotic and abiotic stresses. However, they need to take care of the seeds as these are expensive. They should keep the seeds to grow for the next season.
■ Poor women, especially those who belong to the disadvantaged social groups, were unwilling to join activities in the public domain because they were busy with farm tasks and household chores.	■ Researchers conducted their interviews with women inside their homesteads. Researchers can adjust the time of their interviews and meetings according to the most convenient time for the women farmers.
■ Poor women lacked confidence in expressing their perceptions though they were knowledgeable on the subject.	■ Participatory ranking method using graphic illustration of traits is used like a game. ■ Researchers need to build rapport through frequent visits in the village.

Continued on next page

Table 1 continued.

Constraints/problems	Strategies used to overcome these constraints
Institutional constraints	
■ There is a lack of female scientists trained on participatory rice varietal improvement.	■ Female social scientists/extension specialists were identified to work with the interdisciplinary team. Training courses specified the need for nominating female participants.
■ Male scientists lack gender-sensitivity or responsiveness on social and gender issues.	■ IRRI organized a training activity on the impact of rice plant breeding, which includes PVS and social/gender analysis.
■ There is a lack of trained scientists on the application of participatory approaches in research and extension.	■ IRRI organized a training course on applications of participatory approaches in research and extension, which covers PVS and how to include and interact with men and women farmers in a number of PVS activities.
■ Scientists assume that benefits of new varieties are scale- and user-neutral and that poor and rich farmers, both men and women, can achieve the same type of benefit from new varieties.	■ Social scientists facilitated focus group discussions between plant breeders and different social categories of farmers, especially on field days during evaluation of different lines. These helped change a lot of assumptions.

Source: Paris et al (2008).

- Men and women farmers, rather than breeders, make the final decision to accept or reject new varieties.
- Women's empowerment is enhanced.

Better understanding of the factors that influence women's empowerment have considerable differences depending on (1) the economic status (poor, wealthy, small, marginal, or large farming households), (2) social groups (lower and upper caste), (3) ethnic groups, (4) access to land (farming, landless), (5) production system (rainfed lowland, upland), (6) type of market integration (subsistence, commercial), and others.

Practical exercise

Points of discussion during group exercises:

- What are the roles and responsibilities of women in relation to men in different rice-farming operations (production, postharvest, food preparation, seed selection, storage, exchange, marketing, etc.) in your country?
- Give examples of social (including gender roles), economic, and cultural factors that should be considered in rice varietal improvement.
- What approaches do you recommend to ensure that social, economic, and cultural dimensions are considered in PRA?

Each participant is given three cut cards or pieces of paper (with three different colors to distinguish their answers) to indicate their responses to each question. Only key words or ideas should be written on the cards (or paper). Only one idea should be written per card (or piece of paper). The group then discusses the entries on the cards as classified according to the three questions.

Annex 1

Some notes on analysis of findings on farmers' selection criteria based on their agroecological and socioeconomic environment

There are gender-specific tasks in rice production:

- Households are often headed by males, but females are increasingly becoming the de facto heads in Asia. The male farmer is often referred to as the head of the household, sole decision-maker, and user of technology. However, with the changing socioeconomic conditions and increasing poverty, especially in unfavorable environments, female-headed households are increasing. Women may head households in various ways: (a) a de jure head such as a widow or divorcée, (b) a de facto head such as when the husband is away for an extended period of time, and (c) informal heads such as when they command resources and make decisions.
- Women from poor farming households provide most of the labor in rice production (pulling seedlings, transplanting, and weeding), postharvest (winnowing, hand threshing, and seed drying), and seed management (selection, storage, and biomass use).
- In Asia, depending upon the farm size, economic class, and production system, women's contributions range from 25% to 80% of the total labor use in rice production. Except for land preparation and spraying chemicals, the rest of the rice operations are dominated by women.
- Women's role in seed handling, food processing, trading, and purchase is known to be vital to food security and family well-being, but their positions and interests can be substantially and importantly different from those of men (Farnworth and Jiggins 2003, Seshu and Dadlani 1989). However, they are seldom consulted and involved in the decision-making and planning that affect their labor and resource use.
- Men are mainly responsible for land preparation, application of chemicals, and transporting inputs and products. However, women give more importance to other traits such as competition with weeds and postharvest qualities such as ease of dehusking or threshing, and high milling recovery or suitability for different food preparations (e.g., puffed rice). Women's criteria for varietal selection are likely to be related to their roles and responsibilities (Paris et al 2001b, Sahu et al 2001).
- Technologies have different effects on male and female labor. Technologies are "gender-neutral" and will be beneficial for all. However, some technologies have differential effects on male and female labor due to gender-specific tasks. Examples of these technologies are manual transplanting vs. direct seeding, manual transplanting vs. large mechanical transplanters, handweeding vs. use of herbicide, and others.
- Men and women have different patterns of time use. Women allocate their time for domestic work, earning income, and operation of their own farm. Technologies that will increase demand for labor will certainly have to consider women's time as well.

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Module 3

Stage 1: Setting breeding goals

Module objective

- To show the steps in how farmers' needs and preferences can be incorporated in setting breeding goals. This is based on scientists' knowledge of the agroecological, socioeconomic, and cultural characteristics of farming communities affected by submergence.

Farmers' needs and preferences should be incorporated when setting breeding goals based on scientists' knowledge of the agroecological, socioeconomic, and cultural characteristics of farming communities affected by environmental stress. At this stage it is important to collect information on past and existing varieties planted by farmers in the villages according to the area planted, land type, cropping system, and farming system for the assessment of varietal traits. This will serve as baseline information on farmers' preference in varieties.

Steps in setting breeding goals with farming communities

1. Select the target site for on-farm experiments

Information related to agroecological classification and socioeconomic conditions can be gathered from secondary sources, key informant interviews (KIS), and focus group discussions. This should be done by the research team. Criteria for site selection are set by the research team. Appropriate use of the criteria for site selection is crucial to the success of the project. Inappropriate site identification can lead to significant losses in research investments. Based on the goal and specific objectives of the Japan-IRRI Submergence Project, the following set of criteria was used as a guide in site selection.

a. *Importance of rice in the village*. This can be assessed based on the cultivated area devoted to rice and the number of households engaged in rice farming.
b. *Nature and extent or severity of the abiotic stress*. The area should represent the stress problem to be addressed, which is flash flooding that occurs up to 2 weeks or up to 18 days only since this is the area targeted for the available technology for submergence tolerance. Areas of stagnant flooding are not included (Sub1 Fact Sheet No. 1 at www.irri.org/flood-proof-rice/; IRRI 2009).
c. *Presence of local research staff and extension workers*. The project is about wide dissemination of submergence-tolerant rice varieties and associated management practices; hence, it is critical for the success of the project to have partners mandated to promote technologies and information. These local research staff and extension workers can be from government organizations (GOs) and nongovernment organizations (NGOs), state colleges and universities, and other groups that can help in the transfer of knowledge.
d. *Accessibility, peace, and order*. In many cases, development efforts are hampered by a lack of facilities and infrastructure for mobility and support systems. The presence of factors that can put the project and implementers at high risk should also be assessed.
e. *Areas where the project can have higher impact given the short project duration*. High-impact projects are best implemented in areas where more farmers, families, or other target groups can benefit from the project; where the "multiplier effect"

of development- or action-oriented projects can work; or where existing mechanisms provide a conducive environment for information flow and technology transfer, such as the presence of active farmer-leaders and the spirit of "cooperation" that remains visible within the farming community.

f. *Proximity to research stations and availability of facilities (accommodations, research station, etc.)*. For practical purposes, the research station should not be too far away for the scientists who will manage and conduct monitoring visits.
g. *Interest of the villages and farmers to cooperate*. The village leaders and farmers should be interested in cooperating in the project and be willing to share some resources, take some risks, and participate in activities that will sustain the adoption of technologies even after the termination of the project.

2. Characterize the experimental villages

Prepare a village description guide explaining the conditions and problems in the village. A village description provides an overview of the characteristics of the village that are relevant to better understand the biophysical and socioeconomic situation in the targeted area/site of the project. Any development project must start with careful assessment of the biophysical and socioeconomic conditions that govern the farming systems, and access to, control of, and use of resources.

3. Identify the target population by collecting basic demographic information

Information should be disaggregated by age and sex, and proportion of male-headed and female-headed households (de jure and de facto due to male outmigration). If there is a high proportion of de facto female heads of households, then the project should ensure that the beneficiaries are women. This information can be collected through key informant surveys (KIS) and from secondary sources.

4. Understand farmers' crop management practices, men's and women's criteria for varietal choice, and farmers' constraints, coping mechanisms, and technology needs and opportunities to increase productivity

Collect information on farming systems, indigenous knowledge, practices, and opportunities for improving crop and management practices associated with rice varieties, and social networks. This information can be collected using various participatory rural appraisal (PRA) tools such as KIS, focus group discussions (FGDs), seasonal calendar diagramming, resource mapping, gender analysis, transect walks, semi-structured interviews, problem trees, trendlines, and Venn diagrams (see Appendix 1, Guide in using PRA tools).

5. Summarize and share the findings with members of farming communities and research teams

It is important that the findings be shared with those who provided the information and with the team that has to identify the needs and opportunities for varietal improvement for stress-prone environments.

Appendix 1. Guide in using PRA tools

Key informant surveys (KIS)

These are interviews with selected key individuals who have extensive experience in a certain community or specialized knowledge or skills on a particular topic (Box 1). One disadvantage here may be the possible biases of the individuals being interviewed. Thus, it is important to validate or ask probing questions that will verify the given information. Information from other sources should also be checked. In addition, proper selection of the key informants is also crucial to the quality of the information collected. The informants can be local government leaders, village heads, farmer leaders, leaders of local groups, and men and women leaders, among many others.

Materials: Notebooks and pens, an interview guide

Steps:

a. Prepare an interview guide in advance. This is sometimes called the topical outline. This is not a questionnaire but a list of topics that you want to discuss with those interviewed (grouped in such a way that the sequence of the discussion will be easy to manage). Prepare the initial questions for each topic. The aim is to introduce the topic and make the respondent think as well as discuss about it. Probing questions for each topic should be made available. To probe deeper into the topic, it would help to get more details on the following: what, why, who, when, how, what do you mean, anything else, etc.
b. Select one person to lead or control the interview. Preferably, another person should record the questions,

Box 1. An example of a report based on key informant surveys on farmers' crop management practices, constraints, and technology needs and opportunities for increasing rice productivity in flood-prone areas in Nueva Ejica, Philippines

Villages such as Papaya, San Francisco, San Jose, San Mariano, Santa Barbara, Santa Cruz, and Santo Cristo are identified as the lowest lying and most flood-prone areas in the municipality of San Antonio in Nueva Ecija, Philippines. Flooding starts in June and extends up to November but may vary from September to October. Usually, water flow comes from surrounding areas such as Zaragosa or Aliaga. Being a low-lying area, the municipality of San Antonio serves as the catch basin of water flow before water drains to the Candaba swamps. Consequently, rice farmers cannot plant during the wet season. If ever some risk planting, they do not expect much yield from the flooded area planted, which may cover up to 1,000 hectares. The usual practice of the farmers in the area during this time is to let their land stay idle during the wet season but, as the water recedes, usually in late November, farmers prepare the land for dry-season planting to take advantage of the presence of water. For some years, they scheduled land preparation for the dry season earlier but delayed planting until August. Unfortunately, unexpected flood caught the already flowering plants when they did this. Some farmers inquired about or suggested trying early-maturing varieties so as not to be caught by flood during the critical time of harvest.

Farmers had few qualms about pest management. According to them, they did not encounter problems in regard to pests and diseases except for the occurrence of neck rot or, using their naming system based on the appearance of the bowing stalk, "*binatukan*." They were able to avoid stem borers because they practiced synchronous planting. With regard to their pest management practices, participating farmers said that they usually use whatever they heard about from friends or from anybody and they spray the moment they observe flying insects in their field.

During the last season, farmers in submerged areas planted hybrid seeds such as Bioseed 401, Bigante, and SL8. Bioseed was given a new name as Biosisid because it was the only variety that survived the flooding. Moreover, the Philippine Rice Research Institute (PhilRice), under the IRRI-Japan Submergence Project, introduced *SUB1*-gene varieties such as Swarna-Sub1, Samba Mahsuri, and IR64-Sub1 from IRRI to be planted and assessed for performance in the village of Papaya. Farmers have high hopes for the introduced submergence varieties and asked whether the submergence capability could be extended to 1 month to ensure survival of the plants as long as the flood waters stay in their areas. Dr. N. Desamero, as the team leader, could not promise more than a 2-week submergence period. They were also interested in whether the varieties with the *SUB1* gene could be used for drought areas and, if not, whether IRRI or PhilRice could provide seeds appropriate for such areas. They were happy to know that there are seeds exclusively for drought-prone areas and they would like to test these varieties in their fields.

Initial plans for the project are information dissemination so the farmers will have a background on the varieties and a technology demonstration to be established in 2008 in about seven villages.

Excerpts from Field Reports of PhilRice, August 2007.

answers, and discussions. Take notes in a discrete way.

c. Deal with the topics one at a time. Begin asking questions by referring to something or someone visible. Ask probing and open-ended questions. In between the probing questions, spend a few minutes for discussion. Ask for concrete information and examples. Ask new or additional questions arising from the answers given. Give an opportunity for the interviewee or key informant to raise her/his questions and discuss these too. Involve other people present during the discussion. Pay attention to group dynamics.

Focus group discussion (FGD)

Focus group discussion is a rapid assessment and semistructured data collection method in which a purposively selected set of participants gather to discuss issues and concerns based on a list of key themes the researcher/facilitator has earlier drawn up. It is a cost-effective technique for eliciting views and opinions of farmers—the clients of prospective innovations. Farmers are the best informants of the problems in their own environment.

Materials: Notebooks and pens, guide questions, flip charts

Steps for logistical arrangements for FGDs

a. Establish initial contact in the community such as a local leader, extension worker, or any key person who can help with the preparations.
b. Conduct a meeting to prepare for the FGDs.
c. Develop the guide questions before going to the village.
d. Make sure the questions focus on important issues.
e. Avoid leading questions and biases.
f. Appoint a facilitator and a rapporteur/recorder.
g. The facilitator must be a good listener who can link and follow the

flow of discussion on issues as they emerge during the discussion.

h. Communicate with contact people in the village 2–3 weeks ahead (timing of visit is important).
i. Arrange transport, date, time, location of FGDs, participants in FGDs, venue (school, public meeting place, etc.), and refreshments; seating arrangements should be semicircular to allow interaction and eye contact.
j. The suggested number of participants is 8–10. Inform the local contact about the group composition:
   - Farmers who are knowledgeable about the topic and representative of the intended target population
   - Rice is the dominant crop
   - Farmers who are knowledgeable about the problem in the community of interest to the project
   - The farmers represent different socioeconomic groups (small, marginal, large families)
   - Farmers (both men and women) who are cooperative, interested to participate, and enthusiastic

Steps in conducting FGDs

a. Greet the farmers according to their custom.
b. Introduce yourself and your team/group members.
c. Explain the purpose and scope of the discussion.
d. Start with the phrase "We want to learn from you."
e. Start to build rapport. Inject a sense of humor.
f. Let the participants introduce themselves.
g. Have a meeting with everyone first and then have separate FGDs with men and women.
h. Ask questions based on the prepared interview guide.
i. Record other important issues or ideas that may not be in the guide but can also be considered relevant and crucial to the objectives of the project. (See Box 2.)

Box 2. Example of a summarized report based on the FGD on male and female farmers' criteria for varietal choice, Lao PDR, 2008.

Men and women have different gender roles and responsibilities within households, in farming, and in society, and these roles affect their decision in selecting qualities of rice varieties. Using graphic illustrations of rice traits, six FGDs were carried out in six villages in Champassak and Khammouane provinces. A total of 45 men and 37 women farmers ranked and rated each rice trait that was identified as valuable to them. A variety with high grain yield is obviously a desirable trait for both men and women. This trait is important to have enough for consumption and a surplus for selling. In order to have a higher yield, male farmers particularly want a variety that can adapt to any soil condition. As mentioned by the farmers, the soil in their fields is generally sandy and often needs fertilizer in order to produce good yield. Having land with poor soil conditions also reflects their desire for a variety with good response to fertilizer. According to both men and women farmers, they prefer a variety that is responsive to even a small amount of fertilizer so that they would not need to apply more fertilizer just to have a good yield.

Men and women farmers also agree that they need varieties that are tolerant of submergence. Women are specifically concerned about the effect of flooding on their livelihood. They mentioned that, if they could plant varieties that could survive after flooding, they could be assured of having a harvest that could secure their family needs. On the other hand, having different land types affects farmers' choice of traits for a variety. Some farmers have rice fields in the upland and their main problem is drought and weeds, so they want varieties that are drought- and weed-resistant. Even farmers with lowland rice agree that it will be more desirable if a variety is both submergence- and drought-resistant because, for some time, their crops are subject to both stresses at different stages of rice growth.

Women have an important role in assessing the postharvest quality of rice. The eating and cooking quality of rice are the main concerns of the women. As reflected from the FGD conducted, this fact remains true in Lao communities.

Source: Tatlonghari et al (2009).

Sample guide questions about farmers' knowledge of rice varieties

- What are the popular varieties grown here?
- Why do you prefer these varieties?
- On which land types do you grow these varieties?
- What are the favorable/unfavorable traits of these varieties?
- What criteria do farmers use in selecting varieties?
- Which varieties grow well under water-short conditions?
- Which varieties can withstand submergence for 12 to 15 days?

Seasonal calendar

Seasonal calendars can be used to determine farmers' constraints (e.g., the time of flood and labor scarcity) and technology needs (Box 3). Once these have been identified, researchers can elicit farmers' opinions regarding the project's proposed cropping sequence and accompanying component technologies (e.g., short-duration varieties, new crop establishment method, improved nutrient management, etc.).

Materials: Local materials such as stones, sticks, etc., that people can use as symbols; manila/drawing paper and markers

Steps:

a. Explain to the community what you want to discuss and analyze.
b. Explain the purpose of the seasonal calendar and how you want to proceed.
c. Draw a 12-month calendar. It is more useful to start the calendar with the beginning of a season rather than the beginning of the year. Thus, the calendar need not start in January; it should reflect the indigenous seasonal categories. Use the farmers' indigenous calendar system.
d. Ask the participants to write or draw on the paper.
e. Let the participants fill in the crop activities (e.g., land preparation, harvesting, etc.) and show the occurrence of submergence and the crop stage it affects (e.g., panicle initiation, preharvest, etc.).
f. Ask the farmers what interventions are needed to solve the constraints.
g. If time is available, other seasonal calendars can be developed. These are for months when cash is limited; months of hungry period (e.g., when food is insecure or when rice is bought); men and women have off-farm and nonfarm employment, and they observe social and religious events, etc.
h. Researchers can show and explain opportunities for overcoming the constraints (e.g., early-maturing stress-tolerant varieties, new cropping sequence, and introduction of improved crop management practices, etc.) based on the results of the PRA conducted.

Types of seasonal calendars

1. Climate—Shows the seasons, rainfall distribution, temperature, and time of occurrence of submergence/flood, drought, and salinity.
2. Rice production—Shows the months and rice production operations conducted in each month. The calendar can begin in the cropping season when land preparation starts. This information can be used in identifying the problem (e.g., in what months submergence/flood occurs) and opportunities for intervention (e.g., a new line or variety that can withstand stress or an early-maturing variety to enable farmers to grow another crop after rice).
3. Cropping pattern—Based on major ecosystems, farmers can indicate the range of planting and harvesting

Box 3. Seasonal calendar of rice production in Photak Village, Pakse District, Champassak Province, Lao PDR, 2007.

Activity \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land preparation	↔				←--→							
Sowing						←--→						↔
Transplanting	↔				←--→							
Irrigation		↔ (Feb–Mar)				Water control when raining a lot ←--→ (Jun–Sep)						
Weeding								←--→				
Fertilizer application	Basal ↔		Top-dressing 1 ↔	Top-dressing 2 ↔	Manure application ↔	Basal ←--→	←--→	←--→				
Harvesting			↔ (Mar–Apr)							←--→		
Threshing				↔							←--→	
Hauling				↔							←--→ (Nov–Dec)	
Flooding period								←--→				

Remarks: Varieties TDK 1, PNG 5, PNG 1, KDML105.
Submergence tolerant 10–15 days, depth 1.5–2 m, flooded 10–15 days.
Solid arrow: irrigated farms, broken arrow: rainfed farms.

dates for cropping sequences according to land types and sources of irrigation. This calendar shows the biophysical constraints (incidence of flood, insect pests, and disease) that affect the cropping sequence. This information can be used to identify potential interventions.
4. Livelihood sources—Shows the months of livelihood activities, e.g., rice–brackish shrimp and rice-fish.
5. Availability of labor—Shows the peak and slack period of male and female family labor and months when other family members migrate or are engaged in off-farm and nonfarm employment.
6. Rice provision ability—Shows the number of months when rice is available and scarce (indicator of food security and insecurity).

Transect walks and direct observation

A transect is a cross-section view of a particular agroecological system, with a written description and analysis of its components. The transect is constructed by walking across the area in question, observing the features and discussing these with local informants, and finding out the constraints to each land type from them.

Materials: Cameras to document the walk, paper, map

Steps:

a. Find local people who are knowledgeable about the area and willing to walk around and analyze the situation together.
b. Assign tasks within the team. As much as possible, team members should be divided and spread in different directions if different agroecological conditions are present in the area. If the agroecological conditions are the same, the team should assign members to the other nearby target villages identified as research sites.
c. Walk the transect starting from a vantage point. Observe, ask, listen, and analyze together.
d. Using the base community sketch map obtained during the earlier village visit, ask the farmers to identify land types, resources, the crops/cropping pattern in each land type, varieties used per land type, hydrology, social clustering, etc. It would be easier for farmers to explain the constraints to productivity by showing the sketch map. Encourage farmers to discuss problems and opportunities.
e. Note contrasts and changes and identify zones.
f. Make a transect diagram. Researchers should prepare the transect diagram.
g. The transect diagram should include the different enterprises according to land types, including homestead, problems, and opportunities.

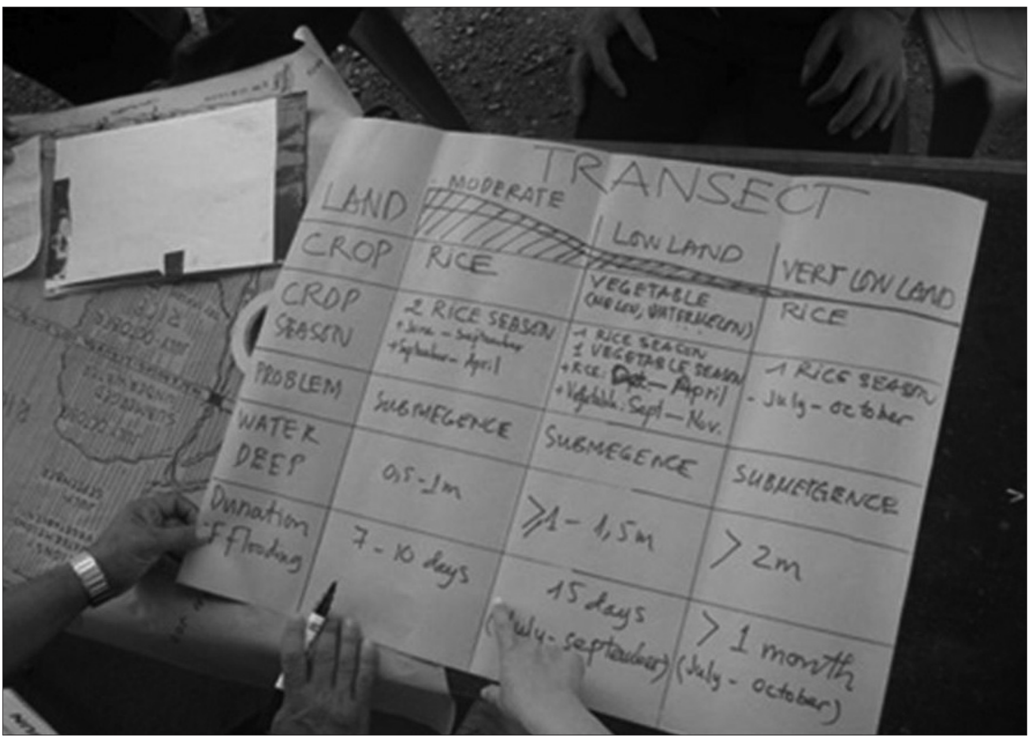
Resource mapping

Mapping is a visual process in which people are given the chance to relate physical and/or social information in a simple and easily understood format. It is a technique that helps to learn about the physical situation of the village land. Maps allow communities to analyze linkages, patterns, and interrelationships of resources and land use, etc.

Materials: Pens and papers

Steps:

a. Provide the participants with base maps (which contain an outline of the village) or let them draw. Ask them to fill in the details. It helps if you let them begin with permanent structures and landmarks such as roads, buildings, rivers, etc.



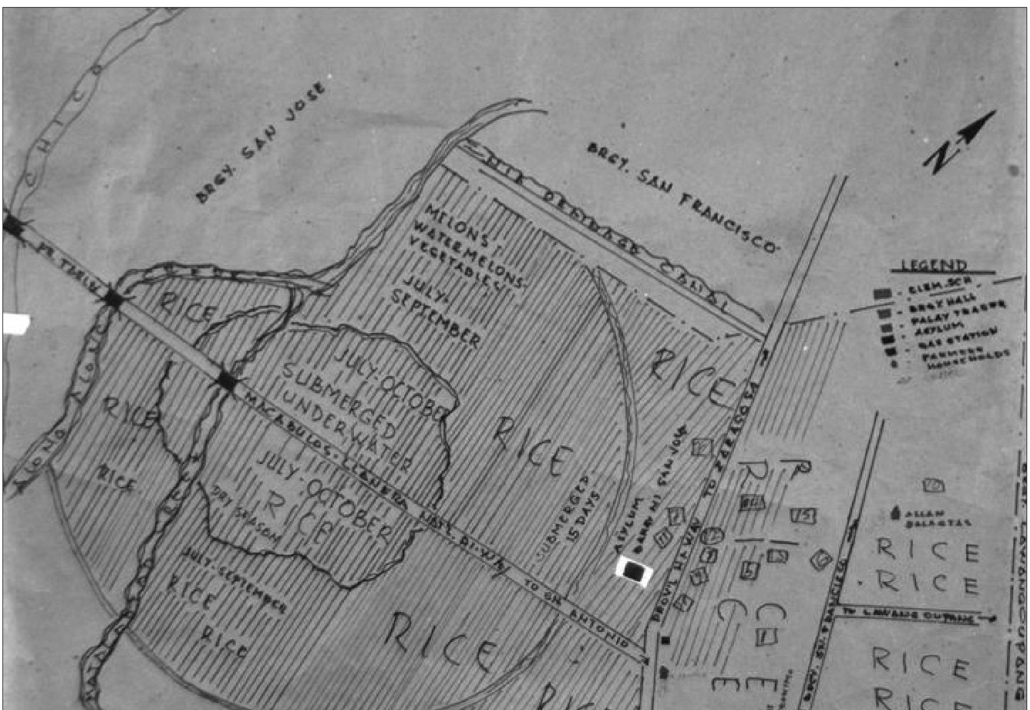
Transect walk at the IRRI-Japan Submergence Project site, Brgy. Papaya, Nueva Ecija, April 2008.

b. If using symbols, draw a legend at the bottom of the map. People can also draw maps on the ground, floor, or paper. Use symbols from locally available materials (i.e., nuts, leaves, pebbles/stones).
c. Ask the community members whether they already have a map. Use the map as a tool for discussion, that is, go through the map, ask for details, etc.
d. Ask which areas are affected by the stress (submergence or floods) and relate these areas to the social maps (showing the socioeconomic status of the population).

Semistructured interview

This is a simple process of talking with individuals (men and women), families, or groups to discuss a specific topic in an informal setting, in which all present are encouraged to offer ideas and opinions (Box 4). In semistructured interviews, the information that needs to be collected is predetermined by the team, but only an interview "guide" is developed and not a complete questionnaire. In this interview, the information (what is said, by whom, how, in what setting, with what observations) should be recorded. The findings with community members should be shared to challenge the interpretations made by the researcher.

Materials: Notebooks and pens



Resource map of Brgy. Papaya, Nueva Ecija, April 2008.

Box 4. Example of a report based on a semistructured interview on gender division of labor in rice production in Lao PDR, 2008.

Rice production and processing activities among poor farming households depend entirely on the availability of male and female family labor. While husbands dominate in land preparation and the application of fertilizer and other chemicals, wives provide more labor than husbands in raising seedlings, pulling seedlings, transplanting, harvesting, and postharvest activities. Removing off-types, selecting seeds for the next season, storing seeds, selling a surplus in the market, and preparing rice for food and other products are tasks dominated by wives. They are mainly the custodians of household cash; thus, they bear the burden of making decisions on how to allocate the limited cash for farm, household, and other needs of the family.

This information is useful for gender roles and responsibilities that influence the selection criteria for varietal adoption.

Gender division of labor in Champassak and Khammouane provinces, Lao PDR, 2008.

Rice farming activities	Champassak				Khammouane		All	
	Pakse		Sanasomboun		Xebangfai			
	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife
Land preparation	96	4	92	8	85	15	89	11
Raising seedlings	40	60	38	62	46	54	43	57
Pulling seedlings	24	76	30	70	28	72	28	72
Transplanting	45	55	47	53	47	53	46	54
Manual weeding	47	53	56	44	54	46	52	48
Application of FYM	70	30	68	32	81	19	76	24
Application of chemicals	63	37	69	31	79	21	71	29
Harvesting	49	51	48	52	49	51	49	51
Manual threshing	58	42	48	52	53	47	53	47
Drying	48	52	46	54	49	51	48	52
Removing off-types	29	71	32	68	30	70	30	70
Storing seeds	45	55	42	58	43	57	43	57
Seed selection	31	69	17	83	30	70	27	73
Marketing	16	84	46	54	39	61	36	64
Custodian of household cash	10	90	9	91	9	91	9	91
Food preparation	0	100	6	94	10	90	7	93

Source: Tatlonghari et al (2009).

What to do.

a. Before the interview, develop the interview guide (e.g., paste it on the back cover of a notebook so it is accessible when needed during the actual interview).

b. In the community, carefully explain who you are and the reason for the interview.

Note: This can be used for conducting gender analysis and understanding gender relations in a farming community. Gender analysis includes questions on what are the major productive, reproductive, and community-related activities that women and men are responsible for before the project. It includes questions such as who often does crop-specific tasks and operations, livestock management, and off-farm, nonfarm, and household maintenance activities that compete for or complement child care and household responsibilities.

Who (husband or wife or both) makes decisions is important in understanding the adoption and nonadoption of new varieties. For example, if both the husband and wife make joint decisions on what rice varieties to grow, then it is important to ask the wife the reasons for deciding whether to adopt or reject a specific variety. The wife may reject a new variety that is difficult to thresh or has poor storage quality or if it requires a longer time to cook.

Problem analysis chart

The different problems are presented and discussed with the community as a whole, showing where different people's constraints overlap and where they differ (Box 5). The problem analysis chart also looks at opportunities for development. It is important that a multidisciplinary team of experts from research and extension institutions be present. Problem analysis and ranking will involve two separate groups: one of women and another of men. Examples of questions are: What are the technical constraints to increasing rice productivity faced by women farmers? By men farmers?

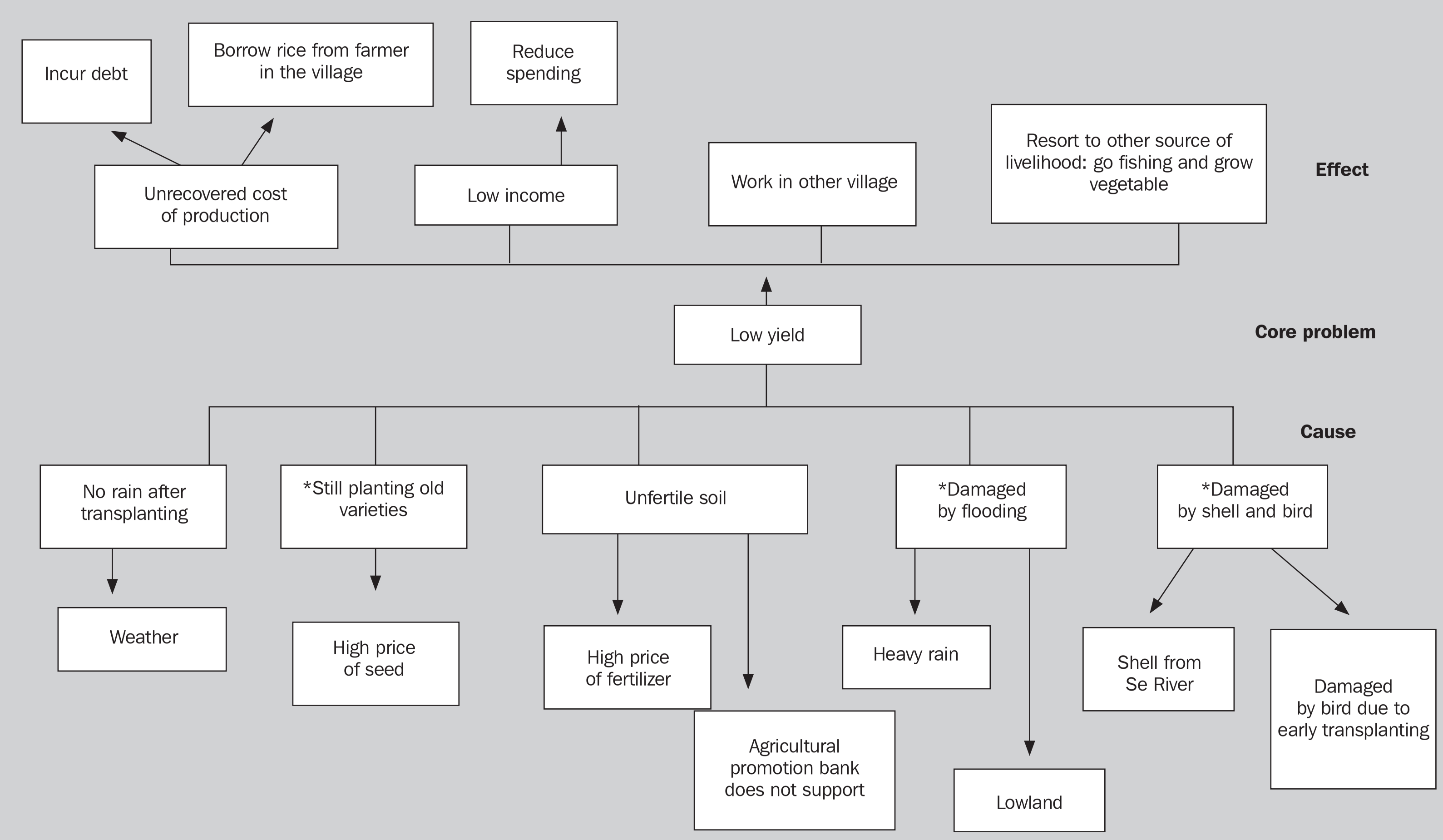
Problem analysis starts with the identification of a major problem, after which a core problem is defined. The causality (cause-effect relationships) of a complex problem environment is investigated and presented. This process facilitates not only the analysis of symptoms or superficial phenomena but also the probing of the problem to its root cause.

Materials: Flip chart paper, markers, or large-point felt-tipped pens (various colors)

What to do:

a. Identify "major problems" existing within the stated problem situation (brainstorming). Each member of the planning team first writes down just one problem that he/she deems to be the core problem. Major problems are those that affect the target population in an extensive way.
b. Write up a short statement of the "core problem." Then, a brief substantiation is given for each proposed core problem. Afterward, the team agrees on the core persons, groups, and institutions involved. If a consensus cannot be reached, make use of decision-making techniques; select the best decision by awarding points or deciding temporarily on one or several core problems. Continue work but return to discuss the core problem. An example of a problem is "low rice yields in low-lying areas."
c. Write the "cause" of the core problem. Direct causes are placed parallel to each other under the core problem. Examples of causes of the problem "low rice yields in low-lying areas" are "lack of improved rice varieties that can recover from submergence, lack of access to improved quality seeds of varieties that can survive submergence stress, etc."
d. Write the "effects" of the core problem. The substantial and corresponding effects of the core problem are placed parallel to each other above the core problem. Examples of effects of the core problem are low cropping intensity, low marketable surplus, low income, etc.
e. Make a diagram showing the "cause" and "effect" relationships in the form of a problem tree. The problem tree offers the opportunity to go beyond a single cause and present complex interrelationships represented by

Box 5. Problem analysis in Photak Village, Khammoaune Province, Lao PDR, 2008.



diagrams (arrows). The cause-effect relationships of a problem can be illustrated differently, depending on the cultural view under which they are considered. If possible, on a separate sheet of paper, provide a more detailed description of the problem. This will help in the identification of indicators in future steps.

f. Review the diagram as a whole and verify its validity and completeness. Once the planning team feels that the necessary information has been used to build a problem tree (a causal network explaining the main cause-effect relationships characterizing the problem situation), the problem analysis can be concluded.
g. Identify and prioritize the causes of the problems that can be addressed and identify research opportunities or interventions. For example, the use of old varieties and crop damage by submergence/flooding can be addressed by testing new lines/ varieties that can recover from submergence and floods.

Trend lines

Trend lines visualize significant changes in key issues in the community over time. Topics for trend lines often reflect themes that people consider important, for example, the number of times flooding/submergence occurred in the last 10 years.

Materials: Materials people can use as symbols and feel comfortable with, Manila paper, and markers (especially where the people are illiterate)

What to do:

a. Explain the purpose of the exercise.
b. The team and the community decide on a list of topics of interest for the trends.
c. Groups of villagers are organized according to gender, socioeconomic status, age, etc., depending on the topics selected and community composition.
d. Explain the concept of trends using a simple graph. Explain how time (in years) moves from left to right along the bottom axis, and the importance of the stress problem, e.g., drought, floods, and soil erosion, in rice production; the topic increases/ decreases on the vertical axis.
e. Ask the groups to draw their lines on the ground or on the floor.
f. Quantification is not always easy. Ask questions if necessary, for example, when were the most, the least?
g. Use the discussion of trends to probe for explanations of the changes. This will help identify underlying problems and traditional activities to correct the situation. For instance, if flooding is getting worse, ask why and find out what measures have been tried in the past and how well they have worked. Ask what participants think might ease the situation.
h. Copy the trends and the explanations onto paper.

Trend lines can also be used in identifying changing trends, for example, climatic changes (years when drought or flooding occurred, increasing or decreasing the area cultivated to rice and other crops, perceptions on whether economic status has improved or deteriorated, etc.), increasing male outmigration, increasing labor participation of female family members in field activities, etc.

Venn diagramming

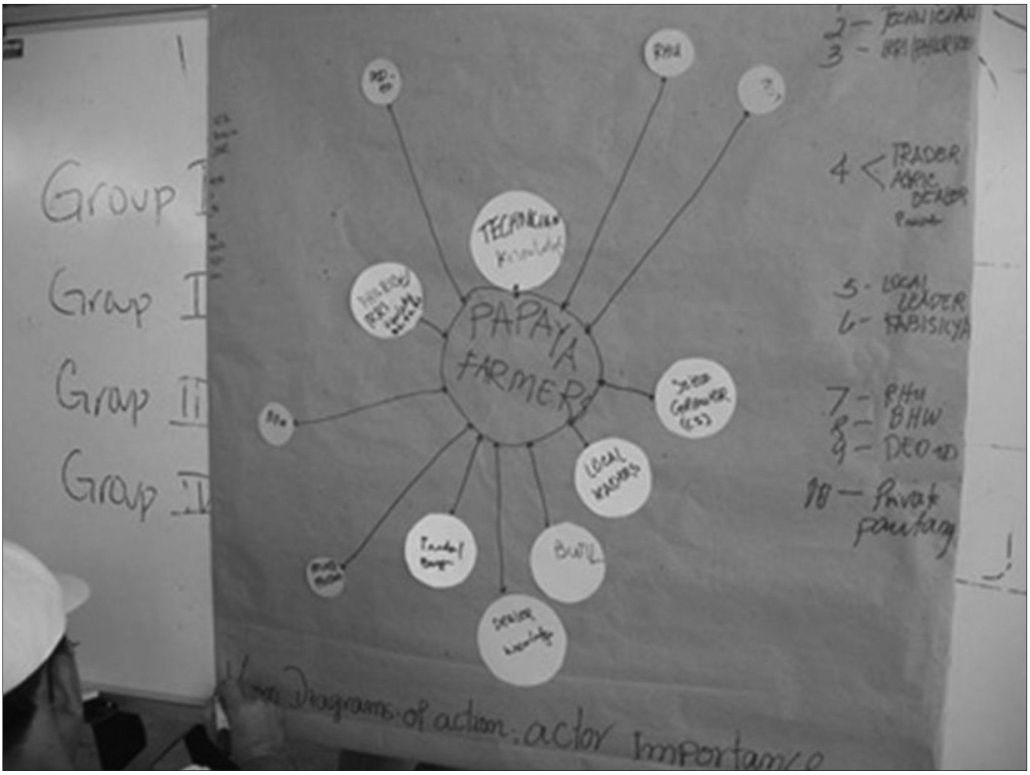
Venn diagramming is a process of listing, ranking, and connecting institutions, groups, or individuals to communication systems and information sources that influence

the community's decision making in development. This tool is also useful in identifying men's and women's access to productive resources and services. For example, because of social exclusion, women often receive or disseminate information through informal social networks. Social networks can also be of the same class. Understanding the sources of information and institutions can help in identifying effective strategies in scaling out technologies and also in identifying potential key agents of change, for example, men and women local leaders.

Materials: Cards and pens

What to do:

a. Cut out different-sized cards (circles) to represent each institution or individual.
b. Explain the objectives of the exercise to all partners.
c. Divide the groups according to gender because men and women usually have different perceptions about the importance of institutions.
d. Ask each group to list the different institutions in the village.
e. Ask about the different roles of the institutions.
f. Ask whether some institutions are more important than others with regard to their role in development and decision making, etc.
g. Find out the most important institution.
h. Write the name of the institution on the largest circle.
i. Ask the community to rank other institutions according to whether they are large, medium, or small.
j. When ranking, put the biggest circle in the center.
k. Ask which institutions are linked to it and, consequently, which ones are linked to others.



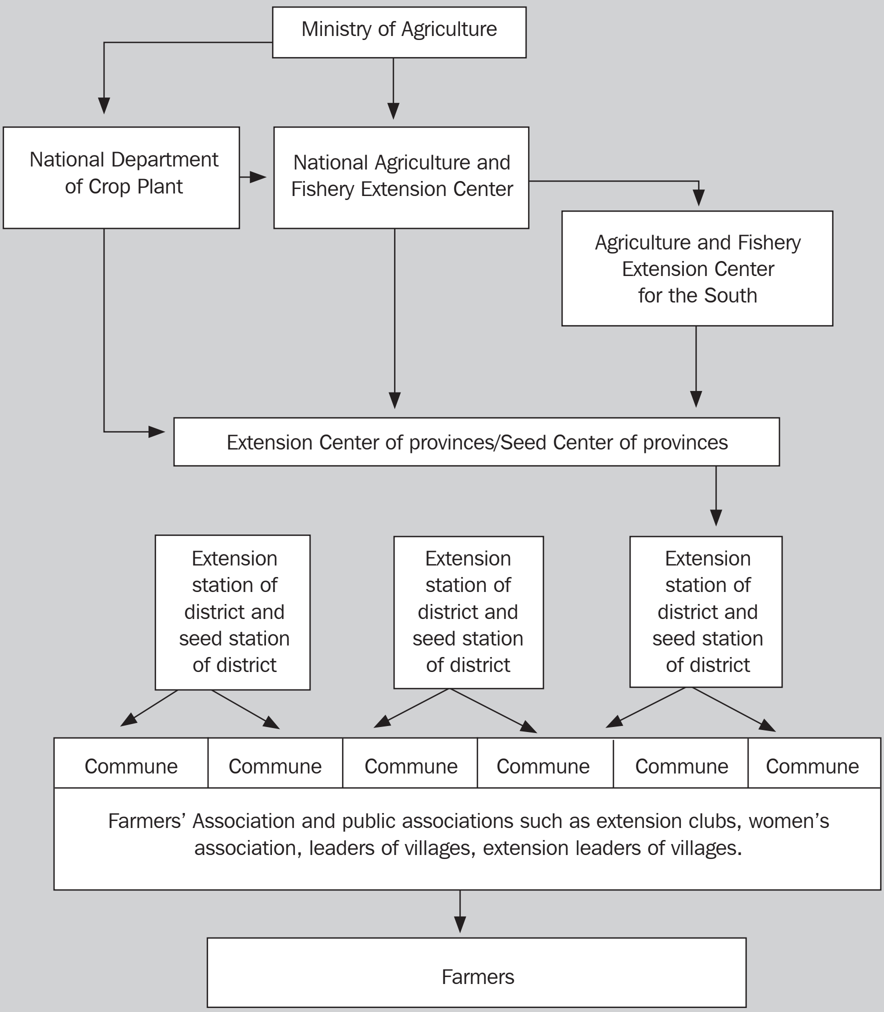
l. Explain that linking means institutions should work together.
m. Linking is symbolized by touching and a degree of overlapping.
n. Touching means that institutions are sharing information.
o. A small overlap means that there is some cooperation.
p. An isolated circle shows an institution that does not have any contact with the others.
q. Allow for debate to take place and note reasons for different trends.
r. Ask participants what the diagram means to them. What would the picture look like in an ideal situation?
s. Write what can be done to achieve ideal relationships.

This tool can also be used in identifying social networks or sources of information, dissemination of new seeds, marketing channels, etc.

The network includes the connection among research institutes, universities, provincial departments of agriculture, provincial extension centers, and provincial seed centers in transferring new technologies to farmers (Box 6). The activities of the network comprise collaboration in technology development and transfer to farmers.

Box 6. Example of the networking and national seed distribution system in Vietnam.

Technologies are transferred to farmers through the formal system from the state level to regional level or to provincial level first. After that, the provinces direct the districts and the districts direct the communes. From the communes, the technologies are disseminated to farmers through the Farmers' Association and to public associations such as extension clubs, women's associations, leaders of villages, and extension leaders of villages. However, in some cases, the technologies can be disseminated through informal systems such as oral transmission among farmers and exchange or giving of materials such as seeds and other inputs.



Source: Chi et al (2009).

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Module 4

Stage 2: Evaluation of new rice lines in a researcher-managed trial

Module objectives

This module aims to provide information on how to conduct researcher-managed trials and analyze the agronomic and socioeconomic data that will be collected from these trials.

- Describe the layout and design in researcher-managed trials
- Provide guidelines on how to collect agronomic and socioeconomic data
- Show the step-by-step procedure on how to conduct preferential analysis and sensory evaluation

A researcher-managed trial is similar to a research station trial except that it can also be conducted in farmers' fields. This trial is also called a mother trial. It evaluates in detail the adaptability of different rice varieties following farmers' management practices that are specific to the locality. It determines more precisely the type of responses to input levels and it evaluates a high-risk treatment, for which little information is available. This results in an increased number of variables and levels included in the treatments and requires a generally larger plot. The trials are replicated within a farmer's field or over fields at different sites and are essentially managed by researchers. The following are the steps.

1. Selection of treatments

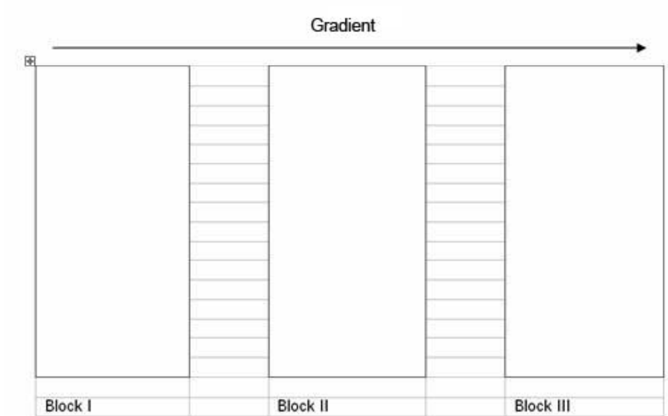
In the IRRI-Japan Submergence Project, varieties include elite lines with the *SUB1* gene plus other varieties. A check variety and local varieties should be included. Entries should be grouped according to maturity and plant height. In this experiment, a total of 16 entries can be included depending on the availability of seeds (Attachment 1).

2. Experimental design

For single-factor experiments, the randomized complete block design (RCBD) is used and, in the case of factorial experiments, the design could be a split plot or factorial in RCBD. Since variety is the only component to be evaluated, the single-factor experiment in RCBD will be followed (Steps 1 to 3).

The three principles of experimental design should be observed. These are replication, randomization, and local control. Replication is usually done to provide an estimate of the experimental error and increase the precision of estimates, and the scope of the experiment. On the other hand, randomization is performed to give each treatment an equal chance of being assigned to any experimental unit while error control/local control is a set of techniques or processes that are used to minimize experimental error for more homogeneous treatments. Randomization in RCBD is applied separately and independently to each of the blocks.

Step 1. Divide the experimental area into three blocks, carefully noting the variability pattern.



Step 2. Subdivide each block into the number of treatments, in this case, 16.

Block I	Block II	Block III

Step 3. Randomly assign each variety to each block.

1	3	16
2	6	15
3	9	14
4	12	13
5	15	12
6	1	11
7	4	10
8	2	9
9	5	8
10	7	7
11	10	6
12	13	5
13	14	4
14	8	3
15	11	2
16	16	1
Block I	Block II	Block III

3. Plot size and plant spacing

The plot size is 4 meters wide by 6 meters long (4 m × 6 m), a total of 24 m^2. The plant spacing is 20 cm × 20 cm. A 4-meter-wide plot will give 20 rows of rice plants (Fig. 1).

4. Field layout

Levees between treatments and replications are not necessary. However, the whole experimental area should be enclosed by levees to prevent contamination from adjacent area.

5. Field operations

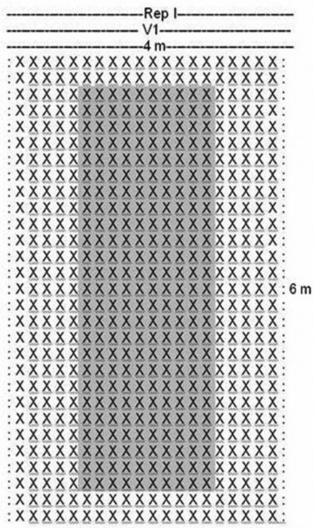
Cultural practices to be used are the same as those employed in the farmers' crop management system.

6. Data collection

a. Agronomic data

All data will be taken from 10 inner rows, leaving 50 cm at both ends per plot (or two hills) as border. Data will be entered in Attachment 2A. The dates of the following operations and growth stages should be recorded, such as (a) soaking, (b) seeding,

Calculating the sample area:
Sample area is calculated as follows:
Sample area = no. of rows harvested × distance between rows (m) × length of sample rows (m)



Example:

If the number of rows to be harvested is 10, the distance between rows is 20 cm, and the length of the sample row is 5 m, the area of the crop cut is 10 rows × 0.20 m × 5 m = 10 m^2 (Fig. 1).

Yield computations:

Grain yield per hectare (kg at 14% MC)

$$\text{Grain yield (kg/ha)} = \frac{\text{ave. grain yield/crop-cut (g)} \times 10}{\text{area/crop-cut m}^2} \times \frac{100 - \text{MC}}{86}$$

Fodder or biomass yield: fresh weight of rice straw threshed right ater harvest

$$\text{Fodder yield (kg/ha)} = \frac{\text{ave. fodder yield/plot in kg} \times 10}{\text{area/crop-cut m}^2}$$

Fig. 1. The shaded portion is the sample area (10 rows × 0.20 cm × 5 m long).

(c) transplanting, (d) 50% flowering, (e) 80% maturity, and (f) harvesting.

b. Information about trial conditions and problems

It is also important to collect some data about the conditions under which the trial was conducted. Information about location, georeference, soil conditions, topography, and pest and disease outbreaks can be useful in interpreting the results of the trial. (See Attachment 2B.)

c. Preference data

Preference data can be gathered using preference analysis (PA). A group of farmers is allowed to “vote” for their preferred varieties during a field day by depositing paper ballots in a bag or envelope in front of the plot. After votes are tallied, the farmers are asked to discuss why they preferred the varieties that received the most votes. Preference analysis generates two kinds of data: (a) a quantitative preference score for each variety expressed as the number of votes it received divided by the total number of votes cast, and (b) a list of characteristics that farmers like about the preferred varieties.

The following are some logistical preparations in conducting preference analysis:

1. Communicate with the village leader, extension workers, and farmer-cooperators for an RM-PVS in the village 2 to 3 weeks ahead to set the time and date of the activity. The PA should be conducted preferably during the preharvest period when most of the varieties are 80% mature.
2. Include an arrangement for a venue for small group discussions involving potential participants in the PA. Inform the local contact about the group composition, which may be as follows, but is not limited to

- Potential male and female farmer-cooperators for PVS (at least 30% of the participants should be female).
- Other stakeholders such as breeders, extension workers, and traders.

3. Make everything clear and clean for the RM-PVS trial before conducting the PA. Make sure that dikes are easy to walk through so that farmers can go around the trial plots.
4. Put a stake in front of the layout of each variety or in any part of the layout where farmers can easily see the labels. The variety names should not be revealed and the plots can be labeled using the researchers' own coding system.
5. Prepare all the materials needed for the PA such as stakes, envelopes or bags, ballots, pens, and flip charts.
   - The number of stakes and envelopes should be according to the number of varieties being tested.
   - Researchers should prepare the total number of ballots according to the number of participants as follows:
     i. (✓) ballots and (✕) ballots in three colors
     ii. (✓) ballots are for varieties they prefer and (✕) ballots are for varieties they dislike
     iii. A different color of ballots should be given to male and female farmer-participants and another color of ballots for breeders/researchers
     iv. Each participant will be given two (✓) ballots and two (✕) ballots
   - Prepare the tally sheets on a flip chart like the sample form in Attachment 3.

Steps in conducting the PA:

1. Invite a group of farmers who are going to participate in farmer-managed PVS (FM-PVS) trials to visit the RM-PVS (mother trial). At least 30% of the participants in the FM-PVS should be women who are actively engaged in farming. These farmers should be representative of the main ethnic and social groups in the community.
2. Explain to the farmers the purpose of the visit.
3. Place a stake with a bag or envelope attached to it in front of each plot in the trial. If the trial is replicated, this should be done only for the best replicate. The container will serve as the ballot box for the variety.
4. Give each farmer two (✓) ballots for best variety and two (✕) ballots for worst variety.
5. Allow the farmers to walk through the trial and present the layout to them. The researchers should let the farmers observe and familiarize themselves with the varieties planted.
6. Allow the farmers to go through the trial freely to vote for the best and worst varieties. They will be asked to vote for (a) a variety they would like to grow on their own farm and (b) a variety they dislike by placing a ballot in the envelope in front of their selected varieties.

7. Votes will be counted by the researchers and farmers and reported to the group of visiting farmers.
8. After the votes have been counted, the whole group will proceed to observe the two varieties that received the highest number of votes. The farmers will be requested to explain why they like the selected varieties.
9. The whole group will then visit one or two of the varieties that received the least number of votes and the farmers will be requested to explain the negative traits of these varieties.
10. Generate a preference score (PS) for each variety by computing the number of positive votes cast minus the negative votes cast divided by the total number of votes that were cast by the farmers.
11. Analyze the data as follows:

The preference score (PS) for each variety is calculated as follows:

$$PS = \frac{\text{Number of positive votes} - \text{negative votes}}{\text{Total number of positive and negative votes}}$$

For example, if 20 farmers are each given 2 positive ballots and 2 negative ballots, the total number of ballots cast is (20 × 4) = 80. If a variety receives 14 positive ballots and 4 negative ballots, the index is calculated as:

$$PS = (14 - 4)/80$$
$$= 10/80$$
$$= 0.125$$

The researcher should summarize the results of the analysis using the sample form in Attachment 3. This will show the farmers' preference at pre-harvest stage and the explanations why the group liked or disliked the varieties.

d. Sensory evaluation

Sensory evaluation is a useful tool for evaluating the cooking and eating qualities of the top three preferred submergence-tolerant varieties selected from the preference analysis and the farmers' local variety tested in the researcher-managed trial. The evaluation is recommended to be conducted one month after harvest. By doing this evaluation exercise, researchers can identify and understand farmers' preferences and the acceptability of the rice genotypes based on their cooked rice qualities.

Preparation for conducting the sensory evaluation:

A. Logistical preparation at the station:

1. *Coordinate with the NARES home economics division.* Researchers should coordinate with their respective agency's home economics division or any other partner institutions to check the availability of facilities and tools needed for the sensory evaluation. A checklist is provided in this module (Attachment 4). Otherwise, if equipment and tools are unavailable, the agency can purchase the materials if they are deemed necessary.
2. *Conduct a preliminary cooking activity at the station.* With the help of personnel from the home economics division, researchers should conduct a cooking trial to determine the optimum amount of water for cooking the different samples.
3. *Prepare trays and containers with the samples.* Make sure that samples will be presented in as similar a setup as possible. Translucent containers or plastic cups of uniform color and size can serve as containers. These should be arranged in service trays according to the experimental

design. Each sample should be covered with an aluminum cover and each tray should be provided with a teaspoon and a glass of drinking water.

4. *Assign a code to each sample container.* Put a 3-digit random number (Attachment 5) on each sample container to minimize expectation error, as farmers may expect that a sample coded A will be "better" than a sample coded D. Researchers can rely on random number tables found in statistical books or manually generate random numbers by random sampling.
5. *Prepare an individual sensory evaluation form*. This should contain the name, date, time, panel number, and code numbers of each sample to be evaluated. The preference and acceptability scores for each sample are written down on the evaluation form. The reasons for selecting the most-preferred sample based on characteristics such as aroma, flavor, tenderness, cohesiveness, color, and gloss will be noted. Farmers can also state their personal opinion on their description of good cooked rice. A sample form is presented in Attachment 6 of this module.

B. Logistical preparation at the village:
1. *Coordinate with the farmer-leaders*. Prearrange with farmer-leaders the time and place where cooking and evaluation will be conducted. If the research station is near the on-farm trial, researchers may opt to cook the rice before going to the field to shorten the evaluation session.
2. *Select groups of men and women farmers.* Form two groups of farmers who are potential participants of farmer-managed trials. The first group will be the first set of evaluators in the morning session and the second group will have their evaluation in the afternoon. In each group, more than 30% of the evaluators should be women since they are more involved in preparing rice for food and other products.
3. *Ask the women farmers to cook the rice samples*. Ask selected women farmers to cook the rice samples according to their current practices. Provide them with one kilo of each rice variety and the cooking materials they need. Researchers should assist the farmers in cooking to make sure that the same amount of water and cooking procedures are applied for all varieties to be tested. Cooking can be done in two sets if materials are limited.
4. *Ask the participating farmers for a socioeconomic profile*. Get background information on each participating farmer such as name, sex, age, and other socioeconomic background that the researchers think might influence their evaluation.

Steps in conducting the sensory evaluation:
1. Gather the group of men and women farmers and give instructions on how to conduct the evaluation.
2. Give each farmer a spoon and a bottle of water.
3. Ask them to line up one by one to smell and taste each sample of cooked rice.
4. Farmers should drink water or rinse their mouth after tasting each sample. This is to avoid any residual taste or rice sample left in the mouth before tasting the next sample.
5. Each farmer should be assisted by a researcher to record their evaluation on the individual sensory evaluation form (Attachment 6).

6. Ask the farmers to evaluate each sample for its acceptability and ranking. Acceptability is indicated by a yes or no response, where yes means acceptable and no means unacceptable. To determine farmers' preference, ask the participating farmers to rank their preferences from 1 to 4, where 1 is the best and 4 is the least-preferred rice sample. Also, farmers can be asked to give their reasons for selecting the sample ranked number one.
7. After the farmers finish with the evaluation, researchers can then collect and review the forms for any unanswered questions or inconsistencies in the answers.
8. The researchers should make a summary table to show some of the initial results (e.g., the variety that got the highest score) of the sensory evaluation (Attachment 7).
9. The results should be presented to the farmers for comments and validation.

7. Data analysis

a. Agronomic data

The data to be collected should be reviewed and verified before analysis. Analysis of variance (ANOVA) enables researchers to detect whether significant differences among treatments exist. Since variety is the only component being evaluated, a single-factor experiment in an RCBD with three replications will be followed. Group the data by variety and replication and calculate the mean (Attachment 8, Table 1), then prepare the ANOVA table (Attachment 8, Table 2). Perform the appropriate statistical computations.

To further analyze the performance of the varieties across sites, another ANOVA can be performed in which sites are now considered as replicates. This is based on the basic criterion that all sites selected have the same flash-flood stress environment. However, before conducting the test, make sure that the data collected have the same varieties for all sites and that the test of homogeneity of error variance has been done. Researchers can use some common tests for homogeneity such as Bartlett's test or an approximate F-test (highest mean square/lowest mean square), where the F value should be less than 3 to assume a homogeneous variance.

b. Preference data

At a single site, descriptive statistics will be used simply to show which among the varieties are the most and least preferred by farmers. Because the manner of data collection gives participating farmers two chances to vote for the best and worst varieties, a set of data is considered as a dependent sample. In this case, no statistical test will be performed.

To test the agreement of preferences between male and female farmers and between breeders and farmers, Pearson's correlation can be used. This can also be used to test the agreement of farmers' preferences with the varieties' average yield. By doing such an analysis, researchers can learn whether farmers' preferences are a good predictor of high-performing varieties and whether yield is the major consideration of farmers in selecting a variety. Details of the statistical analysis are in Attachment 9.

c. Sensory evaluation

A frequency table can be used to analyze the distribution of preferences among samples. Based on the acceptability response, the researchers can generate the following frequency table:

Variety	Acceptable	Not acceptable	Total
Variety 1			
Variety 2			
Variety 3			
Local variety			
Total			

To determine whether there is a significant difference in farmers' preferences among varieties, a chi-square test can be used. Researchers will then consider the number of times a particular variety ranked 1, 2, 3, and 4. An example of tabulation is as follows:

Variety	Rank 1	Rank 2	Rank 3	Rank 4
Variety 1				
Variety 2				
Variety 3				
Local variety				
Total				

However, a chi-square test can only indicate that the preferences of the farmers based on ranking are different from each other. Moreover, it can predict the probability of adopting the varieties based on their acceptability. Binary logistic regression can be generated.

Create three dummy binary variables for a variety, which will be the independent variables of the binary logistic regression:

T1 = 1 if variety = V1, T1 = 0 if otherwise.
T2 = 1 if variety = V2, T2 = 0 if otherwise.
T3 = 1 if variety= V3, T3 = 0 if otherwise.

The response variable will be the acceptability:

Y = 1 if the variety is acceptable,
Y = 0 if otherwise.

By employing binary logistic regression using available statistical software such as CropStat, expected probabilities can be computed. Based on the result, the researcher can conclude which among the varieties are likely to be adopted in the future based on taste acceptability. Data are coded as

Variety	T1	T2	T3
V1	1	0	0
V2	0	1	0
V3	0	0	1
Control	0	0	0

Finally, a simple frequency table can be used to describe the traits being considered by the farmers in selecting the best rice sample. This result is also important for the researchers to be able to determine which varieties, according to some specific traits, are preferred by the farmers.

Further readings

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Lowry R. 1999-2010. One-way analysis of variance for independent samples. Part 2. Available at http://faculty.vassar.edu/lowry/ch14pt2.html.

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Attachments

Attachment 1. Six mega-varieties with the *SUB1* gene and lines that are tolerant of submergence.

Table 1. Entries for RM-PVS.

No.	Entry	Code number
1	Swarna-Sub1 (BC_2F_3)	IR05F101
2	Swarna-Sub1 (BC_3F_3)	IR05F102
3	IR64-Sub1 (BC_2F_3)	IR07F102
4	IR64-Sub1 (BC_3F_3)	IR07F286
5	Samba Mahsuri-Sub1 (BC_2F_3)	IR07F101
6	Samba Mahsuri-Sub1 (BC_3F_3)	IR07F287
7	TDK1-Sub1	IR07F289
8	CR1009-Sub1	IR07F291
9	BR11-Sub1	IR07F290
10	IR66876-11-NDR-1-1-1-1	
11	IR57514-PMI-5-B-1-2	
12	IR49830-7-1-2-3	
13	IR82355-5-2-3	
14	IR82355-5-1-3	
15	PSBRc68	
16	Local variety 1	

Attachment 2A. Data sheet form.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Rep. no.	Block no.	Plot no.	Entry	Date of soaking	Date of seeding	Date of trans-planting	Date of direct seeding	Date at 50% flowering	Date at 80% maturity	Date of harvest	Insect pest			Diseases		
											Stem borer		Brown plant-hopper	Leaf blast	Leaf blight	Rice tungro
											Dead-hearts	White-heads				

Attachment 2A. Data sheet form (cont.)

1	2	3	4	18	19	20	21	22	23	24	25	26	27	28
Rep. no.	Block no.	Plot no.	Entry	% survival in flooded conditions	% survival in normal conditions	Number of tillers at maturity	Number of panicles at maturity	Lodging (%)	Fertile grain (%)	Plant height (cm)	Fresh weight of fodder (kg)	Grain weight (kg/crop-cut)	Moisture content (%)	Grain yield (kg/ha)

Example of calculating crop-cut size: number of rows harvested × distance between rows × length of rows harvested. If number of rows harvested is 10 (from 2 m width), distance between rows is 20 cm, and length of rows is 4 m, crop-cut size = 10 rows × 0.20 m × 4 m = 8 m^2.

Attachment 2B. Standardized procedure for data gathering in researcher-managed participatory varietal selection (RM-PVS).

Parameter	Description
1. Date of soaking	The date when seeds are soaked in water for 24 hours.
2. Date of seeding	The date of seeding in beds (either wet bed or dry bed).
3. Date transplanted	The date of transplanting seedlings.
4. Date of direct transplanting	The date when seeds are directly seeded, in case seeding is not a common practice in the area.
5. Date of 50% flowering	The date when 50% of the rice plants flower. A subsample plot should be established to monitor the date of flowering, say, a 1 m × 1 m subsample plot.
6. Date of 80% maturity	The date when 80% of the rice plants reach maturity. A subsample plot should be established to monitor the date of maturity, say, a 1 m × 1 m subsample plot.
7. Date of harvest	The date when the rice crop will be harvested.
8. Stem borer	Stem borer damage at growth stages 3–5 (deadhearts) and growth stages 8–9 (whiteheads). The scale of deadhearts is 0 = no damage; 1 = 1–10%; 3 = 11–20%; 5 = 21–30%; 7 = 31–60%; 9 = 61% and above.
9. Brown planthopper	For field screening, a minimum of the following density on a susceptible check is necessary: (a) 10 hoppers/hill at 10–15 days after transplanting; (b) 25 hoppers/hill at maximum tillering; (c) 100 hoppers/hill at early booting stage. A scale of 0–9 is used: 0 = no damage; 1 = slight yellowing of a few plants; 3 = leaves partially yellow but with no hopperburn; 5 = leaves with pronounced yellowing and some stunting or wilting and 10–25% of plants with hopperburn, remaining plants severely stunted; 7 = more than half of the plants wilting have hopperburn, remaining plants severely stunted; 9 = all plants dead.
10. Leaf blast	At growth stages 2–3. The scale of predominant lesion types is 0 = no lesions observed; 1 = small brown specks of pinpoint size or larger brown specks without sporulating center; 3 = small, roundish, to slightly elongated necrotic sporulating spots, about 1–2 mm in diameter with a distinct grown margin or yellow halo; 5 = narrow or slightly elliptical lesions, 1–2 mm in breadth, more than 3 mm long with a brown margin; 7 = broad spindle-shaped lesion with yellow, brown, or purple margin; 9 = rapidly coalescing small, whitish, grayish, or bluish lesions without distinct margins. Note: Lesion types 5, 7, and 9 are considered typical susceptible lesions.
11. Bacterial leaf blight	At growth stages 5–8. Scale of lesions: 1 = 1–5%; 3 = 6–12%; 5 = 13–25%; 7 = 26–50%; 9 = 51–100%.
12. Rice tungro disease	At growth stages 3–5. Scale: 1 = no symptom observed; 3 = 1–10% height reduction, no distinct yellow to yellow-orange leaf discoloration; 5 = 11–30% height reduction, no distinct yellow to orange leaf discoloration; 7 = 31–50% height reduction, with distinct yellow to yellow-orange leaf discoloration; 9 = more than 50% height reduction, with distinct yellow to yellow-orange leaf discoloration.
13. Percent fertile grain	Get five plants from the inner 7th row and get the main panicle per plant. Count the number of fertile grains and divide by total number of grains per main panicle per plant. Take the average of 5 plants.
14. Plant height (cm)	Taken from 10 plants selected at random. Use actual measurements (cm) from soil surface to the tip of the tallest panicle (awns excluded). Record in whole numbers (do not use decimals). Take plant height (a) before flooding, (b) after flooding, and (c) under normal conditions.

Attachment 2B continued.

Parameter	Description
15. Percent survival in flooded conditions	Record the number of hills before and after submergence/flooding a few days after the plants start to develop new leaves. Divide the number of plants that survive by the total number of hills before flooding/submergence and multiply by 100.
16. Number of tillers at harvest	Record the number of tillers from 10 sample plants before maturity.
17. Number of panicles at harvest	Record the number of panicles from 10 sample plants before maturity.
18. Lodging	Record the number of 10 sample plants that lodged before harvest.
19. Fresh weight of fodder or sample rice straw after harvest	Record the fodder or biomass weight from harvest area.
20. Grain weight/crop-cut (kg)	Total weight of all grain harvested from sample areas (m^2).
21. Moisture content (%)	Moisture content of grain taken using portable moisture testers.
22. Grain yield (kg/ha)	Computed from grain weight (item 20) and adjusted to moisture content. = (grain weight per crop-cut × 10,000 m^2 per ha)/crop-cut size
23. Adjusted grain yield at 14% MC (t/ha)	= (grain yield/1,000) × (100 – MC/86)

Attachment 3. Evaluation form for researcher-managed trials using preferential analysis.

<table>
<tr><td colspan="10">Rice Variety Evaluation Form for Mother Trials (Preferential analysis)</td></tr>
<tr><td colspan="4">Country:</td><td colspan="4">Province:</td><td colspan="2" rowspan="2">Date:</td></tr>
<tr><td colspan="4">District:</td><td colspan="4">Village:</td></tr>
<tr><td rowspan="3">Variety</td><td colspan="9">Count of positive and negative votes</td></tr>
<tr><td colspan="2">Males (N =)</td><td colspan="2">Females (N =)</td><td colspan="2">Breeders (N =)</td><td colspan="2">Total (N =)</td><td rowspan="2">Preference score</td></tr>
<tr><td>Positive votes</td><td>Negative votes</td><td>Positive votes</td><td>Negative votes</td><td>Positive votes</td><td>Negative votes</td><td>Positive votes</td><td>Negative votes</td></tr>
<tr><td>V1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V7</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V8</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V9</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V11</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V12</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V13</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V14</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V15</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>V16</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="10"></td></tr>
<tr><td colspan="10">Remarks/comments on the overall performance of the two most-preferred varieties:</td></tr>
<tr><td colspan="2">Variety 1</td><td colspan="8"></td></tr>
<tr><td colspan="2">Variety 2</td><td colspan="8"></td></tr>
<tr><td colspan="10"></td></tr>
<tr><td colspan="10">Remarks/comments on the overall performance of the two least-preferred varieties:</td></tr>
<tr><td colspan="2">Variety 1</td><td colspan="8"></td></tr>
<tr><td colspan="2">Variety 2</td><td colspan="8"></td></tr>
</table>

Attachment 4. Checklist of materials for the conduct of sensory evaluation.

Cooking materials	For sample evaluation
4 rice cookers	4 medium-size containers with code numbers
1 measuring cup	30 (plastic) tablespoons
1 ladle	30 bottles of drinking water
1 stop watch	30 individual evaluation forms
1 weighing scale	1 summary table of sensory evaluation
1 kilo of each sample variety	4 pens
3–4 liters of water	
4 rice containers with sample labels	

Attachment 5. Individual evaluation form for sensory evaluation.

No.	Entry	Code number
1	IR64-Sub1 (BC_3F_3)	563
2	Swarna-Sub1 (BC_3F_3)	208
3	Samba Mahsuri-Sub1 (BC_3F_3)	705
9	Farmer's variety	676

Attachment 6. Coding samples of four varieties to be tested.

Panel # ____________

Individual Form for Sensory Evaluation

Please look at and taste each sample of the rice varieties. Write down the code number and indicate “yes” if the sample is acceptable to you and “no” if not. Rank them according to your preference, where 1 is the most-preferred and 4 the least-preferred rice sample.

Country:	Province:	Date:
District:	Village:	
Name:		Gender:

	________ (Code)	________ (Code)	________ (Code)	________ (Code)
Is the sample acceptable? (yes or no)				
Rank				

Check and rank according to priority the basis used for choosing the best cooked sample.

_______ ( ) Aroma	______( ) Flavor	______( ) Tenderness	_____( ) Others (please specify)
_______ ( ) Color	______( ) Gloss	______( ) Cohesiveness	

In your opinion, what are the characteristics of good-quality cooked rice?

Attachment 7. Summary table of sensory evaluation.

Summary Table of Sensory Evaluation			
Country:	Province:		Date:
District:	Village:		
Sample of cooked rice	Rank	Count	
		Acceptable	Not acceptable
Variety 1			
Variety 2			
Variety 3			
Local check			
Total			

Attachment 8. Dummy tables for agronomic data analysis.

Table 1. Grain yield of different varieties (specify cropping season).

Variety	Replication or block			Total	Mean
	I	II	III		
T1: Swarna-Sub1 (BC_2F_3)					
T2: Swarna-Sub1 (BC_3F_3)					
T3: IR64-Sub1 (BC_2F_3)					
T4: IR64-Sub1 (BC_3F_3)					
T5: Samba Mahsuri-Sub1 (BC_2F_3)					
T6: Samba Mahsuri-Sub1 (BC_2F_3)					
T7: TDK1-Sub1					
T8: CR1009-Sub1					
T9: BR11-Sub1					
T10: IR66876-11-NDR-1-1-1-1					
T11: IR57514-PMI-5-B-1-2					
T12: IR49830-7-1-2-3					
T13: IR82355-5-2-3					
T14: IR82355-5-1-3					
T15: PSBRc68					
T16: Local variety 1					
Total					
Grand total					
Grand mean					

Table 2. ANOVA table of a single-factor experiment.

Source of variance	Degrees of freedom	Sum of squares	Mean square	Observed F	Tabular F	
					5%	1%
Replicate variety error						
Total						

Attachment 9. Methodological notes on preference analysis.

Preference analysis
(participatory varietal selection)

Statistical analysis for the preference score of farmers and researchers
Methodological notes

Introduction

This simple statistical test starts from the results of the exercise on preference analysis conducted under the mother trial of the PVS protocol. The three statistical analyses are for a single site inasmuch as the sites have different socioeconomic and biophysical conditions. In this case, we cannot consider each mother trial site as a replicate.

Method of data analysis

1. Descriptive statistics. These can be presented in the frequency or summary table showing which among the varieties are the "most-preferred or best" and the "least-preferred or disliked" by the farmers. Please note that:

$$\text{Preference score} = \frac{\text{No. of positive votes} - \text{No. of negative votes}}{\text{Total votes cast}}$$

To complete the table, calculate the preference scores for the males and also for the females in separate columns, using the formula. Please note that the denominator for the preference score (PS) for males and for females should equal the number of ballots cast, depending on the number of farmers that participated in the preference analysis. See attached matrix of sample raw data.

However, as indicated in the protocol, the identification of the "most" and "least" preferred varieties or selection should be based on the combined male and female farmers' preference scores (another column).

Table for preference analysis (single site)

Table 1. Preference scores of male farmers, female farmers, and researchers in a researcher-managed trial in (village, province, country).

Variety	Preference scores			
	Male farmers	Female farmers	Combined male and female farmers	Researchers
V_1				
V_2				
.				
V_n				

Note: [a]Most-preferred variety. [b]Second most-preferred variety. [c]Least-preferred variety. [d]Second least-preferred variety.

Example (using actual data from southern Vietnam):

Table 2. Preference scores of male farmers, female farmers, and researchers in a researcher-managed trial in Thang My Village, Hau Giang, South Vietnam.

Variety	Preference scores			
	Male farmers	Female farmers	Combined farmers	Researchers
V1	0.136	0.000	0.103[a]	0.167
V2	–0.023	0.000	–0.017	0.000
V3	0.114	0.071	0.103[a]	0.083
V4	–0.080	0.000	–0.060[c]	0.000
V5	0.000	0.000	0	0.083
V6	–0.023	0.000	–0.017	–0.083
V7	0.011	0.000	0.009	–0.083
V8	0.000	0.000	0	0.083
V9	0.000	0.000	0	0.000
V10	0.000	0.000	0	0.000
V11	–0.011	0.000	–0.009	–0.083
V12	–0.080	–0.143	–0.095[b]	–0.083
V13	–0.011	–0.071	–0.025	0.083
V15	0.023	0.071	0.034	0.000
V16	–0.011	0.000	–0.009	–0.083
V17	–0.023	0.000	–0.017	0.000
V18	–0.023	0.000	–0.017	0.000
V19	–0.057	0.000	–0.043	0.000
V20	–0.023	–0.143	–0.052	0.000
V21	–0.057	0.000	–0.043	–0.083
V22	0.034	0.143	0.060	0.000
V23	0.011	0.000	0.009	0.000
V24	–0.011	–0.143	–0.043	0.000
V25	0.102	0.214	0.129	0.000

[a]Most-preferred variety (with same scores). [b]First least-preferred variety. [c]Second least-preferred variety.

2. For the statistical test to be used for the agreement of male and female farmers (total) and researcher preferences, farmers (total), and yield as results of the preference analysis, use *Pearson's correlation coefficient (r)*.

   This technique investigates the relationships between two variables (*x* and *y*). This answers the question: "Is the change in one variable associated with a change in the other variable?" Use the correlation to test the statistical significance of the association. Note, however, that the association here does not imply a cause-and-effect relationship. The interpretation is that a significant correlation shows only that the two factors or variables vary in a related way (positively or negatively). Any statistical software/package can be used to calculate these statistics (Excel, SPSS, SAS, or others).

a. Correlation of preference scores between male and female farmers

Hypothesis:

There is no significant correlation between the preference scores of male and female farmers.

Test variables: Here, the test variables are the preference scores of male and female farmers.

Pearson's correlation coefficient: The levels of measurement of both variables are in a ratio or interval scale.

For an interpretation guide, use the following:

- Reject the hypothesis if the *P*-value is greater than alpha (10%, 5%, and 1%).
- Take a look at Pearson's correlation coefficient (r). If r is positive, there is a direct correlation between the preference scores of males and females.
- Otherwise, if r is negative, there is an inverse correlation between the preference scores of males and females. Also, describe the level of r:

  0 = no correlation
  0.01–0.20 = very weak correlation
  0.21–0.40 = weak correlation
  0.41–0.60 = moderate correlation
  0.61–0.80 = strong correlation
  0.81–0.99 = very strong correlation
  1 = perfect correlation

  Below is a sample of what you will get from the statistical software. See the next pages for the filled-out sample.

b. Correlation of the preference scores of farmers and researchers

Hypothesis:

There is no significant correlation between the preference scores of farmers and researchers.

Test variables: preference score of farmers and researchers.

Pearson's correlation coefficient: The levels of measurement of both variables are in a ratio or interval scale.

Using the same decision criteria and guide in analysis/interpretation of results:

- Reject the hypothesis if the *P*-value is greater than alpha (10%, 5%, and 1%).
- Take a look at Pearson's correlation coefficient (r). If r is positive, there is a direct correlation between the preference scores of farmers and researchers.
- Otherwise, if r is negative, there is an inverse correlation between the preference scores of farmers and researchers. Also, describe the level of r:
  0 = no correlation
  0.01–0.20 = very weak correlation
  0.21–0.40 = weak correlation
  0.41–0.60 = moderate correlation
  0.61–0.80 = strong correlation
  0.81–0.99 = very strong correlation
  1 = perfect correlation

  Example (combined results):

Using the data for Thang My Village, the following is a sample output.
The above data from the sample can be presented in a final report with the following interpretation:

Table 3. Correlation analysis of preference scores between farmers (male and female) and researchers in Thang My.

		Male	Female	Researcher	Farmer
Male	Pearson's correlation	1	0.551**	0.567**	0.955**
	Sig. (2-tailed)	22	0.008	0.006	0.000
	N		22	22	22
Female	Pearson's correlation	0.551**	1	0.101	0.774**
	Sig. (2-tailed)	22	0.008	0.655	0.000
	N		22	22	22
Researcher	Pearson's correlation	0.567**	0.101	1	0.466*
	Sig. (2-tailed)	0.006	0.655	22	0.029
	N	22	22		22
Farmer	Pearson's correlation	0.955**	0.774**	0.466*	1
	Sig. (2-tailed)	0.000	0.000	0.029	22
	N	22	22	22	

	n	r	Probability
Male vs female	22	0.551**	0.008
Farmer vs researcher	22	0.466*	0.029

Sample interpretation (other explanations can be provided):
Results show significant and moderate correlation between the male and female farmers' preference scores. This means that, with r = 0.551 (at 1% level of significance), male and female farmers somewhat agree on their preferences for the best performing varieties tested in the researcher-managed trials in Thang My Village. Similarly, when farmers' preferences (male and female preferences combined) are compared with breeders' preferences, the correlation analysis shows moderate correlation with r = 0.466 (at the 5% level of significance). The results show that there is also a moderate agreement between the farmers' preferences, given their own reasons and set of criteria for selection, and the researchers' own criteria in selecting good-performing varieties.

c. Correlation between yield and farmers' preference score
Hypothesis:
There is no significant correlation between the preference scores of farmers and yield of the varieties tested.

Test variables: Preference score of farmers and yield of each variety/line.
Pearson's correlation coefficient: The levels of measurement of both variables are in a ratio or interval scale.

- Using the same decision criteria and guide in analysis/interpretation of results:
- Reject the hypothesis if the *P*-value is greater than alpha (10%, 5%, and 1%).
- Take a look at Pearson's correlation coefficient (r). If r is positive, there is a direct correlation between the preference scores of farmers and researchers.
- Otherwise, if r is negative, there is an inverse correlation between the preference scores for farmers and yield. Also, describe the level of r:

0 = no correlation
0.01–0.20 = very weak correlation
0.21–0.40 = weak correlation
0.41–0.60 = moderate correlation
0.61–0.80 = strong correlation

0.81–0.99 = very strong correlation
1 = perfect correlation

Example of output:
Using the data for Nongbone Village in Lao PDR:

Table 4. Correlation analysis of preference scores and yield in Nongbone

		Farmer preference score	Yield
Farmer preference score	Pearson's correlation	1	0.526
	Sig. (2-tailed)		0.053
	N	14	14
Yield	Pearson's correlation	0.526	1
	Sig. (2-tailed)	0.053	
	N	14	14

Notes in interpreting the results:

- Preference scores capture farmers'/researchers' perception of good-performing varieties (there may be agreements/disagreements among groups).
  - Is there an agreement in preferences between male and female farmers?
  - Is there an agreement in preferences between farmers and researchers?
  - What factors could affect their preferences?
- Many conclusions can be drawn by looking at the agreement of farmers' preference scores and yield:
  - Can farmers predict a good-performing variety based on its potential yield? Based on their own criteria or own way of assessing performance potential?
  - Is yield a major consideration of farmers in selecting a variety?
  - Do farmers have other considerations in selecting a variety?
- In this example, the farmers' perception of good-performing varieties captured through the preference score is moderately associated with the researcher-calculated yields for the entries in the mother trials, given that r = 0.526 and is significant at the 10% level. This means that there is a somewhat moderate agreement between the predicted yields and the resulting choices of the farmers based on their own set of criteria.
- Results of analysis with strong correlation would indicate that farmers' preferences are good predictors of how the varieties will perform in the field and how they will be accepted by farmers.
- Interpretation of results can be further explained by providing additional information on the farmers' process of selection and the conditions in the field trials. This can therefore highlight the importance of analyzing both the performance of the lines/varieties in the field in terms of yield vis-à-vis the farmers' preferences (socioeconomic information vs. agronomic).
- What other evidence/information would support the statistical results based on the FGD and observations in the field?
- What other conclusions can you make based on the quantitative and qualitative results?

Table 5. Sample table of raw data, indicating raw votes by male and female farmers and researchers, and the computed preference scores.

Variety	Male positive votes	Male negative votes	PS male	Female positive votes	Female negative votes	PS female	Researcher positive votes	Researcher negative votes	PS researcher	Farmer positive votes	Farmer negative votes	PS farmers
V1	12	0	0.136	0	0	0.000	2	0	0.167	12	0	0.103
V2	0	2	–0.023	0	0	0.000	0	0	0.000	0	2	–0.017
V3	10	0	0.114	2	0	0.071	1	0	0.083	12	0	0.103
V4	0	7	–0.080	0	0	0.000	0	0	0.000	0	7	–0.060
V5	0	0	0.000	0	0	0.000	1	0	0.083	0	0	0
V6	0	2	–0.023	0	0	0.000	0	1	–0.083	0	2	–0.017
V7	2	1	0.011	0	0	0.000	0	1	–0.083	2	1	0.009
V8	0	0	0.000	0	0	0.000	1	0	0.083	0	0	0
V9	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0
V10	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0
V11	0	1	–0.011	0	0	0.000	0	1	–0.083	0	1	–0.009
V12	0	7	–0.080	0	4	–0.143	0	1	–0.083	0	11	–0.095
V13	1	2	–0.011	0	2	–0.071	1	0	0.083	1	4	–0.025
V15	2	0	0.023	2	0	0.071	0	0	0.000	4	0	0.034
V16	0	1	–0.011	0	0	0.000	0	1	–0.083	0	1	–0.009
V17	1	3	–0.023	0	0	0.000	0	0	0.000	1	3	–0.017
V18	0	2	–0.023	0	0	0.000	0	0	0.000	0	2	–0.017
V19	0	5	–0.057	0	0	0.000	0	0	0.000	0	5	–0.043
V20	0	2	–0.023	0	4	–0.143	0	0	0.000	0	6	–0.052
V21	0	5	–0.057	0	0	0.000	0	1	–0.083	0	5	–0.043
V22	5	2	0.034	4	0	0.143	0	0	0.000	9	2	0.060
V23	1	0	0.011	0	0	0.000	0	0	0.000	1	0	0.009
V24	1	2	–0.011	0	4	–0.143	0	0	0.000	1	6	–0.043
V25	9	0	0.102	6	0	0.214	0	0	0.000	15	0	0.129

Country	Village	Variety	Maturity	Male	Female	Breeder	Farmer	Yield
Laos	1	IR64-Sub1 (BC_2F_3)	1	–0.25	–0.08		0.083	
Laos	1	IR64-Sub1 (BC_2F_3)	1	0.38	0.21		–0.125	
Laos	1	IR82355-5-2-3	1	–0.04	0.08		–0.042	
Laos	1	IR82355-5-1-3	1	–0.08	–0.21		–0.083	
Laos	1	Swarna-Sub1 (BC_2F_3)	2		–0.02		–0.011	
Laos	1	Swarna-Sub1 (BC_2F_3)	2	–0.05	–0.04	–0.125	–0.043	
Laos	1	Samba Mahsuri-Sub1 (BC_2F_3)	2			–0.25	–0.076	
Laos	1	Samba Mahsuri-Sub1 (BC_2F_3)	2	–0.09	–0.06	–0.125	–0.109	
Laos	1	TDK1-Sub1	2	–0.02	0.06	0.042	0.022	
Laos	1	CR1009-Sub1 (BC_2F_3)	2		–0.15	0.083	–0.076	
Laos	1	IR66876-11-NDR-1-1-1-1	2	0.02		0.042	0.011	
Laos	1	IR57514-PMI-5-B-1-2	2	–0.05	0.04			
Laos	1	IR49830-7-1-2-3	2	0.11	–0.02	0.042	0.043	
Laos	1	PSBRc68	2	0.16	0.13	0.167	0.141	
Laos	1	BR11-Sub1	2					
Laos	1	TDK1	2	–0.02	0.1		0.043	
Laos	1	PNG3	2	0.07	0.04	0.125	0.054	
Laos	1	TDK11	2					
Laos	2	IR64-Sub1 (BC_2F_3)	1	0.01			0.01	2.91
Laos	2	IR64-Sub1 (BC_2F_3)	1	–0.02			–0.01	3.27
Laos	2	IR82355-5-2-3	1	–0.07	–0.25		–0.096	2.91
Laos	2	IR82355-5-1-3	1	–0.05			–0.038	3.44
Laos	2	Swarna-Sub1 (BC_2F_3)	2	–0.01			–0.01	3.56
Laos	2	Swarna-Sub1 (BC_2F_3)	2	–0.07			–0.058	3.55
Laos	2	Samba Mahsuri-Sub1 (BC_2F_3)	2	–0.08		–0.25	–0.067	2.35
Laos	2	Samba Mahsuri-Sub1 (BC_2F_3)	2	–0.15		–0.25	–0.125	2.34
Laos	2	TDK-Sub1	2	0.17	0.13	0.25	0.163	3.15
Laos	2	CR1009-Sub1 (BC_2F_3)	2					
Laos	2	IR66876-11-NDR-1-1-1-1	2	–0.01	0.06			1.98
Laos	2	IR57514-PMI-5-B-1-2	2	0.03	–0.19			2.62
Laos	2	IR49830-7-1-2-3	2	–0.01			–0.01	2.68
Laos	2	PSBRc68	2					
Laos	2	BR11-Sub1	2	0.11			0.048	3.04
Laos	2	TDK1	2					
Laos	2	PNG3	2					
Laos	2	TDK11	2	0.18	0.25	0.25	0.192	4.38

Note: Maturity: 1 = early maturing, 2 = medium maturing.
Village: 1 = Hea, 2 = Nongbone.

Module 5

Stage 3: Evaluation of new rice lines in farmer-managed trials

Module objectives

- Provide information on how to conduct farmer-managed trials
- Describe the layout and design in farmer-managed trials
- Provide guidelines on how to collect and analyze agronomic and socioeconomic data

Farmer-managed trials or baby trials are closely associated with farmers' cropping system. Experiments are laid out on one side of a farmer's field, and replication is across five or more farmers' fields (FC or farmer-cooperator). This usually involves fewer treatments (<3) because only top-performing varieties, which are determined from previous researcher-managed participatory varietal selection (RM-PVS) trials, are included. These are conducted to verify and evaluate the performance of the top two or three best-performing varieties and that of the farmers' varieties. These varieties will be compared (Fig. 1). By minimizing the researchers' involvement, they ensure that the trials are managed in the same way as the rest of the farmers' crop and—always an important consideration in rainfed rice research—minimize the cost per trial. Rather than harvesting and weighing crop samples, researchers often identify preferred lines by relying on farmer ratings of the varieties. In addition to questions about yield and quality, farmers are asked whether they plan to grow the variety next year or have given seeds to friends or relatives. Eagerness to grow a variety again and neighbors' demand for it are strong indications that it is widely preferred. These protocols of farmer-managed or baby trials are explained below. The steps are also shown below.

Steps:

1. **Select the target site for where farmer-managed trials will be conducted.**
   This should be done by the research team together with the local government unit staff and farmers. The criteria for selection of sites for farmer-managed trials in the IRRI-Japan Submergence Project are as follows:
   - Farmers' fields that experience flash floods up to 2 weeks. Water should subside within this period. Where flooding is stagnant for more than 2 weeks is not a good site for the present submergence-tolerant rice lines (www.irri.org/flood-proof-rice).
   - The site should be accessible to vehicles for monitoring.
   - It should be representative of flash-flood-prone areas of the community.
2. **Meet with farmer-cooperators for farmer-managed PVS.**
   Criteria for selecting farmer-cooperators for farmer-managed PVS:
   a. Male and female farmers active in farming
   b. Has at least 500 m^2 for conducting farmer-managed trials
   c. Willing to cooperate and use his/her farm for the trials
   d. Willing to share information with other farmers in the locality and nearby villages
3. **Conduct baseline surveys of farmer-cooperators of farmer-managed PVS.**
   a. Ask the farmers, "How many land types do you have?" "For each land type, what varieties are usually grown?"
   b. Also, ask the selected farmers, "What varieties have you grown in the submergence-prone areas for the last 10 years up to the present according to these types of varieties: (a) traditional variety, (b) high-yielding variety, and (c) hybrid?" The researcher should list the varieties identified by the farmers.

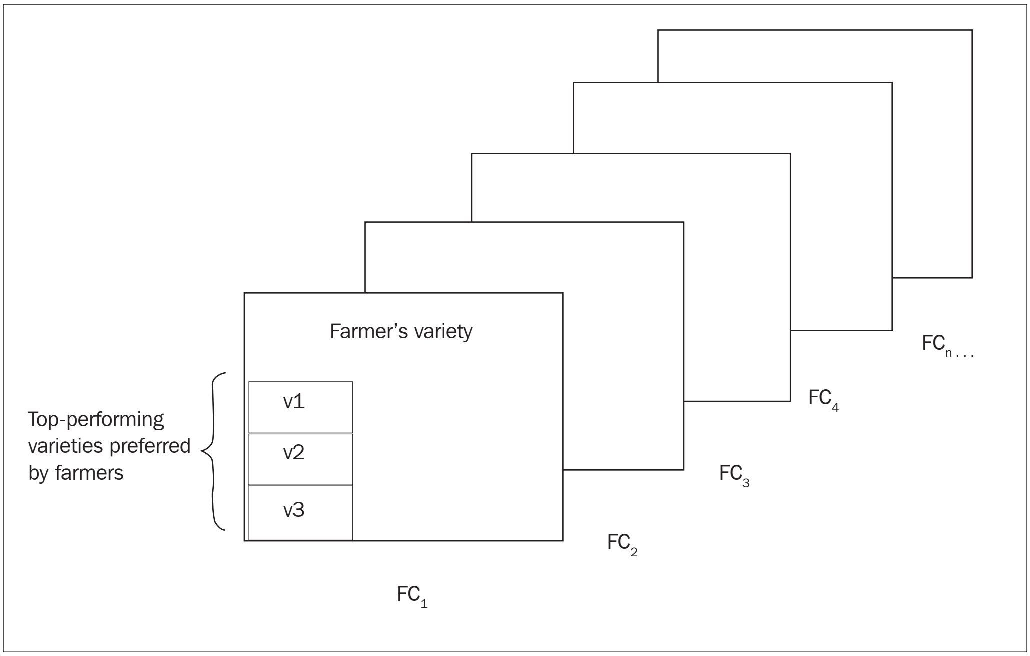

Fig. 1. Layout of a farmer-managed participatory varietal selection (FM-PVS) trial.

c. Ask the farmers about the positive and negative traits of the varieties they have identified.
d. Ask the husbands and wives separately which traits are important when selecting a variety.
e. Criteria set by husbands and wives can be analyzed using a sign test. Husbands and wives are considered related samples because they belong to the same households. Summarize the findings by simple tabulation and present them to the farmers (if possible).

4. Experimental design

In a farmer-managed PVS (FM-PVS) trial, the individual farm is the block. Two to three varieties in the trial are referred to as a treatment. Replication levels for FM-PVS need to be high. Each variety should be tested on at least 10 farms. Researchers can expect to lose 25% of farmer-managed trials due to animal damage, loss of stakes, failure to plant the seed, mixing, etc.

a. Selection of treatments
Varieties should include the farmer's variety and two to three top-performing varieties/lines selected from the RM-PVS.
b. Plot size and plant spacing
Plot size depends upon the average farm size in the area. If the average farm size is 1 ha, 1,000-m^2 plot size is enough for agronomic and economic data collection per variety/entry.
c. Field layout
Transplanted and direct-seeded Sub1 *rice.* Levees between treatments and replications are not necessary. However, the whole experimental area should be enclosed by levees to prevent contamination from the adjacent area.

d. Field operations

Cultural management. Cultural practices to be used are the same as those employed in the farmers' cropping system management. Since this will involve several farmer-cooperators, the date of planting should be properly synchronized and dates closer together should be observed. This will help minimize the standard error when data are analyzed statistically.

e. Distributing the kits

Kits should be prepared before establishing the trials. In each bag of seed, at least 2–3 tags with the variety name should be included. These tags will be used for proper identification of the varieties even after planting. The stakes can be color coded. Farmers should receive the kits during an organizational meeting at which the objectives and procedures of the trials will be explained. During this meeting, the tags should be shown to the farmers. It should be emphasized that the correct placement of the stakes in the plots and proper labeling are critical to the success of the trials. A list of kit numbers and the names of the varieties in each kit should be presented at the organizational meeting. The name and address of the farmer receiving the kit should be recorded. Other socioeconomic information (ethnic group, farm size, land type, etc.) can be recorded for each participating farmer. However, as with any data, it is important to have a plan for the use of information. Data that will not be used should not be collected. In baby trial programs involving many farmers, these data can be used to determine whether different groups of farmers need different types of varieties.

5. Data collection

Agronomic data

In FM-PVS, all agronomic data will be taken from three to four sample areas or crop cuts (CC). CC should be established at planting time and must be maintained up to harvesting stage. Data will be entered on a sample form (data sheet for grain yield). The dates of the following operations and growth stages should be recorded: (a) soaking, (b) seeding, (c) transplanting, (d) 50% and 100% flowering, (e) 50% and 80% maturity, and (f) harvesting.

a. Harvesting for yield data. Harvest only the sample area as specified in the following:

> Farmer-managed PVS—harvest three to four crop-cuts with plot sizes of 10 rows 5 m long

b. Calculating the sample or crop-cut areas. Sample area or crop-cut area is calculated as follows:

> Sample area or crop-cut area = no. of rows harvested × distance between rows (m) × length of sample rows (m)

> Example:
> If the number of rows to be harvested is 10, distance between rows is 20 cm, and length of a sample row is 5 m, the area of the crop-cut is 10 rows × 0.20 m × 5 m = 10 m^2.

Data sheet for grain yield

IDENTIFICATION

Country: ______________________

Province: ______________________ District: ______________________

Subdistrict: ______________________ Village: ______________________

Name of farmer cooperator: ______________________ Crop year: ______________________

Treatment/variety: ______________________

GPS coordinates: Latitude: ______________________ Longitude: ______________________

Soil texture: ______________________ Soil pH: ______________________

SCHEDULE

Date of soaking: ______________________ Date of seeding ______________________

Date transplanted: ______________________

Date of 50% flowering ______________________ 100% ______________________

Date of 50% maturity ______________________ 80% ______________________

Date harvested: ______________________

	Crop-cut	Crop-cut	Crop-cut	Crop-cut	Total	Mean
	1	2	3	4		
Distance between rows (cm)						
Distance between hills (cm)						
Area of crop-cut (m^2)						
Seeding rate						
Percent survival rate in lowland conditions						
Recovery at 30 days after N fertilizer application						
No. of hills at 30 DANF						
Tiller count at 30 DANF						
Fresh weight of fodder or rice straw after harvest per crop-cut (kg)						
Computed weight of fodder (kg/ha)						
Grain yield per crop-cut (kg)						
Moisture content (%)						
Computed yield (t/ha)						

Crop-cut size (m) = ______________________

Length of sample rows: ______________________

Number of sample rows: ______________________

Distance between rows: ______________________

Crop-cut size (m^2) = length of rows (m) × no. of rows × distance between rows (m)

Sample data sheet for collecting agronomic data from a farmer-managed trial.

c. Number of crop-cuts per farm: 4 random samples
d. Data to be collected:
   - Yield per crop-cut: recorded weight (g) of sun-dried grain
   - Moisture content (MC): determine MC from the cleared sun-dried sample with a moisture tester
e. Yield computations

Grain yield per hectare (kg at 14% MC)

$$\text{Grain yield (kg/ha)} = \frac{\text{ave. grain yield/crop-cut (g)}}{\text{area/crop-cut m}^2} \times 10 \times \frac{100 - \text{MC}}{86}$$

Fodder yield: fresh weight of rice straw threshed right after harvest

$$\text{Fodder yield (t/ha)} = \frac{\text{ave. fodder yield/plot in kg}}{\text{area/crop-cut m}^2} \times 10$$

Socioeconomic and preference data

a. The first visit (1 month after transplanting)
   After the trials have been established, each one should be visited by the researchers to ensure that it has been planted according to the design/layout and properly staked/labeled. The researcher should record the details of the land type on which the trial is being grown and any problems that have been encountered or that are expected to affect the analysis (e.g., one of the varieties may be planted in an area shaded by a tree), on a sample form below (Box 1). Also, the researcher should ask about the conditions of the trial after flooding.
b. The second visit (2 weeks before harvest)
   Each farmer-managed trial is visited between flowering and harvest stage (preferably close to harvest). The researcher should record the condition of the trial and any observation that may later on pose problems to the project (e.g., animal damage). This should be discussed with the farmer for possible attention. Principal male and female farmers who are members of the same household should be asked to rate each variety for yield, tillering ability, plant height, tolerance of pests and diseases, tolerance of unfavorable conditions, and for their overall opinion about the variety. The following rating scale should be used:

   1 = Worse than their current variety
   2 = The same as their current variety
   3 = Better than their current variety

   Such ratings are easily converted to numbers and will be recorded on a form similar to the following sample form (Box 2):
c. Third visit (postharvest)
   After harvest, a meeting with participating farmers should be held in the community. Principal male and female farmers should be asked to rate (using the sample form) the varieties for yield and postharvest qualities (Box 3).
   Ratings for eating and cooking qualities may also be obtained if farmers have started to cook the rice. A group discussion on varietal performance should be held and farmers should be asked to talk about the good and bad (positive and negative) characteristics of the varieties.
   For each variety, farmers should also be asked if they plan to grow the variety next year. These ratings and information about the condition of the trial should be

Box 1. Sample form for the first visit to a farmer-managed trial

Respondent's no.: ______________

IDENTIFICATION

Country: | Province:

District: | Village:

Farmer's name: | Name of interviewer:

Seed kit number: | Date of visit:

Type of stress: ( ) Submergence ( ) Salinity/sodicity ( ) Drought

PARCEL INFORMATION: Farm area (ha):

Rice area usually grown (ha): | Season:

Soil texture: ( ) sandy ( ) loamy ( ) clay ( ) Others (specify) | Soil fertility: ( ) very fertile ( ) fertile ( ) unfertile

Land type: ( ) lowland ( ) midland ( ) upland | Tenure status: ( ) owned ( ) not owned

Is the field irrigated or rainfed? ( ) Irrigated ( ) Rainfed

Depict the flooding/submergence situation *(this can be filled out during the whole duration of the FM trial)*

Flooding condition	Flooding 1	Flooding 2	Flooding 3	Flooding 4	Flooding 5
At what stages of rice growth did flooding occur?					
What is the depth of water (cm) and of standing water?					
In what month and week did flooding occur?					
How many days did water remain in the plot?					

What happened to the crop after submergence?

TRIAL DETAILS	Local variety	Variety 1	Variety 2	Variety 3
Name of variety				
Area of farmer's experimental plot (m^2)				
Method of establishment				
Date sown				
Date transplanted				
Expected date of harvest				

Box 2. Sample form for the second visit to a farmer-managed trial

Respondent's no.: ____________

Village name:

Farmer's name:

Kit number:

Date of visit:

Type of stress: ( ) Submergence ( ) Salinity/sodicity ( ) Drought

Notes on condition of trial:

FARMER'S PERCEPTION

For questions on crop stand and overall preference, varieties should be rated on a 1–3 scale. Ask principal male and female farmers who are members of the same household.

1 = Worse than their local variety

2 = Same as their local variety

3 = Better than their local variety

Parameters	Principal male			Principal female		
	Variety 1	Variety 2	Variety 3	Variety 1	Variety 2	Variety 3
Name of local variety						
Tillering ability						
Plant height						
Tolerance of submergence						
Tolerance of salinity/sodicity						
Tolerance of drought						
Tolerance of pests						
Tolerance of diseases						
Lodging resistance						
Overall performance						

Add any information that the farmer thinks is important.

Box 3. Sample form for the third visit to a farmer-managed trial

Respondent's no.: ____________

Village name:

Farmer's name:

Kit number:

Date of visit:

Type of stress: ( ) Submergence ( ) Salinity/sodicity ( ) Drought

FARMER'S PERCEPTION

For questions on crop stand and overall preference, varieties should be rated on a 1–3 scale. Ask principal male and female farmers who are members of the same household.

1 = Worse than their local variety
2 = Same as their local variety
3 = Better than their local variety

Parameters	Principal male			Principal female		
	Variety 1	Variety 2	Variety 3	Variety 1	Variety 2	Variety 3
Name of local variety						
Grain yield (kg/ha)						
Easy to harvest						
Easy to thresh						
Milling recovery						
Market price						
Other uses: (please specify)						
Cooking quality						
Eating quality						
Storage quality						

Comment about the variety's overall performance and add any information that you think is important.

Variety	Local check	Variety 1	Variety 2	Variety 3
Grain yield (kg/ha):				
% milling recovery				
Male: Rank the tested variety according to its overall performance (1 being highest)				
Comments:				
Female: Rank the tested variety according to its overall performance (1 being the highest)				
Comments:				

Box 3 continuation.

SEED DISTRIBUTION

When choosing a variety to grow, who among the family members decides? Please check: ( ) Principal male only ( ) Principal female only ( ) Both
If both, who has more influence in the decision making? ( ) Male > female ( ) Male < female

Ask the following quastions of the household member who has more control and influence on the following activities:

	Variety 1	Variety 2	Variety 3
Do you plan to grow this variety next year? Why? 1 - Yes 2 - No			
If yes, how much area will you plant next year for this type of variety?			
How many people have you shared this type of variety with?			
Do you plan to share this variety and other information with other farmers?			
How will you disseminate this technology?			

recorded on a form that clearly summarizes farmers' opinions and preferences.

6. **Data analysis**

   Agronomic data

   Analysis of variance is computed just like in any data set in a randomized complete block design (RCBD). An exception is when a set of treatments is replicated across farmers' fields. This is also the opportunity to evaluate treatment effects across farmers' fields. Since participating farmers plant different varieties in their fields, there will be some adjustments in the data analysis. A statistical test will be performed to see whether there will be a significant difference between the yield of Sub1 varieties and the farmers' variety. This difference can be directly computed to serve as the data to be subjected to ANOVA.

Socioeconomic and preference data

It is important to describe the conditions of the farmer-managed trials and their biophysical environment, particularly the stress occurring in the selected area, to be able to observe the performance of the introduced varieties. By using simple cross tabulation, researchers can show different scenarios by classifying farmer-cooperators according to their agroecological and socioeconomic status (Box 4).

Another way of looking at the performance of the introduced varieties in response to the stress environment is by classifying the responses according to the stages of rice growth. Simple tabulation can give an overview on which stage of rice growth the introduced varieties were most effective in. However, doing simple cross tabulation is limited to only showing the trend and initial responses. Other statistical tools are still needed to further investigate the factors affecting the responses or whether the values shown in a cross tabulation are statistically significant (Box 5).

It is also important to understand farmers' perceptions about the introduced varieties. For example, farmers' perceptions regarding relative performance of stress-tolerant

Box 4. Sample data

Details of farmer-managed trials in a submergence-prone area in Indonesia, 2009.

Trial details	Values
Number of cooperators	41
Average rice area cultivated (ha)	2.0
Field type (%)	
Irrigated	48
Rainfed	3
Semi-irrigated	49
Soil fertility (%)	
Fertile	90
Unfertile	10
Tenure status (%)	
Not owner	41
Owner	59
Area planted to existing variety (average)	
Ciherang (n = 14)	1.86
Conde (n = 1)	0.32
Inpari 1 (n = 1)	0.50
IR64 (n = 3)	0.63
IR77 (n = 1)	0.61
M. Cilamaya (n = 6)	2.54
Mekongga (n = 8)	0.72
Way A. Boru (n = 5)	1.23
Area planted to submergence-tolerant variety (average)	
Inpara 3 (n = 16)	0.51
IR64-Sub1 (n = 20)	0.46
Swarna-Sub1 (n = 11)	0.36

Source of raw data: Monitoring visits to farmer-managed trials in Indonesia, IRRI-Japan Submergence Project 2009.

Box 5. Sample data

Flooding conditions at different stages of rice growth in farmer-managed trials in Indonesia, 2009.

Flooding condition	Stage of rice growth				
	Stage I			Stage II	Stage III
	Germination to emergence (0–3 DAS)	Seedling (4–21 DAS)	Tillering/ stem elongation (22–45 DAS)	(35 days)	(30 days)
% of households under farmer-managed trials (n = 41)					
Not flooded	93	78	37	78	98
Flooded	7	22	63	22	2
Maximum depth of standing water (cm)	63	54	63	70	60
Flooding duration					
Total days when water remains in the plot	(n = 3)	(n = 9)	(n = 33)	(n = 10)	(n = 1)
0–5	100	22	27	60	100
6–10	0	67	55	40	0
11–20	0	11	18	0	0
Days of total submergence					
0–5	100	44	64	90	100
6–10	0	56	21	10	0
11–20	0	0	15	0	0
Percent survival in existing variety					
0 (all died)	0	33	9	0	0
1–50	0	1	9	0	0
51–99	67	33	33	20	0
100 (all survived)	33	33	49	80	100
Percent survival in submergence					
0 (all died)	0	22	6	0	0
1–50	33	11	21	0	0
51–75	33	22	21	20	0
76–99	1	0	0	0	0
100 (all survived)	33	45	52	80	100

Note: Four farmers did not experience any flooding at any stage of rice growth.
Source of raw data: Monitoring visits to farmer-managed trials in Indonesia, IRRI-Japan Submergence Project 2009.

varieties and the local check in terms of major traits can be tabulated. By indicating whether stress-tolerant varieties are better than, similar to, or worse than their local check, simple cross tabulation will give an overall picture of farmers' perceptions of the introduced stress-tolerant varieties.

Nonparametric test

To further investigate whether there are differences in farmers' perceptions of rice variety traits with respect to gender, both male and female farmers' ratings for the varieties tested in their fields will be considered for analysis. If the principal male and female farmers influence rice-farming decisions, preference ratings of male and female farmers from the same household will be tested for variation. Since the preference ratings are in an ordinal data format, the sign test will be an appropriate statistical test. However, to perform this test, researchers should have sufficient data. The number of sample respondents should be at least 12 pairs; otherwise, this test cannot be performed.

Box 6. IR64-Sub1 vs IR64, Mekongga, Cilamaya Muncul, Ciherang, and Conde.

Agronomic characteristics	Farmers' perception (%)					
	Worse than their existing varietiey		Same as their existing variety		Better than their existing variety	
Tillering ability	(4)	15	(6)	22	(17)	63
Plant height	(14)	51	(5)	19	(8)	30
Tolerance of submergence	(0)	0	(4)	16	(21)	84
Tolerance of pests	(3)	11	(21)	78	(3)	11
Tolerance of diseases	(4)	15	(18)	66	(5)	19
Lodging resistance	(0)	0	(23)	85	(4)	15
Overall performance	(15)	55	(5)	19	(7)	26
Grain yield	(22)	96	(0)	0	(1)	4
Easy to harvest	(7)	30	(9)	40	(7)	30
Easy to thresh	(9)	39	(22)	48	(3)	13
Milling recovery	(5)	26	(8)	42	(6)	32
Market price	(5)	22	(13)	56	(5)	22
Cooking quality	(3)	18	(7)	41	(7)	41
Eating quality	(3)	18	(9)	53	(5)	29
Storage quality*	(2)	2	(11)	11	(4)	4

*No response (83%).

Another way of analyzing the data on preference ratings of male and female farmers is to classify the farmer-cooperators according to their gender. The effect of gender differences can be included by doing ANOVA F. However, though ANOVA F is a more appropriate analytical tool for ordinal data, such a test is limited to the latest version of SAS. To read further on this kind of analysis, refer to Shah and Madden (2004).

Further reading

Shah DA, Madden LV. 2004. Non-parametric analysis of ordinal data in designed factorial experiments. Phytopathology 94(11):33-43.

Module 6

Stage 4: Wide-scale dissemination of lines and varieties selected through PVS

Module objectives

1. Discuss some concepts on technology dissemination that can help participants better understand the underpinnings of this critical aspect of the research-extension linkage.
2. Differentiate between scaling up and scaling out of strategies in technology dissemination.
3. Understand and be able to apply some strategies used in the wide-scale promotion of adoption/adaptation of technologies in rice-farming communities.

The ultimate test for the efficacy of research products is if they are being used by the target users. In the case of rice varietal development, long years of breeding and finding solutions to rice-farming concerns, particularly in unfavorable conditions, should translate into benefits in production, income, and livelihood. In accelerating adoption over a wider area, social, environmental, and economic issues should be examined to generate enough support. It is recognized that success in agricultural research for development depends on strong policy support from authorities and adherence to the principles of equitable distribution of benefits (Islam et al 2007).

Technology innovation is a process in which problems are identified, solutions are found and tested, and, as a result, the target group adopts a technology or other type of innovation (Lilja and Ashby 1999). This can be divided into three stages: design, testing, and diffusion. As such, the test for the relevance of the PVS process and technologies in bringing about rural transformation is the effect and, ultimately, the impact on the lives of rice-farming communities.

Four major considerations are central to bridging the gap between research and extension through PVS. These are major aspects of technology dissemination that link outputs from research on technology development to technology diffusion, namely: (1) diagnosis of the problem and who the clients are; (2) nature of the technology—how it was developed and how it can be applied, including the requirements for adoption; (3) nature of the communication medium to ensure effective packaging and presentation of information; and (4) the technology intermediary or brokering systems that anchor on the facilitating mechanism of an agency, an association, a networking arrangement, and public-private information service providers. These are further explained in the next section.

All these, when interwoven, can make widespread adoption a target-oriented process and participatory in nature. This module now focuses on diffusion but comes full circle and takes off from the first three stages of varietal development and testing in farmers' fields.

Key elements of technology innovation and diffusion to ensure wide-scale adoption

Target problem and target farmers

An effective diagnosis of the problem is the first step to an effective delivery of technologies. This includes the identification of the problem, its root causes, domain of concern, and the corresponding technical options (Labios et al 2004, Lapitan 2008). Careful analysis would reveal the core and subproblems that can be addressed by either research, extension (if the technology is already available), and policy or program focus by the government for widespread adoption, or by capacity enhancement, technology adaptation, farmer training, and community empowerment. Various participatory assessments of needs and opportunities and participatory rural appraisals are now available from previous studies and references. Some of these have been discussed in the first four modules of PVS.

Nature of the appropriate technologies

After determining the rice-farming problem, the search for the most appropriate solutions or varieties should begin. This will entail a series of consultations and understanding of what is in the basket of options. Identifying and using the selected varieties are a continuous process that can determine the performance of the varieties over time and under different agroecological environments and farmers' socioeconomic characteristics. The farmers and the community itself should be at the helm with facilitation support provided by development workers and extension agents. Figure 1 presents the three-way function of key players and the major aspects of technology diffusion. Horne and Stur (2003) work with three simple steps in validating technologies: keep the trials simple, encourage farmers to "play" with the options, and start on a small scale. Involving the community in presenting the results of validation also serves as a preliminary step toward a fast-tracked flow of seeds and technologies.

Communication medium and manner of information delivery

The technology diffusion theories highlight the crucial role that informal and formal channels of innovation play to cover a wide range of environments and farming characteristics, as well as varying socioeconomic conditions. What works well in farmer-to-farmer linkages in the community is a potent area to capitalize on. Farmers' feedback and multistakeholders' support should be major considerations in the communication pathway. Information delivery also includes the information, education, and communication materials that can enhance knowledge, awareness, and skills (KAS).

Technology intermediation and information broker/provider

Public-private partnerships in technology delivery are now commonplace in innovation diffusion. The essence is to bring together the sources and the recipient of information even from the start of planning what and how to deliver the products of research, that is, technologies and information. There is also a growing need to bring into play strong partnerships among farmers, researchers, and development/extension agents in a strategic three-way alliance. This can tap the synergism among key players and the value of sharing of expertise, knowledge, and resources (Fig. 1).

The concept: scaling up and scaling out the impact of participatory rice research

Many studies on the concept of diffusion of innovations clearly define efforts at scaling out and scaling up that can influence the behavior of various stakeholders and knowledge users.

The concept of "scaling up" refers to an institutional expansion from adopters and their grass-roots organizations to policymakers, donors, and development institutions. This concept brings to the fore the expansion of the sphere of influence of technology users to the higher plane of authority to gain support in technology dissemination. National programs and crafting of local and national policies to develop, validate, and widen the reach of technologies are clear examples of scaling up the impact of projects. Providing feedback to research can also hasten the process of scaling

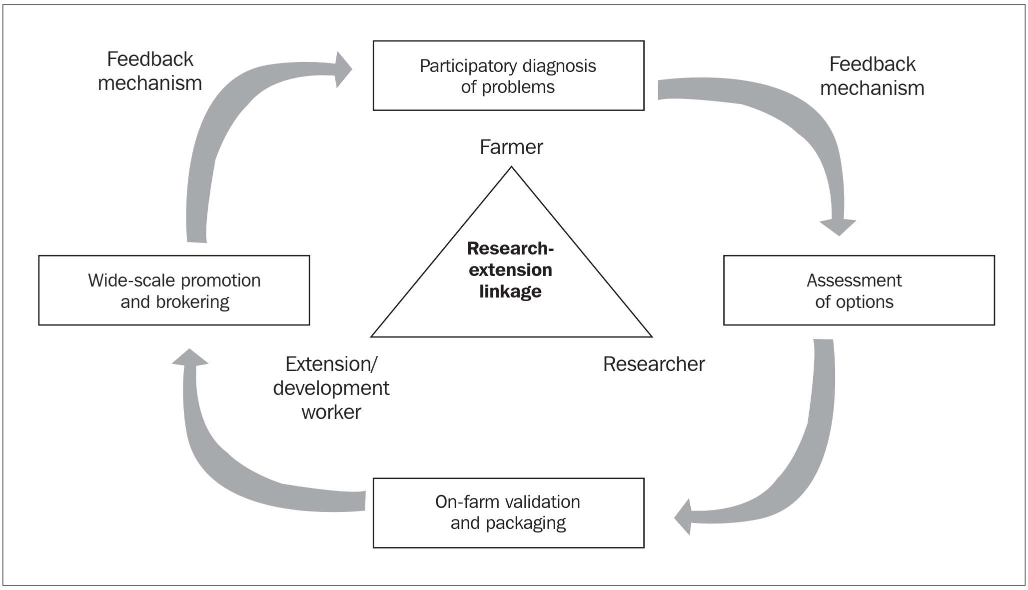

Fig. 1. Model for widespread technology diffusion.

up tools and strategies as they can influence priorities and practices of R&D institutions, thus influencing technology design and scaling-out processes.

Scaling up also connotes a vertical movement of experience, knowledge, impact, and effects, moving up the levels of organization of a sector or society. This implies involving more stakeholder groups when moving up the ladder from farmers to extensionists, from NGO workers to local officials, and from researchers to policymakers/ministers and donors (IIRR 1999).

On the other hand, scaling out is the spread of project outputs (i.e., a new technology, a new strategy, etc.) from farmer to farmer, from community to community, or within the same stakeholder groups. This is horizontal expansion within the same level or sector. For example, a project can gather information in the village on how existing social networks can be tapped to fast-track the spread and sharing of seeds. At IIRR (1999), both scaling up and scaling out imply adaptation, modification, and improvement (not just replication) of particular technologies and techniques, but, more importantly, of principles and processes.

The PVS approach, including its specific related activities, is now fast becoming a mainstay in rice plant breeding and line selection. This approach also provides both scaling up and scaling out of facilitation functions (Fig. 2). IRRI plays the role of a broker from the process of technology development that is attuned to the needs of the rice-farming community and based on participatory processes, and then links up with various entities for widespread technology adoption. Specifically, IRRI as a broker provides the following: (1) assessment of knowledge vis-à-vis the problem in rice farming; (2) a facilitating function for multistakeholder and multilevel consultations; (3) enhancement of linkages among partners for better access and delivery of information; and (4) capacity enhancement for wider application of the outputs of research and methodologies.

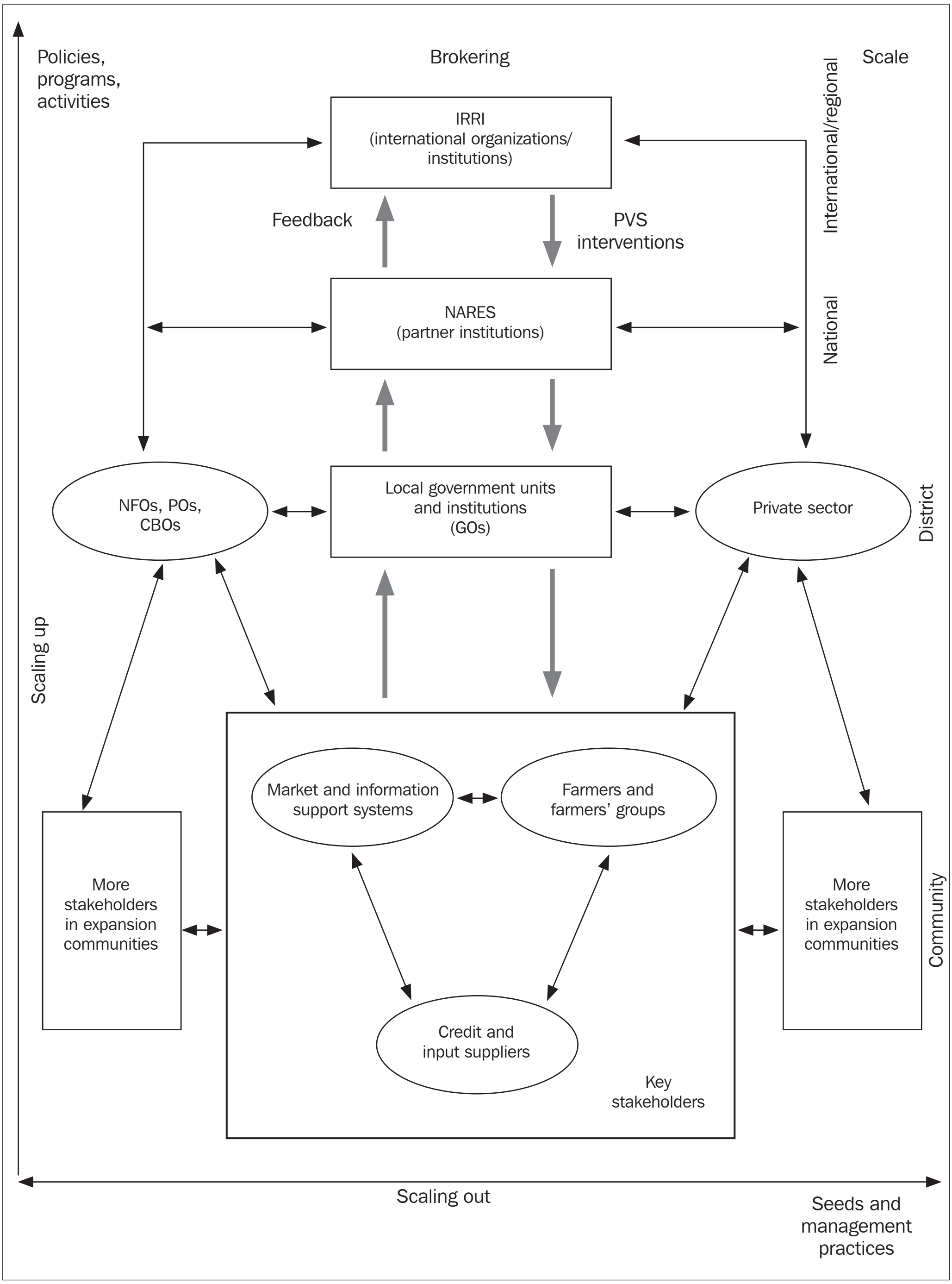

Fig. 2. The role of IRRI in scaling up and scaling out the impacts of PVS processes and technologies. (Modified from Douthwaite 2008.)

In delivering the varieties selected in the PVS and that are institutionalized into the country's seed distribution system, the following elements can serve as a guide:

1. *Make an assessment and tap social and human capital.* This can lend support to these efforts. The results of the PRA on social mapping, Venn diagram, and stakeholders' analysis can be good sources of information on this.
2. *Use a feedback mechanism to redefine the research agenda*. Similar to the case of projects on natural resource management, information accumulated on technology performance and attractiveness and how policies and institutions influence them, technologies, and manner of delivery should be adjusted accordingly (Harrington et al 2001).
3. *Make use of a variety of information, education, and communication (IEC) materials, and information and communication technologies (ICTs).* These should be pretested or validated, targeted to a specific type of reader-user, and easy to understand, particularly by farmers. The use of multimedia, both print and nonprint, can enhance the understanding and application of new techniques and farming practices.
4. *Make use of GIS tools and ground-"truthing" techniques.* The project components on site characterization, baseline surveys, and geo-referenced mapping can help a lot in identifying areas of similar agroecological environments for targeting and wide-scale adoption.
5. *Work from the top (policy) to the bottom rung (farmers) of the hierarchy of partners.* This means the scaling-out strategies should be combined with scaling up to ensure that strategies at the farmers' field level are replicated to other similar areas through public decision-makers interceding in rural development.

Wide-scale promotion of rice technologies by scaling up and scaling out

This section provides a variety of methodologies and mechanisms for both scaling out and scaling up of the impact of technologies and information on PVS preselected lines and varieties. The key considerations in choosing the most appropriate combination are the availability of resources (both human and financial), the capacity of the community and other users to absorb and adopt the strategies, and the results of the assessment of the problems at hand. In most countries, a variety can be used at a commercial scale and be supported by the national government only if it has passed through the normal variety accreditation or registration process.

A. Distribution of farmer-preferred varieties to active male and female farmers in many villages representing the target environment

Purpose: To scale out the results of researcher-managed and farmer-managed trials to farmers and communities by distributing preferred varieties to other farmers in different communities.

Steps:

1. Hold a consultation meeting with local government officials and leaders of the communities of the preselected sites about the activity or project.
2. Select new villages that represent the problem (submergence-prone areas).
3. Select new participating farmers based on the following criteria: rice growers should have a strong interest in and commitment to participating, should have fields representative of the problem, and should represent the majority of the social groups in the community, that is, men and women, small and marginal landholders, minority groups (i.e., Muslims).
4. Ask for men and women from each village as recipients to test the lines obtained from the baby trials. A simple letter of agreement between the project and the farmer partners, stipulating the roles and responsibilities of both parties during and after the project, can be developed (Labios et al 2004).
5. Provide the recipient farmers with 2–5-kg samples each of two or three varieties selected from the baby trials. Farmers should plant these varieties on their own farms without research assistance.
6. Researchers then visit the farms twice during the season to ask farmers for feedback. During these visits, farmers are asked what varieties they like and dislike, and why.

Tip:

1. Field days and field demonstrations including both men and women can be conducted to disseminate more varieties and to encourage spread through farmer-to-farmer exchange.
2. Farmer-preferred varieties can be disseminated with other technologies such as nursery management and soil nutrient management practices (especially in areas with low soil fertility).

B. Conducting a public awareness campaign to disseminate information among stakeholders

In creating awareness, there is a need to identify the target audience, readers, or users and fit the information campaign to the occasion and the participants. These strategies can contribute to both the scaling up and scaling out of technologies.

1. For policymakers and program implementers:
   a) Conduct policy fora to update policymakers on the latest developments in rice varieties suited to a particular biophysical condition or stress. Invitees can include the Ministry of Agriculture head, program leaders, regional or provincial executives, and other local executives who can lend support to the distribution of seeds and technologies.
   b) Have regular consultation and dialogues with the community to gain support from local leaders. This is also a good opportunity to discuss the technologies and

how they can help increase income and livelihood.
   c) Involve local executives and local government units for technical and financial support, especially in areas where the development agenda includes rice-farming productivity as one of the priorities.
2. For local research staff and extension agents:
   a) Hold regular meetings with local executives, research staff, and extension agents (government and the private sector). This is to get them to appreciate the contribution of the project to their development agenda.
   b) Tap the support of the community nongovernment organizations (NGOs). These have development agendas that are aligned to the objectives of enhanced rice production and dissemination.
3. For farmer-leaders, farmer-volunteers, and farmers' associations:
   Farmers that have the capacity through interventions in projects as in the case of IRRI projects in South Asia (Islam et al 2007) and Southeast Asia (IRRI-MOFA Japan Project on Implementation Plans to Disseminate Submergence-Tolerant Rice Varieties to Southeast Asia) are examples of transformed farmers who have become champions of the cause of community development in rice farming and the equitable spread of benefits from improved varieties and technologies.
   a) Farmer-leaders existing in the community are potent partners in technology diffusion. Studies have proved that their contribution to rural development through sharing of information cannot be overemphasized.
   b) Farmer-volunteers are progressive farmers in the community who value the concept of information sharing and learning at the same time. They manage to tend to their own farms and at the same time share the model of "learning-by-doing" with co-farmers and spread the benefits.
   c) More and more rural community development programs are supporting the so-called farmer-volunteers in the villages. They now serve as co-facilitators in spreading information and finding solutions for agricultural development.
   d) A farmers' group or association is a support system that can serve as an entry point for any intervention that can immediately reach a greater number of farmer-members. Officers of these associations are often willing to selflessly share knowledge and expertise with more farmers.
   e) The family approach (FA) involves the whole family—daughters and sons are given their own tasks in rice farming and in demonstrating the technology. For instance, the young daughters and the wife can help in keeping the leaf color chart (LCC) in a

safe place and reminding the farmer about the readings and application of fertilizer (Rashid et al 2007).

4. For local champions:
   A project can reach only a limited number of beneficiaries because of limited time, resources, and capacity. However, many successful rural development programs have identified the presence of caregivers or the so-called local champions who can "multiply" the gains from the project through their own commitment, capacity, and networks. A local champion could be anybody—a farmer, a farm manager, an entrepreneur, or even a rich and progressive farmer—with a conviction to reach out to technology and information users. This person can provide funding, leadership, facilitation skills, resources, and much more.

C. Conducting field days and demonstrations in researcher-managed and farmer-managed trials for scaling out

Purpose: To allow farmers, researchers, extension workers, academe, and others to assess the field performance of PVS varieties and gather information on their perceptions on varietal preferences.

Steps:

1. Invite various stakeholders (farmer-cooperators and -noncooperators, men and women, researchers, breeders, extension workers, academe, and local officials) to visit the PVS trials during maturity (before harvest).
2. Request local counterparts to make sure that all signboards, field labels, megaphones, and other materials needed are prepared before the field day.
3. During the activity, ask them to visit the individual plots with the sets of lines and visually rank the genotypes grown in farmers' fields. Ranking can be done from best to worst. The criteria are jointly defined by breeders and farmers. For example, breeders record the duration, plant height, and yield for each trial.
4. After ranking, discussions among agronomists/breeders, local research staff, and extension workers and farmers can be held on the characteristics liked or disliked. Reasons for ranking should be recorded in diaries.

Tools:

a) Focus-group discussions
b) Ranking

Tips:
Separate the responses of men and women farmers as well as other social groups (i.e., farmers with small, marginal, and large farms, caste, religion, and ethnicity).

Other similar approaches to scaling out:

1. The farmers' field school (FFS) is a participatory approach that uses nonformal adult education methods based on experimental learning techniques and participatory training methods (Asiabaka et al 2003). The concept of FFS can be used for any topic, including plant breeding. In this practice, farmers become experts and facilitators themselves, espousing the process of

decision-making to improve knowledge, experience, and observation skills (Smolders 2006).
2. Diversity fairs and seed fairs are a rich approach to on-farm conservation of seed biodiversity and have been proven successful in Vietnam, India, Nepal, and Latin America. They increase awareness of locally adaptable genetic resources and landraces. These are intended to recognize the custodians of this diversity, enhance farmers' participation, and inspire management of the rich diversity (CIP-UPWARD 2003).
3. The farm walk is fast becoming a strategy to share farm practices and schemes to solve farm problems. This may include a tour of the farm, its components, products, resources, and marketing strategies. This farmer-to-farmer learning experience allows time for questions and answers in the field and an opportunity for farmers to share practices and strategies being used and the concept and principles behind them. In some cases, this is a completely open farm space with a unique mission to engage the community at varying levels.

D. Packaging of information, education, and communication materials (IEC) that can address both scaling out and scaling up of objectives

Print and nonprint media such as the following are used:

- Leaflets, flyers, technology series, training manuals, technical bulletins, information materials, comics or illustrated caricature-based technology magazines, technology videos
- Video of selected appropriate technology—for multimedia effects
- Latest in information and communication technologies (ICTs) such as the use of knowledge banks, interactive e-learning modules, and distance education
- Development of Web sites such as www.irri.org/flood-proof-rice/
- School-on-the-air
- Rice-doctor/farmers' technology clinic
- Season-long training programs
- Cross-farm visits/field visits
- Information/technology caravan
- Techno-demo farm
- Setting up of a trading post-cum-training shelter

E. A survey using a structured questionnaire to assess the spread and adoption of varieties

Purpose: To assess the spread and adoption of varieties among farmers and target areas of new genotypes introduced through PVS and to identify the factors that support and constrain their adoption.

Steps:

1. Sampling of respondents:
    - In each community, all farmers who received seeds from the PVS project should be included in the survey.
    - If possible, at least 20 farmers per village who have not received seed from the project should also be surveyed.
    - At least 20 farmers in a neighboring village that did

    not receive seed from the project should be surveyed.
  - Diffusion of the varieties should be traced by asking one farmer the names of those to whom he or she gave the variety. Those persons can then be surveyed.
2. Through individual interviews, ask the respondent for basic household information: farm size, rice farm area, caste, tenure status, number of livestock owned, source of irrigation, area of each land type, family size, and number of family members working off-farm.
3. Ask them about their varietal adoption/nonadoption using the following:
   - List the varieties (including PVS lines) grown during the last 2 years.
   - Per variety listed, ask them about
     - Year of adoption
     - Who gave them the seeds (neighbor, university researchers, extension workers, etc.)
     - Land type
     - Plot area
     - Did they continue to grow the variety?
     - Why (if yes)?, why not (if no)?
     - Did they give seeds of the variety to anyone? Who (if yes)?
     - Are seeds given to others for free, sold, lent, or exchanged? Price (if sold).
4. Ask them about the source of variety information and future plans for seed multiplication.
   - Have you heard about the mother-baby trial introduced in the village? Yes or no?
   - What are the recommendations to help farmers get their preferred seeds?
   - Who makes decisions about keeping the seeds for the next season? The husband, wife, or both?
   - Do you have any problems in growing or obtaining the seeds of new varieties?
   - Do you want to test new varieties? If yes, why?
   - If you want to test new varieties, how many new varieties can you test each year?
   - If you test a new variety, how much seed is needed?
   - Where do you usually get information about a new variety?
   - Where do you usually get seeds of the new variety?
   - On cooking quality: Do you like the cooking quality of the new variety compared with the variety you use? Why and why not?
   - On eating quality: Do you like the eating quality of the new variety compared with the variety you use? Why and why not?
   - On milling recovery: Is the new variety better than the popular variety in terms of milling recovery?

Tips:

- Make sure that the reason for continuing or discontinuing is because of the positive and negative traits (i.e., yield, eating quality, etc.). It should not be a lack of access to seeds or damage by floods and drought.

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Module 7

Stage 5: Technology tracking and assessment of the immediate effects of the PVS process and technologies

Module objectives

- Discuss some concepts and methodologies for tracking the fate of a technology as part of impact assessment in development-oriented projects
- Discuss how researchers and farmer-cooperators can jointly assess the immediate effects of the PVS process using both qualitative and quantitative methods, such as oral testimonies, adoption studies, and the Women's Empowerment Index (WEI)

Tracking the fate of technologies and assessing the effects of the PVS process are critical to enhancing a project's timely delivery of interventions in a rice-farming community. These are integral elements of overall project impact assessment, which in turn feeds into the decision-making process to deliver the desired objectives. The submergence project implemented in rice-farming communities adopts participatory approaches to bring about a sense of ownership among various stakeholders. This should be a major consideration in defining the steps in tracking technologies and assessing benefits.

The overall impact assessment framework should clearly identify the beneficiaries and focus on changes in (a) human capital related to capacities, skills, knowledge, behavior, relationships, associations, and actions and (b) the activities of the people and organizations within their spheres of influence (Maglinao et al 2005). This influence of the project will spread out as direct farmer-cooperators and their immediate networks are tapped in monitoring project benefits.

Although a more in-depth assessment of project impacts can be done three or five years after the project completion, there are simple methodologies for a rapid assessment of benefits that the PVS process and technologies can contribute in improving the lives of communities having flood-prone rice. This can be done even as the project is still being implemented.

However, a key consideration would still be the proper timing of the assessment. It should not be so early that there are no evident effects yet nor too late so that the learning, insights, and recommendations would no longer be relevant or useful for decision-making (SEARCA 2008). The possible end in doing an initial assessment is capturing the immediate effects of the project in terms of the new varieties and being able to provide feedback to improve the breeding program.

To do this, there is a need to set up a system of data collection for tracking the fate of technologies and information through the social networks within the community. Technology tracking as an ongoing project monitoring and evaluation method is an adaptive management approach to technological innovation and diffusion. This system must be simple enough for farmers to understand it and participate in it. Included in the tracking system is the concept of the "snowball effect" to capture the spillover effects of project-to-farmer and farmer-to-farmer sharing of technological innovations. Support systems and inhibiting and facilitating factors in diffusion can be documented to serve as a guide for succeeding efforts in wide-scale promotion of technologies.

"Impact assessment involves the design of a system, for systematic study, documentation, analysis, and reporting, at different time frames during and after project implementation, the qualitative and quantitative project contributions toward the attainment of planned objectives and targets, and changes in the lives of the target clienteles" (Faigmane and Faigmane 2001).

The term impact is a change that happens at the community level, in research capacity, and at the scientific level (Templeton and Villano 2006). To put the concept of technology tracking into proper perspective, it is also important to distinguish among the three levels of change in the hierarchy of program objectives leading to the attainment of the overall goal. Based on the project logical framework, these changes are impacts, outcomes, and outputs. Technology tracking contributes to the assessment of the project outcomes and, to a certain extent, provides insights into the assessment of project impacts. This opens a window into how the project has contributed the changes through various interventions and processes, such as the PVS approach.

Impact refers to the intended or unintended change that happens to the users of the technologies, information, and other support services that the project provides. Impact is the outcome of the project effect, which in turn was brought about by project interventions. This could eventually lead to changes in the conditions of target beneficiaries. In this case, the interventions are the technologies and management practices for submergence-prone areas. These are expected to contribute change to the lives of the farmers as direct beneficiaries of the project. Examples of impacts are improved employment opportunities, increased farmers' income, improved quality of life, and improved livelihood.

Outcomes or effects, as others call them, are results of the project outputs delivered by the specific project activities. Examples are improved performance of varieties with submergence-tolerance traits, an increase in yield, an increase in production, reduced production losses, and enhanced skills and knowledge attributed to the information materials that have been produced and distributed.

Outputs are forms of the products or services as delivered by or that come from the use and processing of project activities. Examples are an increase in the number of new/improved varieties, the number of improved management practices, the number of new lines, and the number of researchers trained.

Actors' involvement in participatory monitoring and evaluation

Critical to participatory impact assessment is the synergism among the roles of researchers and development workers and how farmers and the community can be actively involved in the process. The farmers to be initially included in the sampling

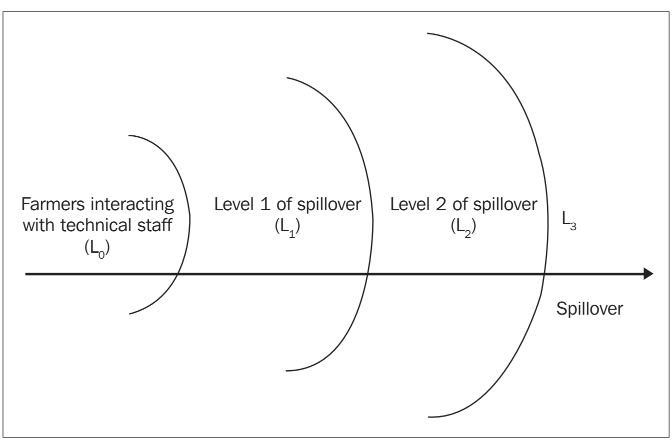


Fig. 1. Levels of technology spillover relative to project intervention. Source: German et al (2006).

frame are the PVS farmers as direct beneficiaries. This represents the initial level of interaction between the researchers and farmers. As much as possible, *at least* 15 female farmers and 15 male farmers in every village or at every site should constitute the study sample. These are the sets of farmers referred to as L_0 in Figure 1. As the survey forms are filled out, the technology tracking system will reveal who is sharing with whom. The level of spillover effects is designated as L_1 to L_n.

Farmer-leaders who are knowledgeable in the community will be tapped as cooperators in project monitoring and impact assessment. A list of actors who can be involved in the data collection and analysis and are anchored on the concept of a three-way arrangement among the farmers, the extension or technology diffusion agent, and the researcher (NARES partner institution) should be prepared.

The results of the initial benefit assessment or outcome and technology tracking should be presented to the community or village for further discussion. The objective is to gather additional bottom-up recommendations and strategies for wider promotion of the technologies. This also gives insights into how to improve the interventions and other strategies for rice-farming community development.

Keeping track of the diffusion of technologies and information

The main objective of tracking the fate of technologies is to understand the processes and benefits in the spontaneous spread and adoption of technologies, thereby enabling the design of strategies to enhance the positive impacts of technology generation and dissemination. This means that additional information will be collected and analyzed on factors that facilitate the flow of technologies, including the social networks, enabling environments, and capturing of a wider domain of program outcomes and impacts.

The end in view is to clearly define the three pillars of technological innovation and diffusion: (1) understanding the nature of the technology (the technology itself and its environment), (2) the nature of the clients, and (3) the nature of the technological flow—what can enhance or weaken the movement of information.

The snowball effect

The first step is to determine the snowball effect. This is a figurative term for a system or process that creates a succession of events that starts from an initial state (L_0) of small significance and continuously builds upon itself, becoming larger over a period of time and stage (L_1, L_2, … L_n). The concept took its name from a small snowball rolling down a snow-covered hillside, picking up more and more snow and accumulating mass and momentum as it rolls along. This concept is a potent means of tracking the multiplier effect of promotion and diffusion efforts of a project. This can also give an indication of the proper timing for a more rigorous impact assessment that will establish long-term benefits from the technology.

The snowball effect can be used as a sampling design as well as a system to keep track of the flow of technologies and information. The initial farmer-cooperators who will first receive the submergence-tolerant varieties can refer the researcher to other people, thus locating others who can be interviewed and from whom more data can be collected. Lindlof

(1995) indicates that, over time, the project gains efficiency in finding those who can provide information on sites and people whose attributes are central to the project. This enables the researcher to build a sample that represents an active social network in an organization or community. To avoid biases in selection, a list can be constructed from which a standard random sample can be derived for other data needs. This can be done unless a complete sampling is needed, especially for a small network of adopters.

Adoption studies: in-depth analysis of technology innovation and diffusion

Coupled with the concept of the snowball effect, a modified methodology for tracking the fate of technological interventions in agriculture can be used in the form of an adoption study. A more encompassing methodology can illustrate the potential applications of findings to enhance the positive impact of agricultural research and extension at selected sites with rice as the main commodity.

The design of an adoption study should capture not only the number of adopters and their reasons for adopting but also gain more in in-depth analysis of the community dynamics and social networking that can have significant influences on the rate of technology adoption. The social networks define how the technologies and information will move within the community, through the existing communication pathway, and even beyond project life. This could be in the absence of outside interventions in sharing information for a more equitable access to technologies and information. Enabling and constraining factors will determine what could spell success in technology diffusion and what could slow down or hinder the process in the communication chain.

Social and biophysical "uptake niches" serve as a basis for the design of technologies targeted for a specific type of farmer and farming conditions to minimize possible problems in technology introduction or intervention (German et al 2006). This analyzes the socioeconomic characteristics of the farmers, their farming practices, and other factors that can influence their decision to adopt a technology.

Impacts are then analyzed, illuminating the positive and negative, intended and unintended consequences and benefits of PVS, and the process of diffusion. The objective is to look for evidence of changes at the farm-household level and within the community. For the farmers, the changes to be examined would be in terms of changes in farming or cultural practices and in terms of the performance of the varieties that lead to changes in yield/production, cost, and income. Indicators of impact could be in terms of the number of farmers and area. Later, this analysis could feed into the intensity of adoption—meaning, there is repeated use of technologies and there is an increase in area where the technology is used by the farmers.

Qualitative assessment of impacts

Oral testimonies of men and women cooperators of farmer-managed trials

Qualitative data are sources of well-grounded, rich descriptions and explanations of the processes occurring in a local context. There is now a growing trend toward combining the use of quantitative and qualitative methods to address a specific problem.

Qualitative data provide more in-depth explanations of numbers derived from quantitative methods.

Oral testimonies are first-hand accounts of farmers' experiences in adapting and adopting the technologies and management practices introduced by the project. This is one of the oldest types of evidence. Information can be handed down from generation to generation and form a rich pool of innovative ideas as farmers integrate their own intricate notions on farming into what they have learned from other information sources. The synergism in information and communication flow that is captured makes for a potent innovation system in a farming community.

Focus of inquiry

The general objective of this inquiry is to document and learn from the experiences of selected men and women cooperators who participated in the process of PVS in particular, and the project in general, and to assess the benefits they gained from it.

Selection of respondents

1. Identify and select at least five men and five women respondents from the cooperators of researcher-managed trials in PVS (RM-PVS) or those who received seeds at the start of the project.
2. The research team can identify the set of criteria to be used in identifying the cases for testimonies. The selection criteria can include the following:
   a. There has been a significant change in the farming system of the farmer that has led to a significant change in his life;
   b. The change can largely be attributed to the submergence project;
   c. The farmer's experience is recognized and the general project impact is already beginning to be known in the community; and
   d. The farmer must be willing to share his experience with others and to cooperate in providing information.
3. Specify the involvement of the respondents in the project.
4. Conduct an interview with the selected men and women respondents. Ask them about their insights and lessons on their experience in participating in the trials, the results and benefits of the new varieties, and their future plans in regard to the varieties. See the attached guide for a focus interview (Box 1).
5. Write down the interviews with the testimonies of the selected cooperators and share this with other farmers (Box 2). The format and scope of the discussion of results can be summarized into the requirement of a publication or any print or nonprint medium for immediate information dissemination (IRRI Sub1 Rice News, Vol. 2, No. 3, 2008; IRRI Sub1 Rice News, Vol. 2, No. 2, 2008).
6. Take note of the cooperators' unique experiences and useful insights; if the respondent grants permission, record the conversation using a tape recorder.

Box 1. Topical guide for oral testimony

A. General Information
   1. Name of respondent:
   2. Age:
   3. Education level:
   4. Number of children:
   5. Address, location of the farm
   6. Description of the farm, landholding
   7. Other occupation, sources of income:
   8. Information about the farm (note: if the farmer is a PVS farmer and has been included in the baseline survey, the information can just be taken from the database).

B. Information about submergence conditions and other biophysical conditions on the farm
   1. Describe the submergence conditions on the farm
   2. Other biophysical conditions
   3. Problems brought about by submergence conditions
   4. Solutions used to alleviate submergence conditions

C. Information about seeds received
   1. How and where the seeds/submergence-tolerant rice varieties/lines were received
   2. Adequacy of information given about the associated management practices. How and where the information, the description of the technologies, and the associated management practices learned from the project were provided. Seed increase to have adequate planting materials for the farm size.

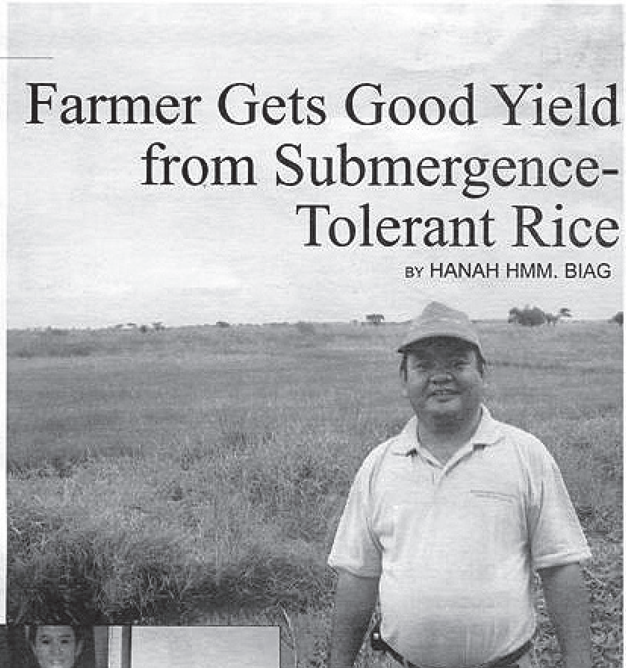
D. Observations about new seeds provided by the project
   1. If the farmer is included in the PVS, focus the baseline survey on the characteristics of seeds used and summarize the information here.
   2. How would you describe the performance of the seeds provided by the project: agronomic, socioeconomic characteristics (cooking and eating quality, postharvest quality), others?
   3. Other information on changes in farming practices because of the use of project-provided seeds.

E. Most significant change or immediate effect of the use of submergence-tolerant varieties and associated management practices on household economy

F. Recommendations for the improvement of seeds and the diffusion system
   1. What are your recommendations to further improve the seeds and associated management practices?
   2. What are your recommendations with respect to the mode of delivery of information to farmers and how the technology diffusion mechanisms can be fast-tracked to reach more farmers?

G. Plan to adopt the new seeds and share them with other farmers

Box 2. Sample oral testimonies in concise format



The ricefield behind Ladores remained idle for many years, but not until Swarna-Sub1 was introduced to him.

Farmer Gets Good Yield from Submergence-Tolerant Rice

BY HANAH HMM. BIAG

A FILIPINO NURSE in Saudi Arabia went back to San Antonio, Nueva Ecija to manage the 40-hectare farm of his in-laws. But to his dismay, he can't grow rice in 10 ha during wet season due to flood.

He is Gelises Ladores of Barangay Sto. Cristo. For 19 years, he said, he doesn't plant during wet season because when flood occurs, the fields would be submerged for as long as 15 days and the water reaches waist level.

The luck of this 52-year-old farmer started to improve only in the 2008 wet season. He learned of the flood-tolerant rice Swarna-Sub1, which can survive 10 days of complete submergence at vegetative stage, matures in 130-134 days, and grows as high as 75 cm-85 cm. He even went to PhilRice's on-farm testing of submergence rice in Barangay Papaya to learn the technology.

Gelises Ladores and his wife, Fructosa, are very pleased with the performance of submergence rice Swarna-Sub 1. Because of it, they earn double hence they have more income to send their two children to college.

Ladores planted 130 kg of Swarma-Sub 1 seeds in 1.5 ha, and harvested more than 100 cavans weighing 70 kg each. He stored 1.5 cavans of seeds for the next wet season and had the remaining harvest threshed and sold at ₱14/kg.

"I didn't expect that Swarna-Sub1 would yield that much. My only concern that time was to get yield from my submerged field," Ladores said, adding that Swarna-Sub1 requires less fertilizer than other varieties, has bigger stem, heavier when threshed, and has good eating quality.

This wet season, Ladores planted Swarna-Sub1 in 21 ha. And to prevent incurring losses, he had Swarna-Sub 1 direct-seeded in May to make sure that the crops are strong enough to tolerate stress when flood occurs and for it to be ready for harvest by October.

Ladores also tried the flood-tolerant IR64-Sub1 in 0.5 ha, but he harvested only 12 cavans due to rats and diseases.

"I prefer Swarna-Sub1 over other varieties for the wet season. But if there are Sub 1 varieties better than Swarna-Sub1, then I would also want to try them," he added.

Ladores is thankful that submergence rice varieties like the Swarna-Sub1 are being developed. It is indeed a big help to farmers in low-lying areas, he said. If not for Swarna-Sub1, he would not be able to double his annual rice production, which gives him more income to support the college education of his two children.

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Measuring women's empowerment due to participation in PVS

An expected outcome of PVS is the empowerment of women farmers in making decisions on rice varietal selection. Women's empowerment can be measured by using the Women's Empowerment Index (WEI). The purpose, steps, and methods are discussed below.

Purpose: To assess and measure women's ability to make decisions on rice varietal choice, acquisition, and disposal by using an empowerment index.

Steps:

1. Select wives of participating and nonparticipating households of PVS (approximately 25% of the total cooperators) by sampling.
2. Social scientists interview the selected wives from poor farming households regarding their participation in deciding about varietal choice, acquisition, and disposal.
   The WEI is determined by identifying the decision-maker (husband or wife) and activities for which a decision is made. A woman's empowerment is higher when she can make a decision alone, even if her husband is present. Thus, the wife is "highly empowered" or "enabled" when she gets a high score. This methodology was modified based on Hossain et al (2004) for agricultural and nonagricultural decisions of a husband and wife in Bangladesh.
   The questions for the activities are:
   - Who decides what rice variety to grow?
   - Who decides what variety to grow or not grow for the next season?
   - Who decides whether to give or not give new seeds to other farmers?
   - Who decides to sell the seeds?
   - Who decides when and where to get the seeds?
   - Who decides whether to participate or not in the PVS trial?
   - Who decides whether to keep the seeds or not for the next season?
   - Who decides whether to apply fertilizer or not and how much?
   - Who decides what crop establishment to use?
   - Who decides whether to weed or not the rice fields and when to weed?
   - Who decides to remove off-types and select seeds for the next season?
3. The Women's Empowerment Index is coded by identifying the decision-maker and the activities when the decision is made. The score is the Women's Empowerment Index. The rating values of the decision-makers have been assigned according to the weight in favor of the wife. For example, a higher value (K) of an indicator (X) indicates a higher empowerment level for a woman as shown below, where K is (1…5): We assigned the lowest value (= 1) when the husband makes the decision alone, even if the wife is present. At the other extreme, the highest value (= 5) was

assigned when the wife makes the decision alone, even if her husband is present. For example, a higher value (*K*) of an indicator (*X*) indicates a higher empowerment level of a woman shown, where *K* is (1…5):

1 = husband alone even if his wife is present
2 = husband dominates wife
3 = husband and wife make joint decision
4 = wife dominates husband
5 = wife alone, even if her husband is present

The above statement can be measured by rating each decision indicator (*X*) as shown below:

X_i = decision-making indicators	K = any rating value of each indicator				
	Low				High
X_1	1	2	3	4	5
..	1	2	3	4	5
..	1	2	3	4	5
X_n	1	2	3	4	5

Therefore, the average scoring value of X_i (i.e., *i*th indicator) for all households would be the average of the value K_i denoted by the following matrix:

$$X_1 = \bar{K}_i \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Eleven indicators for each household to construct the WEI for varietal choice, seed acquisition and disposal, and crop management ($WEvar_i$) are shown in equation 2:

$$WEvar_i = \sum_{i-1}^{11} \frac{X_1}{11}$$

where $WEvar_i$ represents the following indicators of an *i*th household:

X_1 = what rice variety to grow for the next season
X_2 = to give/sell seeds to other farmers
X_3 = to exchange seeds with other farmers
X_4 = when and where to get seeds
X_5 = to keep the seeds for the next season
X_6 = to apply fertilizer
X_7 = when to apply fertilizer
X_8 = crop establishment methods(s) to use
X_9 = to weed the rice fields
X_{10} = when to weed the rice fields
X_{11} = to remove off-types and select seeds for next season

4. Analyze and share the results of these findings. Paris et al (2008), in their study on the impact of PVS on women farmers, reveal that the women who participated in PVS were more empowered in making decisions on the acquisition of seeds (to exchange, and when and where to get seeds). These decisions between the participants and nonparticipants are statistically significant. Thus, to maintain the quality of seeds obtained through farmer-to-farmer exchange, women should be given adequate knowledge and skills on all aspects of rice production and not only on postharvest and seed management aspects.

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