Assessing the Impact of Participatory Research and Gender Analysis

Edited by:
Nina Lilja, Jacqueline A. Ashby, and Louise Sperling
with the collaboration of Annie L. Jones

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The Consultative Group on International Agricultural Research (CGIAR) works to promote food security, poverty eradication, and sound management of natural resources throughout the developing world.

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The purpose of the CGIAR Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation (PRGA Program) is to assess and develop methodologies and organizational innovations for gender-sensitive participatory research and to apply these in plant breeding, and crop and natural resource management.

The PRGA Program is cosponsored by 4 of the 16 centers that make up the CGIAR: the International Center for Tropical Agriculture (CIAT), which serves as the convening center; the International Maize and Wheat Improvement Center (CIMMYT); the International Center for Agricultural Research in the Dry Areas (ICARDA); and the International Rice Research Institute (IRRI).

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CIAT s mission is to reduce hunger and poverty in the tropics through collaborative research that improves agricultural productivity and natural resource management. Headquarters in Cali, Colombia.

CIMMYT is a nonprofit scientific research and training organization engaged in a worldwide research program for sustainable maize and wheat systems, with emphasis on helping the poor while protecting natural resources in developing countries. Headquarters in Mexico City, Mexico.

ICARDA s mission is to improve the welfare of people through agricultural research and training in the dry areas in poorer regions of the developing world. The Center meets this challenge by increasing the production, productivity and nutritional quality of food to higher sustainable levels, while preserving or improving the resource base. Headquarters in Aleppo, Syria.

IRRI is a nonprofit agricultural research and training center established to improve the well-being of present and future generations of rice farmers and consumers, particularly those with low incomes. It is dedicated to helping farmers in developing countries produce more food on limited land using less water, less labor, and fewer chemical inputs, without harming the environment. Headquarters in Los Baæos, The Philippines.

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CONTENTS

OVERVIEW: ASSESSING THE IMPACT OF USING PARTICIPATORY RESEARCH AND GENDER/STAKEHOLDER ANALYSIS

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Introduction

Public-sector and non-governmental organizations (NGOs) are increasingly using participatory methods to widen the adoption and impact of a range of technology innovations in agriculture and natural resource management (NRM). Examples of these technology innovations are: new crop varieties, improved crop husbandry, or changes in the management of soil, water, or forest resources. The growing scarcity of resources for research outside the private sector places increasing demands on researchers to provide evidence that the costs of participatory methods are justified by the results. Carefully conducted impact studies are needed to provide convincing evidence that client participation has been a good investment in the past and will continue to be so in the future.

Although researchers using participatory methods have observed the success of the approach in a variety of fields, and documented results in a number of case studies, the impacts of using participatory research in contrast to other approaches are rarely systematically analyzed and recorded. This absence of well-documented analysis gives rise to important yet unanswered questions that are critical not only for the long-run credibility of participatory methods, but also for the survival of the principle of user or client participation in research and innovation. Ashby (1996) outlines these questions as:

1. What degree of user participation is appropriate at a given stage in the innovation process?
2. What approaches to farmer participatory research and gender analysis (PRGA) are most effective for different types of technologies: e.g., knowledge or management intensive?
3. Are farmer PRGA approaches broadly applicable?
4. How do we measure benefits and monitor performance in relation to different goals (of various stakeholders)?
5. What are the costs?

An objective of using gender/stakeholder analysis is to assess how best to involve all stakeholders in the innovation process. This requires that we consider what patterns affect development among the stakeholders, analyze what activities the different types of stakeholders carry out, and assess with what resources different stakeholders work. Gender and stakeholder analysis does not always directly provide answers to agricultural production or NRM problems. But, it does provide means of raising questions about links between and among different stakeholders and agricultural production or NRM. Moreover, carefully conducted and documented gender/stakeholder analysis builds a solid basis for developing strategies to incorporate gender issues that are key to the success of development efforts (for gender analysis frameworks see for example: Wilde and Vainio-Mattila 1995, Lingen 1997). Similarly, a sound assessment of the impacts of gender/stakeholder analysis provides convincing evidence on how effectively it meets the overall goals of the development efforts.

This introductory essay analyzes the main features of work being done to assess the impact of applying participatory research approaches and gender analysis to processes of innovation in agriculture and NRM, as a basis for recommending new directions for understanding and achieving greater impact in the future. We begin with a brief review of the status of impact assessment on PRGA. We discuss the main gaps in current work in the light of these key concepts of impact assessment. Next, we propose a general framework for assessing the impacts of using participatory research approaches and gender analysis. In this context of the framework, we also refer to the empirical cases of impact assessment, which are presented in the following chapters of this book.

State-of-the-Art Impact Assessment of Participatory Approaches and Gender/Stakeholder Analysis

A most important feature of the enormous body of work in progress using participatory approaches for rural development, agricultural innovation, and NRM is that the adage "a rose is a rose is arose" in no way applies. A high diversity of objectives and expected impacts are attributed to participation, making it a complex task to define the most important impacts for assessment in relation to different stakeholders' interests. These impacts range along a continuum from efficiency or functional types of impact to capacity building and empowerment. For example, participation is used to improve the design and adoption of an agricultural technology – an efficiency outcome. A somewhat different outcome attributed to participation is that of local people's improved capacity to manage soil and water resources sustainably, and to maintain local control over this management.

Another feature of the diversity of expected impacts attributed to the use of participation is the lack of discrimination between process outcomes and final or "technology" outcomes. For example, a participatory approach to technology development can have an effect on the way experiments are carried out (process outcome) and thus on the number and type of people adopting the final technology hence capturing the economic benefits from adoption. The way the research is carried out, in other words, whether it is participatory or non-participatory, will also have a direct impact on the costs of doing research.

Similarly, the impact of using a participatory approach is often confounded with the impact of the innovation (technology) introduced using it. Why is this important? First, confounding these two impacts may overestimate that of participation by attributing to it results that could be accomplished by introducing the same innovation without a participatory approach. Typically, the impacts of participatory projects are measured in absolute terms, as project impacts achieved to date (see for example Hinchcliffe et al. 1999 for a review of impacts of 23 watershed management projects). To measure the impacts of the given participatory approach, we must compare the achieved project impacts to those that would have been achieved if the project had used a non-participatory approach. Published studies include little evidence on the impacts of participatory research compared to a non-participatory, counterfactual case. Even where an attempt is made to measure the impacts compared to a counterfactual case, too little attention is paid to appropriate choice of case. A counterfactual study is typically difficult to establish because of the selection bias inherent to the participatory research: the participating communities are not usually randomly selected and participation is voluntary, giving rise to selection biases.

The same situation holds true for the use of gender analysis: many objectives and expected impacts are attributed to gender differentiation. At the same time, gender analysis is applied with little systematic discrimination. How variances in use might produce completely different impacts is not carefully analyzed either. Three basic types of application are common in agricultural or environmental research and development. A "diagnostic" use of gender analysis involves describing who does what and when in agricultural production and in the management of natural resources. It involves describing who controls resources and makes decisions about them; and who benefits from this distribution of power and responsibility (Feldstein and Poats 1989) in order to call attention to differences between men and women and their likely effects. Two other action-oriented uses of gender analysis can be termed "design-" and " transfer-oriented." Design-oriented applications of gender analysis use an understanding of gender differences to develop specific innovations tailored to the different resources and capabilities of women. Such innovations are often, but not exclusively, designed to mediate or overcome inequity effects of gender differences. Transfer-oriented applications of gender analysis use an understanding of gender differences to ensure women's access to innovation. This approach is used to mainstream access to and use of innovations that are expected or assumed to be of similar utility to men and women.

A second feature of this body of work is that the cause-effect relationships expected to lead from participation to any given impact or combination of impacts are seldom explicit. As a result, the many varieties of participation in use are loosely associated with a large set of equally diverse outcomes. Little work has been done to examine whether the expected results of participation are well grounded in demonstrable or replicable cause-effect relationships. This makes it difficult to generalize about the impact of participation, to understand what contributes to success, or to predict with any accuracy what the impact of a participatory intervention is likely to be. Such lack of clarity about the causes of success and failure makes it difficult both to scale up the geographical coverage and to predict how many participants benefit.

Framework for Impact Analysis of Client Participation in Research

Even if a participatory project successfully achieves its set objectives, without an explicit impact analysis framework no basis exists for understanding how and why it worked or for reproducing its effects on a broader scale, in other sites, or with other target groups. This section addresses the need for an explicit impact analysis framework by presenting and illustrating the use of several concepts specifically for the impact assessment of participatory research approaches and gender analysis.

Some useful guidelines and frameworks for impact assessment and project evaluation are available (Horton et al. 1993, Murphy 1993, Rossi and Freeman 1993, Alston et al. 1995, SLM-IM 1998, Ezemenari et al. 1999). This section discusses some of the key elements that can be drawn from the general impact assessment literature. Some specific elements are also developed that are needed to understand what difference is made to the impact of agricultural innovations by including participatory approaches and gender differentiation.

Here, we define impact assessment as: "*An assessment done at a given point in time, and its objective is to measure the expected and unexpected impacts of the project. The timeframe of the* *analysis can be backward looking (ex-post) or it may be a forward looking (ex-ante) analysis. Project impacts are evaluated by comparing situations or conditions: before/after, with/without, or achieved/expected comparisons."* Here we must differentiate between "impact assessment" and "monitoring and evaluation" (M&E). We define M&E as an on-going activity throughout the project life and its objective is to monitor the process of implementation and feed back information about the process.

This book has a separate section on M&E where McAllister provides an extensive framework for M&E in NRM (chapter 7). The M&E framework she presents has many similar components with the impact assessment framework presented in this overview chapter. She also discusses many tools in participatory monitoring and evaluation (PM&E). Da Silva et al (chapter 8) describe the process of developing and implementing a participatory monitoring plan implemented for a project in Brazil. They discuss two types of monitoring, with and without indicators, and draw some conclusions from the learning process. Campilan and Prain (chapter 9) report on a Centro Internacional de la Papa (CIP) - Users' Perspectives With Agricultural Research and Development (UPWARD) experience in using self-evaluation as an approach to help researchers assess their own practice of participatory research. Seven case projects from five Asian countries are briefly described.

"Who does the impact assessment?" is a question that is often asked when planning the impact assessment work. Some approaches assume that the person doing the impact assessment is an objective evaluator who has no other stake in the project. In reality, the evaluator is usually a project staff member and has a stake in the assessment's outcome. Who designs the assessment tools and determines the indicators used in the impact assessment is important and we will also try to address this in our framework.

The impact assessment framework we propose describes six key concepts:

1) Who are the stakeholders in the impact assessment and what are their impact interests?
2) What are the most important impacts to be measured?
3) How does the project scope and approach influence the impact?
4) What are the cause-effect relationships hypothesized to lead to impact?
5) How do we measure the impacts?
6) How do we judge the success of the project?

Concept 1:
Who are the stakeholders in the impact assessment and what are their impact interests?

A stakeholder in the proposed impact assessment framework can be anyone who has an interest in PRGA: anyone, who participated in the project, evaluates the project's usefulness, financed the research, or uses the results.

Different stakeholders often have different ideas in terms of a given project's expected impacts. The stakeholders' impact expectations may differ in two ways: 1) different stakeholders may have different sets of expected impacts; and, 2) different stakeholders may have different priorities among all expected project impacts. The first is an issue of consistency between how different stakeholders understand and perceive project goals. The second is an issue of the magnitude of impacts and the difference between stakeholders' priorities—that in the end will influence how different stakeholders view the project's "success" and actual achieved impacts.

Different expectations need to be considered at the beginning of the impact assessment work when determining which impacts to assess. Expectations also need to be taken into account at the end of the assessment when the project results and success will be viewed differently by different stakeholders because of their different expectations. For example, consider the following scenario: a project's objective was to increase rural women's income, but in its implementation, only men participated (for various and mostly legitimate reasons) and as a result, men's incomes increased. Clearly the incomes of the participating rural households increased—but when asked, men, women, donors, project staff, and the person doing the assessment viewed the success of the project very differently.

Hence an essential starting point of impact assessment is to assess what are the expected impacts of different stakeholders and compare whether they are consistent with the project goals and actual implementation. Once we have compared various stakeholders' expected impacts to the project goals, what does this tell us? It tells us if the expectations were sufficiently clarified at the start and if the beneficiaries' opinions affected the project goals. If expectations were not well clarified, where do we go from there? Do we assess the project according to the expectations of a certain stakeholder group or groups or according to stated project goals? We will address this issue next.

Concept 2:
What are the most important impacts to be measured?

Typically a project evaluator judges the project's success by measuring if the goals were achieved. Assessing the impact expectations of various stakeholders gives a range of impact/s that the evaluator might expect to find, given the project goals, but also allows the definition of some unexpected impacts based on information from the stakeholders' impact expectations.

Defining which impacts to measure is the starting point for focusing the work and determining the methods to be applied. Limited time, budgets, and skills make it impossible to assess all potential impacts. Thus the reasons why certain kinds of impact need to be assessed must be identified. The purpose of the impact assessment is to understand the innovation's economic benefits to the users so an economic rate-of-return study may be appropriate, but is not sufficient for most participatory projects. We need to understand how the process benefited different stakeholders; hence a more descriptive and illustrative adoption study may be required. When concern is raised about equity, the benefits to different beneficiary groups must be assessed. A concern also exists about the effects of the participatory process and the proposed innovation on human capital or the environment, and so a social and environmental impact assessment is needed.

We need to distinguish between different types of potential project impacts to capture their complete range. We define three categories of impacts: process, technology, and costs.

Process impacts, when assessing the effects of using a research approach or methodology, are generally of two types: (1) feedback to research for technology development, and (2) social and human capital formation impacts. Process impacts relate to the entire innovation process and particular types of participatory approach used. The hypothesis here is that stakeholder participation in research results in technologies that are more consistent with clients' needs. Examples of process impacts are:

- Project's research objectives are consistent with clients' needs because clients are involved in project planning.
- Participating clients are empowered to carry out some of their own experiments and seek and find solutions on their own.
- Clients have technologies available to them that meet their criteria.
- Many intended users quickly adopt the technology.
- Participating clients investing resources into the research process strengthens their commitment.

Technology impacts are related to the technology's adoption and the direct economic benefits to its users. Technology benefits are not realized until the "end" of the innovation process. All the potential process impacts at different stages are aggregated into final technology impacts. The same technology impact can be attained from many combinations of different types of participation at different stages. Examples of technology impacts are an increase in the:

- Number of adopters among the intended users.
- Income among intended users.
- Equity: the income share of the poor in the community is stimulated more towards the income share captured by other groups.

Cost impacts of participatory approaches are of two different types: project and participant costs. Both process and technology impacts have direct implications on the costs of research. Cost-effectiveness of a given technology or research approach cannot be assessed until the end of the innovation process. Examples of cost impacts are:

- Total research costs are reduced allowing resources to be allocated to other uses.
- Most costs are incurred early in the project cycle.
- Some of the research costs are transferred to beneficiaries.

Given the variety of potential impacts to assess, starting simply with the most obvious and most easily valued impacts is best. For example, in participatory plant breeding (PPB) it is easiest to start with the directly measurable productivity changes that can be valued by market prices. In NRM projects, for example, intervention may prevent soil erosion that would otherwise disrupt a downstream or "off-site" agricultural activity such as a fishery or irrigated fruit plantation. The net change in fish or fruit production due to controlling soil erosion can be identified and valued. Each of these examples has secondary impacts that are also important, but for the impact analyst it is best to start with the impacts that are most easily identified and valued. Secondary impacts can only be assessed if time and resources allow.

Concept 3:
How does the project scope and approach influence the impact?

The impacts of using participation or gender analysis can be expected to vary, depending on the stage in the innovation process at which they were applied. Farmer participation at different stages of innovation can have different impact on the technology or innovation design, as well as the potential adoption/acceptance among the intended users. Farmer acceptance of the technologies being developed is more assured if they participate early in the design stage. When planning and setting goals, farmer participation may help to steer the research in a more focused fashion and more directly towards farmers' priority needs. Commonly, farmer participation steers research in completely unanticipated directions. Similarly, who participates at different design stages may lead to different priorities being identified for different beneficiaries.

Defining project scope: stages of innovation. The participatory innovation process can be divided into three stages: design, testing, and diffusion. For each of these, farmer participation can have a different purpose:

- The **design** stage is when problems or opportunities for research are identified and prioritized, and potential solutions to priority problems are determined. The outcome of the decisions made at this stage is an array of potential solutions. These solutions can be any of the following: a completely new solution is invented and needs to be tested; a new application of an existing solution is identified as having potential, but needs to be tested; or an existing solution can be used, but needs to be promoted.
- The **testing** stage is when potential solutions chosen for testing are evaluated. Decisions are made about who does the testing, and where and how it is done. The outcome of this stage is recommendations about the innovation or technology to intended users for mass distribution.
- The **diffusion** stage involves building the awareness of recommended solutions among future users. It involves decisions about when, to whom, and in what way to build awareness, supply new inputs, and teach new skills to future users. The outcome of decisions made at this stage is full or partial adoption, or no adoption.

Many projects do not necessarily begin at the design stage. For example, a project of participatory varietal selection may begin at the testing stage: farmers are asked to evaluate a sample of materials, using their own selection criteria etc. So, when we analyze the impacts of that particular project, we cannot expect wide-scale adoption (= a diffusion stage outcome) if the project's scope was the testing stage only. Also, note that "stages of innovation" is not the same as "project cycle." Each project, even if only carried out at the "testing stage" of the innovation process, has its project cycle of planning, design, implementation, monitoring, etc. It is also a typical scenario that a participatory project may trace through the stages of innovation through various paths: it may begin in testing stage, and given the findings decide to go to the design stage next and so on.

In chapter 2, Weltzein et al. provide interesting empirical evidence about when projects are actually involving farmers in the research process. In conducting their overview of over 40 formal-led PPB projects to date, it became clear that most programs involved farmers in the testing of varieties, materials that were genetically fixed and often already released. (The authors refer to "farmer-led PPB" as situations where the farmers' own crop development or seed supply systems receive support, and "formal-led PPB" as situations where farmers join a formally initiated process of crop development.) The authors also examine farmer involvement in the framework of a whole technical process of plant breeding and variety development, similar to the general stages of innovation described above, but more specific to formal-led plant breeding.

Defining the approach: types of participation. Project impacts depend upon the stage in the innovation process and also on what types of participatory approaches and gender analysis methods were applied. To define what kind of impacts can be realistically observed, different "types of participation" need to be distinguished. We characterize the participation of farmers and scientists at various stages in the innovation process, using a typology developed for this purpose (Lilja and Ashby 1999b). The particular typology used here systematically focuses on who participates in pivotal decisions made in the innovation process.

Variations in the level and intensity of stakeholder participation in a process of innovation for technology development can be characterized in terms of the balance of power and authority among the stakeholders at a given stage in the process. Numerous classifications of participation are available; many of which build on Biggs and Farrington's (1991) four categories (contractual, consultative, collaborative, and collegiate) based on increasing degrees of farmer initiative in decision making. Other classifications distinguish more categories of participation by including dimensions such as initiating action or sharing information in addition to decision making (e.g., Pretty 1994). We define five different types of participatory research depending on who makes key decisions that move the innovation process from one stage to another. A different type of participation is possible at each of the three stages of innovation, and even by activity within each stage..

Developing the typology for types of participation showed us that an important concern is that we clearly differentiate and define the type of communication between farmers and scientists and that the data were obtained through organized communication between or among the two groups. By organized communication we mean a well-defined methodology for carrying out a procedure (informal surveys, transect walk, etc. as well as formal surveys). Organized communication is not an ad-hoc opportunistic event. We also differentiate between *one-way scientist- or farmer-led communication,* which is always scientist-initiated and where farmers respond to scientists' inquiries, and *two-way communication,* which may be scientist- or farmer-initiated, where scientists make sure that farmers understand their opinions and ideas or proposals and objectives, and vice versa. (We use a generic term "farmers" to describe any target group and the term "scientists" for outside agencies, extension systems, or formal research agencies.)

The different types of participation are defined as:

- **Conventional** (or contractual): Scientists make the decisions alone without organized communication with farmers.
- **Consultative**: Scientists make the decisions alone, but with organized communication with farmers. Scientists know about farmers' opinions, preferences, and priorities through organized one-way communication with farmers. Scientists may or may not let this information affect their decision. The decision is not made with farmers nor is it delegated to them.

- **Collaborative**: The decision is a shared decision between farmers and scientists involving organized communication with each other. Scientists and farmers know about one another's opinions, preferences, and priorities through organized two-way communication. The decisions are made jointly; scientists or farmers do not make them on their own. No party has a right to revoke the shared decision.
- **Collegial**: Farmers make decisions collectively in a group process or individually by those who are involved in organized communication with scientists. Farmers know about scientists' opinions, preferences, proposals, and priorities through organized two-way communication. Farmers may or may not let this information affect their decision. When this type of participatory research is initiated, a scientist may be facilitating farmers' collective or individual decision making or may have already built farmer ability to make the decision without outsider involvement. Farmers have a right to revoke the decision.
- **Farmer experimentation**: Farmers make the decisions individually or in a group without organized communication with scientists.

Why does it matter who makes the decisions in the participatory process? For example, if outsiders/scientists make all the key decisions without farmer participation in the early stage of an innovation process, then farmers cannot influence many features of the innovation that are fixed by those decisions. The outcome of the participatory research is different when scientists and farmers plan together in the early stage and share key decisions, thus increasing the likelihood that the farmers' top priority is addressed. The outcome of participatory research is different if farmers make all the planning decisions and only consult scientists late in the process when problems arise. Table 1 presents a "checklist" for assessing the participatory approaches. You can use it to define the type of participatory approach you have been using in the past, are currently using, or plan to use in the future. Then consider what types of impacts you can realistically expect given the type of participatory approached applied and at which stage.

It is illustrative of the state-of-the art in PRGA impact assessment that none of the empirical projects presented in this book specifically articulate the type of participatory approach that was used. Only the purely methodological chapters discuss the different approaches. Another issue that is often overlooked is that of how well the participants represent the general population or the target group they are intended to represent. Little attention is paid to explaining how the participants were selected or to understanding how the choice of participants selection may lead to different results, and the impact it may have on the characteristics, and hence the adoptability, of the resulting technology.

Defining who participates: types of gender analysis. Who participates in the different decisions is potentially a determinant of the impact of the participatory process on the research results — particularly technology design, and thus the design of the outcomes of farmers' using the resultant technology. We define gender analysis as a particular case of stakeholder analysis where gender is the chief discriminating variable for defining the stakeholder group of interest. Stakeholder analysis also considers, for example, wealth, occupation, age, or ethnicity, as important discriminating variables, which – like gender – are also, determinants of the type and level of impact of participatory approaches and technical change.

Table 1. Checklist for assessing the participatory approaches in each stage of innovation[a] based on locus of decision making.

Stage of innovation: who decides?		A	B	C	D	E
DESIGN		A	B	C	D	E
1	What is the target group or clientele at the research initiation stage?					
2	What are the topics, opportunities, or problems at the diagnosis stage?					
3	What is the most important problem or opportunity that has been identified for research?					
4	What are the available solutions and relevant information about the problem or opportunity?					
5	Are the available solutions inadequate and does more information need to be sought or generated to reach a potential solution?					
6	What is the relative importance of solutions that have been identified?					
7	Which solutions are worth testing?					
TESTING						
8	What is the target group or clientele for evaluating the potential innovations or technology options?					
9	Should the testing be done on farm, or on station, or both?					
10	What aspects of innovation or technology option are important to evaluate?					
11	What is the yardstick for measuring what is an acceptable solution or not?					
12	What is recommended to other farmers?					
DIFFUSION						
13	What is the target group or clientele for awareness building, and validation and dissemination of tested innovation or technology options?					
14	When, to whom, and in what way to promote awareness of solutions and publicize information about it?					
15	When, to whom, and in what way to supply new inputs needed for adoption?					
16	When, to whom, and in what way to teach new skills needed for adoption?					

SOURCE: Lilja and Ashby (1999b).

a. Stages of innovation: A = on-farm research (scientists alone without organized communication with farmers), B = consultative (scientists alone with organized communication with farmers), C = collaborative (scientists and farmers jointly through organized communication), D = collegial (farmers alone with organized communication with scientists), and E = farmer experimentation (farmers alone without organized communication with scientists).

Our framework for analyzing how using gender analysis affects the research process as well as the technology design and adoption distinguishes three ways of using gender analysis in the innovation process.

- **Diagnostic gender analysis:** When gender differences in the client group(s) for the research are described and different problems or preferences are diagnosed, but this information is not taken into account in priority setting, design of solutions for testing, or their evaluation and adoption. Diagnostic gender analysis may conclude that gender differences are not an important criterion for designing the research; or it may identify gender differences as an obstacle to adopting technical solutions for men or women members of the client group.
- **Design-oriented gender analysis:** In addition to describing gender differences in the client group, and in their problems and preferences, different research and development paths are designed that take into account gender-based constraints, needs, and preferences. Design-

oriented gender analysis may result in men and women developing and adopting different technologies, which may require different dissemination approaches.

- **Transfer-oriented gender analysis:** In addition to describing gender differences in the client group, and in their problems and preferences, different adoption and dissemination paths are designed to overcome access to and adoption of a given technology known (or assumed to be) of similar importance to men and women. Learning-oriented gender analysis results in the same technologies being disseminated to men and women in different ways.

Uses of gender analysis can be classified using Table 2 to identify the stage in the innovation process when analysis of gender differences was used, and when gender might contribute to different outcomes for men and for women.

Table 2. Checklist for types of gender analysis.

Stage of innovation/Type of gender analysis[a]				
DESIGN		**1**	**2**	**3**
1	Was the client group differentiated by gender at the research initiation stage?	X	X	X
2	Were different topics, opportunities, or problems defined for men and women at diagnosis stage?	X	X	X
3	Was analysis made of whether men and women's preferences differ about what is the most important or highest priority problem or opportunity for research?		X	X
4	Were different available solutions identified for men and women?		X	X
5	If it was decided that the available solutions were insufficient and other solutions needed to be generated, were different solutions sought for men and women?		X	X
6	When deciding the relative importance of solutions to be tested, were the differences between women and men's priorities analyzed?		X	X
7	When deciding which solutions were to be tested, were some women's and some men's solutions chosen for testing?		X	X
TESTING				
8	Was the client group for evaluating potential innovations or technology options differentiated by gender?	X	X	X
9	When deciding whether to test on farm, or on station, or both, were the potential differences in women's and men's opinions analyzed?		X	X
10	When deciding what aspects of innovation or technology option are important to evaluate, were preferences analyzed by gender?		X	X
11	Was it determined whether women and men have different yardsticks for measuring what is an acceptable solution or not?		X	X
12	Was it considered whether men and women wanted to recommend different solutions to other farmers?		X	X
DIFFUSION				
13	Was the client group for awareness building, and validation and dissemination of tested innovation or technology options, differentiated by gender?	X		X
14	Were the differences between men's and women's preferences considered when deciding when, to whom, and in what way to promote awareness of solutions and publicize information about it?			X
15	Were the differences between men's and women's preferences analyzed when deciding when, to whom, and in what way to supply new inputs needed for adoption?			X
16	Were the differences between men's and women's preferences analyzed when deciding when, to whom, and in what way to teach new skills needed for adoption?			X

SOURCE: Lilja and Ashby (1999a).

a. Types of gender analysis: 1 = diagnostic-oriented, 2 = design-oriented, and 3 = transfer-oriented.

You can use the Table 2 checklist to define the type of gender analysis you have been using in the past, are currently using, or plan to use in the future. Then consider what types of impacts you can realistically expect given the type of participatory approached applied and at which stage. Inclusion or exclusion of gender analysis in various stages of innovation leads to different process outcomes and impacts.

Some projects were more specific about describing the type of gender analysis they applied than they were in describing the type of participatory approach used, but in many cases gender analysis was not specifically described other than describing number of women participating or how men's and women's preferences differed. In chapter 4, Hagmann et al. provide an example of a project learning process over a 10-year period in Zimbabwe. Through interaction with farmers as recorded in many illustrative examples, the authors trace the learning process, which leads to developing a new approach to agricultural extension in NRM issues, one in which stakeholder and gender differentiation is an integral part of the extension efforts. In chapter 5, Paris et al. provide an example of a PPB project that is carefully conducted and gender-differentiated. They give a good example of a diagnostic gender analysis conducted at the beginning of the study and the description of the progress so far made in conducting design-oriented gender analysis.

Concept 4:
What are the cause-effect relationships hypothesized to lead to impact?

The impacts of participation are realized through a chain of cause–effect relationships starting from the type of participation implemented, and a particular stage in the innovation process.

The **cause** can best be understood as the participatory or gender analysis approach applied and the stage in the research process when it was applied. The **effect** can be understood as the hypothesis about expected impact yet to be tested empirically. For example, through collaborative maize evaluation trials, with farmer participation, conducted at the technology design stage (= cause), researchers understand farmer priorities about desired maize characteristics, and may identify some new, shared priorities for maize research. The hypothesis of the expected impact (= effect) would be that "research priorities change," which can be then empirically tested.

The rigor and credibility of an impact assessment is improved if the cause and effect relationships hypothesized as leading to a possible impact are specified beforehand by formulating a verifiable impact hypothesis. This formulation aids and guides data collection processes, because specific data requirements for impact hypothesis testing are more easily deduced. This can be done for desirable and expected impacts, and for undesirable and unexpected impacts.

For example, farmer field schools (FFSs) often use collegial participation in which farmers make decisions collectively in a group process involving organized communication with technical experts ("scientists"). In this example, collegial participation is introduced at the diffusion stage of an integrated pest management (IPM) and crop improvement program. Farmers make decisions about which the client groups are for validation and dissemination; they decide how to promote awareness of IPM solutions, how to supply new inputs, and how to teach new skills. The hypothesis about the process impacts of the collegial participation in the FFS in this example might be: *"As a result of collegial participation, farmers' skills to self-manage a field school on IPM will increase."* Indicators of increased management skills that could be used to test the hypothesis might be: "*Farmers continue to run the FFS over time without outside contributions; they set up new FFSs, which they run in neighboring communities; they expand the FFS to include new topics other than IPM"*.

Farmers' increased management skills to run FFSs may be the most important impact for some stakeholders in this example. But other stakeholders may give equal or higher importance to the understanding effect of using collegial participation in the field school on controlling serious crop pests because of adopting biological control IPM practices. The chain of cause-effect relationships that the impact assessment needs to flesh out in this example would include the effect on the adoption of IPM practices of the initial FFSs organized with collegial participation, as well as the effect of new schools organized by these farmers. The extent to which adoption of practices introduced through the IPM field schools led to control of serious crop pests would be assessed. The hypothesis about the technology impacts in this example would state: *"An increase in the control of serious pests can be attributed to the observed increase in the adoption of biological control IPM practices."*

An important reason for making the process impact hypothesis, as distinct from technology impact hypothesis, can be illustrated from the following example. Suppose that the impact assessment finds that farmers did continue to run FFSs with collegial participation, to set up new ones, and to introduce new topics. The study also showed that adoption of the biological control IPM practices introduced through the FFSs was low and that no significant increases in the control of the crop pests targeted was observed. In this example, the effect of collegial participation implemented through self-managed FFSs was to increase farmers' management skills; but the approach did not have the anticipated technology impact. Now suppose, in this example, that the impact study also found that farmers had introduced some new crops and crop rotations and disseminated this practice through the FFSs, altering land use and reducing the crop area suffering from pests targeted for biological control. Farmers participating in the FFSs had less area in the crop affected and a more diverse enterprise. A process impact hypothesis could be formulated: "*As a result of collegial participation, farmers' understand IPM problems better and are better able to invent and disseminate new solutions to these."*

In chapter 2, Weltzein et al. show that in most of the participatory, formal-led, breeding programs that they reviewed, intermediate expected impacts are well defined. However, in most cases, the empirical validation of these anticipated impacts has not yet been reported. Similarly, in chapter 3, McGuire shows that expected impacts in most farmer-led, plant breeding projects are well defined. In both cases it seems that the explicit cause-effect relationship is not as well defined. Many formal and farmer-led projects have not yet carefully analyzed how the approach they used resulted in a certain outcome. To replicate the results at other locations, this also must be understood.

In chapter 4, Hagmann et al. are able to make some specific cause-effect conclusions and show that addressing a certain gender-related issue, for example women's ability to be elected as chairpersons, leads to a specific impact achieved. In this example, it leads to a rise in confidence that allowed women to negotiate more for their needs than before. Table 3 gives further examples of cause and effects of two different participatory approaches applied at various stages of innovation. (For more details see Johnson et al 2000).

Table 3. Examples of consultative and collaborative participatory research applied at different stages of technology development (cause) and expected impacts (effect)

	Process impacts: Feedback to research for technology development	**Process impacts: Social and human capital formation**	**Technology impacts**	**Cost impacts**
Testing:				*Effect:* Moving from contractual to consultative or collaborative forms of participation generally increases the costs of doing research at the particular stage where it is incorporated. However, it may reduce cost at subsequent stages. *Effect:* Collegial research reduces research costs at the stage where it is implemented because costs are transferred to farmers.
Consultative Approach *Cause:* Researchers learn farmers' opinions about researcher-defined priorities.	*Effect:* Research priorities change to reflect farmers' priorities, but they must also be scientists' priorities.	*Effect:* No impact expected.	*Effect*: The size of the beneficiary group increases because the priority topic chosen for research is more relevant to targeted farmers' needs and priorities.	
Collaborative Approach *Cause*: Researchers understand farmer priorities and may identify some new, shared priorities.	*Effect:* Research priorities change to reflect farmers' priorities and may include some that were not scientists' priorities.	*Effect:* Farmers/communities improve their ability to interact with outsiders, to articulate and evaluate their opinions and priorities, and to negotiate joint solutions with other stakeholders who may have different opinions.		
Design:				
Consultative Approach *Cause:* Researchers learn how farmers evaluate researcher-designed technologies.	*Effect*: Criteria for accepting/discarding technologies changes to reflect farmer's criteria, provided that the criteria also meets that of scientists.	*Effect:* No impact expected.	*Effect:* The number of potential adopters within the target group increases because the specific technologies selected for recommendation are more appropriate given farmers' criteria and constraints.	
Collaborative Approach *Cause:* Researchers learn about farmers' testing and evaluation methods and criteria and may develop some new, shared ones.	*Effect*: Criteria for accepting/discarding technologies changes to reflect criteria of both farmers and scientists.	*Effect:* Farmers/communities enhance their own testing and evaluation skills with an increased knowledge of scientific methods of experimentation and evaluation, and improve their ability to negotiate joint solutions with other stakeholders who may have different opinions.		
Diffusion:				
Consultative Approach *Cause:* Researchers learn about farmers' opinions about researcher-designed diffusion mechanisms.	*Effect:* Farmers identify the best technology diffusion method from an array of possible methods that scientists designed or proposed.	*Effect:* No impact expected.	*Effect:* The probability is increased that potential adopters for whom the technology is appropriate will be aware of it and be willing and able to adopt it.	
Collaborative Approach *Cause:* Researchers understand farmer's opinions about how technologies are diffused and adopted, including any new ideas that result from the collaboration.	*Effect:* Farmers and scientists identify the best technology diffusion method from an array of possible methods that farmers and/or scientists designed and/or proposed.	*Effect:* Farmers/communities learn what is involved in mass diffusion of technology such as the complexity of adoption decisions and the importance of complementary inputs, e.g., seeds, credit, or information.		

Concept 5:
How do we measure the impacts?

Once the impact hypotheses are clearly defined, we must identify manageable and relevant indicators in order to measure or observe the full complexity of a given impact. Both 'generic' indicators, which are based on agreements with external stakeholders such as project staff and researchers, and 'internal' indicators, which are mainly used by local stakeholders and vary from place to place, should be used. The set of indicators needs to provide sufficient information about the impact area to be observed, and indicators need to be meaningful for different users of the information.

Using the same IPM example, a process impact hypothesis of a collegial-type project at the testing stage could be: "*Farmers enhance their own testing and evaluation skills with an increased knowledge of scientific IPM methods of experimentation and evaluation.*" What type of indicator would be relevant to measure this type of expected impact? In this case, the tool to measure the given impact would probably differ significantly depending on whether scientists or farmers designed it.

Once all the indicators are defined for the process, technology, and cost impacts, the appropriate data collection methods must be defined for each. Individual interviews and formal surveys, as well as focus group interviews are needed. Also, the existing historical data sources need to be identified.Process impacts, especially those of social and human capital impact, have value, but cannot often realistically or easily be measured in monetary terms, and hence are often measured in qualitative and descriptive terms. The aggregate impact of the process impacts is the technology or the innovation, which itself can usually be valued in monetary terms. In chapter 1, Probst provides an extensive discussion on how to measure natural and social capital, and provides examples of the indicators to use.

It is important to note that we can measure reasonably well the economic benefits arising from technology or innovation adoption in terms of changes in income or in terms of whom captures the new income from the change caused by the innovation or technology. However, the positive impact on income does not always mean increase in total income, it can also mean a more stable income or a reduction in the previous trend of decreasing incomes. The measurement of economic benefits to users is often fairly straightforward; for example, estimating the value of increased production or reduction in pest damage due to the new technology, or estimating the reduction in income losses due to soil degradation. It is important not to try to deduce any secondary impacts of economic benefits without further analysis, such as project impacts on improved nutrition or better education, because change income alone does not contribute to these changes in expenditure. For example, a new technology is expected to increase the welfare and empowerment of women as a result of an increase in the income controlled by women. The cause and effect relationships leading to an expected change in income can be hypothesized from the theory of equilibrium wage determination and household decision-making models (Lilja et al. 1996). The effect of an increase in income on empowerment and its effect on women's welfare require the testing of separate hypotheses.

Cost data often seem difficult to obtain. It is useful to note that costs and benefits have symmetry: a benefit forgone is a cost, and a cost avoided is a benefit. For example, a value of intervention that prevents soil erosion can be approached from both sides: direct costs and costs avoided. In this case, 'costs' would include the capital and operation costs of implementing the soil erosion project, and 'costs avoided' would be the value of reduced need for chemical soil improvement. When market prices cannot be used directly, it may be possible to use surrogate-market technique. This technique uses the market prices of substitute or complementary goods. For example, the value of an unpriced environmental amenity, such as clean air, may be a factor in the price of marketable asset, such as land value. Analysis of the land price differentials among the areas with differing air quality may give an indication of an implicit price for this unpriced environmental amenity (Dixon et al*.* 1996).

Projects in this book, except Bellon et al. (chapter 10), did not look at cost impacts of the approach used specifically. In chapter 6, Gami and Justice provide an example of the analysis of the cost of farmer-evaluated as compared to traditional technology. They used simple partial budgeting, which is often sufficient to draw the preliminary cost impacts of the technology created or evaluated through participatory means. Their analysis did not, however, look at the costs of the approach itself, in addition to the cost of the technology.

Any comparison for assessing impact needs to have defined the type and amount of a difference attributable to the intervention that will be considered significant, or evidence of successful impact. In other words, a boundary between the successful or desirable condition and the unsuccessful or undesirable condition needs to be explicitly defined. For this purpose, threshold values or qualitative states can be established for impact indicators. For example, a land management intervention can be considered sustainable at farm level if the needs of the farmer are satisfied and natural resources are conserved. Indicators for farmer satisfaction include crop yield, net farm income, and frequency of crop failure. Indicators for natural-resource conservation include soil depth, organic carbon, and permanent ground cover. In the final assessment, each indicator value needs to be converted into index values, which indicate if it is at a sustainable level. The final sustainability index can be obtained by calculating the average of both indices (farmer and natural resource conservation). The higher the value, the more sustainable the intervention has been at the farm level (for more details, see SML-IM 1998).

The present book devotes several chapters to empirical results of the impact assessment work from recent and on-going PPB projects. Bellon et al. (chapter 10) describe a project in Mexico that tries to determine the possibility of improving maize productivity while maintaining or enhancing genetic diversity. They assess the welfare impacts of farmer participation in landrace improvement using farmers' perceptions of germplasm and knowledge gained through participation, analysis of genetic diversity using phenotypic characteristics, and molecular markers, and the economic analysis of efficiency and distribution of benefits among socioeconomic groups. Monyo et al. (chapter 11) describe the farmer-participatory development of a new pearl millet composite population in Namibia. The constituent varieties in this composite were jointly identified—by farmers for preferred traits and by the breeder for their suitability to improve yield and agronomic characters. The value of involving farmers is evidenced by the rapid adoption of pearl millet varieties. Courtois et al*.* (chapter 12) describe the first year results and further anticipated impacts of a farmer participatory breeding program for rainfed rice in eastern India. Authors discuss the issues and lessons learned during the course of the project's first year.

Several chapters are also devoted to results of the impact assessment work in participatory NRM research. Hamilton and Norton (chapter 15) describe the experience in assessing the impacts of a participatory IPM project. Their methods include both qualitative and quantitative impact assessment indicators. The quantitative approach involves evaluating the overall participatory research program first, and then separating out the portion of benefits due to participation or to gender analysis. Loevinsohn et al. (chapter 13) report on an evaluation of an IPM project in Kenya. This pilot project uses the FFS approach. The authors provide insights into the costs, benefits, and institutional implications of the choices that policy makers in the national and international agricultural research institutes must make when taking up participatory approaches. Vernooy et al. (chapter 14) present the work in progress of the CIAT "Hillsides Project". The authors describe a set of instruments they have developed to support and improve decision making about the management of natural resources through collective action at the landscape level.

Concept 6:
How do we judge the success of the project?

Probst (chapter 1) identifies some key aspects that need to be considered when we look for success factors and the eventual impact of PRGA activities. These success factors include the type of NRM problem; social, biophysical, and political conditions; the approach to NRM research; and methods of M&E. Although Probst discusses these key success factors in the context of NRM, in many cases they are also applicable to plant breeding. McGuire (chapter 3) also discusses some of the factors that contributed to the success of farmer-led PPB projects, in terms of obtaining set goals.

Both Probst and McGuire discuss the specific factors to which we need to pay attention in order to improve the success of the participatory research, and hence achieve its goals. However, the overall success of a given participatory project must be assessed in comparison to some base case. To make the final assessment about the success of the participatory project, we need to consider two levels of comparison. We need to measure first the project impacts, and second those of the given participatory approach; we must compare the achieved project impacts to a counterfactual case (control).

When we measure the impacts that will arise "with" the project and compare them with the situation as it would be "without" the project, we are measuring the incremental net benefits arising from the project investment. This approach is not the same as comparing the situation "before" and "after" the project. The before-and-after comparison does not account for the change that would occur without the project and thus may lead to an erroneous statement of the benefit attributable to the project investment (for further discussion, see Gittinger 1982).

Choosing the counterfactual can be difficult because of the selection bias problem that is inherent to many participatory projects. Projects often choose, or are required to work in, certain regions, and selection bias arises because the participating communities and participating individuals within the communities were not randomly selected. If projects purposefully select certain communities to participate in the project, it is difficult to determine if the same results would have been achieved even in the absence of the project, or if the same approach would yield the same results in another community. To answer these questions, we would need to replicate the project in several different types of communities and have control communities that would have the same characteristics as the study communities.

Another type of selection bias also occurs because participation is often voluntary, and, because people can choose whether to be part of the project or not, those people who will participate may not be representative of the total population. For example, those choosing to participate in the varietal selection trial may decide to experiment on the new plant varieties in their own fields because they have large landholdings and can better carry a risk of crop failure than can others in the village. Assessment of such persons' willingness to experiment on their own fields with the test varieties would lead to an erroneous assessment of the project's impact on farmer experimentation (see more details on selection bias in participatory research in Johnson et al. 2000).

Few of the projects presented in this book paid specific attention to the selection bias or how to deal with it, so available empirical examples are lacking: McGuire (chapter 3) highlights some conceptual challenges for assessing the impact of farmer-led PPB. One such is a basis for comparison: no case used formal controls (i.e., parallel work in conventional breeding), and even a retroactive comparison is difficult as most cases had no formal work that directly corresponded with project activities.

Rossi and Freeman (1992) describe some choices of the appropriate types of controls:

- *Randomized*: Individuals are randomly placed into two groups, those that receive the intervention and those that do not. This allows the researcher to determine program impact by comparing means of outcome variable.
- *Constructed*: Individuals to whom the intervention is applied are matched with an "equivalent" group from whom the intervention is withheld.
- *Statistical*: Compares participants and non-participants controlling for other characteristics that may be statistically different between the two groups.
- *Reflexive*: Participants who receive the intervention are compared to themselves before and after receiving the intervention.
- *Generic*: The impact of the intervention of beneficiaries is compared with established norms about typical changes occurring in the target population.
- *Shadow*: The judgement of experts, program administrators, and/or participants on what is ordinarily to be expected for the target populations are compared to actual outcomes.

In most PPB projects, the most logical counterfactual case is the existing conventional breeding program.

In many cases, impact assessment is concerned with the impact of a project that has multiple and possibly conflicting objectives or impact expectations caused by differences in stakeholders' perceptions about project goals. For example, a project may be perceived as having an objective of increasing both income and equity. The relative importance of different objectives (expectations) has to be decided in order to assess the overall success of the project. This is because specifying a distributional objective, such as placing additional emphasis on the benefits to women, implicitly argues that an extra unit of income to a woman is weighted more than an extra unit of income to an average man. It also implies a belief that the opportunity cost to society of meeting the objective by distorting research investment is lower than the cost of meeting it entirely with other policies. Therefore, to assess the success of the overall project impact, the implementing agents need to specify how much they are willing to trade off in efficiency gains for achieving more of the equity (empowerment) gains.

Outline of the Book

The Consultative Group on International Agricultural Research (CGIAR) Program on PRGA for Technology Development and Institutional Innovation organized a 2nd International seminar in Quito, Ecuador from the 6th to the 9th of September 1998. The central objective of the seminar was to understand the status of existing knowledge about the impact of various approaches using PRGA in agricultural or natural resource management. Over 100 researchers and development professionals attended the seminar.

In addition to papers commissioned by the PRGA Program, most of the papers in this book were collected through an open call for papers on existing experience of the PRGA practitioners in NRM and in plant breeding. These papers were intended to briefly describe lessons learned from past experiences. Specifically, authors were asked to focus on tools and methods for conducting impact assessment of participatory research or gender analysis. They were asked to describe the lessons learned from impact indicators/welfare criteria used for assessing the success of the PRGA, and provide examples and reasons why some approaches were successful or unsuccessful in achieving impact/welfare gains. Authors were also requested to list their hypotheses and suggestions about how tools/methods could be improved to be more useful in the future projects. The guidelines for authors at the Quito meeting are set out below.

The paper should describe

- Research or development initiatives involving farmer participation and gender analysis in the use and conservation of genetic resources, in particular plant breeding,

OR

- Research or development initiatives involving stakeholder participation and gender analysis in NRM. Natural resource management may include, for example, use and conservation of biodiversity, IPM, watershed management, forestry or agroforestry related activities, soil and water conservation, agrosilvopastoral or range management, but is not limited to these. Individual or collective action or both may be included.

The following points should be discussed:

1. Assessment of the success or lack of success of using participatory approached or gender analysis is included.
   What difference did participation make to the success or lack of success of the work being reported in achieving its objectives? What is the timeframe? What was the situation before participation was introduced? How did this change as a result? What difference did using gender analysis make to the success or lack of success of the work in achieving its objectives? What is the timeframe? What was the situation before and after?
2. Clear description of the process is given.
   What process, methodology, tools, or techniques were used to implement participation and/or gender analysis? What does the impact assessment tell us about the appropriateness or

deficiencies of the process or methodology used? Are there different stages or steps in this process, and what differences in impact occur over time?

3. Explanation of how impact is defined is included.
   How is the impact of participation defined? Are there indicators or criteria to describe the outcomes of the participation or of differentiating beneficiaries or stakeholders by gender? Is the quality or quantity of their participation being monitored for example? Are the effects of any changes in participation being detected, and how are these effects defined and measured? Were there effects identified in the answer to Question 1 above that were not predicted, or included in monitoring, but that the authors recommend taking into account in future?
4. Impact of using gender analysis is defined.
   What effects of using gender analysis are expected and how are they being measured? Were there effects identified in the answer to Question 1 above that were not predicted, or included in monitoring, but that the authors recommend taking into account in future?
5. Examples of tools and methods used in impact assessment are given.
   How are the effects of participation being assessed? What methods or tools are used? Who is involved and what are their roles in assessing the impact of the participation? What works? Give examples and reasons why some tools were successful in achieving impact/welfare gains? What methods or tools for assessing the impact of participation or gender analysis have not worked and why? What is being done to assess the effects of differentiating beneficiaries and/or participants by gender? Is there any comparison between differentiation by gender with their other characteristics, such as how poor they are or the natural resources they manage or control for example
6. Analysis of the lessons learned is included.
   What lessons were learned about doing impact assessment? How could the approach to monitoring/evaluation/assessing impact be improved? What questions are left unanswered? Were any unanticipated effects observed that could be usefully documented in future, and if so how? Who should be involved in impact assessment, and what should their roles be? How could we improve tools/methods for doing monitoring, evaluation, and impact assessment to be more useful in the future?

The papers chosen for presentation were divided into the following categories based on content, each of which forms a separate section in this book:

- **Part 1: Types of participation and their impact**
  This section outlines definitions of types of participation and focuses on questions such as: "Why we are doing impact analysis, what impacts are we measuring, and for whom is the analysis"? The PRGA Program commissioned all the chapters in this section.

- **Part 2: Types of gender/user differentiation and their impact**
  In the second section, types of gender/user differentiation are examined and related to the expected impact of the PRGA research.

- **Part 3: Methods and tools for monitoring and evaluation of NRM projects**
  The third section draws from practical experiences assessing the impact of participatory research and gender/user differentiation, and authors examine contrasting approaches to participatory methods for M&E.

- **Part 4: Measuring the impact of participatory plant breeding**
  The fourth section concentrates on specific research design issues to enable measurement of the impact of PPB. The main research design elements for assessing the impact of using participatory research are identified and related to specific cases, both formal- and farmer-led PPB.

- **Part 5: Measuring the impact of participatory NRM**
  The fifth section examines the specific research design issues to enable measurement of the impact of NRM. Major elements of research design in participatory NRM research are identified, and related to the specific cases of NRM projects.

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PART 1:

TYPES OF PARTICIPATION AND THEIR IMPACT

CHAPTER 1

SUCCESS FACTORS IN NATURAL RESOURCE MANAGEMENT RESEARCH: DISSECTION OF A COMPLEX DISCOURSE

Kirsten Probst∗

Introduction

Natural resource management (NRM) deals with decision making related to the multiple and competing use (including protection) of the limited natural resource base (i.e., water, atmosphere, soil, plants, and animals), and with organizing, implementing, and controlling resource use (Schwederski et al. 1997, p 23). When related to agriculture NRM may include, for example, activities in the fields of: use and conservation of biodiversity, integrated pest management (IPM), watershed management, (agro) forestry, soil and water conservation, irrigation, and range management. Management of natural resources is complex because of temporal and spatial biophysical interdependencies such as individual and common property resources, long-term and off-side effects, social dimensions, side-specific variations, and risk of conflict arising among different resource users (Table 1). Thus institutional and organizational innovations are needed, apart from site-specific technical innovations.

What has international agricultural research contributed to NRM? What is the mandate of the Consultative Group on International Agricultural Research (CGIAR)? Its mission is, through strategic and applied research, to contribute to promoting sustainable agriculture for food security in the developing countries. The focus is on increasing agricultural productivity, safeguarding natural resources, and helping people-centered policies for environmentally sustainable development. In addition to continuing its work in high potential areas, the CGIAR is particularly committed to addressing the problems of the poor in less-endowed areas (CGIAR 1995).

How can agricultural research better respond to the needs of poor farmers and effectively contribute to successful and sustainable NRM compatible with improved agricultural productivity? The CGIAR Systemwide Program on Participatory Research and Gender Analysis (PRGA Program) is a concerted attempt to increase the impact of agricultural research by improving the methods and practices of research. In many cases where services are most effectively delivered, they are "co-produced" with the clients (Ostrom in Evans 1996, p 1035; Ashby and Sperling 1995). A variety of approaches labeled as participatory have evolved in NRM and have been in use for about 20 years. However, most experiences in developing participatory innovation for NRM have been gained in development efforts rather than in research. Evidence is lacking of what works and does not work under different conditions, and of what are the critical success factors (Toomey 1998). The PRGA Program aims to assess and develop methods for gender-sensitive participatory research in NRM and to identify lessons of success through action research and case studies.

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Table 1. Key features in natural resource management (NRM).

In NRM there are ...	This implies that...	Therefore a need exists for...
temporal and spatial biophysical interdependencies of NRM problems.	a broader perspective is needed to understand and solve problems, e.g., landscape or watershed level.	**collective action**, involving **all relevant stakeholders**, and improving **land literacy** for **collective landscape monitoring.**
difficulties in measuring long-term or offside effects of NRM practices.	the individual resource user loses perspective and may not be directly affected.	**motivating** for action and creating incentives in the short run.
scarcities of natural resources.	conflicts may arise among different user groups.	**strengthening organizational capacities** to manage collective action and solve conflicts, and to adapt strategies for innovation changing environments over relatively long periods of time.
high variabilities on and among farmers' fields.	situation (site specific) solutions are needed.	**individual action**/innovation.

What factors are decisive for NRM research to be successful? Project success is generally assessed in relation to goal attainment and the impact achieved. However, projects can be evaluated in different ways and the goal-based focus of evaluation has alternatives (see Figure 1④). Also, the impact can be caused both by using research products (innovations) and by the process of innovation development. Here we assume that, although oriented towards equity and poverty alleviation, the overall desired impact of NRM would be to increase (or maintain) natural capital (e.g., increasing soil fertility, biodiversity, maintaining ecological functions, reforestation, and improved water quality); as well as building the less visible social and human capital (see Figure 1②) to maintain natural capital and benefit from it in the long run. To identify factors that influence the extent of NRM research success, we must take a broader perspective (Figure 1). Some factors can be assigned to site-specific frame conditions that are largely out of researchers' control; others can be assigned to the research approach that researchers can adjust.

Based on a literature review, which is far from exhaustive, this chapter tries to frame the debate by illuminating key aspects that need to be considered when we look for success factors in NRM research. They are (Figure 1):

- The type of NRM problem (①) and the frame conditions (②),
- The approach to NRM research (③), including
- Methods of impact assessment, monitoring, and evaluation (④).

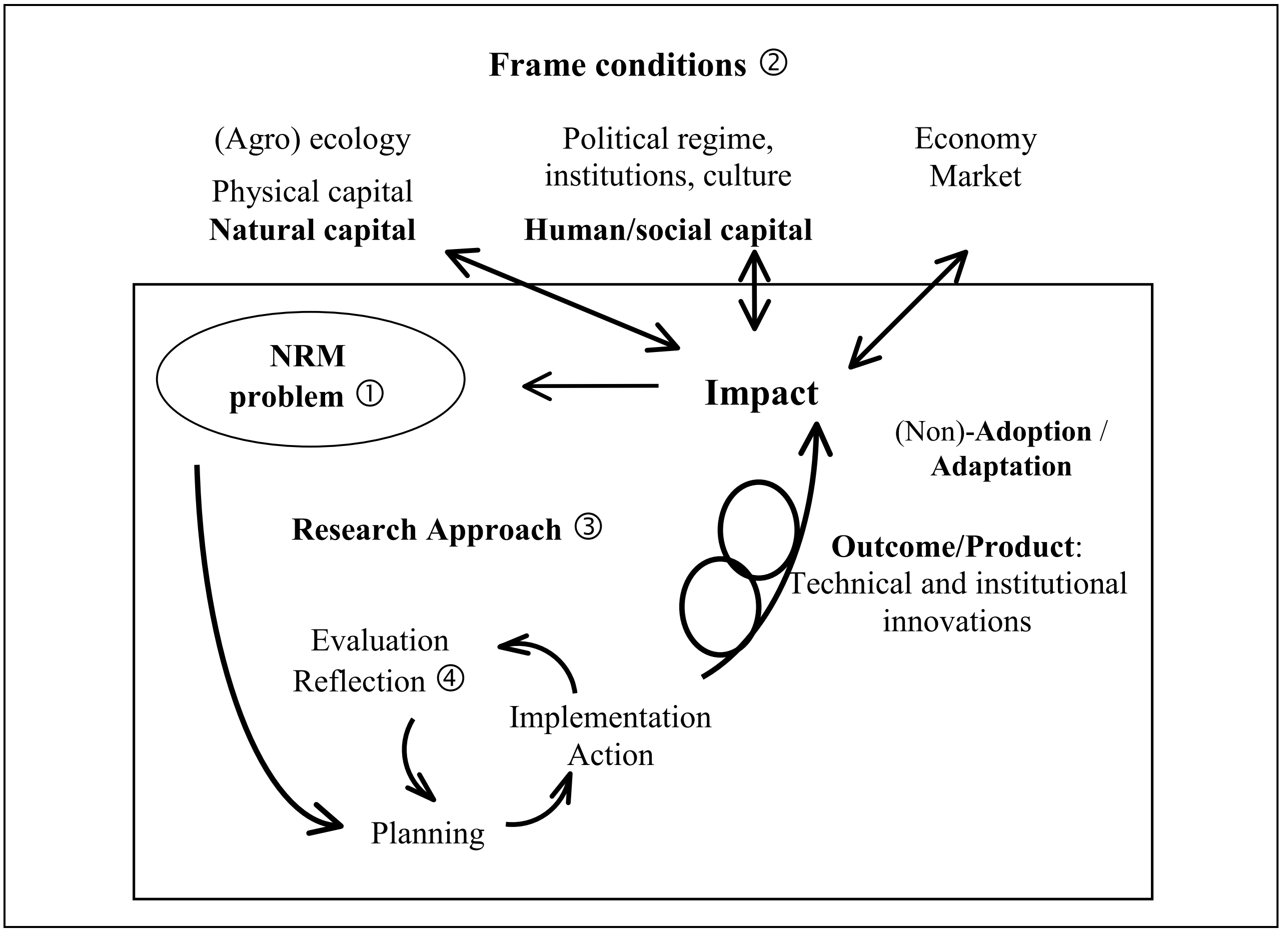


Figure 1. Framework for natural research management research.

The NRM Problem (Figure 1①)

The type of NRM problem has implications on the mandate, roles, responsibilities, and commitment of different actors within an innovation process for solving that problem.

Perception of the "problem"

Positivist science assumes that only one reality exists that can be "objectively" measured with scientific tools. However, an NRM problem identified by researchers might not (yet) be perceived as a problem by resource users, or might be of minor relevance in contrast to other problems that are actually more pressing from the farmer (holistic) point of view. Problem perception will even differ among different stakeholders that have divergent interests and priorities. People perceive different realities because of their sociocultural, economic, religious, gender, or age group differences. Research has to take farmers' perceptions and knowledge seriously to be successful because:

(1) Farmer "insider" knowledge complements researcher "outsider" knowledge, and
(2) The perception of resource users will ultimately determine their willingness to make a decision on changing their behavior and to put innovations into action.

The initiative to tackle a perceived NRM problem can come either from the farmers' side asking for outsider support (demand-pull on research, e.g., by rural people's organizations) or from outsiders aiming to change farmers' behavior and promote their adoption of innovations. In any case, NRM research can only be successful if the perceptions of those who are acting in the resource context are put at the center of considerations. Dialogue and mutual learning can help to create awareness and a common understanding of problems as a basis for joint action.

Property regime

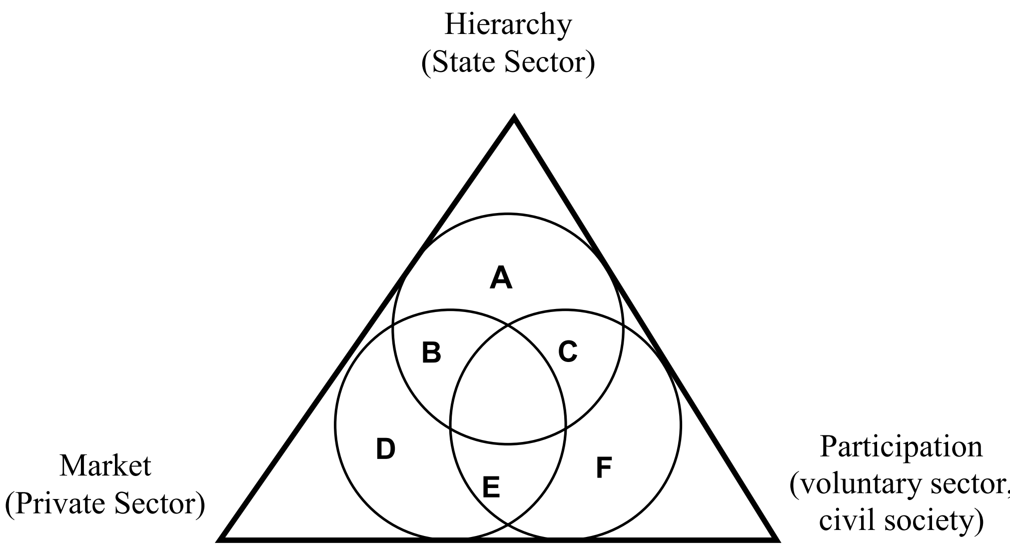
Who owns the particular resource? Who is the primary decision unit? Who receives the benefits?

In the continuum of property rights, we have exclusively private property rights (private goods) at one extreme and no property rights at all (public goods) at the other. In NRM we frequently deal with common pool resources, which belong to an intermediate category, the primary decision unit being a group of individuals (Murty 1994, p 581). According to Garder et al. (1990, p 335), common-pool resources are sufficiently large that excluding potential beneficiaries from their use is costly. Assuming that resource users are individualistic, resources held in common are doomed to over-exploitation ("tragedy of commons"). On the other hand, Richards (1997) argues that policies favoring individual resource privatization have resulted in high environmental and welfare costs and increased pressures on common property management regimes, especially if market-oriented NRM is promoted among indigenous groups with limited previous market exposure ("tragedy of the non-commons").

Bromley (1992 in Murty 1994, p 582) makes a distinction between common pool resources and an open access regime. The latter has no primary decision unit: every individual has a privilege to use the resource since no one has the right to stop him doing so. Keidel (1995 in Picciotto 1997, p 355) suggests another classification of goods and institutional patterns (Figure 2).

Thus three options exist for managing common resources: (1) market, (2) governmental regulation, and (3) voluntary collective action. The market failure in the management of commons has been recognized in certain cases, and the inefficiency of governmental regulation, because of the high cost of policing large resources without people's participation (Murty 1994, p 582, 593). Given that the state-property regime predominates in many countries, incentives need to be provided to the local communities to secure their participation in managing these resources (Murty 1994, p 582, 583). The success of participatory NRM will largely depend on a fair appropriation of benefits.

The sense of the term "participation" needs to be reconsidered in this context: Who is participating in what? Where is the ownership (property, primary decision unit, mandate, or initiative)? Do individuals participate in "higher tasks" that are rational from the perspective of a group or state? Or do officials and private institutions provide services, participate in or support farmers' affairs? At what scale is the NRM tackled (field, household, village, watershed, or region)? Who has to be addressed (individuals, local groups etc.)?



	Nature of project goods	Dominant parameter[a]	Institutions[b]	Examples
A	Government	H	State agencies	Law, police
B	Toll	M, H	Public or regulated private corporations	Public utilities
C	Public	P, H	Hybrid organizations	Policy, rural roads
D	Market	M	Private corporations, farmers, and entrepreneurs	Farming, industries, services
E	Civil	P, M	NGOs and PVOs	Public advocacy
F	Common Pool	P	Local organizations and cooperatives	Natural resource management

a. Parameters: Hierarchy = H; Participation =P; Market = M.
b. NGO = nongovernment organization, PVO = private voluntary organization.

Figure 2. The nature of goods and institutional design patterns (after Keidel 1995 in Picciotto 1997, p 355).

Support needed

The nature of an NRM problem indicates what kind of outside support and inputs are needed, for example, technologies, knowledge, and facilitation. Do farmers lack knowledge, for example, on insect pests and ecological principles? The farmer field school (FFS) approach to IPM aims at farmers acquiring such knowledge through discovery-based learning in especially designed learning situations. This entails solving problems for which solutions already exist and that are "rediscovered" by farmer groups (Loevinsohn et al. 1998b, p 2). According to Loevinsohn et al. (1998a, p 8) the FFS is, however, unsuited to discovery situations where farmers do not have answers to problems and nor does anyone else. In this case, a greater concentration of experimentation and (joint) research efforts is needed.

Whereas IPM is a knowledge-intensive NRM task, watershed management is rather management-intensive, requiring organizational innovations at local level next to technical features.

Loevinsohn et al. (1998b, p 2) distinguish "discovery"-oriented efforts to find solutions to specific resource management problems from "literacy"-oriented initiatives that try to build farmer and community capacities to manage resources on a continuing basis. Researchers may argue that development is not their job, and that it may be inappropriate to expect agricultural researchers to be drawn into such activities for which they have neither the skills nor the resources (Bebbington et al. 1994, p 10-11). Consequently, **NRM research is likely to be more successful if cooperation and networking with other institutions leads to synergy and a complementary provision of services**. NGOs, for example, can play a crucial role in helping farmer associations develop the administrative and technical skills required to become strong and independent partners to research organizations (Bebbington et al. 1994, p 27).

Frame Conditions (Figure 1②)

The economic and political frame conditions (i.e., the setting of the NRM context) clearly have an influence on "what works and what does not" and on the outcome and impact of participatory NRM research. Much depends on policies that affect agriculture, for example, price policy, security of tenure and rights regarding land, service infrastructure in roads, and credit and input supply (Chambers et al. 1989, p xvii).

A prominent lesson from projects supported by the German Agency for Technical Cooperation (GTZ, German acronym) is how greatly participatory development approaches depend on political and administrative environments that are conducive. This particularly concerns some form of "democratic" political decision making and a functioning system of local government. In contrast, where decentralization remains limited to a deconcentration of government administration and services, and financial resources for local development are not handed over but remain with central government or the line ministries, the danger is that - in the absence of resources at local level - a few participatory islands appear. These are nurtured by project support and resources, but destined to vanish as soon as external funding stops. Roles often remain limited to participating in work and, increasingly, in taking over costs. A political empowerment is rarely intended (Scherler et al. 1998, p 13).

To what extent does the success of participatory NRM research depend on pre-existing features (endowments) of the society and policy that are relatively difficult to change in the short run? Or can synergistic relations be built in the relatively short run even under unlikely conditions (constructibility view) (Evans 1996, p 1036)? This leads us to the issue of "social capital". What stock of social capital is needed as a precondition for successful participatory NRM (research)? And how far can social capital be built through participatory approaches?

The concept of social capital has gained currency over the last decade in the development discourse of anthropologists, sociologists, political scientists, and economists. Coleman (1988) and Bourdieu (1993) largely developed the concept, and it received more recent spurring from Putnam (1993a) and Fukiyama (1995). Social capital has become a key term of the development lexicon (Harriss and deRenzio 1997, p 920; Wall et al. 1998, p 300). The concept promises a new and potentially fruitful linkage to other disciplines that use the idea of capital, particularly to economics (with economic capital) and ecology (with natural capital) (Wall et al. 1998, p 318).

In the early post-war period, when economists turned their attention to economic development, they thought that the key difference between rich and poor countries lay in the amount of physical capital owned. According to Ostrom (1994, p 527-528) physical capital is the arrangement of material resources to improve flows of future income. The 1960s saw the remarkably successful Marshall Plan assistance in Europe and the disappointing experience of foreign aid in less developed countries. At this time the concept of capital was broadened to include human capital, which is the knowledge and skill that individuals bring to the solutions of any problem (Ostrom 1994, p 527-528). "New institutional economics" have broadened the focus to include the incentive structures that lead to the accumulation of physical and human capital and technological progress (Clague 1997, p 13). Attention has turned to the institutional requirements for economic growth such as legal frameworks, social networks, and relations of trust, summed up under the heading of social capital (Nederveen Pieterse 1997, p 140-141). Harriss and deRenzio (1997) and Wall et al. (1998) made a substantial review of recent theoretical and policy literature on social capital.

Interpretations of social capital

Based on different perspectives social capital is interpreted and defined in many ways, Putnam's usage being the most common. Some interpretations are:

(1) Putnam (1993b in Harriss and deRenzio 1997, p 920).
Features of social organization, such as networks, norms, and trust, which facilitate coordination and cooperation for mutual benefit. Working together is easier in a community blessed with a substantial stock of social capital. The social capital embodied in norms and networks of civic engagement seems to be a precondition for economic development and for effective government. Development economists take count: civics matters.

(2) Coleman (1990, p 302 in: Harriss and deRenzio 1997, p 921-922).
In Coleman's account, social capital is defined by its function. Social capital is not a single entity, but a variety of different entities having two characteristics in common. The entities all consist of some aspect of social structure and they facilitate certain actions of the

individuals who are within the structure. Like other forms of capital, social capital is productive. Coleman argues that social capital can constitute useful capital for individuals through (a) the significance of insurance, related to the obligations and expectations arising in social relationships; (b) the information communicated through social relations; and (c) the ways in which the existence of norms and effective sanctions facilitates action.

(3) Patricia A Wilson (1997).
According to Wilson, the term social capital has been used to describe what the Frenchman Alexis DeTocqueville observed in the USA in 1835—a propensity for individuals to join together to address mutual needs and to pursue common interests.

(4) Bourdieu (1993, p 32-33 in Harriss and deRenzio 1997, p 921).
Bourdieu argues that one can give an intuitive idea of social capital by saying that it is what ordinary language calls "connections". By constructing this concept one acquires the means of analyzing the logic whereby this particular kind of capital is accumulated, transmitted, and reproduced. One also acquires the means of understanding how it turns into economic capital and, conversely, the means of grasping the function of institutions such as clubs or, quite simply, the family, the main site of accumulation and transmission of that kind of capital. Bourdieu regards different forms of capital as cumulative and interchangeable (Nederveen Pieterse 1997, p 141).

(5) Ostrom (1994, p 527-530).
Social capital is the arrangement of human resources to improve flows of future income. The presence of physical capital is usually obvious to external onlookers, but social capital may be almost invisible unless serious efforts are made to inquire about the ways that individuals organize themselves and the rights and duties that they follow.

(6) Wilson (1995 in Wilson 1997, p 746-7).
Just as the inter-personal aspects of total quality management (TQM) ushered in trust-building and team-building to the private and public sectors, so the concept of social capital brings these values center stage in the so-called third sector: civil society. Social capital is a determinant of local economic development, it promotes business networking, shared leads, equipment and services, joint ventures, faster flow of information, and more agile transactions. Social capital is essential for maintaining and enhancing the value of public goods.

(7) Auty (1998, p 470).
In the context of local vulnerabilities to (environmental) hazard, social capital will reflect both the quantity of social cooperation (e.g., whether responses to cope with environmental hazards take place within households or collectively between households) and the quality of this organization inclusiveness (e.g., transparency and accountability of decision-making institutions).

Of course some voices also draw attention to the "dark sides" of social capital:

(1) Nederveen Pieterse (1997 p 142-143).
First, social capital is particularistic; networks have boundaries and boundaries are exclusionary. The other side of embedment is exclusion; the other side of trust is risk. Accordingly, social capital may be a strategy of risk management. Second, social exclusion and closure facilitate trust and cooperation by ensuring that relations are predictable and the leakage of resources prevented. Third, concentrating social capital has long been a

fundamental strategy of power (clubs, cartels, organized crime, etc.). Fourth, cooperation can also be a competition strategy (e.g., alliance policies and nonaggression pacts.

(2) Bebbington et al. (1994, p 23-25).
Rural peoples' organizations do not represent an ideal of rural democracy; we cannot and should not expect a single organization to represent all interests in a village. Working with local organizations may not always enhance the equity of a research project's impact.

(3) Beall (1997, p 950)
Synergy between representatives of communities and governments might reinforce and cement relationships founded on patronage and clienteles.

(4) Ostrom (1994, p 528)
Some groups can use all forms of capital to gain advantage over other groups or even to harm them while benefiting from the harm.

Therefore, developing trust among and across boundaries (classes, gender, status groups, minorities, etc.), shared membership, and horizontal ties seem to be important for positive social capital (Nederveen Pieterse 1997, p 143; Harriss and deRenzio 1997, p 924).

Wall et al. (1998, p 319-320) and Harriss and deRenzio (1997, p 932-933) conclude that for the concept of social capital to be useful analytically, different usage (depending on theoretical roots) and **different levels of analysis** must be recognized. For example, Harriss and deRenzio (1997) distinguish:

(1) Family and kinship connections.
(2) (Wider) social networks or "associated life" (e.g., "networks of civic engagement" or "local associations").
(3) Cross-sectoral linkages - combining different resources and different kinds of knowledge ("complementarity", "mutually supportive relations between public and private actors").
(4) Political capital - constituted by the norms and networks that shape the relations between civil society and the state; **informal** institutional arrangements that may lead on the one hand to clientelism, rent seeking, and exclusion, and on the other hand to effective representation, accountability, and participation ("embedment").
(5) Institutional and policy framework - the set of **formal** rules and norms that regulate public life in a society; it can influence the formation of other forms of social capital, but it also represents in itself a resource that facilitates coordinated action by citizens.
(6) Social norms and values - defined by widely shared cultural beliefs and the effects these have on the functioning of a society as a whole.

Creation of social capital

In view of its importance to local economic development and for the maintenance of natural capital, social capital formation (i.e., social capital building) seems to be a central task for development planners (Wilson 1997, p 34). But, how can social capital be created?

(1) Putnam (1993b, p 180) states that social trust, norms of reciprocity, networks of civic engagement, and successful cooperation are mutually reinforcing. Where no prior example of successful civic collaboration exists, barriers of suspicion and shirking are more difficult

to overcome (p 174 in Harriss and deRenzio 1997, p 923-924). This deterministic and unsatisfactory way of "path dependence" is criticized.
(2) Investing in social capital frequently takes the form of bargaining over which rules will be adopted to allocate benefits and costs of collective action (Ostrom 1994, p 558-559). Creating the social capital that makes physical capital operational over the long run is something repeatedly done by individuals who successfully use physical capital (p 530). If external agents of change do not take into account the delicate balance of interests embedded in social capital, then when investments in physical capital are undertaken, efforts to improve productivity can have the opposite effect (p 559).
(3) As Coleman notes, most forms of social capital are created or destroyed as by-products of other activities (Coleman 1988, p 118 in Nederveen Pieterse 1997, p 143; Harriss and deRenzio 1997, p 922).
(4) Coleman suggests that the relation between state-sponsored activities and social capital is a "zero-sum" relation, in which government involvement leads to atrophy on informal networks, diminishing social capital (Coleman 1990, p 321). But, other authors argue for synergy, implying that civic engagement strengthens state institutions and effective state institutions create an environment in which civic engagement is more likely to drive (Evans 1996).
(5) Social capital is built in a humble, piecemeal way through countless decisions of individuals about whether to get involved, and once involved how to proceed (Wilson 1997, p 745-746). It is also built through individuals stepping out of isolation, enjoying being connected, and taking over responsibility for their public lives (Wilson 1997, p 756).
(6) If social capital is a self-organizing system, what is the role of development planners in social capital formation? Wilson argues that professionals can become catalysts of productive social capital if they learn the tools (participatory methods and action research, organizational learning, dynamic systems analysis, and communicative action), skills, and values of social capital building (Wilson 1997).

Although the concept of social capital is still weak and needs further theorization and operational planning, we can conclude on the one hand that a substantial stock of social capital being part of the frame conditions is likely to be a success factor for NRM (research). On the other hand, the process of participatory NRM research itself is likely to make a contribution to social capital building, thereby increasing the probability of NRM turning out to be successful.

Type of agriculture

The type of agriculture to which an NRM problem is related is another issue referring to the frame conditions that deserves attention. The Brundtland Commission identified three types of agriculture (WCED 1987, p 120-2 in Chambers et al. 1989, p xvii-xix): industrial, green revolution, and resource-poor. Industrial and green revolution agriculture are both relatively simple in their farming systems, often with large fields and monocropping, uniform in their environments, and low-risk. Conventional agricultural research has been successful with these types of agriculture, because standard methods of agronomic research have generated technology packages that are simple and amenable to widespread adoption in uniform and relatively low-risk environments.

Resource-poor agriculture can be characterized as complex in its farming systems, diverse in its environments, and risk prone. It is found mainly in rain-fed areas, often undulating and with fragile or problem soils, and includes farming lands in highlands, dry lands, and wetlands. The physical, social, and economic conditions within resource-poor agriculture are highly variable and differ more from those of research stations. Consequently resource-poor farmers have been slow or unable to adopt many of the recommendations flowing from agricultural research (Chambers et al. 1989, p xviii-xix). **For NRM research related to this type of agriculture to be successful, new methods, thinking, and values have to enter into science and agricultural professionalism.**

Approach to NRM Research (Figure1, ③)

Research includes dimensions such as research organizations and partners, the context/process (origin of research topic, use of results, follow up, etc.), the underlying conceptual framework (research objectives, assumptions, hypotheses, theory, and school of thought), and the research tools used (Hoffmann 1992, p 271; Adolph 1997, p 48). These elements, designed to meet the beneficiaries' requirements, need to be defined and well matched within an **approach** (Figure 3). Emphasizing only a single element is of no use; the whole approach cannot be better than its weakest part.

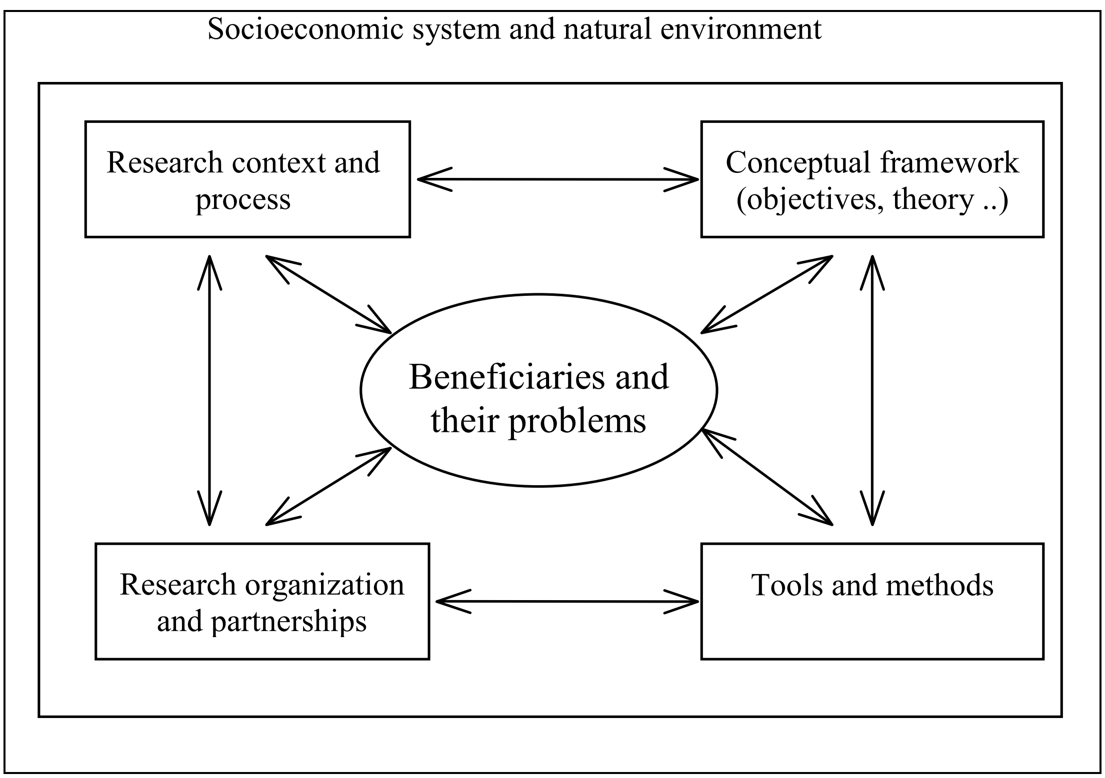


Figure 3. What needs to be defined and well matched within a research approach (altered from Hoffmann 1992, p 271).

As Hoffmann (1992, p 272) stated, in the case of approaches to agricultural extension, existing (research) approaches do not follow taxonomic systems for classification and designation. Names of approaches are frequently not self-explanatory; in many cases they can only be understood if one knows their history:

- Commodity research
- Agroecosystem analysis
- On-farm (client-oriented) research (OFCOR)
- Farming systems research and development approach
- Rapid rural appraisal (RRA)
- Samuhik Brahman (Joint trek)
- Participatory rural appraisal (PRA)
- Participatory action research
- Participatory analysis and learning method (PALM)
- Farmer field school (FFS)
- Comités de Investigación Agrícola Local (CIALs)
- Participatory technology development (PTD)
- Natural resource management by self-help promotion (NARMS)
- Groupe de Recherche et d'Appui pour l'Auto-promotion Paysanne (GRAAP)
- Méthode Active de Recherche et de Planification Participative (MARP)
- Rapid Assessment of Agricultural Knowledge Systems (RAAKS)

Descriptions of approaches range from single case studies to general and abstract recommendations. Taking the above-mentioned definition of approach as a yardstick, descriptions covering the whole system are rarely complete; nor are recommendations made on under what circumstances the approach could be applied elsewhere, and what kind of adaptations had to be made.

Looking at different approaches one can identify diversity and contrasts, thereby encountering distinctive features and dimensions, which help to classify the approaches:

Centralized (top down)..................................Decentralized, participatory (bottom-up)
Basic research...Adaptive research
Marketing.."Co-production", participatory approach
Researcher-led..Farmer-led
Discovery-oriented.......................................Literacy oriented
Partial...Holistic, multidisciplinary
Research only...Integrated range of services
Government agency-based.............................Self-help, NGO-based
Functional participatory research...................Empowering participatory research
Participation only in some stages....................Participation in all stages (priority stages of the research and development process setting, implementation, evaluation)

Kinds of participation

It has to be stressed that the term "participation", like many other words in development jargon, is so widely and loosely used that its meaning has become blurred (Mikkelsen 1995, p 62). Many authors have tried to distinguish different kinds of participation.

(1) Mikkelsen (1995, p 63) makes an important distinction between two different **types** of participation, transformational and instrumental: two major alternative uses of participation center around participation as an end in itself or as a means to development. As an end, participation entails empowerment, and helps promote ideological or normative development goals such as social justice, equity, and democracy. In the alternative form, participation is interpreted as a means to efficiency in project management. In reality the two rationales for participation are often present together.

(2) Biggs (1989, p 3) describes four different **modes** of participation. They are: contractual (scientists contract with farmers to provide land or services), consultative (scientists consult farmers about their problems and then develop solutions), collaborative (scientists and farmers collaborate as partners in the research process), and collegial (scientists work to strengthen farmers' informal research and development systems in rural areas).

(3) Pretty (1994) distinguishes among seven different **levels** of participation: passive, information giving, by consultation, for material incentives, functional, interactive, and self-mobilization.

The opportunities for, and degree of, farmer participation vary considerably according to the different "strata" of the research process. These are:

(1) Basic research - to generate new understanding of biological processes,
(2) Strategic research - to solve specific research problems,
(3) Applied research - to create new technology, and
(4) Adaptive research - to adjust technology to the specific need of a particular set of environments (ISNAR 1984 in Farrington and Martin 1988, p 15-16).

If farmer participation moves upstream in formal research from the adaptive and testing phases to include pre-adaptive phases (e.g., setting research priorities and defining criteria for success) several benefits could result. These might include real problems more quickly solved, research resources more efficiently used, and better relations with farmers (Ashby 1996; Toomey 1998).

Thinking about participation also involves questioning who should participate in NRM research—representatives of a population or only local experts and innovative farmers (Ashby 1996, p 19)? The CGIAR is particularly committed to addressing the problems of the rural poor. The PRGA Program twins gender analysis with the development of participatory research methods because rural women form a growing proportion of the very poor (feminization of poverty) (Toomey 1998, p 10). Gender and stakeholder analyses are thus important tools for ensuring that user participation includes women and marginalized groups.

Recognizing that different people and different communities react differently to similar events, and given the diversity of NRM problems and of site-specific frame conditions, and changes over time, it must be stated that **there is no best way to conduct research**. Researchers have no absolute rules, no "best practice", they can follow to know exactly what to do in a particular situation. A framework for success may also become a recipe for disaster when applied indiscriminately and without careful consideration of the respective context (Peters 1997). A "marketing approach" successful in industrial or green revolution agriculture, is in many cases inappropriate in resource-poor agriculture, where more empowering participatory approaches might be needed, and vice versa. Approaches can only be developed within their unique context; they cannot be selected, transferred, or even copied. Because research has to react to changing social and environmental circumstances over time, continuously adjusting and further developing, a given approach is indispensable (Hoffmann 1992, p 271-276).

However, a comparison of successful and less successful cases can help understand general principles, concepts, lessons learned, and patterns identified across several cases that might serve as broad guidelines for forming and developing a site-specific approach. The World Bank, for example, identified four basic principles for agricultural extension:

(1) Situation specificity,
(2) Financial sustainability,
(3) System flexibility, and
(4) Participation (Hayward 1989 in Hoffmann 1992, p 274).

How far these general principles also apply to NRM research, and how to refine them, must be investigated. Approaches that are developed and adjusted based on such principles are more likely to be successful. Descriptions of cases rarely reflect or explicitly identify the factors (inherent in approaches) that were decisive for a project being successful. Some exemplary recommendations and potential success factors follow.

Research context and process

To decide a research topic, initiative, or planning:

(1) Ensure beneficiary participation in planning and incorporate indigenous knowledge and ideas into the project design (Adolph 1997, p 81). If the initiative for a project comes from outside, people perceive the project activities as a "free gift", which they can either accept or refuse, but not modify (Adolph 1997, p 88).
(2) Widen the impact of participatory research by involving farmer organizations in the research process - instead of individual farmers being the researchers' point of contact (Bebbington et al. 1994, p 3).
(3) For gender analysis, stakeholder identification - involve marginalized groups, including equity issues; create subgroups to target particular beneficiaries (Bebbington et al. 1994, p 25; Ravnborg and Ashby, 1996).

To implement:

(1) Keep close and transparent interactions between the project implementing agency and villages (Adolph 1997, p 82); mutually exchange information, create a dialogue (Mazzucato and Niemeijer 1996, p 19-20).
(2) Provide a forum for analysis and negotiation of diverse interests (Ravnborg and Ashby 1996).
(3) Have beneficiaries make contributions (in cash or kind/labor) (Adolph 1997, p 82).
(4) Build confidence: the pace of programs and projects must be slow to build motivation, confidence, and rapport amongst all the groups involved (Hinchcliffe et al. 1995, p 15).
(5) Create learning situations in the farmer environment (Mangan 1997).

To evaluate and follow up:

(1) Self-evaluation enriches the learning process in institutions. It leads to greater honesty about what does and does not work, particularly if local people's measures of what constitutes success are used (Hinchcliffe et al. 1995, p 15).
(2) Follow-up on the issues that farmers identify as problems (Adolph 1997, p 53).

Conceptual framework (objectives, theory, etc.)

(1) Actively encourage the capacity of individuals and institutions to innovate and experiment. Predicting the technologies that may be appropriate in a particular time and place is impossible. Future technologies will supersede the good ones of today. What needs to be made sustainable is the process of innovation itself. (Hinchcliffe et al. 1995, p 14).
(2) Take a broader approach, e.g., including income generating components in the project design (Adolph 1997, p 82), multidisciplinary research (Janssen and Goldsworthy 1996).
(3) Apply a constructivist, "soft systems thinking" approach, particularly in watershed management, because here one deals with a multitude of actors with diverging interests, objectives, and priorities. In the soft systems approach, research becomes a learning process during which all actors together explore the world (Adolph 1997, p 49). Perceptual barriers in understanding and accepting participation can be traced to the tradition of Western science that is built on repeatability, reducibility, and refutability. When confronted with the complexity of real world systems, "the response of science has been to retreat into the comparative safety of isolating variables to be measured" (Bell 1994). This in turn can lead to a form of methodologically enforced tunnel vision in which science ultimately "fools itself into believing its own objectivity" (McArthur 1997).
(4) Researchers alone cannot develop hypotheses. Confront those concerned. The research process needs to follow an inducible logic, attempting to identify an underlying principle for observed phenomena or problems, instead of collecting evidence for a predefined hypothesis (Adolph 1997, p 51).

Research tools

Design research tools in such a way that they allow all those concerned to express themselves freely, using their own frame of reference (Adolph 1997, p 52).

Research organization and partnerships

(1) Use joint approaches and networking with allies; creating a "lobby group" to coordinate activities, learn from experiences, and achieve an increased impact (Hinchcliffe et al. 1995, p 16; Hagmann et al. 1997, p 14). Cooperate with local development agencies, which can provide support that researchers cannot give (animation, awareness-raising, non-formal education, etc.) (Bebbington et al. 1994, p 15).
(2) Include all actors and service providers in innovation and learning systems (no separation of research and extension) (Hagmann et al. 1997, p 17).
(3) Facilitate the innovation process, i.e., taking the initial innovator's risk, resolving conflicts, etc. with an external organization (project) (Hagmann et al. 1997, p 14).
(4) Clarify roles - those of the different institutions, such as governments and NGOs, involved in joint approaches to NRM (Hinchcliffe et al. 1995, p 16).
(5) Change staff attitudes and behavior towards farmers through training, structural changes (job descriptions etc.), and create an incentive structure (Hagmann et al. 1997, p 15).
(6) Be flexible - external institutions must be flexible and responsive, and ready to learn with farmers. A thoroughly designed and preplanned project is not a good project (Hinchcliffe et al. 1995, p 15).
(7) Have a strong philosophical framework for deep-seated changes within an organizational culture (Hagmann et al. 1997, p 15).
(8) Keep a continuity of staff/personalities within organizations (Hagmann et al. 1997, p 15).

It must be re-emphasized that each approach must be developed within its respective context and needs to be continuously adjusted over time. Even if an approach was designed in a highly promising way, the quality of implementation must be taken as a yardstick, i.e., concept and reality must be distinguished when approaches or processes are linked to impact. Barriers and obstacles to implementation might for example arise because of "people problems" such as power struggles, emotional outbursts, delayed action, and misunderstandings.

Numerous success and failure factors are interacting and influencing a project's process and outcome. They are not universal in their significance and the influence of a single factor depends on others. They are cumulative and can add up to a major effect. Hence, the ability of a (research) project to (1) identify such factors influencing its process and outcome, and (2) be able and flexible to react to them are assumed to be major keys to success. This leads us to monitoring and evaluation (M&E) as an important tool to systematically support management and learning within a project.

Monitoring and Evaluation (Figure 1④)

The understanding of "research approach" and "participation" is characterized by enormous diversity. In the same way, monitoring and evaluation are all embracing terms that can mean different things to different people and institutions. Although the term “monitoring” goes hand in hand with “evaluation”, they differ (Abbot and Guijt 1998). Reducing definitions to a common denominator, one can state that:

(1) Monitoring consists of regular, periodic **recording** of information and collection of data.
(2) Evaluation focuses on (systematically) **assessing** information, including information generated from monitoring to help decide on courses of action to be taken (Campilan and Buenavista 1997, p 7).

According to Patton (1997, p 23), the general definition has three interrelated components: (1) the systematic collection of information, (2) about a potentially broad range of topics, (3) for a variety of possible judgements and uses.

Evaluations can thus include several kinds of purpose, focus, data, and design (Patton 1997, p 22). Contrasts include for example:

External evaluation..Internal evaluation
Outcomes/impact assessment..........................Process evaluation
Experimental designs.....................................Case studies
Accountability systems...................................Management / learning effort
Indicator based..Descriptive
Project-/outsider-led M&E............................Local M&E

For many individuals and institutions, the task of M&E is not entirely new. It is part of their normal activities - either consciously or unconsciously (Campilan 1997, p 86; Abbot and Guijt 1998). To survive, farmers are also “tracking change” to learn, adapt, and innovate. The challenge is to build on this inherent capacity so that M&E becomes a more effective tool for achieving research and development goals (Campilan 1997, p 86). The importance of local people assessing and monitoring change in their environments is acknowledged, for example, in the concept of grassroots indicators (Hambly 1996).

A traditional approach has been to define project or program evaluation as determining the extent to which a program attains its goals. However, evaluation can and does involve examining much more than goal attainment, for example, project implementation and process, unanticipated consequences, and long-term impacts (Patton 1997, p 23). Table 2 provides a framework, which helps place and classify different approaches to M&E (such as social or environmental impact assessment and participatory monitoring and evaluation). Table 3 lists examples of NRM-related cases.

Patton (1997) advocates “utilization-focused evaluation”, which begins with the premise that evaluations should be judged by their utility and actual use. This evaluation answers the questions of clearly identified primary intended users who are responsible for applying evaluation findings and implementing recommendations (p 21). It does not promote any particular evaluation content, model, method, theory, or even use. Rather it is a process for helping primary intended users select the most appropriate content, model, methods, theory, and uses for their particular situation. Intended users are more likely to use evaluations if they understand and feel ownership of the evaluation process and findings; they are more likely to do so if they are actively involved (Patton 1997, p 22).

Table 2. Framework to describe monitoring and evaluation approaches. (Altered from Patton 1997).

Purpose of participatory monitoring and evaluation (M&E)	
Using findings/results	**Using evaluation logic and process**
-**To make judgements** (accountability perspective) e.g., Did the program attain its goals? Should it be continued or ended? Summative evaluation after project completion -**To facilitate improvements** (developmental perspective) e.g., What are the strengths and weaknesses? What kind of implementation problems emerged? >Informing an ongoing cycle of reflection and innovation to make decisions on improvement. -**To generate knowledge**, (knowledge perspective) conceptual use of findings, e.g., research to discover new knowledge, identify lessons of success, test theories, and generalize across time and space	- To enhance shared understandings - To support and reinforce the program intervention (management tool) - To increase participants' engagement, sense of ownership, and self-determination (participatory/empowerment M&E; building a culture of learning) - For organizational development
Focus of evaluation, e.g.,	
Goals and outcomes – to what extent is the program succeeding in goal/outcome attainment?	Process – what is happening and why? How do participants perceive the program?
Impact – what are the direct and indirect impacts (social, environmental, economic, etc.)?	Implementation – to what extent was the program implemented as designed? What are the barriers to implementation?
Cost-benefit analysis – what is the relationship between program costs and benefits?	etc.
Evaluation methods / design	
Quantitative data......................	Qualitative data
Experimental design.................	Naturalistic inquiry
Deductive inquiry mode............	Inductive inquiry mode
Random sampling....................	Purposive sampling
Pre /post measures...................	Process oriented
External stance.........................	Internal stance
Functional participation............	Empowering participation

Monitoring and evaluation have an impact if the results stimulate thinking, confirm certain impressions, provide new impetus, and are used to make decisions. In some cases, the process of engaging in evaluation can have much or even more impact than the findings generated. Individual changes in thinking and behavior, and program or organizational changes in procedures and culture can occur among those involved in evaluation as a result of learning during the evaluation process (Patton 1997, p 90, 99).

Table 3. Some cases of impact assessment and participatory monitoring and evaluation (PM&E) in natural resource management, and general guidelines.

Type of research	Case (Reference)
Integrated pest management (IPM)	Assessing the Farmer Field School Approach (Loevinsohn et al. 1998b) Comparative analysis of IPM technology generation in Nicaragua (Nelson 1994) Impact of farmer field schools (Kenmore 1997) Participatory pest analysis (Mangan 1997)
Watershed management (WSM)	22 participatory watershed development projects - case studies of the processes and impacts (Hinchcliffe et al. 1995) Comparison of participatory WSM to a top-down approach in India (Adolph 1997) Farmers' workshop as a tool in evaluating WSM (Adolph and von Oppen 1997) Participatory WSM in India (Shah 1994)
Soil conservation	Historical environmental impact assessment (Showers and Malahleha 1992)
Sustainable agricultural production systems	Social Impact assessment - Projet de Gestion des Ressources Naturelles, Mali (Neubert 1998) PM&E sustainable agriculture initiatives (Guijt 1998)
(Agro)Forestry	PM&E in community forestry (Kumar Rai 1998)
Biodiversity	Measuring biodiversity in home gardens (Boncodin and Prain 1997)
Livestock /range management	Regular research field hearings (RRFH) (Baker et al. 1988) Participatory planning, M&E of grassland management (Waters-Bayer and Bayer 1997) SEPO- Outil participatif pour l'auto-évaluation des actions d'aménagement pastoral (Acherkouk 1995)
Others	Community environmental monitoring, Australia (Alexandra et al. 1996)
General guidelines	Process monitoring (GTZ 1993) Participatory impact monitoring (Germann et al. 1996) Systematization (Selener et al. 1996) Evaluating technology with farmers (Ashby 1991) Impact monitoring of sustainable land management (Herweg et al. 1998) PM&E (FAO 1990) Logframes to monitor farmer participatory research (Farrington and Nelson 1997) Landcare and catchment groups (Woodhill and Robins 1998)

Participatory monitoring and evaluation (PM&E)

This is why PM&E has become a growth topic and shows much promise: from increasing accountability to enhancing participation, improving mutual understanding, increasing local level capacity, and sustaining partnerships between different stakeholders (Abbot and Guijt 1998). Because no single operational definition exists of "participation" (see Figure 1③), different definitions exist of PM&E, from stakeholder groups providing information during consultation processes to an internal process largely controlled and owned by villagers for their benefit.

In their review of "Participatory approaches to monitoring the environment", Abbot and Guijt (1998) found that although much is written about PM&E relatively few practical experiences are documented. Most approaches appear to be highly participatory in data collection (monitoring), but only a few involve stakeholders in the early stages (designing the monitoring process) and later stages (analysis/evaluation and dissemination of monitoring findings) (Abbot and Guijt 1998).

The Users' Perspectives With Agricultural Research and Development (UPWARD) (1997) and the Participatory Methodologies Forum of Kenya (PAMFORK) (1997) conducted further reviews of PM&E experiences from different sectors such as agriculture, public service, health, environment, and community development. Participating in M&E adds value in:

(1) Recognizing multiple objectives and perspectives/enhancing mutual understanding.
Even if farmers and researchers agree on the goals and objectives of a project or proposed innovation, they are likely to differ about the criteria they feel should be used to assess the impact and appropriateness of a particular technology or resource management strategy. One of the greatest potentials of PM&E is in viewing the project from different angles and combining multiple perspectives of different stakeholders (Campilan and Buenavista 1997, p 11) and in developing strategies for collaborative assessment (McArthur 1997, p 15). PM&E thereby promotes dialogue among the stakeholders (PAMFORK 1997, p 5).
(2) Being a dual tool.
It is a management tool to help project participants improve their efficiency and effectiveness. It is also a learning tool to increase awareness and understanding of the various factors affecting the project, thereby increasing their control over the research and development process (Campilan and Buenavista 1997, p 10; PAMFORK 1997, p 5; UPWARD 1997, p 88).
(3) Promoting empowerment, ownership, and capacity building.
PM&E empowers and promotes ownership (PAMFORK 1997, p 10). Direct involvement in monitoring leads participants to develop a sense of responsibility, enables the direct translation of new insights and attitudes into action, and increases the capacity to distinguish natural changes from those induced by management (Alexandra et al. 1996 in Abbot and Guijt 1997).
(4) Facilitating transparency and accountability among stakeholders (PAMFORK 1997, p 6).
(5) Recognizing and enhancing gender parity leading to positive development (PAMFORK 1997, p 5).
(6) Resolving conflict (ideally, but in certain instances it may also create conflict) (UPWARD 1997, p 89). Stakeholders bring to the PM&E platform their respective agenda and interests.
(7) Efficiency - collecting and processing information with higher relevance and less effort (Guijt and Sidersky 1996).

Despite these potentials of PM&E critical aspects and trade-offs also exist, for example:

(1) Trade-offs inherent in PM&E refer to the balance between (a) "scientific rigor" and "local participation and practical utility", (b) information that is "good enough" and "soon enough", (c) "standardization or scaling up" and "site-specific indicators" (Abbot and Guijt 1998).

(2) The process is costly in terms of money, effort, and time. Project stakeholders can be expected to participate in M&E only if they see this as relevant and if the outcomes directly benefit them (Campilan 1997, p 68).
(3) The initiative comes from outside. Few cases illustrate how institutionalization of PM&E is carried out and whether it can be sustained beyond the project life.

One should view PM&E as a complement, rather than a substitute for the more conventional M&E (McArthur 1997, p 15). However, given the large-scale and long-term nature of NRM problems, the need to involve multiple stakeholders, to improve land literacy and to conduct collective landscape monitoring (see Table 1), **PM&E is likely to be a key factor for successful NRM research**. That is, if it can be effectively incorporated into an ongoing research process. Systematic reflection on monitoring results and regular feedback are prerequisites for detecting successes and failures, and the underlying causes. Based on such systematic learning, institutions might come to the conclusion that their research approach needs adjusting, the research topic redefining, additional partners seeking out, et cetera.

How to measure natural and social capital*?*

At first it was assumed that the overall desired impact of NRM would be to increase (or maintain) natural capital and to build (the less visible) social and human capital. But, how do we measure if these desired changes occur?

Aspects of "natural capital" are usually measured by regular observation and collection of mainly quantitative data on biophysical variables (e.g., soil moisture, soil nutrient and organic matter content, number of pest species and beneficiaries, yield, number of trees planted, water run off, etc.). Apart from the whole range of scientific methods and parameters available, there are also local (grassroots) indicators to measure changes in ecosystems (Hambly 1996). The degree of accuracy needed depends on the purpose and the end use of the data collected. In some cases, precise data are unnecessary and it might be sufficient to describe the direction of change toward or away from improvement instead of determining absolute figures. Guijt and Sidersky (1996) experienced that for farmer-to-farmer extension and donor reporting, exact organic matter content was less important than knowing that six out of ten farmers had noticed a significant change in soil humidity as a result of planting along contour lines.

Abbot and Guijt (1998) defined three categories of participatory methods for environment monitoring:

(1) Methods based on visualization techniques of PRA (e.g., mapping natural resources),
(2) Those using oral testimony to uncover patterns of environmental and social change, and
(3) Those based on adapting methods of ecological assessment to make them more accessible to local people (e.g., inventories of resources and wildlife surveys).

In contrast to the more tangible natural capital, social processes and social capital are difficult to measure, and M&E commonly rely on qualitative documentation of emerging changes and trends.

Burdge and Vanclay (1995 in Ross 1997, p 2) believe social impacts include all social and cultural consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to another, organize to meet their needs, and generally cope as members of society. Cultural impacts involve changes to the norms, values, and beliefs of individuals that guide and rationalize their cognition of themselves and their society. Ross (1997) gives examples of guiding theoretical models (community response model, social organization model), that help to elaborate indicators for social impact assessment.

Also, social capital as a variable needs to be made operational in specific indicators. Examples of suggestions and attempts for measurement are summarized below.

(1) Wall et al. (1998, p 314) presents a summary chart with indicators used by the three featured theorists Bourdieu, Coleman, and Putnam (Table 4).

Table 4. Indicators used for measuring social capital.

Bourdieu	Coleman	Putnam
Individual / class faction: -titles / names -friendships / associations -memberships -citizenship	Family / community: -family size -parental presence in the home -mother's expectations of child's education -family mobility -church affiliation	Community / region -memberships in voluntary organizations -voting participation -newspaper readership

SOURCE: adapted from Wall et al. (1998, p 314).

(2) The Inter-American Foundation is known for its participatory grassroots approach to community development in Latin America. The foundation developed a framework to measure three intangible factors: personal capacity (self-esteem, cultural identity, creativity, critical reflection), organizational culture and capacity (vision, participatory practice, autonomy, solidarity), and community norms (values, attitudes, relations) (Ritchey-Vance 1996 in Wilson 1997, p 751).

(3) Haddad, of the International Food Policy Research Institute (IFPRI) suggested measuring social capital in a survey in Kwazulu-Natal in South Africa along five different dimensions. They are: (a) economic and social networks (family and non-family-remittances, sharing of land, sharing of dwelling, child care, looking after livestock, etc.), (b) participation in community groups, (c) civic-ness (such as voting and knowledge of local events), (d) trust, and (e) violence (CGIAR 1998).

(4) Sampson et al. (1997 in CGIAR 1998) attempted in Chicago to measure social capital (or what they called "collective efficacy" = "social cohesion among neighbors combined with their willingness to intervene on behalf of the common good"). The authors gauged the degree of two related variables –"informal social control" and "social cohesion and trust" –

by asking residents questions about their neighbors' behavior. They also asked questions such as: How strongly do you agree that:
(a) People around here are willing to help their neighbors,
(b) This is a close knit neighborhood,
(c) People in this neighborhood can be trusted,
(d) People in this neighborhood generally do not get along with one another, and
(e) People in this neighborhood do not share the same values?

Conclusions

The CGIAR's PRGA Program aims at generating methodological knowledge related to NRM research that synthesizes lessons of success across different cases. This will lead to accumulated wisdom - guidelines and principles towards more successful NRM research - that help decision makers and researchers develop approaches. These principles cannot be applied indiscriminately, but must be adapted to the specific context.

Based on literature and our own considerations, some potential success factors attributable to the frame conditions on the one hand, and to the research approach on the other, are outlined in this paper. Such theoretically derived success factors need to be verified and completed through empirical studies. Questions for analyzing different cases might be:

(1) What is the concept/approach of this case (objectives, theory, project design, history, tools/methods, organization, partnerships)?
(2) How far is the case in line with theoretically derived principles for success?
(3) Is the program implemented as designed? What are the barriers to implementation?
(4) What is the outcome or impact of this case (technical or institutional innovations, adoption or adaptation; distribution of benefits; natural or social capital building, unintended effects, etc.)?
(5) What are the underlying causes for success or failure?
(6) Are there processes and strategies for learning about strengths and weaknesses?
(7) What has been learned by stakeholders involved in the research and development process? Have any adjustments been made in the approach as a result of learning?

How "success" is defined in NRM research and by whom (researchers, local people, poor, men/women, etc.) has to be clarified. Success is mostly assessed in terms of a project's visible biophysical or economic output (natural and economic capital building). On the other hand, equity and poverty-orientation, and the non-visible social dimensions of impact are frequently neglected. More attention should be paid to the potential contribution of participatory research approaches to "social capital building". This requires further efforts to develop methods and indicators for the operating and measuring of "social capital".

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CHAPTER 2

FARMER PARTICIPATION AND FORMAL-LED PARTICIPATORY PLANT BREEDING PROGRAMS: TYPES OF IMPACT TO DATE

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General Characteristics of Formal-Led Participatory Plant Breeding (PPB)

Formal sector institutions (e.g., national plant breeding programs, Consultative Group on International Agricultural Research [CGIAR] institutes, or extension services) are increasingly experimenting with farmer participatory approaches in plant breeding to strengthen farmer production systems in different ways. In contrast to "farmer-led PPB" projects (McGuire et al. 1999), those led by the formal sector have a strong institutional orientation. Formal-led PPB programs have an obligation to feed information back to the formal research sector, and to feed forward to farming communities. They are expected to improve or complement the formal sector research system (e.g., refining breeding strategies) or possibly reorientate entire programs. Mostly, formal-led PPB programs also involve strong linkages to the formal variety release and seed production system. Finally, scientists involved in formal-led programs have a mandate to extrapolate their results beyond the individual farmer or community with which they work, and programs often need to show the advantages of farmer participation compared to breeding work centred at research stations or standard on-farm approaches. Thus this dual need to focus on end-users and on the formal sector institutions themselves shapes the types of participation, the types of products used or targeted, and the types of data needed for formal-led PPB programs (Weltzein/Smith et al. 1999).

Formal-led participatory breeding programs are relatively new. Most of the cases identified date from the last 10 years, with only two or three initiated earlier. Mostly they were relatively small in scale, working only at one or two sites and usually involved fairly intense types of direct farmer and scientist interaction. We would characterize much of this small-scale research work as functionally motivated and aiming at "functional participation", that is, trying to understand better what farmers want or need to feed back insights to formal research for improving future on-farm productivity. Formal-led PPB programs that have addressed what may be called capacity building or more empowering approaches ("empowering participation") are those programs that have tried to scale-up the work to involve more farmers, representing more households, and a larger target region. These programs have more often focused on farmers' skill building needs, and have searched for a clear division of labor between farmers and scientists that builds on the comparative advantage of each and that ultimately devolves much of the decision making to farmers and their communities.

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Most of formal-led PPB to date (some 40 different field programs) have centered breeding efforts on major crops, that is, the crops to which the formal sector normally gives priority. Should researchers truly move to strengthen the minor crops (also known as "neglected crops"), the division of responsibilities and types of participation with formal-led PPB could radically change, with researchers offering strategic support to what are essentially farmer-driven programs.

Goals of Formal-Led PPB Programs

Formal-led PPB programs can have a diversity of overarching goals, and hence a diversity of anticipated impacts. The most common goals have been to contribute to increased production in farmers' fields and to increase farmer income through developing and enhancing the adoption of suitable, usually improved, cultivars. These are the basic goals of any formal-led breeding program, and participatory approaches are often experimented with to achieve them more effectively and more efficiently. In this context, formal-led PPB programs sometimes seek to refine their knowledge of farmers' needs or preferences, or reorient general breeding directions such as type of base germplasm used, the priority traits sought, and the management and organization of station trials. Institutional and organizational changes that facilitate decentralization and/or scaling up of the breeding program often come hand in hand with these efforts to meet farmers' location-specific varietal needs.

Biodiversity enhancement is another broad goal towards which some PPB programs strive. Participatory breeding programs with this goal tend to work more often with the farmers' own germplasm or a combination of local and exotic materials; many also involve farmers in the screening of a wide range of varieties in the preadaptive stages of research, either in on-station trials or in community plots. In several cases, PPB programs have also released populations or have purposely promoted breeding strategies that result in heterogeneous materials.

Another important goal of PPB programs is to provide benefits for specific types of users (e.g., the rural poor, women, and farmers with marginal soils) or to deliberately address the needs of a broader range of users. Such a goal necessitates an extensive diagnosis among well-defined types of potential user and stakeholder groups. This goal is often in contrast to traditional centralized breeding programs, which work under the assumption that benefits from routine station-based research or research-controlled on-farm trials are "user neutral".

When addressing issues related to improved adoption of breeding products and/or biodiversity enhancement, PPB programs often find themselves confronted with the need to address modifications in policy, whether these be seed regulations or variety release criteria and procedures. Most modifications are sought to accommodate the expanding and institutionalizing of approaches that better serve farmers' aims. These may include modifications in the scales of testing and of desired cultivar adaptation, the kind of data required for release, and the number of cultivars released at any one time.

Finally, some programs specifically work towards enhancing the farmers' own breeding process, that is, providing technical knowledge and insights so that farmers themselves are more successful in their own selection and seed production efforts. This skill-building goal is often addressed together with a more general effort towards strengthening the capacities of farming communities to interact and derive and demand benefits from the formal research institutions—whose mandates are to address local-level needs.

In conducting an overview of formal-led PPB programs, we became aware of how much the goals set for PPB programs shape the entire research design and of secondary effects that PPB programs achieve. Set goals greatly influence what is on offer (skills or varieties), the type of germplasm used, the type of farmer involved, the scale worked at, the trial design, and the seed multiplication procedures. However, we found that the goal-setting process itself was rarely articulated or transparent—that is, goal setting was not seen as something that needed to be discussed within and between the scientific and farming communities.

Table 1 summarizes the primary goals guiding 40 PPB programs that the formal sector has initiated or led. The comprehensive review shows that most (78%) programs have focused on various aspects of production increases, the same goals toward which classical breeding programs strive. The programs examined have most often targeted marginal environments, where impact from classical breeding programs was less than expected or completely unsatisfactory. Thus, many programs were oriented toward identifying better varieties, those that offer clear advantages over farmers' own local varieties or locally-available cultivars. Often linked with this objective has been the need of scientists to better understand farmers' selection criteria and preferences for a range of traits, possibly traits with which farmers have had no previous experience (68% of PPB programs). This knowledge usually feeds back directly into on-going breeding efforts, to change priorities for testing and selection criteria. Another closely related objective, of specific importance to marginal environments, is the possibility of releasing varieties adapted to specific zones of cultivation (13% of formal-led PPB programs).

Table 1. Formal-led participatory plant breeding: Goals of program development (n = 40 cases[a]).

Goal (motivation)	Number of cases	Percentage of cases
Productivity increase (better varieties)	31	78
Research efficiency (farmer varietal criteria, approved testing)	27	68
Biodiversity conserved/ enhanced	8	20
Policy changes (release, seed multiplication)	5	13
Facilitate farmer learning	3	8
Other	3[b]	-

a. Some cases are listed twice because they had multiple primary goals.
b. This category includes two different motivations: empowerment, and benefits to specific users.

Although the review identified programs that targeted other goals, such as enhancements in biodiversity or farmer capacity-building directly, these were most often deemed secondary goals in the overall PPB program. It thus appears that the full range of goals has not been systematically explored in formal-led PPB programs (and that the full range of potential impacts has not been identified). The relative narrowness of present aims shaping PPB work is perhaps a feature of the newness of the approach. Certainly future efforts should more consciously aim to explore the bounds of the potential of different participatory breeding approaches.

Farmer Participation in Different Stages of a Breeding Program

The technical process of variety development for any crop of any pollination or propagation system can be classified into three major steps. These constitute the technical process of plant breeding and variety development. Schnell (1982) describes them as:

(1) Generating variability,
(2) Selection, and
(3) Testing of experimental cultivars.

The first step is achieved in most programs by making deliberate crosses between diverse parents with complementary trait combinations. In some specific cases, this could also be achieved by assembling germplasm on a larger scale, for example, at the beginning of a new program. In some cases, breeders use mutagenesis to induce new variability within a target breeding material. In cross-pollinated crops, where population improvement methods are common, the building of base populations and the generation of new progenies for testing, are part of this step of generating variability for further improvement activities.

The second step comprises the process of narrowing down the new variability generated from a few thousand or hundred plants or progenies to a limited number of potential new varieties, usually about 10 to 40, and often referred to as experimental varieties. In self-pollinated crops, or when developing hybrid parents this is usually referred to as selection in segregating generations. In population improvement schemes this is the phase of progeny testing. For clonally propagated crops this is the phase of narrowing down the many new clones to a few clones with more planting material for more detailed testing. At this stage usually only minimal seed or planting material of every plant, progeny, or clone is initially available. During this process of narrowing down numbers, the quantity of seed or planting materials is also built up to allow more thorough, multi-location testing of candidates that usually have to fulfil a set of minimum criteria, that is, experimental varieties. Thus the seed increase ratio of the crop partly determines the length of this stage.

Step three is the testing of these experimental varieties for productivity traits, their range of adaptation, and acceptability. The experimental varieties are tested in replicated trials over an increasing number of locations, with increasing plot sizes. This testing phase normally begins with trials that are named initial variety or hybrid trials, and continues until varieties are proposed for release and/or distribution.

This classification helps compare among different crops and crop types. It also allows comparing and optimizing resource allocation in the different stages of a program. Comparing results from long-term breeding research within this framework allows comparing across species and within a crop; and technical education in plant breeding is often conducted within the framework of these categories. Because education in plant breeding is mostly technical in nature, it is usually limited to these three stages.

A successful breeding program, however, needs two additional stages that go beyond purely technical issues. The technical process needs to address and be matched to fit a set of identified goals and objectives with well-defined targets for the breeding program. Primary and secondary goals need to be identified, as discussed above. To fulfil them, specific objectives for the breeding program must be identified and prioritised, and targets set. In identifying appropriate objectives and targets for a breeding program, knowledge about the target farming system(s) and farmers' needs are important, and farmers' selection criteria is helpful. Although breeders are rarely trained to elicit this type of information, farmer participation can be a powerful tool to achieve a meaningful reorientation of a breeding program.

To be successful, the technical process of the breeding program also needs to feed into an efficient system for varietal release and dissemination, that is, an identified system for delivery of the technical product to potential users. Evaluations of past impact of breeding programs have often pointed out that weaknesses in such delivery systems limit or slow adoption. In view of the unsustainability of large-scale, state-run or directed efforts for seed production and distribution in many developing countries, areas for reflection might be the strengthening of the local seed sector or the catalysing of more local seed suppliers (whether private sector or otherwise). Some estimates suggest that, worldwide, the local seed sector provides at least 80% of farmers with most of their seeds (Cromwell et al. 1992).

To examine the potential for, and actual farmers' involvement in, this whole process of a breeding program, it may help to depict these stages in a cyclical fashion (Figure 1). This makes it clearer that feedback between the different stages is possible and should be institutionalised in programs. In participatory breeding projects, many of which are exploratory to a large extent, envisaging this feedback and influencing and opening up opportunities throughout the cycle of stages of the program for farmer input is particularly important, even if the degree of input may vary by stage.

In conducting the overview of formal-led PPB work to date, it became clear that most programs involved farmers in the testing of varieties, materials that were genetically fixed and often already released. Several programs addressed the setting of breeding priorities and targets. Relatively little work has been done on exploring farmers' contributions to setting overall goals of a breeding program, generating variability, or selecting experimental varieties from segregating populations. The variety diffusion process is a step that has also received relatively little attention, but is starting to attract interest.

Farmer Participation and Crop Type

Most PPB efforts to date are focused on staple food crops or are in areas with locally important quality preferences. For instance, several PPB programs were found with the staple potato in the Andes, but not in Central America where potatoes are something of a luxury vegetable. Rice PPB was found in Asia and Africa, but not in Latin America where rice is grown with mechanized production as more of an industrial crop. None of the cases examined dealt with crops grown using mechanized production.

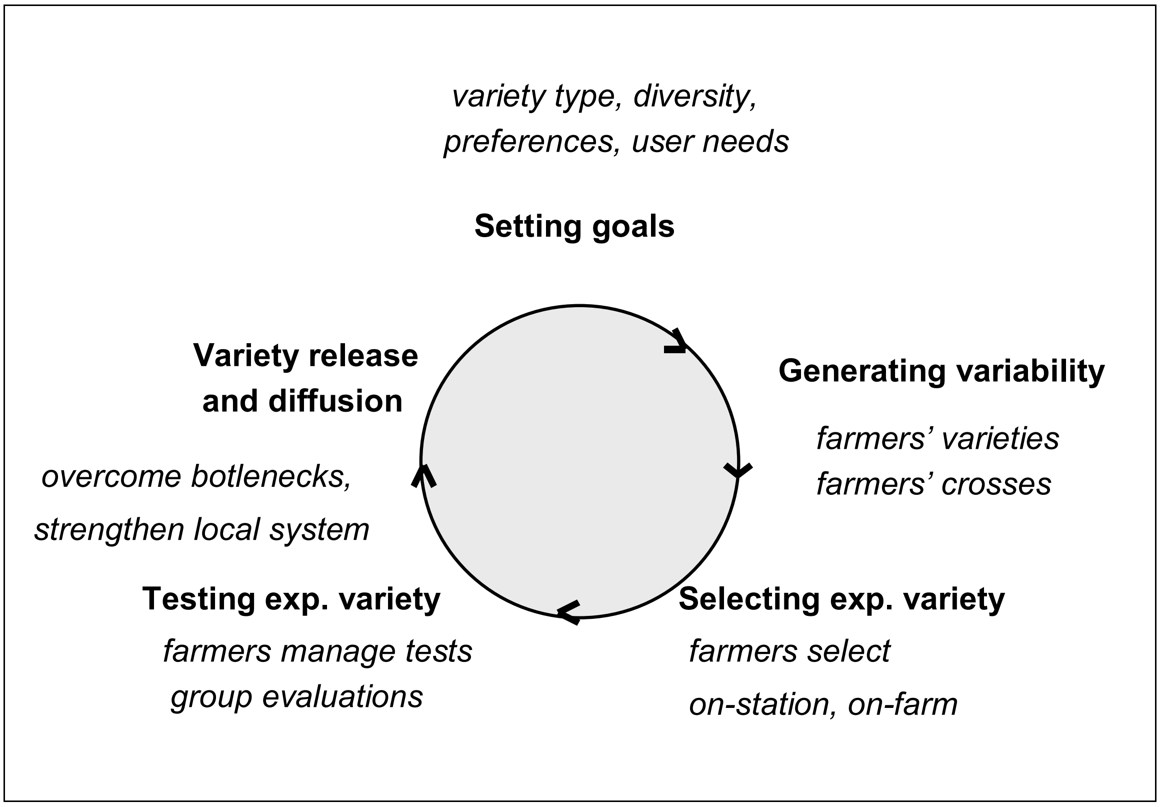

Figure 1. The cycle of plant breeding stages, with examples for farmers'contributions (in italics).

Of the crop experiences examined, most (24 of 46 crop examples) are with self-pollinated crops, followed by cross-pollinated crops (15 examples), clonally propagated crops (7 examples), and agroforestry tree species (two examples). For all crop types, most of these projects involved farmers in some form of participatory variety selection, and few involved farmers in generating variability or selecting within segregating populations (Table 2). Several of the projects linked work on varietal selection with achieving a better understanding of farmers' selection criteria and varietal needs. This information usually feeds back into breeding programs immediately and affects the setting of priorities. However, only a few projects implicitely involved farmers in jointly setting overall priorities.

Table 2. Numbers of participatory plant breeding projects classified by crop pollination biology and general stage of farmer involvement[a].

Pollination biology	Testing varieties	Selection in segr. populations	Setting priorities
Self-pollinated	19	7	7
Cross-pollinated	9	3	7
Clonally propagated	6	1	4

a. Classification is, of necessity, approximate. We took description of stages of the breeding as a guideline (Schnell 1982).

Although our working definition of PPB limits it to selection within a species, a few comments on between-species selection are needed. The recent review includes two cases where farmer-participatory methods were used for selection among tree species for potential use in agroforestry breeding projects (Franzel et al. 1995). Clearly situations exist where selecting the most appropriate species is a necessary first step before any type of breeding work is contemplated.

In addition to pollination biology, the seed increase ratio of a crop (i.e., how many seeds can be harvested from one plant) also influences the type of participation feasible and the farm-level impact. In crops with low seed increase ratios, it may be difficult to produce enough early generation seeds to allow for on-farm testing of progenies with a representative set of farmers. In such cases, community representation and community plots are possibly the better route for involving more farmers in the evaluation process.

Similarly, the sowing method that farmers use may limit the type of trial design, which is feasible for farmers' fields, and thus the kind of experimentation that farmers can do. In regions where hand-sowing in hills is predominant, one can easily envisage testing many varieties in a relatively uniform part of the field. If sowing is done by machine, only a few large plots are possible. The time available for optimal sowings may also vary. For many dryland crops, this is the critical factor for successful cultivation, thus only trial designs can be implemented that do not slow down the process of sowing. If this sowing time is also highly unpredictable, the researcher will find difficulty in being present at the time of sowing and farmers will be mostly fully responsible for trial designs and their implementation. Another factor that may influence the type of farmer participation envisioned is the level of diversity among the locally grown cultivars. In highly diversified cropping systems, with a range of differing crop uses, new germplasm may require more long-term testing with a wider variety of users, and for a broader range of uses, before farmers can take adoption decisions.

These observations show that the biology of the crop and crop management systems in the target region also determine the type of participation in a breeding program.

Types of Farmer Contribution Found in Formal-Led PPB programs

A way of differentiating farmers' contributions to a participatory breeding program is to examine the nature of this contribution. We have identified four main thrusts where farmers:

(1) Contribute key information based on their knowledge and experiences,
(2) Contribute genetic materials,
(3) Conduct trials, and
(4) Select and evaluate germplasm.

Farmers' knowledge and information

In the cases we examined, farmers' knowledge was often integral to achieving a better understanding of the varieties farmers presently grow. Farmers' descriptions of their cropping system, major constraints, key aspects of the farming system, and social institutions are all information that makes an important contribution to the orientation of a breeding program. Another important requirement for a breeding program is to understand farmers' needs and preferences for the specific traits of a crop. This kind of understanding often leads to descriptions of appropriate type of varieties, a reorientation of the breeding program in terms of selection strategy, and germplasm used for breeding. Farmers' knowledge is also essential to better understand a local seed system, and opportunities for increasing its efficiency and its ability to serve a wide range of farmers.

In some of the cases we examined, the description of locally-grown varieties in the target areas allowed breeders to become familiar with the varieties that farmers grow and helped breeders choose appropriate materials for testing and breeding that could fulfil some of the farmers' basic requirements; or it allowed the breeder to choose materials for testing that differ sufficiently from the locally grown varieties for key traits (Witcombe et al. 1996). The description of the local process of seed production and management is another example where farmers' information was key to a program's success. Based on a careful analysis of farmers' strategies for seed potato, production technologies for improved seed health and storage conditions were developed in the Andean region and in eastern Africa (Haugerud and Collinson 1990). Another example where farmers' information played a key role in orientating the breeding program, is the work on pearl millet in the desert region of Rajasthan. Farmers in this region do not differentiate particularly between different varieties, but rather between different plant types. They associate strongly between adaptation to specific growing conditions and specific plant types. Farmers who regularly produce their own seed often select panicles representing very different plant types for their seed lots. For a breeding program targeting this region, adoption of any new variety will depend on its capacity for contributing to the success of these diverse seed lots (Dhamotharan et al. 1997).

This type of farmer contribution thus provides breeders with necessary information for identifying the appropriate type of variety, both in terms of genetic make-up (hybrid or heterogeneous open-pollinated variety) and in terms of key plant traits. Similarly, research efforts aimed at improving institutional support for seed production and distribution can derive key interventions from a sound analysis of farmers' information. Better understanding key production constraints may allow breeders to modify the testing environments on the research station to test materials more effectively for key adaptations. This understanding, especially when combined with an understanding for the major uses of a crop or varieties, will also help breeders reorient their programs and be better able to meet farmers' key needs.

These examples indicate that the types of impact that a PPB program can expect from letting farmers contribute their information to the joint program are largely related to making research more effective and improving the dissemination of new technologies. Farmers' information may have some impact on the level of biodiversity maintained in the target farming system if the breeders start targeting a wider range of plant types, or if more variable types of varieties are available for dissemination as a result of these discussions with farmers.

An important advantage of explicitly searching for and including farmers' knowledge for developing and implementing a PPB program is that it is easy to involve many farmers and, with appropriate care, stakeholders can also be involved who are often overlooked or excluded (e.g., women, poor farmers, and minorities). Discussions with farmers on specific topics related to the breeding effort do not have to be conducted during the growing season when farmers' time is often limited and valuable.

Farmers contribute genetic materials

Farmers often contribute genetic materials to breeding programs, especially participatory breeding programs focusing on adaptation to specific stresses, production systems, or niches. Specific quality traits or crops, for which little breeding has been done so far, rely strongly on farmers' contributing their own genetic materials to a joint breeding effort. In such cases, farmers' genetic materials are commonly **key** to success.

Farmers' genetic materials can be used in different ways. In a few cases with cross-pollinated crops, the farmers deliberately create new variability by facilitating outcrossing between highly diverse types of varieties, often their landrace and an introduced modern variety. These outcrosses often reveal enormous genetic variation and many new combinations of traits. In the case of pearl millet in Namibia, one such population was used as the base for creating a new breeding population (Bidinger 1998). In several cases, farmers have contributed landraces as parents for crossing, or for targeted improvement efforts. A good example for this is the project on breeding for chilling tolerance in rice in Nepal. Breeders identified the local landrace in a series of tests as highly tolerant of chilling temperatures during the early growth phase and during grain filling. This variety was crossed with a high yielding, chilling-susceptible variety. Farmers used the progenies from this cross for selection of a new variety (Sthapit et al. 1996).

Farmers' varieties usually form the basis for further improvement in projects that mainly aim at improving farmers own skills in improving the genetic composition of their varieties and seed stocks. An example is a project, led by the national program of Honduras and Cornell University, with a component of teaching farmers techniques for pollination control for maize in a region with a high degree of local varietal diversity (Gomez 1996). Thus the base material for the efforts for improvement are the farmers' varieties or possibly other materials that are available to them.

Farmers' genetic materials often broaden the genetic base of the participating breeding program considerably. The material derived and disseminated from these efforts can also represent a wider range of diversity than the products of previous efforts. The use of farmers' genetic materials sometimes contributes to conserving landrace materials in the local farming system, particularly in cases that focus on building farmers' skills. The types of impact that were observed or expected from using the farmers' genetic materials have been mostly related to enhancing biodiversity or conserving local germplasm in the farming community and enhanced productivity in specific production systems.

Farmers conduct trials

In almost all the cases examined, farmers manage trials on their own land as part of the PPB program. Farmers normally decide how to experiment, that is, they choose the field for growing the trial(s), manage the nutrients and other aspects of crop husbandry, choose the control variety, and contribute to the trial design. In many of the cases where farmers evaluate stable varieties, this contribution is key to the breeding program's success. Farmers provide the appropriate testing conditions, which enhance the selection program's efficiency.

An example is the work with potatoes in Ecuador, where farmers test varieties over a wide range of altitudes and fertility conditions. Research stations do not cover this range of altitudes, and usually do not manage trial fields at different levels of input. In this case, farmers selected new desirable clones for adoption after only 2 years of testing, whereas officially released varieties had scarcely been adopted earlier (Andrade H, personal communication, 1998).

Another example where farmers' trials are key to the joint breeding effort is the case of pearl millet in southern Africa, where farmers grow nurseries of diverse pearl millet varieties and germplasm accessions usually in community plots for selecting material for further testing on their own farms. In this case, the farmers' fields also provide more appropriate testing conditions and better access to farmers (Monyo et al. 1997). More farmers can come and see and assess the new breeding materials.

The key impact from farmers' contributing trials to a participatory breeding effort is an increase in research efficiency through providing appropriate testing conditions. Through on-farm trials, farmers get early access to new genetic materials and have the option to adopt these varieties. Increases in productivity and initial adoption can be immediate results from farmer-managed trials. This would normally lead to further dissemination and adoption of the new varieties. Farmers may also decide to use them in their own breeding work and thus influence the level of genetic diversity in their farming system. Farmers' experimentation with new germplasm is a powerful tool to create the basis for a range of impacts on-farm.

However, among the cases examined, several report that poor farmers or women can experience greater difficulty in growing trials. Better-off farmers often have more time to devote to farming or have a stronger role in decision making about land allocation on their farm. If poor or women farmers are among the targeted group, specific planning is needed so that they can benefit from the planned activities.

Farmers select and evaluate

This contribution of decision making among a set of varietal choices goes beyond providing information alone. Farmers in these cases make judgements based on multiple criteria; they decide which trade-offs to make and which combination of traits to favour. These are often complex decisions because numerous traits can be considered and because differences between individuals may be small for individual traits. To identify materials that contribute new opportunities for enhanced productivity or stability of production requires an intimate knowledge of the target farming system, production system, and social system.

In many PPB programs, farmers make the final selection decisions, for example, among entries in an on-farm trial, or among entries in larger nurseries grown on-farm or on-station. Selection usually involves evaluating a variety for a number of traits in combination simultaneously. Trade-offs are assessed between the different traits, for example, yield potential and earliness, or panicle size and tillering behaviour. A farmer is often the better judge in predicting which combination of traits may have potential use for specific growing conditions and production goals on his farm or in his area of cultivation. Several well-documented cases show that farmers' selections indeed performed well, better than breeders' selections, in the conditions for which they were selected (Sperling et al. 1993). Breeders often find it difficult to have a broad enough understanding of the diversity of growing conditions and the corresponding relative weaknesses of the local cultivars to make appropriate selection decisions that anticipate the full range of potential adoption possibilities.

Thus, farmers' involvement in decision making can have far reaching impacts and often leads directly to more adoptable varieties especially in areas where none were before. Researchers usually gain a better understanding of farmers' assessment processes and can thus target their program better towards meeting these needs.

Most programs use several types of contributions from farmers and to different degrees. They also change their organizational set-up to adapt to the needs of the farming communities and to improve the program's impact. The fast and comprehensive learning experience for the participating scientists is a basis for these rapid changes in the operational forms of PPB projects. The other basis is the rapidly increasing role of farmers in the decision-making process and in guiding the project toward other areas of work (e.g., seed system support) to improve the scope and scale for impact.

Impacts of Formal-Led PPB

Impact of PPB projects led by formal sector institutions was analyzed for both groups of partners in this process: the farmers, their families, their communities, and associations; and the researchers and their institutions. The farm-level impacts have in many cases exceeded researchers' expectations.

Framework for thinking about PPB impacts

Like any type of plant breeding, PPB is a process that may take 2 to 5 years to have initial results and still several more years before its true impact begins to be realized. Recognizing this, a group of PPB practitioners (drawn from the plant breeding group of the Participatory Research and Gender Analysis program) has begun conceptualizing a set of intermediate impacts with accompanying indicators.

Table 3 shows two examples of possible intermediate impact indicators being used in two ongoing PPB field programs. A challenge of this developing PPB work is to assess the trade-offs of aiming for different intermediary impacts—and ultimately goals.

Table 3. Examples of types of intermediate impacts anticipated for major impact categories from two ongoing participatory plant breeding (PPB) research programs.

Impact categories effects on:	Intermediate impacts: Example 1	Intermediate impacts: Example 2
Formal breeding process (feedback to research)	Changes in the selection strategy: selection criteria selection environment type of germplasm used gender differentiated selection criteria identified	Positive change in the way formal breeders view PPB Strengths and weaknesses of available germplasm better understood (for researchers or for farmers) Farmers' preferred traits, user- and gender-differentiated, better understood
Acceptance (adoption)	Increase in adoption: number of lines requested for independent testing number of farmers requesting lines More requests from farmers of different wealth categories Farmers retain seed for further testing	Identification of farmer-acceptable varieties Particularly disadvantaged users (e.g., women) identify acceptable varieties Rate of varietal spread quickened Seeds of preferred varieties given to neighbors
Farmer production	Varieties show yield advantage on-farm	

Continued.

Table 3. Continued.

Impact categories effects on:	Intermediate impacts: Example 1	Intermediate impacts: Example 2
Farmer-held diversity	Number of varieties used on-farm increased (no. of varieties being a rough proxy for variety diversity)	Enhanced diversity through deliberate cross-pollination in farmers' fields
Farmer breeding / seed processes (technical / social)		Enhanced farmers' capacity to mass select Enhanced farmers' ability to maintain open-pollinated varieties
How local people are organized to manage crop development: - breeding/ select - seed supply issues	Farmer group formed to produce and distribute seed of preferred varieties in the village	Nodal seed experts in community identified Enhanced farmer ability to produce quality seed
How formal research organizations organize breeding: - breeding org. - supply org.	Move to replicate farmer conditions on research stations Greater percentage of trials in farmers' fields The role of decentralization vs. participation understood Changes in variety release procedure considered	Better understanding (by researchers) of farmer seed flow system
"Empowerment"		Farmers set their breeding objectives Farmers control breeding methodologies Farmers perform breeding activities Farmers work through existing or newly formed community-based organization or farmers' groups

Specific PPB impacts

Changes in orientation of breeding program. Many participatory breeding projects were initiated in regions that are marginal in terms of the environmental conditions for crop growth and productivity increase. These regions are often where plant breeding programs have had limited prior impact. The PPB research targeting these types of environment has examined the suitability of specific breeding strategies in achieving better genetic gains under such conditions through insights gained from farmers, and farmer expertise in selecting among plants, progenies, or varieties. Such close interactions can profoundly influence the overall strategy of an evolving breeding program.

An example is the pearl millet breeding program of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). The program is for the dry zones of the state of Rajasthan, and was initiated in 1989 in response to findings indicating that local landraces tended to show higher grain yields under severe stress conditions. The approach taken was to improve testing sites in the target region and develop breeding populations using the local germplasm. Farmers were involved in the project implicitly to identify their needs and preferences and thus contribute to refining the program's goals and objectives. The initial findings of this work indicated that farmers in different regions and representing different social strata and gender had widely differing preferences and needs (Weltzien-R et al. 1998).

A more detailed understanding of farmers' seed management practices revealed that farmers often use small quantities of modern varieties as components of seed mixtures and thus considerably broaden the genetic base of their own seed lots. Farmers could thus enhance their chances of obtaining increased yields under better growing conditions. At the same time, poor farmers, especially women, expressed concern over this practice of mixing improved varieties with local ones, because the seed produced from these mixtures shows less adaptation to the predominantly poor soil conditions. Poor farmers are often dependent on seed from better-off farmers, but the seed these provide does not serve the poor farmers' needs as well as it used to. Because poor farmers dominate in these regions and better-off farmers also own field with poor soils, the breeding program decided to fill this gap by focusing its efforts on developing materials specifically targeted towards poor fertility soil conditions and a higher stability of grain yield. This constituted a profound change, because it required changes in the management of research station fields and in the germplasm base for breeding, and further research into the methodology for achieving these goals, including sharing responsibilities with farmers. The program also helped a local nongovernement organization (NGO) identify farmer-preferred sources of landrace-type seed for increase and distribution to those farmers who are facing difficulties with seed production. In collaboration with the national authorities, steps were initiated to change release procedures for pearl millet so that varieties specifically adapted to these marginal conditions would have a higher chance of being identified as superior by the national variety testing scheme, and thus a chance to be released.

Another example where farmers' involvement in the breeding program has led to profound changes in the orientation and operation of the breeding program itself is the case of potato breeding in Bolivia (Thiele et al. 1997). The research program focused on developing techniques for farmer evaluation of potato clones, which had previously been tested for potato late blight resistance and yielding ability on research station trials. During these experiments, the researchers gained an understanding of farmer-relevant criteria, which have been incorporated into the breeders' selection strategy on-station. At the same time, farmer groups are now involved routinely in evaluating a larger number of clones on the research station and subsequently on their own land. These farmers usually remain involved with the breeding program and often multiply seed potatoes for further distribution in their villages. Thus farmer tests have become an integral part of the routine testing procedure for new potato clones in Bolivia.

Improved varieties for marginal areas. Because farmers were involved in the selection in segregating generations, a rice variety (*Oryza sativa*) was bred that combined the high level of chilling tolerance of landrace rice varieties of the Nepal mountains with the increased productivity from modern varieties. So for the first time the farmers in these hilly regions could benefit from a plant breeding effort targeting their region (Sthapit et al. 1995; 1996). Initial adoption of this variety was high and, more interestingly, the success of farmers' selection encouraged them to continue further selection in this and other material. They were thus carrying the process further even with reduced support from researchers (Sthaphit, personal communication, 1998).

Bean (*Phaseolus vulgaris* L.) breeding in Brazil was successful through involving farmers in breeding a variety that combined disease resistance (*Macrophomina* and *Fusarium* wilt) with the preferred seed coat color, drought adaptation, and yield characteristics for the dry zone of northeastern Brazil. Farmers were involved in selection in segregating materials on-station and later in testing experimental varieties on their own farms. Before the variety could be formally recommended for cultivation in this region, farmers were growing it and demanding more seed (Zimmermann 1995).

Immediate adoption and yield increases. Farmers in a remote area of India, where soils are highly degraded and production is subsistence oriented, could identify varieties of several major crops that provided them with new options, more food, and greater stability of production (Witcombe and Joshi 1996; Witcombe et al. 1996). The documentation of adoption of the rice variety "Kalinga III" is a good example of the spread of a variety identified through farmers' participation in variety testing. This study shows that adoption of the variety began in the study villages the year following the first trials conducted by farmers. Seed of the preferred variety began spreading to other villages in the second year following farmers' trials. Although the project helped spread the seed in several ways, much of the found spread resulted from farmers' own initiatives in selling and giving away seeds to others, inside and outside the village. The spread of this variety continues, but official release in the state of Rajasthan (where the project is located) pends and thus government subsidies for producing and distributing seed of this variety are not available to farmers. A study of the impact of this one rice variety, identified through farmer participation, estimates rates of return for the overall project between 47% and 70%. This figure is as high or higher than for regular successful, non-participatory agricultural research. This indicates that participatory research with a comparatively local focus, and thus a smaller target region, can have similar rates of returns. In this case, it was mainly because this variety provided farmers with great yield benefits and more production stability. The advantage of participatory variety testing is precisely that these attributes can be rapidly identified because varieties are being tested under a wide range of conditions that farmers manage themselves.

Benefits for women and poor farmers. Breeders have often worked under the assumption that benefits of new varieties are scale- and user-neutral, that poor and rich farmers, or men and women can achieve the same type of benefit from these new varieties. In many cases of widespread adoption, differences in preferences and potential benefits were observed, but the conventional approach to breeding (of variety release and of extension) has often been unable to offer effective solutions to meet these diverse needs.

Participatory approaches are often designed to involve as partners in their program a wide range of farmers representing different social groups, gender, or otherwise differentiated groups.

These approaches potentially have the in-built capacity to respond to specific groups' needs and to make use of different user talents. Women in particular are often plant breeders in small-scale farmer production systems, responsible for domesticating wild species, selecting germplasm, and saving seed.

In many instances, women's criteria may be significantly different from men's—dual involvement in breeding/selection is necessary to meet each partner's needs. In Mali, maize evaluations showed men putting production and early maturity as the main criteria, with women focusing on organoleptic and processing aspects (Kamara et al. 1996). Rice work in West Africa had a similar gender division, with scientists from the West Africa Rice Development Association (WARDA) reporting that men focused on yield and yield-related traits, such as plant vigor, and women concentrated on quality attributes, such as bold grains.

Involving women in PPB can confer benefits for all the community not just poor women. Over a 3-year period, Rwandan experts selected a pool of varieties (21 separate bean types) that outdid breeders' choices in their own production terms by up to 33%—and met quality characteristics of interest to diverse community groups (Sperling et al. 1993). Not involving women or poor users may bring negative, not just neutral, consequences**.** In the Gambia, men's production systems involved almost 100% adoption of high yielding variety (HYV) rice, and female production systems remained based on the use of *Oyza glabberima*, a rice species indigenous to West Africa. This wholesale adoption by men marginalized women's products and transferred other rice lands into the hands of men who received all benefits from commercial sale (S. Hecht, personal communication, 1998, citing the work of J. Carney).

The overview of formal-led PPB cases pointed to specific ways in which PPB has helped researchers focus their efforts on the poorer sectors and highlighted some strategies for addressing their particular needs:

(1) Testing in low-input situations,
(2) Emphasizing the development of some early varieties (often grown by farmers among an array of varieties that fill different use niches),
(3) Paying attention to multiple crop uses in the selection process,
(4) Identifying a diversity of varieties so as to stabilize production, and
(5) Ensuring that varieties grown for the market have characteristics that can fetch good prices.

Varietal diversity increased. Many of the examined cases of PPB involve farmers in the testing of more varieties than traditionally takes place during the adaptive or extension phase of formal research. It is commonly observed that farmers' selections differ as their needs differ, for example, farmers who own poor land tend to prefer different varieties than farmers who have better fields. Women farmers often select more explicitly on grain quality characteristics and make different choices than do men farmers. The outcome of PPB programs is usually that different farmers in different communities select different varieties and thus PPB in most cases has contributed to increased varietal diversity.

A clear example is the "Informal Research and Development" (IRD) program initiated in Nepal with the explicit objective of increasing the varietal diversity of rice varieties suitable for early planting under irrigated conditions (*chaite* rice) (Joshi et al. 1995). Potentially useful rice varieties identified by researchers were distributed to about 1800 households in the target area for this project. Farmers were given some written information about the variety they received and were encouraged to compare it with their own variety in their own fields. Researchers did not participate in these evaluations, but returned 2 years later to a sample of the recipient farmers to assess the effect of the approach.

The follow-up revealed that about 35% of farmers who had received a seed packet had adopted from one to four varieties of the six distributed for testing. In this area, a single cultivar was dominating cultivation prior to the participatory work. Most of the farmers who decided to adopt a new variety belonged to the group of farmers who regularly produce sufficient or surplus food for their families. Only 15 % of the adopters belonged to the food deficit group. Interestingly, the preferences for specific cultivars seemed to differ between farmers belonging to these different groups, indicating that they have different needs for cultivars and their key characteristics. A conclusion of this report is that not any one single variety could meet all these needs. This IRD approach proved to be a powerful tool for offering a wide range of diversity to a wide range of farmers.

Similarly impressive PPB results relating to enhanced varietal diversity occurred in two major cassava-growing regions of Colombia: a seasonally dry ecosystem in the north (an area with poor soils and 800-1000 mm rainfall annually, bimodally distributed), and more recently the highlands of southwest Colombia (Iglesias et al. 1990). Researchers from the Centro Internacional de Agricultura Tropical (CIAT) and a branch of the Corporación Colombiana de Investigación Agropecuaria (CORPOICA) initiated a participatory crop improvement effort in 1996. The aims were to learn more about farmer criteria for choosing cassava varieties for consumption, marketing, and processing, and to evaluate traits within a genetic base that had not been preselected, hopefully to generate varieties that were both more acceptable and more "biodiverse". An average of 28 communities per year were involved in the clonal evaluation effort in northern Colombia, with community participation organized via chip-drying cooperatives.

Researchers quickly realized that effective varietal comparisons could be made only if the planting material for local varieties and new breeders' clones was produced under similar conditions, to avoid bias caused simply by its health and vigor. This concern was addressed by producing all planting material in a common location under conditions approximating those of the farmers. It also became clear that farmers and researchers often used different terms for variety evaluation; a glossary of farmer evaluation terms was compiled.

Farmer evaluations of advanced clones from cassava breeding programs resulted in the release of three new varieties in northern Colombia (a significant addition to the two varieties in use). Through this process, researchers acquired a better understanding of farmers' selection criteria and were able to quantify certain of them in ways that would facilitate researchers' selections (e.g., farmers' preference for "hard" roots corresponded to roots of over 35% dry matter.) A unique aspect of this work is that researchers developed a cost comparison between their farmer-participatory approach and traditional variety evaluation, indicating that data points from farmer-participatory trials cost about US$ 0.50 and those from typical researcher-managed advanced yield trials cost about US$ 0.80.

Changes in variety release procedure and seed production system. Centralized fora or committees for any individual country usually enforce variety release procedures. Needs of specific regions, especially in marginal areas, and those specific consumers or users are not easily considered in such centralized procedures. As PPB tends to reveal such differentiated needs and those for diversity, recommendations on how to change the existing release procedures are often a direct result of working more closely with farmers. Participatory research also contributes to making farmers more aware of these procedures and can spur ways for farmers to initiate policy changes.

A PPB program in India is working to encourage formal committees to give greater official weight to farmer evaluations. The program argues that data synthesized from farmer varietal evaluations (i.e., qualitative assessments) should be used as a base for varietal release decisions. In many cases, such data may be more predictive of future adoption than the standard yield measurements, which form the core of most release decisions (J. Witcombe, personal communication, 1998).

Work with potatoes in eastern Africa further demonstrates how standard, but more rigid, procedures can become more flexible. A thorough survey and enhanced interaction between farmers, breeders, and social scientists led to changes in the selection and release procedures for potato varieties in Rwanda. The main difference was that testing of varieties for release was done under no external input conditions. The program resulted in the release of several new varieties during the first 5 years, a short time. Farmers readily accepted these varieties and two varieties could be found countrywide 5 years later (Haugerud and Collinson 1990).

Often PPB goes hand in hand with recommendations to develop or build on local, more decentralized seed systems, which can provide location-specific varieties that farmers themselves effectively multiply and distribute. For instance, prior to the civil strife in the early 1990s, both Rwanda and Burundi Ministries of Agriculture and Rural Development tabled plans for decentralizing seed services—partly to accommodate more decentralized breeding (Sperling, personal communication, 1998). Programs of PPB are also increasingly including seed production components, which are integrated and innovative, to quickly deliver the positive impacts that PPB can achieve. Good examples of this come from the PPB and seed work with cassava in Colombia (Iglesias et al. 1990) and with potato in Bolivia, Peru, and Ecuador through a set of collaborations between the national seed projects and the Centro Internacional de la Papa (CIP) (Thiele et al. 1997; Thiele 1999).

Changes in institutional organization. Organizational innovation often proves central to the kinds of impact that PPB programs strive to achieve. Decentralization of screening can link testing to truly local conditions, and give a leap to the seed multiplication and diffusion process. Several PPB programs have considered organizational innovation to be at the core of their work.

An example is the barley breeding research of ICARDA in collaboration with national programs in Syria and northern Africa. The program has shown that decentralizing the breeding program is essential for achieving genetic gains under growing conditions that are common in farmers' fields (i.e., low external inputs) and the high frequency of drought stress and frost during the flowering and seed set stages of crop development. The program has achieved initial forms of decentralization by developing new research stations located in the target region of the specific breeding programs (Ceccarelli et al. 1996). At present, it is experimenting with further decentralization through testing breeding material in farmers' fields in the initial stages of the selection program. In this case, the key partners in the research are a few farmers chosen for their interest in barley improvement and their willingness to accommodate a relatively large researcher-designed and researcher-managed experiment in their fields. Initial results indicate that this further decentralization is highly effective and the breeding program is benefiting from farmers being involved in the selection process.

The issue of decentralization (and its mirror, scaling up) was the direct subject of investigations in the Great Lakes' Region, in both Rwanda and the Democratic Republic of the Congo (DRC). Several options for decentralization were "tested": through the extension service, through self-designated farmer research groups, and through farmers' cooperatives and women's groups. Several seasons of testing showed the most effective channel, for both feedback to research and feed forward to farming communities was the women's groups and cooperatives (which, in this case, were female). In the Rwandan instance, the women's group (supported by an NGO, COOPIBU) multipled and distributed a ton of bean seed before the other organizations made the final decision on which varieties to multiply. The DRC cooperative, "Women United for the Development of Burhale" (Femmes solidaires pour le développement de Burhale [FESODEU]), chose to multiply and market their selections packaged in small packets of 50 to 100g to their 5000-strong membership and sold all the multiplied material in a matter of weeks. However, using such groups results in sporadic rather than a more universal coverage (Sperling 1994).

The WARDA is also pursuing the issue of decentralization, and on an impressive scale. With its National Agricultural Research Systems (NARS) partners in 17 West African countries, WARDA has initiated PPB programs with a focus on experimental varieties (in some cases also released) relatively late in the selection process. The group is evaluating, with partners such as extension and development agencies, NGOs, and cooperatives, the effectiveness of testing varieties with farmers'participation (M Jones, T Dalton, and N Lilja, personal communication, 1998).

Conclusions

This review of about 40 formal-led PPB programs demonstrates that a wide range of impacts were achieved through use of participatory approaches, despite the short time that most of these projects have been in operation. Through the close collaboration of farmers and formal researchers, breeding progress was made in regions where variety improvement efforts of centralized programs with large uniform target regions have been less than successful. Farmer participation opened new opportunities for reducing the lag-time between variety testing, release, and adoption; and, through making new germplasm available to farmers in experimental quantities, the basis for adoption was repeatedly laid. The improved understanding of local seed production and dissemination systems allowed researchers and project managers to overcome specific seed system constraints and to make targeted interventions to overcome seed supply problems quickly. This helped farmers gain access to the desired seeds rapidly, from known and reliable seed sources. Farmer participatory breeding programs also led to new alliances between research and development organizations. As a result, changes occurred in the orientation of breeding programs and in variety release procedures, and changes in formal seed regulatory policies were recommended and in some cases (in Latin Amercia, Africa, and Asia) implemented.

Achieving specific benefits for specific user groups, such as poor or women farmers, really only became possible **through** participatory research programs. Enhancing their capacity to voice their concerns and needs was a major outcome of programs that explicitly targeted this type of goal. Such user-driven programs were also often those that had a complementary strong capacity building component—to strengthen farmers' own breeding, selection, and seed management skills. In the cases examined, such skill building proved integral to the scaling-up of the specific participatory breeding effort.

Although the impact of PPB to date has been impressive, this review of programs also highlights that many options for farmer participation in the plant breeding process are yet to be explored. Having more widespread goals, focussing on a broader range of crops, working with explicitly more diverse user groups, and experimenting with organizational options may identify wider and more varied benefits that PPB can achieve.

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CHAPTER 3

CONSIDERING THE IMPACT OF FARMER-LED PARTICIPATORY PLANT BREEDING: LESSONS FROM CASE STUDIES TO DATE

Shawn McGuire∗

Introduction

Participatory Plant Breeding (PPB) denotes a range of activities that seek closer user involvement in crop development and/or seed supply. PPB promises to meet different (although possibly conflicting) goals: improved crop development, biodiversity conservation, and farmer empowerment. We can draw a useful distinction between "formal-led PPB", where farmers join a formally initiated process of crop development, and "farmer-led PPB", where the farmers' own crop development or seed supply systems receive support. These systems are not completely distinct, and possible starting points for PPB may extend along a continuum. Formal-led overshadows farmer-led PPB, both in the literature and the way in which PPB is usually conceived. However, farmer-led PPB deserves more attention. Farmer breeding remains important wherever formal systems fail to fulfil the needs of all users, particularly where environments (ecological and socioeconomic) for crop growth and use vary, or differ greatly from those tested by formal breeding. Farmer breeding is also the main force for development for so-called minor crops. For these reasons, and because formal seed supply may not be timely, nor affordable, nor offer suitable diversity, farmers' own sources (farm-saved seed, local sale, exchange) continue to supply 80% of planting material worldwide.

Considerable activity, initiated by grass-roots social movements and (less heralded) by farmers themselves, suggests that farmer-led PPB may be more prevalent, and be found in different places, than we realize. Different possible objectives for farmer-led PPB point to multiple definitions of impact. Moreover, basing work in informal systems points to different perspectives on "participation" than seen in formal-led PPB. Here, we explore these issues through 11 documented case studies of farmer-led PPB, which reveal different approaches to supporting farmers' systems of crop development and seed exchange (McGuire and Manicad 1998).

Table 1 lists cases. Briefly, the Beej Bachao Andolan (BBA) is an independent farmers' initiative to collect, test, select, and promote diverse varieties of different crops. Both the Comités de Investigación Agricola Local (CIALs) and the Sustainable Agriculture and Village Extension Project. (SAVE) organize farmers' groups to test and promote new varieties and technologies. Several CIALs developed local seed production enterprises. The community-based center, CONSERVE, collects and conserves regional rice varieties; training farmers to evaluate and further breed this diversity. In Guanxi province, China, women farmers in two different villages organize selection to regenerate locally valued maize varieties. Projects in Alternative Agriculture (PTA) support communities of small holders across Brazil to evaluate, conserve, and further breed farmers' varieties of maize. The Relief Society of Tigray (REST)

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supports community seed banks for variety conservation and affordable seed supply to Tigray farmers, mobilizing skilled farmers for local selection and storage. The Seeds of Hope (SOH) project sought to resupply to Rwandan farmers valued varieties that were lost during the genocide, using farmers to identify material. Users' Perspectives With Agricultural Research and Development (UPWARD) organizes farmers' groups to collect and conserve local varieties through community seed banks. A century ago, the United States Department of Agriculture (USDA) mailed millions of seed packets of novel varieties and species to farmers for testing, adaptation, and selection. Finally, the Escuela Agrícola Panamericana (EAP)-Zamorano Agricultural School promotes the continued use and development of local maize varieties, training farmers in selection methods.

Table 1. Outline of case studies with sponsoring institution, location, and time of activity[a].

Case study	Sponsor	Country	Period	Selected references
BBA[b]	Beej Bachao Andolan (Save the Seeds)	India	1990s	Kothari 1997
CIALs[d]	CIAT	Colombia	1990-	Ashby et al.1996
CONSERVE[c]	Community-based native seeds research Centre	Philippines	1992-	Berg and Alcid 1994, Magnifico 1996
Guanxi[b]	Two villages in Guanxi	China	1990s	Song 1998
PTA[c]	Projects in alternative agriculture	Brazil	1990-	Cordeiro and de Mello1994
REST[c]	Relief Society of Tigray	Ethiopia	1988-	Berg 1996
SAVE[c]	CARE	Sierra Leone	1990-95	George et al. 1992
SOH[d]	Seeds of Hope	Rwanda	1994-95	Sperling1996
UPWARD[c]	User's perspective in genetic resources research	Philippines	1992-	Prain and Piniero1994
USDA[e]	US Department of Agriculture	United States	1840s-1924	Fowler1994, Kloppenberg 1989
EAP-Zamorano[e]	EAP-Zamorano Agricultural School and Cornell University	Honduras	1993-	Gómez and Smith 1996, Gómez et al. 1995

a. For acronyms see Appendix II.
b. Farmer groups.
c. Nongovernment organizations.
d. CGIAR projects.
e. National agricultural research systems.

Farmer-led PPB is based in farmer practice and is distinguished by its wide range of possible approaches for support, including germplasm, skill development, promotion of links among users and between institutions, and indirect approaches. Work with germplasm includes input of materials, support to storage, improving germplasm access, and making good or novel material more "visible". Indirect needs involve market development, education and promotion, and policy lobbying.

Informal institutions such as local nongovernment organizations (NGOs) are more prominent than formal-led PPB. The nature of institutions supporting PPB influences program goals as well as approaches and capacities for impact evaluation. For example, informal institutions may place more emphasis on developing farmers' critical awareness, but less on formal monitoring and evaluation, than do formal research institutions. However, for all cases and types of institutions, assessing impact (especially for empowerment-related objectives) and weighing trade-offs among objectives pose considerable challenge. Finally, farmer-led PPB offers different meanings for "participation"; because corresponding non-participatory (i.e., formal) work is usually absent, assessing the impact of participation *per se* is difficult.

Participation Successes

Working with farmers helped meet a wide range of objectives through PPB. For crop-related goals, in many cases the supply of previously unavailable crops or varieties helped farmers to increase their cropping options. Farmer participation was valuable in collecting germplasm, screening it for local adaptation, and supplying it to others, helping to rapidly identify and promote promising material (e.g., PTA, SAVE, CIALs, USDA, BBA, CONSERVE, and REST). Further, in some cases farmers themselves selected and improved crops according to their own objectives (e.g., Guanxi, REST, USDA, PTA, CONSERVE, and EAP). Farmers did this both of their own accord and encouraged by skills-support from project interventions—most notable in the last three examples. Support frequently involved the supply of exotic material, although in some cases the "visibility" and thus the awareness and use of local germplasm was increased. Farmers' seed systems were also involved to ensure **access** to such materials, especially for poorer groups (e.g., CONSERVE, REST, PTA, and Guanxi). Local seed storage systems, using traditional or adapted methods effectively enhanced local germplasm availability; and often also served as *in situ* conservation, keeping material in use that might otherwise have been lost to the region (e.g., BBA, CONSERVE, PTA, REST, and UPWARD).

Participation is essential for meeting other, non crop-related objectives, such as skills-enhancement, devolution of decisions, and empowerment. Farmer involvement shaped approaches and helped determine training priorities for skills' development in breeding and germplasm evaluation, contributing to successes in SAVE, EAP, CIALs, CONSERVE, and PTA. Often, farmers share skills among themselves (both local "good practices" and new skills). For example, in breeding, a few cases tried to enhance a process that was already occurring. Some cases sought a deep level of participation, presenting farmers or farmer groups with a choice of goals to pursue, tailoring approaches to individual or local needs. Others worked with farmers to develop critical awareness of related issues, such as genetic resource and seed release policy (e.g., CONSERVE and PTA). Such approaches aim for user empowerment.

Although women dominated two cases (SOH and Guanxi), only UPWARD described using gender analysis, successfully linking women's roles with seed conservation. For diagnosis and impact assessment, differentiation by stakeholders in general and by gender in particular, remains a major gap in PPB work to date.

Occasionally, PPB is less successful, particularly with highly technical activities (e.g., selection and evaluation or documentation), because of limited knowledge (either of farmers or institutions) or local resource limitations, such as insufficient land. However, farmers sometimes compensated by adjusting goals and practices or by seeking technical assistance or training. The nature and level of farmer participation, the supporting institutions, and the types of relationships they establish, strongly shape the impact of PPB.

Participation Processes

Two aspects of "participation" are important in farmer-led PPB and distinguish it to some extent from formal-led work: subject-position and objective of participation. The subject-position (**who** involves or supports **whom** to do **what**) shapes perspectives on participation. Formal-led projects usually seek to involve farmers to varying degrees in their activities. Perspectives in farmer-led work tend to vary more. Projects may be externally or farmer-initiated and may try to support farmer processes such as seed exchange or not intervene in particular processes (although projects may count on them for impact). BBA and Guanxi are examples of farmer initiatives with little outside support. Participation can only be understood from a position within the community. Further, participation may aim for agricultural or social development objectives (compare Okali et al. 1994). Farmer-led projects have a greater tendency to pursue transformative goals with participation, with a strong emphasis on empowerment.

With these aspects in mind, we consider processes of participation. Farmers directly involved in PPB activities broadly group into two: those who experiment and those who are poorer or seed-insecure. More formal institutions that introduce new germplasm or skills correlate well with the first group, and the second group relates more to local initiatives supporting local seed systems for security and diversity of access. Some cases, such as PTA or CONSERVE, target poorer farmers, while UPWARD organized both a women's group and a (male) tribal group. Others (e.g., SOH and SAVE) acknowledged barriers to poorer groups participating.

Several cases (e.g., CIALs, SAVE, and UPWARD) successfully involved farmers through groups, some were formed especially for project work, while others (e.g., CONSERVE, PTA, REST, and EAP) derived from existing local institutions such as cooperatives, labor unions, or farmer organizations. Guanxi and BBA worked through informal local associations in their own communities. The relationship between such groups and the wider community was little examined. The institutional association of groups influences their accountability; for example, member-driven institutions with structured involvement (such as cooperatives) may be more transparent.

Lead collaborators are often self-selected out of individual interest, or are taken to represent a particular group (often, but not always, elected by the group). Some cases collaborated with farmers recognized as local experts. Assessments suggest that focusing on a smaller group of skilled collaborators can save time and facilitate technical work, especially if that group has a specific role in farmer breeding or seed supply. However, the needs and preferences of particular stakeholders may be missed if no broader input is given, or they may be cut off from dissemination. The project UPWARD offers both positive and negative examples; their women's group effectively linked conservation to a gender-specific role in household seed security, but their tribal group (male, élite) had poor ties with the community.

Just as work often developed from germplasm input to evaluation, adaptive trials, seed multiplication, and local sale, the roles of participants also evolved. Farmer groups often became more independent with experience, starting new activities or demanding specific services or support. For instance, farmers considered forming new associations for training others (e.g., CONSERVE) or seed production (e.g., CIALs and SAVE).

The participation of broad groups of users is most important in diagnosing problems (a stakeholder analysis of the seed system) and in setting goals. Some cases (CONSERVE and PTA) developed analytical frameworks with farmers to diagnose local constraints to farmer breeding, and chose approaches similar to those mentioned in this chapter's introduction. However, some cases began strongly inclined to certain goals, such as conservation. This influenced other choices, such as type of germplasm, and sometimes conflicted with other farmer interests, as seen in UPWARD. These issues of problem diagnosis, involving different users, and institutional inclinations, merit much further attention.

Objectives and Intermediate Indicators of Impact

With a wide range of goals, cases defined impact in different ways. Central to most cases were germplasm and breeding-related objectives:

(1) Increased choice of acceptable varieties (CIALs, SAVE, PTA, BBA, USDA, CONSERVE, and SOH).
(2) Improved varieties that better meet user needs in yield, quality traits, stability, etc. (CONSERVE, PTA, REST, EAP, and Guanxi). These are measured by:
   (a) Adoption rates,
   (b) Farmer or formal evaluation, and
   (c) Income (includes that from seed sales – USDA and CIALs).
(3) Seed system goals are related to this, improving **access** of material to users via:
   (a) Enhanced "visibility" or greater awareness of useful germplasm and where to find it (REST),
   (b) Increased local knowledge of performance, e.g., locally relevant evaluation information (CIALs, SAVE, PTA, BBA, and CONSERVE), and
   (c) Better availability through sufficient, timely, and affordable supply, such as through community gene banks (REST, UPWARD, and PTA).
(4) Support for alternative (e.g., low-input) cropping systems (CONSERVE, BBA, and PTA).

Objectives in skills enhancement for breeding, selection, or testing usually were to impart new skills to farmers, addressing gaps in knowledge and practice (EAP, PTA, CONSERVE, and CIALs). However, some cases sought to extend local "best practice" among farmers (REST, Guanxi, and BBA), although they did not explicitly state this as an objective. In either case, indicators include skills that are learned correctly, learned flexibly and adapted to local contexts, and transferred.

Many cases sought biodiversity-enhancement (BBA, CONSERVE, PTA, REST, SOH, UPWARD, EAP) where:

(1) More varieties and species are in active local use,
(2) Local capacity for conservation (*ex situ* or on-farm) is enhanced, and
(3) Local material is valued and used more.

Indicators considering diversity at the genetic level were less common. Some cases considered an important outcome to be improved links:

(1) Among farmers, with more exchanges, group meetings, workshops, or other informal encounters, and
(2) Between farmer and formal institutions, with more visits or germplasm exchange events.

Finally, empowerment was a common objective, seen in terms of:

(1) Improved self-reliance,
(2) Increased farmer control over resources and decisions (often related to processes previously abandoned; PTA), and
(3) Enhanced capacity, seen at three levels:
   (a) Skills - capacity developed in germplasm management or breeding (EAP, CIALs),
   (b) Systems - capacity developed in research skills, awareness of seed systems, and germplasm collections, e.g., farmers can identify and access germplasm and test its applicability (BBA), and
   (c) Policy - capacity developed to critically understand and influence the direction of research or of relevant policy areas, such as intellectual property rights (IPRs), germplasm access, and seed policy, e.g., farmers develop positions on farmers' rights and germplasm exchange (CONSERVE and PTA).

Some cases tried to assess the nature of participation, in terms of **how many** and **who** were involved and to what **depth**. Again, subject-positions reflect how "participation" is perceived. Usually, externally initiated projects that formed farmer groups made some attempt to specify the nature of participation and the level of involvement of different user groups. The projects of EAP, CIALs, UPWARD, and SAVE noted women's participation (low except for UPWARD), although only the last two projects specified social status/wealth of participants. Other projects reflected farmer-initiatives or local institutions (NGOs, farmers' groups, or associations), whose internal dynamics are little known (e.g., BBA, CONSERVE, Guanxi, REST, and PTA). Overall, cases did not differentiate impact by user groups (e.g., according to wealth or gender). Only SOH, with its large survey, specifically evaluated **access** to benefits for different user groups.

Tools and Methods for Assessment

Among cases, the terms of impact vary with different goals, and the processes for assessment were both externally and internally initiated. A few cases had more formal, external evaluations (SAVE, REST, and CONSERVE), while SOH conducted two formal, random sample surveys to measure the effect and social scope of their seed supply activities. Although most cases sought feedback from farmers to some degree, CONSERVE and PTA had participatory evaluations using indicators from earlier participatory problem diagnosis and goal setting with farmers. Analysis and negotiation of new goals between farmers and NGOs were explicitly related to conceptual frameworks. Internally initiated assessments (e.g., BBA and Guanxi) were not described, but are presumably more informal and participatory in the broad sense in that users themselves determined progress and modified their goals over time. Overall, participatory methods among cases involving more formal institutions were little discussed. However, few cases provided detail on the process of diagnosis or goal setting, which is implicit in farmer-only initiatives. This is unfortunate, as farmers' own indicators for PPB work could offer many insights.

Methods for assessment included meetings where users discussed impact issues, or seminars or workshops with dispersed groups or individuals (e.g., PTA, CIALs, and EAP). For instance, a workshop involving some former trainees enabled EAP to assess how effectively skills were transferred, and to estimate the number of farmers to whom these skills were passed. Most cases noted farmers' enthusiasm (or lack thereof) for seed, training, or conservation work, often using this as an *ex post* justification that the initial problem diagnosis was correct. For example, SAVE remarked that the incredible popularity and wide use of its seed packets indicated that farmers had lacked access to new sources of germplasm. Only the CIALs undertook a cost-benefit analysis to show savings in extension staff time from farmer participation, although the USDA calculated financial benefits up to 1916 from novel crop and variety introductions, showing that these greatly outweighed the (considerable) costs of collection and distribution to farmers. On the whole, tools and approaches for assessment receive little detailed discussion; the lack of reflexive discussion and of processes for diagnosis or assessment, makes it difficult to analyze methods comparatively.

Although assessing some crop development goals, such as yield, is relatively straightforward, only a few cases (CIALs, CONSERVE, PTA, and EAP) reported formal measurements of performance. Other cases rely on farmers' own assessments; PTA in particular noting farmer preference for information from single large plots rather than small replicated plots from formal testing. Assessments of other agronomic or performance characters, or the number and diversity of testing sites gave little detail, although this was certainly an issue when users or environments varied greatly. Measuring impact on biodiversity impact poses more challenges; only SOH is directly measuring genetic diversity, although other cases considered diversity at the level of morphological varieties.

Some conceptual challenges for assessing the impact of farmer-led PPB remain unaddressed. One such is a basis for comparison: no case used formal controls (i.e., parallel work in conventional breeding), and even a retroactive comparison is difficult as most cases had no formal work that directly corresponded with project activities. Another conceptual challenge is that of trade-offs between different objectives. How crop genetic diversity may interact with production-related goals (two goals that several cases combine), or the relationship between breeding strategies and farmer empowerment, is complex. Such trade-offs carry important implications for PPB methodology. Baselines (largely absent) are needed to evaluate changes. Better analytical frameworks to relate different goals and to put farmers' decisions (e.g., for diversity use) in a social and ecological context could greatly help in weighing trade-offs and in projecting future impact. Current research (e.g., IPGRI 1996) may help to fill this gap in the future.

Lessons Learned

PPB activities congruent with existing practices, roles, and institutions, such as farmers' selection and exchange, tended to be more effective. Diagnosis, particularly of gaps or limiting factors to farmer breeding, was important for this, and a stakeholder analysis of local seed systems is necessary to disaggregate needs and roles by different users. CONSERVE and PTA effectively worked with communities to diagnose needs, developing their own analytical frameworks to allow decentralization and give local groups greater choice of goals. Linking local groups through meetings or through networks (especially for cases aligned with social movements) can facilitate such decentralization through further exchanges of experience, spread of germplasm and ideas, and the formation of new groups (e.g., CIALs, PTA, SAVE, and BBA). However, explicit consideration of user-differentiated needs and impacts was sparse in most cases and remains an important gap in all PPB work.

Some approaches helped impact. Targeting specific users (e.g., tenants or women) at the outset helped some cases to focus support strategies. Species focus, or testing site locations and conditions, can help target specific groups (although equally it can exclude them). Other technical choices can help keep participation broad, such as supplying seed in small amounts to keep prices low, reaching more farmers, or avoiding that seed become a resource of interest to local élites (e.g., SAVE and USDA). Finally, working through groups can allow involving those with time constraints (such as the very poor), and enable difficult activities for individuals (e.g., testing in multiples sites or variety isolation) to take place (e.g., PTA, Guanxi, and SAVE). As with networks, groups can help make superior germplasm, skills, or practices more "visible", and facilitate farmer-to-farmer extension and exchange. Nonetheless, more information on internal group dynamics, and on how such groups relate with the broader community, will be needed to assess user-specific impact.

As demonstrated by SOH, poor or socially marginal users may lack access to germplasm despite its local availability. Support to local seed systems was useful for improving some users' access to germplasm, whether for local (e.g., REST) or exotic (e.g., PTA) materials. Some cases enhanced farmers' ability to assess material through training in more formal screening techniques, or through organizing wide testing (especially for novel species) and documentation, to evaluate across different management and environmental conditions.

Often, local storage effectively improved germplasm access or short-term conservation, although this benefited from links to existing roles and activities. Farmer evaluations enhanced the value of such collections, although usually for their own rather than more formal use.

Developing skills that addressed knowledge gaps (e.g., pollination biology - EAP) or specific applied goals (e.g., isolation of desired types – Guanxi and PTA) was widely appreciated and effective. Flexible, farmer-centered approaches, and focus on basic principles helped farmers adapt techniques to their own situations. These are effective working guidelines, although only EAP describes specific training methods.

Projects lacking diagnoses of user needs and practices had difficulty in maintaining interest. A lack of clarity with participants about objectives can also jeopardize work. For example, existing home gardens made UPWARD's separate establishment of community seed banks redundant. Also, tribal leaders had little interest in production, which did not mesh well with the NGOs' interest in conservation.

In some cases, support from other institutions could help in PPB work and impact assessment, especially where knowledge or resources are limiting. For example, although farmers can understand and describe morphology, important aspects of biodiversity may still be missed. Although documentation and baselines are necessary to accurately assess changes in biodiversity, they remain weak areas because participants have not received support and often continue unconvinced of their potential value. Despite the potential for technical backstopping and complementary institutional roles, few attempts to forge links between NGOs or farmer groups and formal institutions have built lasting or two-way ties. Counting on such links early in a project's development could pose problems. Barriers to cooperation, both structural (economic or policy) and cultural (distrust), lie between these highly different types of institutions and need to be understood and addressed for future work to build better links.

Conclusions

Goals, perspectives on participation, and approaches to evaluation are manifold. No single PPB approach or definition of participation can address all perspectives in farmer-led PPB. However, attention to seed systems was a common factor in farmer-led PPB for problem diagnosis and for considering **access** to benefits. Participation is particularly important in diagnosing needs and in setting goals, and helps later evaluation to also be participatory. Nevertheless, more transparency among stakeholders in setting goals would improve some cases. Frameworks for considering support approaches can help by looking at factors that may constrain farmer breeding, and proper baselines would help assess impact. However, this still needs to consider farmers' crop development, biodiversity conservation, and empowerment as a process, and look to user-differentiated impacts.

Many questions remain unanswered for PPB practice. For instance, in skills development, what subjects are most important, and what methods allow for flexible, adaptive learning? Approaches for testing or selection to address highly diverse or variable environments or users' groups also need more attention. Future work that explicitly compares different tools and methods (for diagnosis, training, breeding, etc.) would be valuable, although more reflexive discussion helps in all cases. From the multiple objectives, possible outputs (both products and processes) are diverse. A common set of criteria for assessment across different case studies may be of limited use at this stage.

Internal evaluation, especially for local initiatives, is important and links to other goals for local independence and empowerment. Farmers' indicators and opinions are important, but more attention needs to be focused on how these relate to others' indicators, especially where other types of institutions are cooperating. Indicators for some goals remain difficult and understanding trade-offs between different types of goals or approaches is highly challenging. Helping to guide projects in decision making requires more than just good baselines; it requires conceptual frameworks for understanding processes (such as farmer decisions affecting on-farm genetic diversity), and assessing trade-offs, both with goals and methodologies.

Future work must pay greater attention to a stakeholder analysis of how needs and benefits differ by user, also including non-farmer stakeholders, who have scarcely been considered to date. Evaluating differences in user accessibility to germplasm or to knowledge, as done in SOH, may be useful here. Horizontal exchange of germplasm, skills, or information is an important aspect of farmer-led PPB, and needs more attention in evaluating impact. Finally, farmer-led PPB raises important policy issues, suggesting that changes in policy or researcher attitudes should also be monitored.

Institutions are important to farmer-led PPB. The relationship between institutions and communities structures the effects on different users. Further, despite their potential, interactions between different types of institutions to support work and evaluation remain weak. At the very least, the level and quality of institutional interactions need to be prioritized in future impact indicators. Some important proponents of farmer-led PPB are closely tied to social movements and genetic resource politics. For institutional cooperation (and, indeed, farmer-led PPB) to develop, we need a better understanding – and respect – of diverse perspectives on PPB and participation, and of the tensions that can arise among institutions.

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PART 2:

TYPES OF GENDER/USER DIFFERENTIATION AND THEIR IMPACT

CHAPTER 4

LEARNING ABOUT STAKEHOLDER / GENDER DIFFERENTIATION IN AGRICULTURAL RESEARCH AND EXTENSION IN ZIMBABWE: IS HE THE FARMER OR THE FARMER'S HUSBAND?

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Introduction

Agricultural research and extension are often male dominated domains. The introduction of women's projects, and more recently the gender perspective and gender differentiation, are issues frequently taken as a fashion rather than as a substantial contribution to rural development. However, the reality in many societies in Africa south of the Sahara is that male labor migration into towns over several decades has resulted in a situation where female-headed households outnumber male-headed ones in the rural areas. Also, even in the male-headed households, women often carry out the main agricultural work. The question arises: are the men the farmers or are they merely the husbands of the farmers? For research and extension to be successful, agents must address the people who work on the land—men or women.

Background

The project Conservation Tillage for Sustainable Crop Production Systems (ConTill) began in 1988 as a research project with two research stations, one near Harare and one near Masvingo (300 km south of Harare). The project was based in the Institute of Agricultural Engineering (IAE) of the Department of Agricultural, Technical, and Extension Services (AGRITEX), the national agricultural extension service. Researchers of the department who wanted to expand their work on soil erosion elaborated the initial project concept. The goal was to test different conservation tillage techniques. After testing on the research station, the extension service was to disseminate the proven techniques to smallholder farmers to halt the alarming rate of soil erosion. The user group of the project results was the extension service for whom the project was to develop extension messages; and farmers were the indirect target group. The project approach reflected the thinking of the department at that time, following the transfer of technology (TOT) model, where researchers develop technologies, extension hands them down to farmers who are left as recipients of "proven" technologies and who are expected to adopt them. Social issues in general and that of gender in particular were not considered at the start because the project was simply expected to develop technical solutions.

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The project decided to embark on an on-farm trial program in 1990 because on-station research proved to have little effect. Adaptive on-farm trials were initiated in which farmers were encouraged to test and adapt a researcher technique. Again, at this stage the project did not carry out a gender analysis and did not consider gender-specific issues.

In the first year of working with farmers in on-farm trials, the importance of social issues, communication, gender, and participation were revealed as major issues. The active involvement and dialogue with male and female farmers during that year revealed that the TOT model did not suit smallholder conditions and different extension approaches had to be considered. The dynamics, more insights, and analysis during the work with farmers caused the on-farm component of the project to develop into farmer participatory research. In 1994, the lessons of the action learning process were synthesized into an approach for participatory innovation development and extension and practiced as a new extension approach in seven intervention areas (Hagmann et al. 1997; 1998a). This approach is being integrated into the extension department (Hagmann et. al 1998b).

Facts on gender in the working area

Two baseline surveys that considered stakeholder analysis and gender issues were carried out: in 1991 in Gutu District and in 1994 in Zaka District of Masvingo Province. The needs and interests of men and women in terms of labor distribution, work organization, crop preferences, and access to resources were identified according to household categories, which were classified according to household headship. To highlight the diversity within female-headed households they were divided into de facto (where the husband has migrated to town) and de jure (comprising widows and unmarried women). Table 1 gives an overview of the situation, which is representative of many areas in Zimbabwe.

In the working area 40% to 60% of all the households are female-headed, but only slightly more than 10% of these participate in agricultural extension training. Even in male-headed households women carry out most fieldwork and have more agricultural knowledge than do men (Schäfer 1998). These figures may partly explain the low output and success of extension. In agricultural extension, only about 10% of the extension workers are female.

De facto female-headed households are the wealthiest. High remittances from their husbands who work in towns enable them to hire labor and draught power and to buy fertilizer if required. However, this situation also makes the households more independent from the agricultural output and can result in low production because of low interest in agriculture. The poorest people in rural areas are the de jure female-headed households. Widows in particular belong to the most disadvantaged group in society. They still have access to land (which is officially registered under the husband), but have few resources for production.

Decision-making competence is highly variable. In male-headed households, men (officially) make most decisions on agriculture. However, women traditionally cultivate certain crops, such as groundnuts and vegetables. In female-headed households, women make most decisions except in cases where the husband comes home regularly.

Table 1. An overview of the characteristics of male-headed and female-headed households in Gutu District, 1991 and Zaka District, 1994, Masvingo Province, Zimbabwe.

Characteristics	District	Type of household[a] (%)		
		Male-headed	De facto female-headed	De jure female-headed
Household type	Gutu	39.1	44.3	16.6
	Zaka	62.1	24.2	13.7
Available labor force (ave)	Gutu	4.3	3.3	3.9
	Zaka	4.2	3.3	3.9
Available land (ha)	Gutu	5.2	3.3	3.5
	Zaka[b]	na	na	na
Remittances per year (ave in Zim $)[c]	Gutu	323 (38)	1595 (85)	279 (63)
	Zaka	183 (17)	805 (30)	175 (9)
Involved in extension program (master farmer)	Gutu	25.0	11.5	14.0
	Zaka	26.3	11.2 (all women)	

a. De facto female-headed households were those where the husband had migrated to town; de jure female-headed households comprised widows and unmarried women.
b. na = data not available.
c. Figures in parentheses indicate percentage of total household income.

The missing link: weak communication between the actors

Communication within families, within communities, and between farmers and extension workers proved to be insufficient. This situation is a source of disagreement and conflict and renders any development intervention ineffective unless these issues are specifically addressed.

As part of the extension department, we initially did not want to impose too many new procedures. Therefore, the on-farm program began conventionally and left the farmer selection and initiation to the local extension workers. They chose mainly male farmers who often were also members of the master farmer club on which extension focused its training. The project stressed partnership and invited these selected and interested (male) farmers and the extension worker to the research station and explained and discussed the future joint venture in detail.

Assuming that families operate like typical core families, we thought that although the women did not join their husbands at the research station, these farmers would inform their wives of what occurred. Water being a major problem in the area, the farmers were interested in a number of soil and water conservation techniques of which they were asked to choose one to test on their fields. They were interested and eager to test a tillage system called "tied ridging", which provides obvious benefits in water conservation. A visit to farmers' fields and a method demonstration was agreed upon and a date planned. At the end of the visit to the research station, both the extension worker and researchers believed they had successfully initiated the program in a participatory manner. The reality proved them wrong (see ***Situations 1***).

Situation 1:
Information flow: Where is the blockage? A week after the visit to the research station we made a follow-up visit to these farmers. Naturally we assumed that after visiting the research center the farmers would discuss their impressions with their families and explain what they wanted to do and what had been agreed. Mr Mapuranga had visited the research station, but was not at home when we visited. Assuming that his wife would be well informed we asked her about progress in implementing what was discussed at the research station. To our surprise, she knew nothing of her husband's visit and refused to implement any trial because of this. The reaction of other wives also surprised us. Whenever the husband was not available they simply invited us to leave a message. Few appeared interested in discussing the matter with us.

A similar occasion happened 3 years later, when the farmers again wanted to visit the research station. Lack of transport permitted including only one person per household. We stressed the preference of a balance of women and men. The visit went well, half of the households being represented by women and half by men. A week later we specifically assessed the information flow by asking the person (husband or wife) who did not take part in the visit what information their partners had given them. Where wives had visited the station all the husbands were well informed except one. In the households where husbands went to the station, in only two out of 16 cases were their wives well informed.

Situations like these reveal weak communication within the families, particularly between husbands and wives. The information flow appears to follow the hierarchical structure in which the male head of household is not obliged to inform other household members, but females and children are accountable to the male head and therefore information flows smoothly in this direction. We also realized that communication among female members of the household is better than that between the sexes. The same applied to communities; farmers complained that their leaders never reported on the meetings and courses they attended.

The different perspectives of men and women on certain issues further complicate communication. For example, they were revealed strongly during a farmer workshop when the problem of land shortage was analyzed. Men were convinced uniformly that land pressure is simply a result of unequal land distribution, whereas women maintained their view in a heavy debate that too many children are the reason for land shortage and therefore birth control should be practiced. Generation conflict strains communication in the families yet further, so that it is difficult to speak of a homogenous family unit. Sociocultural change has contributed to a disruption of family relationships and communication (Hagmann 1993; Nyagumbo 1997). This fact must be specifically considered in the framework of an outside intervention.

These revelations question the conventional extension approach. Another part of the learning process in the project showed that male domination in extension limits its attraction for women. Several factors explain the low attendance of women in extension meetings:

(1) Suspicion and jealousy make it difficult for de facto female heads of household to attend extension meetings; their husbands in towns often do not allow their attendance. In areas where the male extension worker is known to have relationships with female farmers, their attendance is minimal. At present, only about 10% of extension workers are female.

(2) Male-dominated extension focuses on the main (cash) crops whereas women are more interested in women's crops, food security, and diversity in nutrition.
(3) Extension training focuses on the master farmer program to obtain a certificate, which requires a certain degree of literacy. Because of the education system, women are usually less educated (Lacher and Dikito 1991) and therefore can easily feel excluded and withdraw.
(4) Women's workload (particularly caring for children) limits their availability for meetings.
(5) Training facilities do not accommodate the women's needs (e.g., those breast-feeding were not allowed to enter certain facilities).

Extension meetings and training sessions are mainly based on teaching through oral communication. Written or visual material would help better information flow within the family through sharing and debating, but hardly any is produced and given out to farmers. Therefore women who do not attend the meetings are solely dependent on the husband's verbal information. If he has misunderstood or forgotten parts of the lessons, no wonder the women, who carry out most of the fieldwork and who should finally translate this knowledge into practice, are lost and become skeptical about new ideas.

Who decides? Or "the cock may crow to announce daybreak but that does not mean that the hen has not realized it" (African proverb)

Decision-making processes and rationales in farming families determine innovation development and extension. These processes are highly complex and can only be assessed through close monitoring and a trustful relationship with individuals. Often men and women stressed that the husband makes most of the decisions in the family and in farming, but the longer we knew these families and the more we interacted, the opposite turned out to be true (see ***Situations 2***).

Situations 2:
"Leading from behind." Mr Mambama, a farmer, was introduced to us as influential and the best cotton grower in the area and insisted we hold demonstrations on his farm. However, this was without the knowledge of his three wives. All preparations were made and researchers and other farmers went to his farm, but he was not there. His wives told us that the demonstrations could not be carried out because the head of household was not at home. Attempts were made on two more occasions, but both times he could not be found. Later, we discovered that the wives had been against the demonstrations. The famous and respected cotton grower did not want to lose face and felt ashamed to tell us that his wives had made their decision and boycotted him. Therefore he hid whenever he saw us coming.
Whose priorities count? After a good harvest, we were interested in how the income from crop sales would be spent and who decided on these issues. Mr Tiri and his wife had a good harvest. We had known them for over 2 years and during a visit we asked Mr Tiri informally how many bags he would sell and how the money would be spent. He hesitated and put the number of bags at "about two cart loads". He quickly added that he would buy roofing material for the house with the money, and particularly stressed that he and no one else in the household makes such decisions. A week later, Mr Tiri was not at home, but his wife was working in the field. We asked her informally about crop prices, grading, and the usual problems. She was satisfied with prices, but they had not yet spent the money earned. She hesitantly added, "I think we are going

to buy a cow, but baba (the head of household) decides on such issues anyway." We returned to Mr. Tiri's homestead 3 weeks later and he proudly announced that he had bought a cow.

These stories contradict the husbands' presentation of their position given below.

Situations 3:
Male generosity. Mrs Jena is a highly dedicated and successful de facto female head of household. During a field tour her husband, who lives in town and was never interested in farming, was present. He tried to present his wife's experiments and commented on our recognition of her work by emphasizing that her success was due to his influence and advice.
The husband's property. In one case, the wife obtained a Master Farmer certificate and the husband (a teacher) wanted to insist that it be issued in his name because she was his wife.

Analyzing these examples, it appears that women's status and power in decision making is much higher than perceived from outside. Proverbs such as "if you want something from father, go to mother" highlight women's position in the cultural tradition. Extension, however, is based on the outside perspective and does not consider real power relations. The examples in ***Situations 2*** reveal that the decision-making criteria can hardly be modeled because they depend on power relations in the household and on spontaneous, situation-specific parameters that are highly dynamic and gender specific. Purely economic rationales have rather low priority. Therefore, technology development based on economic criteria alone is far too reductionist.

Diversity and dynamism in household factors

We also realized that factors (e.g., resources and beliefs) tended to be highly variable between households such that there was no typical or average family situation. Also these social factors, for example household headship, tended to change quickly (***Situations 4***).

Situations 4:
Addressing a moving target. The Gwarimbas were one of eight households recommended to the project by extension staff. At the start of the season up to January, Mr Gwarimba headed the household. In February, he was sent to prison for 10 months for allegedly stealing a donkey. That left his wife as head of household. In May, she found employment in the local township and the eldest daughter assumed household headship. She married 3 months later and the next eldest took over as head. So within 1 year, this particular household changed from male-headed to mother female-headed to eldest daughter female-headed to second daughter female-headed.

This was not a unique situation. In hardly any of the households and groups where we worked was the household headship stable over several years. Obviously, a differentiation and related planning in research and extension based on categories of household headship that are assessed in a baseline survey at a given time would be irrelevant in such a dynamic system. Technologies geared towards male or female farmers only might not address the households needs.

Gender roles in local institutions

Local institutions (traditional and modern) are increasingly recognized as the backbone for sustainable rural development. Interventions to strengthen existing local institutions are highly important and require a thorough analysis of their functions and roles in the rural society. The role of gender is a crucial factor that needs to be understood. Again, this can only be assessed successfully through long-term observation in a process of change (***Situations 5***).

Situations 5:
Don't trust the "big men"! On a field day we were introduced to the committee members of the farmers' club. One member was an ancient woman. The members stressed that she held the post of treasurer, the most important on the committee. They explained that the post makes or breaks most clubs and therefore requires a completely honest person, one who not even the chairman can persuade to abuse the club's finances. According to the committee members old ladies are best fitted for this post.
The big man chairs. Group gardens are typically women's domain. Men are also involved, but women carry out most of the activities. We learned about a garden group with 20 members, one of whom was a man. He was nominated as the chairman of the group, although he was a builder and usually unavailable.

The use of Venn diagrams is a participatory rural appraisal (PRA) tool for analyzing local organizations. Venn diagrams revealed that women perceive institutions as important for certain functions (e.g., natural resource management) differently than do men. Further differences existed between the perceptions of young and old women and men. Women tended to be closer to the traditional institutions and men, particularly young ones, considered "modern" institutions such as village development committees and councilors more important. These differences must be considered in project implementation, where a forum or platform has to be built on which rural people can negotiate these different perspectives and can agree on the local institution and the appropriate members, male or female.

An important problem with de facto female households was revealed in community workshops when the husbands working in town were unavailable. The husbands sometimes did not support important decisions, because they did not participate in the workshops. A way of overcoming this problem is to organize workshops at weekends when there is more likelihood of everyone's attendance.

Gender roles in innovation development

The experiences with regard to research and the technical development of innovations revealed differences in the behavior of male and female farmers. Overall women were more the technology testers and men more the innovators. Women expected clear guidelines and instructions on how exactly to carry out steps A to Z and then would rigidly and reliably follow them. Once these were agreed upon, most female-headed households were serious and reliable partners. However, when adapting and modifying technologies, developing their own ideas, and initiating their own experiments became involved, then men were more innovative. Many male farmers were not serious and reliable, but came up with new ideas and experiments much faster and more often than did women. They were more open to experimenting and taking risks. This pattern can be explained by women's traditional roles in the family hierarchy where they are more the executors and implementers (the decision "takers") of decisions made by elders and men. Within the given decision framework, however, women were able to create their own space. The rigid hierarchical structures were largely a result of colonial structures. Women's avoidance of high risk is part of the food security strategy, for which women feel more responsible because, for example, they raise the children.

Many de facto female-headed households that received substantial remittances from husbands in town proved to be farm managers rather than farmers. As soon as they could afford to do so, they hired a cheap permanent laborer or casual laborers who carried out most of the fieldwork. An extreme example of this is when one woman apologized for her weed-infested field with the excuse that her laborer had left and never came back. So, she could not do the weeding. Depending on the commitment of the female farmers, high external resources can result in high production or, because of their independence, in low production. In some cases the husband in town has to make certain decisions. This can be disastrous if planting should be carried out and the woman has to wait for the husband to come and give the go-ahead. These cases, however, are rare and Schäfer (1998) found that women are proud of being able to make their own decisions.

Methodology

The methodology to consider the gender perspective that was applied in the project consisted of a developmental framework in the form of "Training for Transformation" (Hope and Timmel 1984). It emphasizes a more egalitarian development, includes both sexes equally, and offers more specific tools to strengthen the involvement of women and other gender sensitive methods.

"Training for Transformation" (TFT) as a philosophical and developmental framework

This training program was developed in Kenya in 1974 and adapted to Zimbabwean conditions by Hope and Timmel (1984). It originates in the pedagogy of Freire (1973) and is built on developing the conscience through participatory education, where learning is based on experience in the living world of the actor. Teaching therefore consists of dialogue via problem posing, which means facilitating communication and asking questions to help groups find the causes and the solutions themselves, instead of the teaching of "foreign" knowledge and realities. TFT provides concrete methods to implement Freire's approach and empowers local people to control their lives through actively participating in their own development and sharing ideas and knowledge. It stresses the importance of both males and females participating and cooperating in organizational development to build institutions that help people become self-reliant. It aims at strengthening dialogue, people's confidence (e.g., slogans like "nobody knows everything and everybody knows something"), and their ability to take criticism; and it integrates social analysis to help groups find the root causes of problems (Hope and Timmel 1984).

Freire's key principles form a philosophical framework that is relevant for any individual living in a society and it can be applied to many situations in life. Its major strength is that various characters with different attitudes and in different mainstreams accept and agree on these principles. It manages to integrate and unite these often-conflicting interests under the umbrella of the key principles. In Shona society, sociocultural change has weakened the social coherence and security that was based on traditional roles, rules, and regulations. Therefore, according to our experience, a new "umbrella" that can replace, or at least partly substitute, the old security is particularly important because the desire for social harmony is extremely strong and dominates most individuals' decisions. Without providing a platform to develop the new "umbrella", cooperation and leadership structures in rural communities will remain weak and often dominated by the unresolved social conflicts, which also adversely affect innovation development and extension.

Farmers were introduced to this framework in awareness-raising workshops with the whole community, where both men and women were invited specifically. The methods in the form of codes used (pictures, songs, slogans, and proverbs) proved highly efficient in strengthening women's involvement. Regular follow-ups to TFT are built in to different stages of the process.

Gender sensitive methods and approaches

Gender issues or relations were never made an isolated, specific topic because this would have created aversions and sometimes resistance on the part of some extension workers and on the farmers' side. It proved more efficient to put the goal (e.g., technology development or spreading of knowledge) in the forefront and discuss gender perspectives that emanated as constraints or potential in the goal's achievement. In this way, the role of gender and the required changes were taken seriously because they were directly seen in relation to achieving the desired progress. Briefly, the consideration of the gender perspective was seen as an important tool in the development process, but not as a goal or an end in itself. This insight resulted from experience in the department of extension where, in an affirmative action, a campaign on gender issues had been run several years before. Training workshops for higher-level extension staff were held and in the project planning everything was to be carried out "with gender in mind" or "with the specific consideration of women". The campaign had almost no effect at farmer level and at higher level resulted in resistance against gender issues, particularly among men. It was a typical outside-driven effort where a concept was pressed on people without going through a learning process.

In our approach, the facilitators were responsible for encouraging the equal involvement of both sexes. The facilitators were extension workers from the department of extension and nongovernment organizations (NGOs). Their main task was to empathize with gender issues and ensure that both sexes felt addressed specifically. In many cases, they had to encourage women or delay men as needed. Therefore, these facilitators went through a learning process while interacting with farmers to internalize the gender perspective. Training of extension workers became an important focus. Training in gender issues was not an isolated activity, but went alongside that for participatory approaches. Specific methods and tools were applied as given below.

Give women the chance to articulate themselves. Two methods fit under this category. First, whenever discussing with the male head of household or in workshops, we asked the women if they would like to join the discussions, or we directed questions to them specifically to involve them and to give value to their opinions. Women followed this invitation willingly in most cases and articulated themselves well if given the chance. Men also usually reacted positively. This method might be culture-specific, but proved the most crucial element in equally involving women and men in discussions. Often women seemed eager to contribute; they only needed a formal invitation from chairpersons or facilitators, who have to break the usual pattern and emphasize the importance of equal participation.

In the second method, women and men were specifically invited to participate in extension meetings, community workshops, field days, look-and-learn, or evaluation tours. This has been effective and after some time it became the "new culture" that both participate equally.

Create awareness for gender-specific perspectives and priorities. Four methods were used here. First, in workshops, forming small groups according to gender and age (e.g., young and old women and men, in problem, needs, and potential analysis) was an efficient tool to create an awareness of differences in perception and priorities caused by gender and age. Plenary presentations of their results and consequent discussions increased the value and importance of women's perspectives and made men understand these.

Second, the use of proverbs, codes, and songs related to gender were useful tools that were mainly used indirectly in situations where gender was not discussed as the specific issue.

Third, when discussing new technologies, specific consideration was given to the impact on male and female farmers in terms of resources, labor, and skills. Such PRA methods as seasonal diagrams and matrix scoring were useful in this context. The gender perspective was always discussed in view to its impact on a technology and not on gender per se.

Fourth, when meetings and workshops were planned the time that women could also attend was taken into consideration (e.g., weekends or non-working days) and venues were negotiated to accommodate everybody.

Create situations where women can prove their capabilities. Two methods were used. First, in role-play, exercises, and during discussions often women-specific tasks and abilities are required. For example, on topics such as gardening and women's crops, and other operations that women usually carry out, men participate in the discussions, but are less competent than are women. The recognition of these tasks as equally important raises the confidence of women and at the same time makes men realize the knowledge and competence of their wives.

Second, women as chairpersons for group discussions, as presenters of their experiments, and other positions where they could expose their capabilities was important in making men recognize women's potential.

The Impact: Women's Response

The impact achieved through addressing gender issues was measured qualitatively and quantitatively. It would be miraculous if such a process flowed without problems and resistance from some actors. In one case, for example, a husband did not allow his wife to participate in a 2-week course in TFT, but did not openly say so. Such incidences were normal in the process, but often 1 year later, when such positions were renegotiated properly among these actors, things changed and the formerly resistant persons became sometimes the drivers of the process themselves. Often the resistance had to do with fears of losing face and power. The facilitator had to identify this and then buffer some of the fears through recognition and discussions with the individuals. The process of participatory development involves changes in attitudes and paradigms that require time and endurance.

All the examples of impact show a common denominator: the strengthened self-confidence of the actors. Confident people are unafraid to share ideas and they tend to be unafraid of re-negotiating and bargaining for their roles and powers. This process and the tools applied enabled a new dialogue and communication that has increased the accountability of local leaders to the people because their functions and roles were also negotiated by the villagers in the process of empowerment through strengthening self-confidence.

The project internal monitoring of the process allowed follow-up on gender-specific impacts. Some of the general project impacts follow.

Impacts with regard to the involvement of women and men

(1) In farmer and community workshops we monitored the participation of male and female farmers. After introducing TFT, participation was mostly equal. In workshops where both sexes were specifically invited (by farmer leaders), 30% to 50% of those attending were women, whereas only 10% were women in ordinary extension meetings. The verbal contributions of women went up to over 50% in some cases, but was overall slightly less than men's contributions.

(2) Women's interest in experimentation increased greatly. Often they became more active than men, and the reliability and quality of research increased. Several times during evaluation tours women openly showed that they knew more about trials than did their husbands, or corrected their husbands when they tried to "show off". This could be a sign of changing authorities because of the recognition of women's knowledge.

(3) Women's role as technology testers rather than innovators remained, but women caught up in the number of self-initiated experiments. They preferred small trials where little risk was involved, but produced a high number of good experiments and valuable ideas (Table 2).

Table 2. Self-initiated trials in a farmer group in Chitembe village, southern Zimbabwe.

Farmer experimentation on type of innovation[a]	Household head[b]		
	Male	De facto female	De jure female
Tied ridges	0	0	1
Strip cropping	0	1	1
Fanya juu terraces	0	1	1
Vetiver grass	1	3	3
Stone bund terraces	0	3	0
Compost	4	2	4
Garden trials	4	3	6
Vegetables in contour	1	0	0
Sweet potatoes on ridges	1	1	0
Vegetables in bags	1	0	0
Open pollinated maize varieties	0	0	1
Tree plantations	4	4	6
Animal feeds	0	0	1
Infiltration pits	0	2	0
Indigenous pesticides	0	0	1
Soil fertility trials	0	2	0
Paprika	0	0	1
Total	16	22	26

a. Within these innovations several different ideas were being generated and tried.
b. De facto female-headed households were those where the husband had migrated to town; de jure female-headed households comprised widows and unmarried women.

Impacts with regard to women's position in the society

(1) Women who were rather shy and quiet gained considerable respect from other farmers because of their good presentations of their experiments (see ***Situations 5***). The "learning by experimenting" process and the acknowledgement of non-formal, non-scientific knowledge built up their knowledge and the confidence to expose it and share it with other farmers.
(2) In some of the local institutions, women were elected chairperson. The rise in confidence allowed women to negotiate more for their needs than before (see ***Situations 6***).
(3) According to men whom we asked about changes, they claimed to be more aware now of the important contributions of their wives in farming and realized the benefit of wives also going to the meetings. Respect for women may have increased.
(4) According to observations and discussions with women, their self-esteem, their confidence, and their pride in being a farmer have increased because of acknowledgement and building up of knowledge based on experience. Together with TFT and tools to negotiate power relations this may have improved relationships between men and women in the communities. Their capacity for self-organization has visibly improved (see ***Situation 7, 8***).

Situations 5:

The silent speak. Mrs Magura usually behaved like a farmer's wife. Although she participated in workshops and always joined researchers in discussions with her husband, she was quiet and did not appear too interested in sharing ideas. One day we took visitors to their farm and Mr Magura, who normally explained about the farm and their experiments, was not there. Mrs Magura did not hesitate to explain all the experiments and answer all questions well and confidently. She even showed some of her own experiments of which we were unaware. Her husband's absence was her chance to prove herself even more capable than he was.

Situations 6:

Bargaining for new social norms. Mr Gwaungana, a farmers' club chairman had two wives, one running a vegetable market in the nearby growth point and the other "helping him in the fields". In the framework of the ConTill Project, mid-season tours were organized where farmers share and exchange experience and ideas that emanate from their experiments. For these tours around the village, men and women were specifically invited and both sexes were active in discussion. With most households, husband and wife presented together, but Mr Gwanungana presented his experiments alone. Soon after he began, the women in the group interrupted him and asked for his wife to come forward also and explain the trials with him. Mr Gwaungana told the group that he would have liked his wife to be present, but she was shy and therefore had stayed at home. The women in the group criticized him openly for hiding his wife and not allowing her to interact with other farmers. They said that men like Mr Gwaungana prevented their wives from fully participating. Finally, Mr Gwaungana apologized to all the women present before proceeding with the discussions on "his" experiments. The new norm that women should be equally presenting and interacting was strengthened in this community.

Situations 7:

Guarding self-discipline. After a community workshop, farmers decided they wanted to revive their traditional work organization and formed groups to work together in the fields. It went well until that season's harvest when one woman no longer went to work in the others' fields. The group did not confront her, but decided to go to her field and harvest it for her. After this, the woman was one of the most active persons in the group.

Situations 8:

Negotiating for leadership qualities. The kraal head is a highly respected traditional leader in the communities, which also often have other formal or political positions. During a review and re-planning workshop, farmers were asked to review their activities by group according to village. During the report back to the plenary, one village group said that they had nothing to present because nothing was worth reviewing in their village. Other participants insisted that they share their reasons why nothing went on. After much probing by the participants, the wife of the kraal head of this village stood and stressed that the main problem was the kraal head, who did not give any feedback after going on look-and-learn tours and workshops. All the other villagers agreed with her and were relieved. The kraal head was quiet, but later explained that he had been unaware of the consequences and promised to improve on this leadership quality. Later we heard from villagers that he now shared ideas more openly and kept them informed.

Impacts with regard to the project's technical output

(1) Simple, lightweight implements that can be used with donkeys (which women preferred in agricultural work) were developed because women articulated their needs.
(2) Issues in which women were specifically interested obtained more weight in discussions and experiments (gardening, certain crops, food security, and bakery and soap-making cooperatives etc.), many independent from the project.
(3) The increased understanding of biophysical processes and technologies that were developed and their adoption (in some cases up to 80% of households practiced these technologies) has resulted in increased yields, diversification of crops, improved soil and water conservation, and other non-agricultural, income-generating activities.

Lessons Learned

The learning process in the project was used for conceptual development. The lessons learned were iteratively molded into an approach to participatory extension and innovation development based on experimentation (Hagmann et al. 1997; 1998a). During the process, we worked closely with the local extension workers. Their role-change from teacher to facilitator took time and required continuous training and learning efforts while working with farmers. This learning experience was used to develop a training strategy for extension workers. At present, the approach is being scaled up in the extension department, and extension workers are being re-oriented in a training and learning process of about 2 years duration. Stakeholder and gender differentiation is an integral part of this training.

The practical experiences and pitfalls were eye openers to the ConTill project and forced the (male) researchers to learn what gender differences mean in reality. As biases and their related problems became known, the conventional "norms" in research and extension were more questioned. This action learning process with regard to gender resulted in the following insights that were identified as crucial for success of the project.

(1) Outside interventions normally interact with community or family representatives, who are mainly men. This is a trap because power relations and decision-making competence in the families and in the communities indicate that women greatly influence the decisions announced by men. Therefore, an intervention should not be satisfied in interacting with representatives, but should try to include the hidden decision makers and strengthen their confidence to express themselves.
(2) With up to 45% of de facto female-headed households, rural communities are "incompletely represented" in most of the workshops et cetera. Many decision makers are only part of the communities at weekends. This has implications on the timing of community workshops.
(3) The weak communication and information flow necessitates facilitating communication between the various actors as a major focus of the external interventions. A platform, methods, and tools for negotiation at community level must be developed.
(4) Whom to address, the farmer or the farmer's husband? The focus should not be women or men separately because the distribution of tasks is not homogenous but highly variable and situation specific in each household. In agricultural research and extension, those who work the land should be addressed, be they men or women. The definition of a farmer should be

clarified and both sexes should be addressed together and equally as farmers. Addressing male and female farmers separately in agricultural extension can worsen communication and the information flow in families.

(5) Stakeholder and gender differentiation is one part of the process. More important is the debate on the different perspectives, the negotiation of underlying interests and roles, and the "stakeholder and gender" integration under a newly emerging common framework. This process of differentiation and integration is the foundation for successful innovation processes.

(6) The implication for research and extension would be to facilitate identifying the problem and needs with the presence of both men and women, to rank priorities together and according to gender, and then to develop the extension program together. A choice of technological options should be developed together to correspond to farmers' (male and female) criteria, which are highly diverse and situation specific.

(7) All farmers, but female farmers in particular, have a wealth of knowledge based on experience. However, extension is based on formal knowledge, which is communicated orally. To value farmers' knowledge, a shift towards experiential learning is needed. Extension has to build upon the farmers' knowledge system rather than impose scientific knowledge with the objective of replacing traditional knowledge, which intimidates illiterate people in particular. This shift will increase women's confidence and position.

(8) Self-confidence, self-esteem, and the value of being a farmer are generally low. In the colonial era, African farmers were looked down upon as being backward and uneducated. Eradicating and replacing indigenous farming practices by concentrating on commodities and the commercialization of African agriculture was the goal. This has largely destroyed self-esteem, pride, and to a certain extent cultural identity (Page and Page 1991; Madondo 1995). This trend continued in the post independence era because the paradigms were not changed (Madondo 1995). Therefore, reviving and strengthening self-esteem and confidence are ultimate goals of human development to increase people's self-empowerment.

Intensive interaction and dialogue with farmers helped deepen the insight of project staff in the social set-up of rural communities and families, which had not been possible with a quantitative survey. The real issues such as power and social organizational problems only came out because of the intervention of the action learning process when individuals in the system reacted for or against change. This process revealed the true roles of the various actors and their interests, whether they were women, men, local leaders, businessmen, government field workers, or bureaucrats. Our insight reminded us strongly of the statement of Kurt Lewin, a founder of action research, "If you want to know how things really are, just try to change them". Without a process intervention (e.g., had we just carried out a gender survey) the real facts would not have been revealed and a pretended harmony would have overshadowed gender perspectives and conflicts. This lesson challenges sole analytical research approaches by outsiders.

Conclusions and Recommendations

The following conclusions and recommendations were drawn from this experience.

(1) A static situation analysis at the project's start is important, but the real issues and priorities only reveal themselves during an intervention when the system reacts towards the intervention. Therefore, problem analysis is an iterative process itself. If taken seriously, the gender issue will always be revealed as crucial in such a learning process. Being sufficiently flexible to take up such results and adapt the project concept and planning in a cyclical way is likewise crucial. Logframes can be counterproductive to such a process if followed rigidly for project implementation. A strong component of process monitoring and documentation needs to be built in as a benchmark for changing activities according to new insights.

(2) An action learning with people is basic. Mistakes are unavoidable, but admitting them, learning the lessons, and improving is important. This requires high flexibility in technical and management terms, but is a successful way to work with people and not for them.

(3) The process should be both human- and technology-centered. Development of human capacity in terms of self-organization, strengthening of confidence, and negotiating roles and power must be seen as a way of making research and technology development and extension more efficient.

(4) Human capacity specifically includes that of women who are the backbone of African agriculture. Therefore, the point is not whether gender differentiation is needed, but that we must consider people as farmers (female or male) who work the land. The gender perspective should be in-built to any serious development process. Promoting gender differentiation as an isolated theme or component can be counterproductive (e.g., women's projects) because they prevent the people themselves negotiating gender roles.

(5) Strengthening of confidence via action learning and increasingly recognizing one's own capabilities and functions in society are the most important elements that lead to self-empowerment. The necessary situations must be created.

(6) The tools and methods for addressing gender are culture specific and should be developed and adapted with local experts. No blueprint is available because gender priorities may differ by project and the tools must be situation specific. However, one method should be universally applied: give women the chance to prove their capabilities wherever possible.

(7) At a time of rapid sociocultural change, gender roles and relations are highly dynamic. Therefore, building a platform is important, one on which rural people themselves can negotiate for new roles, functions, norms, and for new power relations. Roles can be more favorably negotiated via technical issues than via discussions on gender because the advantages of any changes must be concrete and obvious in real life situations. The process requires skilled facilitators at various levels.

(8) Stakeholder and gender analyses and differentiation are crucial for identifying specific interests, but too limited if these interests and roles are not actively debated, negotiated, and re-integrated towards change.

Action learning was the dominant vehicle in the development of the ConTill Project. The learning process happened on two levels: farmers learned through experimenting and the project itself learned through the cycle of action and reflection. Project concept and approach underwent drastic changes in this process and the gender perspective emanated as a crucial and required specific action.

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CHAPTER 5

INCORPORATING GENDER CONCERNS IN PARTICIPATORY RICE BREEDING AND VARIETAL SELECTION: PRELIMINARY RESULTS FROM EASTERN INDIA

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Introduction

Some historians of agriculture believe that women were the first to domesticate crop plants and thereby initiated the art and science of farming. While men went out hunting, women started gathering seeds from the native flora and began cultivating those of use as food, feed, fodder, fiber, and fuel. Women traditionally were seed selectors. Even today, this tradition continues in many parts of the developing world (Swaminathan 1985). However, there are fears that the Green Revolution with the introduction of new varieties will totally take away women's traditional responsibility of seed conservation (Shiva 1988). In low input farming systems, women traditionally were the managers of germplasm (Satheesh 1996). But, modern practices have pushed seed into a market economy outside the village community, and have displaced women from their original role. Women farmers should be included whenever possible in germplasm enhancement and conservation programs, particularly in unfavorable rainfed lowland environments where they are the principal users of rice products and byproducts.

Encouraging women farmers to participate in the process of germplasm enhancement and conservation is important for achieving positive impact on poor rice farming families in rainfed environments. Household food security (and child food security) is strongly linked to women's access to income-generating technologies. Including women in the early stages of technology design ensures that new technologies can be adopted rapidly (CIAT 1997).

As emphasized by Quisumbing et al. (1995):

> "Reductions in asymmetries between men and women in access to agriculture and other resources, the use of women's expertise in the early evaluation of new technologies, e.g., new rice cultivars in rainfed environments, are essential in sustaining food security."

Thus, high priority is given to strengthen, consolidate, and mainstream both participatory research and gender analysis (PRGA) in international, national, and local agricultural research under the System Wide Initiative on Farmer Participatory Research and Gender Analysis in Plant Breeding and Natural Resource Management (CIAT 1997).

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This chapter presents preliminary findings in developing methodologies for incorporating gender perspective into the farmer participatory plant breeding (PPB) work at the International Rice Research Institute (IRRI).

Review of Past Studies

Researchers have highlighted the importance of including women as early evaluators of crop varieties (Fresco 1982; Ashby 1989; Paris 1989; Sperling 1995). In a farmer participatory research (FPR) project on pearl millet breeding for marginal environments, Weltzein et al. (1995) invited both men and women to evaluate the station trials. Farmers from the village with poorer soil conditions, who had experience with some of the cultivars in their own fields, appeared to prefer a new type of material derived from combining high tillering local varieties with large panicle modern varieties. Men and women from this village equally preferred this type. However, male farmers from the new village with better soil conditions preferred this type of material much more than did women from the same village. These women selected mostly material with large panicles and high grain yield potential. The follow-up discussions indicated that for women from these villages, grain yield, early availability of grain, and ease of harvesting by hand (lower panicle number and lower plant height) were the main considerations for making selections. For the men, stover yield and quality appeared a stronger concern. However, whether the women's criteria were considered in the plant breeding objectives is not mentioned.

In Andra Pradesh, we can cite two examples of divergent preferences revealed through matrix scoring. After matrix, scoring pigeon pea varieties against 10 criteria, women farmers indicated they would not again grow a variety released by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). This was despite their higher yields and greater pest resistance, and because of their bitter taste (Women of Sangams Pastapur etc. and Pimbert 1991 in Chambers 1997, p 180). In an FPR study on rice breeding in the high altitudes in Nepal, Sthapit et al. (1996) found that the evaluation scores among male and female farmers in Chhomrong village showed significant agreement. Women farmers reported that they would like to decide on variety selection after the postharvest evaluation. Consumers preferred white-grained rice to red-pericarped rice because it saves women time in milling. While visiting the farmers plots female farmers commented in a group discussion:

> "If we can change our local rice into white grain rice it will save a lot of our (women's) time. We spend 1 to 2 hours extra in dehusking rice until we get white grain. Machhaapuchara-3 has both grain and more straw. It has long panicles and grains are plenty. It matures with the local one and the plant is taller. If it tastes good, we would like to continue this variety."

Sthapit et al. (1996) also observed that women farmers are particularly skilful in assessing postharvest traits such as milling recovery, and cooking and eating quality of rice. Expert women farmers for this purpose can be identified from a village workshop. Men farmers are more skilful in assessing the standing crops for yield potential, management requirements, and threshing criteria.

Two studies in Africa described women's knowledge and criteria for varietal selection, but whether their criteria were considered in rice research was unclear. For example, among the Kpelle rice growers in the rain forests of central Liberia, women use and recognize over 100 different varieties of rice. As Gay (1982, p 23 in Jiggins 1986, p 16-19) describes:

> "Women save the seeds from harvest, select what is to be planted in the new season according to the land which is under cultivation and also can choose precisely what fits her tastes and the conditions of her land."

To test knowledge on rice varieties, Gay (1982 in Jiggins 1986) designed an experiment where people would sit back-to-back and give each other, in turn, enough information for the receiver to pick out, from 25 freshly harvested stalks, the variety that the sender had in mind. Some women, usually older women who were senior wives and leaders in their cooperative work groups, could send and receive information about rice varieties with only two or three errors in 25 attempts. Conversely, some men could scarcely get two or three correct answers in the same test, and no man scored as high as the best woman did. Moreover, these women used categories that formed a clear and systematic framework for describing rice. They mentioned such features as husk and seed color, length at the tip of the rice, size of the grain, ease with which the husk can be removed, length of time required to cook, and suitability to different types of soils and terrain.

Hansen (1995) emphasized that clear gender differences exist in local plant genetic resources in food and agriculture (PGRFA) management. Women are local seed selectors for the range of end-use criteria relating to the household food requirements, for example, palatability, taste, color, smell, and cooking time. Women's focus on the household economy provides a balance to market-oriented pressures that emphasize high yield and uniformity. To the extent that a gender division exists, where women are responsible for food crops and men responsible for cash crops, the task of managing PGRFA commonly follows similar gender division. In the study villages, women are responsible for local PGRFA management for cowpea, beans, finger millet, and sweet potato.

In evaluating gender impact and the work of the International Agricultural Research Centers (IARCs), Jiggins (1986) made three recommendations:

(1) The IARCs' work would benefit from exploring the existing seed technologies and varietal preferences;
(2) The relevance of the IARCs' work would increase if they better understood the relation between desired seed or stock characteristics and domestic processing, preservation, and preparation of foodstuffs for consumption and sale; and
(3) The IARCs should give sufficient attention to collaborative investigation, through the national agricultural research systems (NARS) and with other research and technology development centers, on how present benefits derived from multiple use of biomass might be alternatively provided as monocropped modern varieties (MVs) grown for yield become more widespread.

Background

In September 9-11, 1996 a group of 50 researchers and development professionals attended an international seminar and planning meeting on PRGA in Cali, Colombia. The four thrusts identified for the PRGA Program on Plant Breeding were to:

(1) Assess and develop participatory breeding methods including the user at given stages in the breeding process,
(2) Critically look at the issues of user differentiation and gender analysis along the seed technology chain,
(3) Explore different organizational options, including alternate divisions of labor between farmers, scientists, and nongovernment organizations (NGOs), and
(4) Look into the implications of decentralization for the design of seed support services.

The goal of the PRGA Program on PPB is to develop, test, and refine methodologies of PRGA as they apply to the development of new technologies in germplasm enhancement.

In March 1997, a farmer PPB program for rainfed rice (see Chapter 12) was developed at the International Rice Research Institute (IRRI) in collaboration with NARS in eastern India. The aims were to test the hypothesis that farmer participation for rainfed rice breeding can help develop suitable varieties more efficiently, and to identify stages along a breeding program where farmer interfacing is optimal. The project has two components. The first is a plant-breeding component, which aims to develop and evaluate a methodology for participatory improvement of rice for heterogeneous environments, and to produce and improve adoption of material suiting farmers' needs. The second is a social science component, which aims to characterize cropping systems, diversity of varieties grown, and crop management practices of rice farmers; and to elicit farmers' selection of criteria and their reactions to a range of cultivars and breeding lines.

In 1998, we began to incorporate gender concerns in the on-going PPB project conducted by IRRI scientists in collaboration with NARS in eastern India. The strategies for incorporating the gender perspective were by:

(1) Developing methodologies for assessing male and female criteria of useful traits of rice varieties of male and female farmers;
(2) Developing participatory approaches that include male and female farmers in selecting new rice lines;
(3) Further enhancing women's knowledge and skills in germplasm conservation; and
(4) Enhancing NARS' capacities in conducting male and female farmer participatory approaches in rice germplasm enhancement and conservation in rainfed rice environments.

The research villages

We initiated the gender study in two villages, Mungeshpur in Faizabad district and Basalatpur in Siddathnagar district, eastern Uttar Pradesh. These are the same villages where the PPB project was conducted. Table 1 summarizes the villages' characteristics. Basalatpur represents favorable lowland rainfed areas, which are submergence-prone, and Mungeshpur represents drought prone areas that are favorably rainfed during years of low rainfall. Although MVs show higher adoption in Mungeshpur, these varieties are unsuitable for cultivation under rainfed conditions and often suffer from submergence, drought, and stress at reproductive and ripening phases when the crop is planted late. Farmers in Mungeshpur have more access to supplementary irrigation, which enables farmers to grow vegetables and to increase crop diversification during the winter season (Nov/Dec – Mar/Apl). Most farm households in Mungeshpur belong to the lower caste (backward and scheduled) and Muslims dominate in Basalatpur. The Yadavs, a subcaste of the backward caste in Mungeshpur, take care of milch animals. In this village, bullocks continue to be used for land preparation and threshing is done manually. In contrast, land preparation and threshing in Basalatpur is mechanized with the use of tractors. The degree of market orientation is higher in Basalatpur (nearer the city) where more rice is sold. Rice grown in Mungeshpur is mainly used for home consumption because of low marketable surplus.

Table 1. Characteristics of two research sites in the farmer Participatory Plant Breeding project, eastern India.

Characteristics	Research sites	
	Basalatpur, Siddharthnagar	Mungeshpur, Faizabad
Distance to market (km)	5	28
Agroecology	submergence prone	drought prone
Farming households (total no.)	140	133
Upland (%)	30	20
Between upland and lowland (%)	0	20
Lowland (%)	70	60
Adoption of modern varieties (%)	<20	82
Irrigation (private pump) (no.)	1	10
Average farm size (ha)	1	0.49
Caste composition of households (%)		
Upper caste	6	9
Backward caste	18	49
Scheduled caste	21	42
Minority	55	0
Importance of livestock	Low	High
Degree of market orientation	High	Low

SOURCE: NDUAT 1998.

The socioeconomic characteristics of the respondents

As Table 2 shows, most of our respondents belong to the lower social class who have small sized landholdings. Females are younger and have lower literacy rates compared to males, and have over 20 years of farming experience.

Table 2. Socioeconomic characteristics of respondents in the Farmer Participatory Plant Breeding project, eastern India.

Characteristics	Mungeshpur, Faizabad		Basalatpur, Siddharthnagar	
	Male	Female	Male	Female
Number of respondents	15	15	15	15
Upper caste (%)	20	7	0	0
Backward caste (%)	60	80	100	100
Scheduled caste (%)	20	13	0	0
Average age (yr):				
Upper caste	51	50	-	-
Backward caste	51	46	54	40
Scheduled caste	57	47	-	-
Years in school (no.)				
Upper caste	13	0	-	-
Backward caste	5	0	3	2
Scheduled caste	0	0	-	-
Years in farming (no.)				
Upper caste	15	10	-	-
Backward caste	30	26	36	20
Scheduled caste	37	24	-	-
Household size (no. members)				
Upper caste	5	9	-	-
Backward caste	7	6	6	7
Scheduled caste	7	9	-	-
Landholding (ha.)				
Upper caste	2.10	1.90	-	-
Backward caste	0.69	0.59	0.58	0.49
Scheduled caste	0.60	0.35	-	-

Cropping systems

In both villages, rice / wheat mixed with mustard is the dominant cropping pattern, occupying more than half the cultivated area. The rest is grown to different crop sequences and crop combinations depending on the land type, supplementary irrigation, and availability of labor.

Monsoon season (Jne/Jly – Nov/Dec). Rice is the dominant crop grown during the monsoon season (*kharif*). In the lowlands in Basalatpur, farmers grow rice only during this season, occupying 92% of all cultivated land. Pigeon pea (2%) and green fodder (3%) were grown on the uplands and the rest (3%) left fallow. Crop diversification is higher in Mungeshpur where 75% of the cultivated area is planted to rice and the rest distributed to pigeon pea (4%), maize (3%), sugarcane (4%), green fodder (5%), vegetables (1%), and other crops (1%). Fallow occupies 7% of the area.

Winter season (Nov/Dec – Mar/Apr). In the winter season (*rabi*) in Basalatpur, 70% of the cultivated lands are left fallow because of the flooding of low-lying areas from December to January. Wheat mixed with mustard occupies 14% and mustard occupies 13% of the total cultivated land. Pea mixed with mustard, potato, and other crops each occupy 1%. In

Mungeshpur, wheat with mustard occupies 74% of the area planted during this season. The rest is planted to gram with mustard (6%), fodder (6%), pea with mustard (4%), mustard (4%), potato (4%), and vegetables (1%). Fallow occupies 1% of the area.

Gender division of labor

The extent of female participation in rice production is high in both villages. Some tasks in rice production and postharvest operations are gender specific. Land preparation and application of chemicals are men's responsibilities in both villages (10% of fertilizer application is done by women in Basalatpur). In Mungeshpur, women from the lower social status dominate in pulling of seedlings (100%), transplanting (70%), weeding (80%), application of farm yard manure (60%), harvesting (82%), and threshing (82%). In Basalatpur, men and women equally share in the pulling of seedlings and harvesting. Women do the transplanting of seedlings (100%), and most of the weeding (75%), with men doing most of the spraying (90%). Basalatpur is more mechanized, using tractors for land preparation and threshing, but in Mungeshpur bullocks are used for preparing the land and threshing is done by hand. Postharvest activities such as seed selection, storage, dehulling paddy manually, hand threshing, parboiling rice, and making rice puffs—all done within the homesteads—are major responsibilities of the females. Aside from their significant contributions in crop production, they take care of dairy cattle, collect green animal fodder, and feed and tend livestock. Thus, the women are responsible both for most of the crop and livestock operations and they are users of the byproducts, particularly when men are engaged in non-farm jobs (Paris et al. 1996).

Despite the significant contribution of women in the farming systems, women are rarely consulted on farm-related matters or included as cooperators in on-farm experiments, particularly in germplasm enhancement. Several ways have been suggested in which breeders might incorporate farmers' selection criteria. One approach is for breeders to elicit farmers' selection criteria. Another is to use a fully participatory approach to cultivar selection wherein breeders along with farmers select the most promising lines. Here, selected lines are further screened on farmers' fields using farmer-managed on farm trials. A third approach is to obtain farmer assessment of advanced lines grown in experiment stations and assessment by other farmers of new rice cultivars grown by farmer cooperators. However, in these approaches, male scientists tend to include only male farmers. Thus, efforts are now being made to include women in the various activities in conjunction with the farmer PPB project in eastern India. These activities are: (1) surveys eliciting farmers'selection criteria, (2) farmer participation in on-going experiments on varietal selection, and (3) farmers' assessment of new rice lines at different stages of production including postharvest.

Tools and Methods Used

Eliciting male and female farmers' criteria of useful traits of rice varieties

In June 1998, we interviewed 15 males and 15 females from separate households and different social groups in Mungeshpur, Faizabad district and Basalatpur, Siddathnagar district. We first asked each farmer what traits he or she considered in selecting rice varieties in the upland and lowland fields. To assess how farmers valued each trait, we asked the question: "If you had 100 *paisa,* how much would you pay for each trait?" The value in *paisa* allocated to a particular trait corresponded to the weight or importance given by farmers. We summed the weights per trait of all respondents in each land type and took the proportion of each trait to all traits mentioned. Because many traits are interrelated we reclassified them in consultation with a plant breeder. For example, we grouped traits such as ease in dehulling and milling recovery under postharvest quality.

Table 3 shows selection criteria of male and female farmers for different land types and villages. Preliminary findings in Basalatpur show that male and female farmers agree upon the most important traits they look for in varieties for the uplands. The popular traditional varieties here are "Bengalia", "Oriswa", and "Kuwari-Mashuri". These are short duration (90-110 days) and medium height varieties. The average yields are 2.5 tons per hectare. Farmers prefer short duration rice varieties in the uplands because of the importance of growing early winter crops such as oilseed, linseed, pulses, peas, and potato. "Bengalia" is also better eaten after being parboiled otherwise its grains easily break. Women in Basalatpur use the traditional rice varieties for making puff rice and "Churra" (like cornflakes). For women who continue to use the traditional method of hand pounding rice, postharvest qualities such as easiness to dehull and high milling recovery are additional useful traits they mentioned that men did not mention.

For lowland areas in Basalatpur, both male and female farmers agreed upon the important traits for lowland rice varieties. High grain price is an important consideration for farmers here because they sell the traditional varieties of rice in the market. These, like "Kalamanak", command a higher price, as high as Rs25.00 per kg because of good taste and aroma. "Kalamanak" gives low yields at 1.5 to 2 tons per hectare. In contrast, grain price is not an important consideration in Mungeshpur because rice is mainly used for home consumption and seldom sold in the market.

In Mungeshpur, males and females agreed upon important traits in selecting varieties for the uplands. Women gave more important consideration to postharvest qualities and grain quality such as bold and pure grains. For the lowlands, both males and females cited better grain yield, medium duration (125-135 days), biomass, and resistance to abiotic stress as their selection criteria for lowland rice varieties. Women gave higher weight to better adaptation to specific soil type and grain quality. Women mentioned additional useful traits for varieties in the uplands and lowlands that were not mentioned by men—competitiveness with weeds and postharvest quality. Weeds are the major problem in the uplands, particularly when rice is direct seeded. In the lowlands, weeds are more prevalent during drought. These additional traits are related to the roles and responsibilities of female family members (e.g., hand weeding and feeding rice straw to livestock).

These initial findings indicate that, although these women farmers have lower access to education and extension services compared to men, they are knowledgeable about useful traits for developing rice varieties suitable to specific environments. Breeders can use farmers' criteria with their own criteria for selection.

Table 3. Traits[a] farmers mentioned as useful when selecting rice varieties in Basalatpur and Mungeshpur, eastern India. Numbers are rounded and given in percentages.

Traits	Basalatpur				Mungeshpur			
	Upland		Lowland		Upland		Lowland	
	Male	Female	Male	Female	Male	Female	Male	Female
Grain yield	36.67	39.50	48.67	49.67	41.67	35.96	42.06	40.45
Duration	25.83	34.50	0.67	1.00	20.56	25.84	20.56	15.00
Grain price	0.00	0.00	15.67	16.00	1.67	2.81	2.97	1.82
Resistance to abiotic stress	8.33	6.50	0.67	0.33	5.56	6.18	5.10	5.00
Biomass quality	3.33	2.50	5.33	4.67	5.00	2.25	5.52	8.64
Taste	1.67	0.50	10.33	12.33	2.78	2.81	2.12	3.18
Bold and pure grain	7.67	1.50	1.67	0.00	4.44	4.49	3.40	5.00
Adaptation to specific soil type	3.33	3.00	2.33	0.67	5.00	4.49	5.52	6.36
Postharvest quality	0.83	3.00	6.67	7.67	0.00	5.06	0.00	2.27
Resistance to biotic stress	4.17	2.50	1.00	1.33	3.89	1.69	4.25	3.18
Cooking characteristics	0.83	1.00	1.67	2.00	3.89	3.93	3.40	5.00
Response to fertilizer	2.50	1.00	2.67	1.33	5.00	2.25	4.25	1.82
Competitiveness with weeds	0.00	0.00	0.00	0.67	0.00	2.25	0.00	2.27
Resistance to lodging	1.67	0.00	2.33	0.67	0.00	0.00	0.85	0.00
Early vegetative vigor	0.83	0.50	0.33	0.00	0.56	0.00	0.00	0.00
Culm strength/diameter	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00
Adaptation to several preparations	1.67	3.50	0.00	0.00	0.00	0.00	0.00	0.00

a. Traits are given in order of importance: grain yield includes tillering, panicle length, and number of grain; resistance to biotic stress includes resistance to pests, bugs, and blast; resistance to abiotic stress includes resistance to zinc deficiency and drought; biomass quality includes height, and quality and quantity of straw; postharvest quality includes easiness to dehull and milling recovery; and cooking characteristics include cooking time, elongation ability, aspect after cooking, and impression in the stomach.

Farmer participation in rice varietal selection

During the 1998 monsoon season, two farmers from each of the villages of Mungeshpur and Sariyawan (rainfed neighboring village) of Faizabad district and Basalatpur of Siddathnagar district were selected to check the performance of 13 rice genotypes on their fields. The genotypes were 10 advanced lines from a shuttle breeding program from Uttar Pradesh and three released varieties for lowlands. Of 15 varieties, only 13 rice genotypes could be tested, because two varieties did not germinate during seedbed preparation. Of the 13 genotypes in Basalatpur, two are scented varieties (“Kamini”, which flowered in 136 days, and “Sugandha” flowering in 124 days). Scientists distributed the seed through the farmer PPB project. In this approach, breeders select the most promising lines with farmers. Including female farmers as cooperators gave them an equal chance to participate in decisions in selecting rice genotypes.

The average rice yields obtained by the two female farmers were higher (2 t/ha in Mungeshpur and 3.3 t/ha in Sariyawan) than those obtained from the male -managed farms. Average yields were below 2 t/ha because of the infestation of pests and diseases at the time of maturity. This indicates that if women are given equal access to improved seeds and farm management skills, they can be better farmers.

Farmers' preference ranking

Ten farmers (five females and five males) visited the individual plots and ranked the 13 rice genotypes grown on farmers' fields past maturity stage. Farmers were asked to rank the 13 rice lines from 1 (excellent) to 13 (worst) on the basis of visual assessment. The rankings of the new cultivars by the farmers generated an n x k matrix, where n are the lines being evaluated and k are the farmers evaluating the crop performance. Kendall's Coefficient of Concordance (W) was used to measure the agreement in rankings among male farmers, among female farmers, and the correlation between male and female farmers' ranking. High and significant correlation values indicate close agreement on the ranking of the 13 rice genotypes by men and women in the sample.

Table 4 shows that in the two villages, male and female evaluators were in close agreement in the ranking of the 13 lines. The W's were highly significant, revealing that farmers' ranking is acceptable. In Mungeshpur, PVS3 (NDR-973004) was ranked highest by both males and females because it matures early and yields better compared to the local check (Mashuri). Both PVS3 and PVS13 are resistant to abiotic stress. In Basalatpur, both male and female farmers rated PVS2 as the best variety because of its higher yields (3 to 3.5 t/ha) and early maturing compared to "Kalamanak", which matures after 160-165 days.

Lessons Learned

Including women farmers at the early stage of germplasm enhancement and varietal selection is necessary for the adoption of suitable rice varieties in stressed environments. However, we encountered several problems in increasing their participation. Some of these were:

(1) It was difficult to find female scientists in agricultural universities who were willing to do fieldwork under adverse conditions and work with a team of male scientists. Farmer participatory research becomes a full-time activity particularly during the peak seasons when evaluation has to be done. Because of social restrictions, male scientists tend to exclude women farmers in the project.
(2) Harvesting and threshing small quantities of new rice cultivars impose more drudgery on female cooperators. Dehusking paddy manually and hand threshing the small quantities of new rice cultivars for identification and evaluation were too laborious and time consuming. Thus, researchers and field workers had to help women during the harvesting and threshing phase.
(3) There were too many lines to evaluate. Instead of rating 13 lines, women farmers prefer to evaluate a maximum of six rice lines on their small fields. Moreover, because of lack of new seed and failure of seed to germinate, few farmers were able to participate in the farmer participatory varietal selection.
(4) Female cooperators should not just include those from the lower social status. Upper caste women who are de facto heads of households, who have long-term experience in farming, and who are willing to "experiment" and make decisions should also be included as cooperators in the experiments on rice varietal selection.

Table 4. Average scores and farmers' rankings[a] of 13 rice genotypes, Basalatpur and Mungeshpur, eastern India.

Variety no.	Varietal lines[b]	Basalatpur				Mungeshpur			
		Males		Females		Males		Females	
		Ave. scores	Rank	Ave. scores	Rank	Ave. scores	Rank	Ave. scores	Rank
PVS1	NDR-40032	3.6	2	3.8	3	5.2	5	4.8	5
PVS2	Kamini/ KMJ-1-17-2	2.0	1	1.4	1	8.0	7	3.8	3
PVS3	NDR-973004	5.4	5	4.0	4	1.2	1	1.4	1
PVS4	NDR-95003	7.0	7	7.4	8	3.4	3	4.2	4
PVS5	Satyam	5.8	6	6.8	7	11.2	11	12.6	13
PVS6	Sugandha/ NDR-973000	7.0	8	6.6	6	8.6	9	12.0	12
PVS9	NDR-9730015	3.6	3	3.3	2	8.4	8	10.8	11
PVS10	NDR-9730020	8.2	9	9.0	10	9.6	10	9.4	9
PVS11	Malasia/ Mashuri	11.0	11	11.2	11	5.6	6	7.0	7
PVS12	RAU-136/ RAU-1306	11.6	12	11.6	12	4.6	4	6.0	6
PVS13	NDR-9730012	4.2	4	4.2	5	1.8	2	1.6	2
PVS14	RAU-1326	13.0	13	13.0	13	11.8	13	7.4	8
PVS15	NDR-9730025	8.6	10	8.8	9	11.6	12	10.0	10
	Kendall's W^c	0.75*		0.85*		0.87*		0.88*	

a. Rankings from 1 (excellent) to 13 (worst) on basis of visual assessment.

b. Where varietal lines differ, the first given is that used in Basalatpur, the second that used in Mungeshpur.

c. Kendall's coefficient of concordance (W); * = significant at $P = 0.01$.

These preliminary findings indicate that although women have less access to education and extension services, they are as knowledgeable as men in identifying the useful traits in rice varietal selection because of their active participation in almost all crop operations, and their specific use of rice products and byproducts. Given proper guidance and technical knowledge, women can contribute strongly to seed-related activities such as faster adoption of improved rice varieties, better management of new seeds, and conservation of rice germplasm. We will continue to validate these findings at other sites, particularly during the sensory evaluation test, and further develop methodologies for including women in plant breeding and plant varietal selection.

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CHAPTER 6

PARTICIPATORY TESTING AND EVALUATION OF MANUAL RICE TRANSPLANTERS BY NEPALESE WOMEN FARMERS

Vinay Kumar Gami∗, Scott E Justice∗∗

Introduction

Although mechanization of rice transplanting will offer benefits to Nepali agriculture, it may also bring high social and economic costs by displacing rural labor. Because women and children perform almost all rice transplanting in Nepal, the arrival of "powered" machine technology would affect their labor disproportionately. Already, powered rice transplanters are becoming common in the Indian states of Hariyana, Punjab, and Uttar Pradesh. If the adoption rate for this machine follows the same pattern as for the Indian combine harvester, it will probably reach Nepal Terai soon. These powered transplanters can greatly disrupt and displace traditional labor patterns. Such social upheaval is often assumed to be the necessary price to pay for modernizing agriculture. We believe this need not be the case.

Background

In the Nepal Terai, as in the rest of the Indo-Gangetic Plain, farmers are experiencing increasing labor shortages during the paddy season, especially during rice transplanting. Current transplanting practices are relatively labor-intensive, requiring 30+ laborers per day per hectare transplanted. Powered rice transplanters are already in use on Nepal's southern border. Developing and adopting mechanized manual rice transplanters favors powered rice transplanters in several respects: manual transplanters represent an intermediate technology that is locally manufactured, affordable to small-scale farmers, and gender neutral. Like the larger powered transplanters, the manual one and the accompanying push row weeder have many advantages over hand transplanting. They require less precise land preparation; create conditions for better water and weed control; allow for the planting of seedlings 15-20 days earlier; and reduce the inherent drudgery in hand transplanting.

The idea of introducing a manual rice transplanter in Nepal is not new. The Agriculture District Office (ADO) in Rupandehi District previously tried to mechanize rice transplanting using a manual transplanter. Although no available reports or documents are available from this project, the ADO staff informed us that their testing and demonstrations elicited little response from farmers.

In June 1997, three local outreach or research agencies were invited to take part in the new program: ADO, Bhairahawa, the National Wheat Research Program (NWRP), Bhairahawa, and the Nepal Community Support Group (NECOS), a permaculture

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nongovernment organization (NGO). Each participating agency was to provide access to a group of women farmers with whom they had previously worked. However, the agencies disagreed with regard to the "gender orientation" of the program. In a spirit of compromise, two largeholder male farmers were included in the "small-scale farmers" program, in addition to the two smallholder women's groups.

Objectives

The primary objectives of the program were to:

(1) Describe and identify current transplanting practices and problems;
(2) Elicit farmers' expertise and perspectives for the research and evaluation of the International Rice Research Institute (IRRI) manual transplanter and weeder;
(3) Compare the cost of current farmer practices with costs associated with using the IRRI six-row manual transplanter;
(4) Evaluate whether women farmers could use this machine, both socially and physically; and
(5) Ascertain whether any changes in the machine's design could enhance or ease its operation by women farmers.

Methodology

Farmer participatory research

Efforts to implement farmer participatory research (FPR), which is stated as an important goal of the Nepal National Agricultural Research Council (NARC), have been met by a reluctance to involve farmers in the research process until a technology has been "proven". National and international public sector research in agricultural engineering has typically embraced a paradigm based on a linear, top-down transfer of technology (TOT). Machines developed and "perfected" on research farms flow down the TOT pipeline to researcher-led farmer field trials (FFTs), and finally to farmers waiting at the "bottom" to buy. Douthwaite et al. (1998) and Starkey (1986) point out that this research orientation has often failed in its efforts at farmer adoption of technology. Cases in point are "improved" germplasm that farmers deem unsuitable during large-scale FFTs; or, in agricultural engineering, machines that were researched and developed by engineers from International Agricultural Research Centers (IARCs) and national agricultural research systems (NARS), but farmers never adopted. The failure to clearly understand farmers' needs and wants, and the resulting inefficiency of such programs, is a prime reason that funding agencies have shied away from public sector agricultural engineering programs in developing countries (Douthwaite and Bell 1998). At a time of shrinking agriculture research budgets and donor fatigue, particularly in the field of agricultural engineering, the "top-down" development of technologies has wasted precious research time and resources. Many see FPR as a set of methodological tools that will speed the development and extension of farmer-tested, farmer-approved technologies. Dr Eugene Saari, South Asia Regional Pathologist of the Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT) emphasized this in his farewell address at the NWRP, Bhairahawa. He encouraged researchers to include farmers earlier in the germplasm selection process as a way of saving precious resources and to speed up the development time of new "farmer approved" wheat varieties.

The synthesis of basic agricultural engineering research and FPR methods was first tested in an earlier FPR program focusing on the Chinese Hand Tractor Program sponsored by CIMMYT, Nepal in collaboration with NWRP and others. In the present project it has resulted in a partnering of farmers, local workshops, blacksmiths, agricultural engineers, and researchers. From the project's start, these stakeholders are engaged in an on-going process of evaluating results and adapting the research methodology. In this way, the problem-solving capacity of the group and the project as a whole are made more dynamic.

Project farmer-training workshops

In the first year, two separate training sessions were held at NWRP. Fourteen female and eight male farmers from agency-selected villages took part. The first training session combined classroom instruction and fieldwork. Participants were first introduced to the mechanized transplanting process and given an overview of seedbed construction and the economics of the transplanter and weeder. The group then received hands-on practice in the making of two "mat type" seedbeds. In the days following training, we visited the locations to help groups make their own seedbeds.

The second training session was held 3 weeks later, when the seedbeds at NWRP were ready for transplanting. After a review of the first session, the second focused on field operation of the transplanter. During the practical, trainees took turns transplanting 0.06 hectares of seedlings. In the following weeks, 0.05 hectares were transplanted at Bankati (women's group), 0.02 hectares at NECOS (women's group), 0.06 at Karhiya (large-scale farmer), and 0.05 hectares at Bewoora (large-scale farmer). Thereafter, two types of push row weeders were provided to the groups for their use.

Agronomic and socioeconomic data collection

Agronomic data were collected with the help of the farmers throughout the rice season. Socioeconomic data (on farmers' actions, reactions, and suggestions) were collected during the many field visits through participant observation and informal individual and group interviews.

Machine Evaluation and Preliminary Results

Transplanter

The machine used was designed by IRRI (and manufactured in India) to simplify earlier more complicated picking and planting mechanisms (Table 1). Its operation involves two motions: a downward stroke to pick up a group of 3-7 seedlings from a seed tray and plant them in the soil; and an upward stroke to release them and move the tray laterally to present new seedlings for the next cycle. With proper training, small workshops could easily fabricate the machine using locally available materials. The Agricultural Implement Research Center (AIRC), Birganj has already successfully produced a transplanter in its small workshop (personal communication, Chief Engineer G. Sah, AIRC, 1998).

Table 1. The International Rice Research Institute (IRRI) 6-row transplanter: features and specifications.

Features and specifications	Details
Field capacity (IRRI results)	0.3-0.35 ha/day depending on operator's skill level
Ease of operation	1 person stepping backward moves push-pull handle. Moved downward to transplant 6 rows of seedlings.
Simple construction	Can be fabricated at local workshops using locally available material
Field labor requirement	Three people
Specifications:	
Planting depth	2-5 cm
Adjustable seedlings per hill	3-7 plants
Field standing water depth	1-5 cm
Weight (with optional wheel attachment)	25 kg
Length (with handle folded)	100 cm
Width	123 cm
Construction	Aluminum sheet, steel supports, and wooden skids
Seedling preparation:	
Size of seedling mat	20 cm X 50 cm
Number of seedling mats per hectare	400-450
Size of seedbed per hectare	1.2 m X 45 m
Seed requirement per hectare	30 – 40 kg

Below we list considerations to be taken into account for successful use of a transplanter.

Seedling stage

- Variety of rice
- Type of nursery (*dapog* or wet bed)
- Type of soil used for seedbed
- Date of seeding
- Seed quality
- Seed germination
- Age of nursery and management process
- Root length / density
- Density of seedlings / variety

Field selection

- Size / shape of field
- Soil type and nature
- Previous crops
- Physical properties of soil and type of field preparation determine time for proper settling after puddling
- Drainage and land leveling are important factors to ensure proper depth of water during transplanting

Machine and operators

- Daily inspection of machine to ensure that all moving parts are lubricated, and all nuts and bolts are tightened
- Seedling density adjustment
- Speed depends on experience and capacity of operator

The farmers easily made the required seedbed preparations with minimum guidance from the trainers. However, their follow-up seedbed management was lacking. Under the traditional method of seedbed preparation, farmers do not check on newly broadcast seeds for several days. The new technology demands that the seedbeds be watered several times a day in the first 4 to 5 days. Compounding this problem is the fact that the seed mat is grown on a thin layer of soil (1.5 cm) that is placed on a plastic sheet. This means that the mat cannot pull water from below the sheet and thus relies on sprinkle irrigation during the first 5 days and on flood irrigation after this. The end result was that not even large-scale farmers adequately watered the properly constructed beds. The mats showed large areas of seedling mortality, especially along the more vulnerable outside edges.

On the other hand, farmers demonstrated ingenuity both by correcting inefficiencies in seed mat preparation and loading, and by adapting indigenous tools for use with the new technology, with the added benefit of reducing the need for externally provided tools. In one instance, when the seedling mats were too thick, farmers improvised by slicing soil from the mats to obtain the required thickness. Farmers did not like the straight butcher knife that was provided them, instead opting for their own local sickles to cut the mats to size. The manual, and therefore our training, insisted that the seedbeds “had” to be cut with a special knife and measuring tray, yet they quickly tired of cutting precisely sized mats with the special measuring tray provided them and started “eyeballing” the cuts. Although their seedmat slices were sometimes too narrow or too wide the farmers were able to make them fit in the machine simply by quickly “cutting and pasting,” and, despite our continued objections, these mats worked well in their machines. In another instance, the manual called for a special carrying tray (and an additional monetary outlay) to take the mats from the seedbeds to the rice fields. Again, ignoring our protests that group members would damage the seedlings, they began transporting seed mats in their traditional baskets, because they said the trays were too bulky. Time and again, healthy stands of rice demonstrated to researchers that the farmers were experts in the care of rice seedlings.

Examining how easily women operated machines produced mixed results. Those women whose machines experienced mechanical difficulties believed that operating all day would be too hard, even if a small group shared the work. Conversely, women who had a chance to use the properly functioning machines thought that a group of three to four women could easily operate the machine all day. Additionally, from our observations we found that although husbands and sons were also anxious to try operating the machine, they were content to “let” the women operate it themselves.

During the actual planting process the machine performed well, even in unleveled fields, provided that standing water levels were below 5 cm. The amount of time between deep plowing and transplanting varies by soil type and/or soil structure. Working with the farmers we found that fields plowed by bullocks needed only 10 to 12 hours to settle sufficiently for transplanting. Conversely, fields plowed by four-wheel tractor (deeper plowing by nine-tine cultivator) must be allowed to settle for longer (24 to 48 hours) to prevent the transplanter from sinking too deeply in the puddled soil. This problem occurred only on the research farm’s fields and large-scale farmers’ fields, where large tractors were used.

Difficulty in transplanting was also encountered when standing water was deeper than the recommended 1-5 cm. In this case, the machine did not operate properly and thereby reduced the stand (number) of hills. Again, such areas should be drained 1 to 3 days before transplanting.

The most significant problem that occurred was with the machine itself. Together with the farmers, we found that several times the machine did not manage even a single pass in the small *khets*. The work would have to stop for the machine to be adjusted or the chain restored in position. This was highly discouraging for researchers and farmers alike. Nevertheless, at other times the transplanter would work as advertised for at least several passes, giving both farmers and researchers a promising glimpse of the machine’s potential.

Push row weeder

The push row weeder is made to slide on its front skids between the rows of rice and to mechanically uproot and bury weeds with the trailing rotor blades. Manual weeding requires an average of 120 person hours to weed one hectare. Conventional single-row machines weed in 80 to 90 hours per hectare. A double-row machine can weed 1 hectare in 25 to 35 hours, but may be too difficult for most women to push. The potential advantages of the mechanical weeder include reduced labor costs for weeding, the promotion of green manuring, and budget savings through reduced spending for chemical fertilizers. When the weeder was used on time, farmers reported that the machine worked effectively and decreased the time required for this job. However, problems arose for farmers who began their first weeding later than the recommended 21-day maximum. After this period, the weeds can form a strong mat that the machine is unable to uproot and bury. These farmers were forced to revert to hand weeding. Another problem reported by farmers was that our locally manufactured weeder, made with heavier gauge material, was too heavy and sank into the mud. The local workshop was notified, and will use lighter gauge material for future weeders.

Yield data

Table 2 gives the agronomic data collected. The Bankati women's group had the largest yield (4841 kg/ha), which is nearly double the district average of 2500 kg/ha. The success surprised both the women and the scientists. The women remain wary about investing in this technology, however, because of excessive breakdowns of the machine.

The Piparahiya women's group had the smallest yield, 1914 kg/ha. This group is situated in a particularly impoverished area and is among the poorest farmers of the entire district. Upland, non-irrigated field conditions and a lack of fertilizer use are both consistent with this observation. Despite the dismal yields and machine breakdowns, this group said it recognized the potential value of the machine, and was the first to ask to be included in the following year's program.

The yields for the two large-scale farmers were well above their own reported averages. They are both interested in participating in next season's program and intend scaling up their experiments with the machine. They also faced recurrent breakdowns of their machines. However, they feel that were the machine of better quality, it could be made to work more effectively. Both large-scale farmers expressed the opinion that this machine represents a means of overcoming their current labor shortages. Also, they felt that it could reduce their crop establishment costs by at least 30%.

Table 2. Rice yields[a] obtained with mechanization, Bhairahawa, Nepal.

Village or group	Area planted (ha)	Variety	Yield (kg/ha)	Fertilizer used[b] (kg)
Bankati women	0.05	Radha-17	4841	Basal urea: 1 DAP: 2 1st TD: 3
Karhiya large-scale farmer –				
1st plot	0.03	Chaita-4	4595	None
2nd plot	0.03	Radha-4	4275	None
Bewora large-scale farmer	0.05	Radha-4	4068	Basal urea/DAP: 1st TD 11
Bhairahawa RARS[c]	0.13	Makwanpur	3791	1st TD 20
Piparahiya women	0.02	Local	1914	None

a. Rice was irrigated except by the Piparahiya women's group.
b. DAP = diammonium phosphate; 1st TD = top dressing, the urea that is broadcast into 20-30-day old rice.
c. RARS = Regional Agricultural Research Station

Partial budgeting

From farmer interviews and discussions, and from reviewing the IRRI-reported capacity of the transplanter, we have conservatively estimated variable costs involved in traditional transplanting versus mechanized transplanting with the IRRI model. With the traditional method, it takes 25 people 1 day to transplant 1 hectare. With the manual transplanter, it takes 2 people 1 day to transplant 0.25 hectares. Additional savings are possible with the mat-type seedbeds. Under the traditional method, it takes 6-10 local laborers 1 day to uproot and bundle the seedlings for 1 hectare. Using seed mats, it takes 1 person 1 day to cut seed mats for 0.25 hectares. Under traditional conditions, it takes 43 person-days to transplant 1 hectare. Using the transplanter and wet seedbed method, it takes 12 person-days to transplant 1 hectare. In our calculations, we use a wage of 50 NRs per day per laborer under traditional practices and 60 NRs per day for skilled operators of the transplanter (food not included). Plowing costs average just over 2000 NR per ha. Traditional methods cost 2000 NR for plowing and 2150 NR for transplanting, a total cost of 4150 NR. The improved method costs 2000 NR for plowing and 720 NR for manual transplanter, a total cost of 2720 NR. The net savings per hectare are therefore 1430 NR.

Lessons Learned

Carefully preplanned demonstrations are critical for avoiding negative demonstration effects for the farmers. We experienced a few unavoidable problems with the machine during several of the transplantings that dampened enthusiasm among some of the small-scale farmers. We found that the Amar Industry IRRI Model transplanters were of variable quality and that several machines had to be modified locally to reduce breakage. Encouragingly, the local workshops that we partnered with are confident that they can improve the quality of the transplanter.

We believe that the difficulties experienced with water stress and seedling mortality could be resolved by using perforated plastic sheets as has been done in India. This would allow the seedlings to pull moisture through the sheet from the underlying soil and thereby reduce the necessary number of waterings to one or two per day.

Finally, more in-depth training for machine operators is essential to the successful extension and adoption of the manual rice transplanter. These training sessions would focus on seedbed and seedling preparation, machine maintenance, adjustment, and trouble shooting.

The average woman in our study was able to operate the transplanter effectively, but exerted more effort on the average than did men. For women to be able to work all day without great fatigue, it seems that the smaller 5- or 4-row versions of the machine are needed. It has also been suggested that these smaller and lighter versions may be appropriate for the smaller terraced *khets* in the mid-hill rice regions.

The farmers and user groups used the manual rice row weeders to varying extent. However, although their reactions to the weeders were noted, no agronomic or economic data were collected. This weeder provided potential benefits through both green manuring and labor savings, which warrants further study.

Several earlier attempts at small farm mechanization in Nepal proved unsuccessful. This is in direct contrast with the reactions of our own farmer groups. A possible explanation for an increase in farmer enthusiasm, mentioned by farmers and agricultural researchers alike, is an emerging, region-wide labor shortage. When earlier demonstrations were conducted, farmers had little difficulty finding laborers, whether family members or locally hired, to work in their fields. Today, however, larger-scale farmers go as far as Bihar to find labor. Perhaps this explains why they have approached our program with enthusiasm and a willingness to take risks in experimenting with new labor saving machine technologies.

Another reason for our preliminary success may be the participatory research approach itself. In the past, agricultural engineers have tended to view their machines as finished products needing no further modification or improvement. In contrast, FPR methodology recognizes that, no matter how "perfected" by the research and development process, all technologies evolve and are modified to suit local needs and conditions. This is perhaps even more the case for machine technologies. Although agricultural engineers originally developed the manual transplanter, our farmers became active researchers and innovators once the transplanters were brought to their own farms, where they could be experimented with under their own conditions and on their own terms. Rather than introducing the technology using the traditional, top-down, "take-it-or-leave-it" approach, we instead worked in partnership with farmers to adapt this technology to their own needs and conditions. As other researchers have noted, FPR has, prima facie, several drawbacks such as lost opportunities for agronomic data collection, numerous delays, and increased research costs. However, we believe that richer data have been gained than lost. Had the experiments been conducted as research station trials, (with four to five seasons of data required before going to farmers' fields) we would not have learned that:

(1) Farmers employed time and cost saving shortcuts,
(2) Women farmers can operate the machine effectively,
(3) Local workshops can fabricate the machine, or
(4) Even with training, farmers have significant difficulty with seedbed management.

This comes in addition to a wealth of agronomic data generated all in the first year of the experiment. We feel that the advantages of this FPR methodology more than compensate for its shortcomings. Indeed, the FPR methodology meets the challenge of higher standards of project efficiency that donors demand. Finally, this preliminary research demonstrates the potential of the manual transplanter to achieve the best of two worlds: to minimize and eliminate the negative effects of mechanization on rural women; and to offer small-scale farmers an opportunity to participate in, and benefit from, the imminent mechanization of Nepali agriculture.

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PART 3

METHODS AND TOOLS FOR MONITORING AND EVALUATION OF NATURAL RESOURCE MANAGEMENT PROJECTS

CHAPTER 7

MONITORING AND EVALUATING PARTICIPATORY RESEARCH IN COMMUNITY-BASED NATURAL RESOURCE MANAGEMENT PROJECTS

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Community-based projects on natural resource management (NRM) present special challenges for participatory research (PR) because of the complexity of social and institutional arrangements that govern local access and rights to resources, underlying power dynamics within the community, and competing and divergent local interests in how natural resources are used. In the context of NRM, PR provides a forum through which local people contest or legitimize rights to resources. Monitoring and evaluating PR processes can help make these underlying social dynamics explicit, and help researchers guide the process.

This chapter examines the challenges and proposes an approach for monitoring and evaluating PR for community-based NRM projects. It is based on work conducted during an internship at the International Development Research Centre (IDRC) for two natural resource programs: the Community-Based Natural Resource Management (CBNRM) program, which works in South East Asia, and the Alternative Approaches to Natural Resource Management in Latin America and the Caribbean (MINGA). This chapter relies on a combination of literature review, visits to projects in the Philippines, past field experience using qualitative research methods, and consultation with program officers, project researchers, and the IDRC evaluation unit. The views expressed here are the author's sole responsibility and do not necessarily represent IDRC opinions.

Participatory Research

"Participatory research" is broadly understood and includes a plethora of tools and methodological approaches. Rooted in ideological and radical social movements, which mobilized local people to challenge existing power regimes, PR has become increasingly popularized as a means of capturing local knowledge and perspectives and for involving local people in research and development activities that affect them (Freedman 1997, p 774-775; Selener 1997). The term is used to describe various types and levels of local participation, representation, and control over the research process. It includes consultative participation from which researchers make decisions about community needs and interventions, farmer-researcher partnerships in designing and implementing on-farm experiments, involving communities and user groups in decision making about new management practices or resource boundaries, multi-stakeholder processes involving different scales of resource management, and so on. Different types and levels of community participation are described elsewhere (Biggs and Farrington 1991,

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p 56-57; Pretty 1994, p 41; Selener 1997). Biggs and Farrington (1991) differentiate farmer PR as contractual (farmers lending land to researchers), consultative (researchers consult farmers and diagnose their problems), collaborative (researchers and farmers are partners in research), and collegiate (researchers encourage existing farmer experimental activities).

Participatory research may involve local people at different stages of the research process, and different interest groups within the community may be represented and participate in different capacities at these stages. The rationale for using PR may be functional or empowering. Functional participation encourages local involvement as a means of improving the effectiveness, efficiency, and usefulness of the research to local people. The goal of empowering participation is to empower marginalized people by strengthening their capacity in decision making and research (Ashby 1996, p 16-17). The rationale for PR use can also combine functional and empowering, and this may influence the tools chosen, the extent of local participation, and the level of representation of different groups. Advocates of PR as a means of local empowerment argue that gaining "power" or "ownership" over the research process is a step towards gaining power in society (Selener 1997). If "empowerment" is a goal, local institutional and individual capacities must be strengthened by involving local people throughout the research process, in identifying and defining problems, collecting and analyzing information, planning possible solutions, and mobilizing local action for change. Because PR is interpreted broadly, for evaluation purposes we need to "categorize" or "differentiate" its use in a project to gain a meaningful understanding of how a particular participatory approach contributes to the research results (Found 1997, p 117).

Participatory Research for Community-Based NRM: Searching for Adequate Stakeholder Involvement

Increasingly, interdisciplinary and PR approaches are recognized as essential to address the complex nature of NRM issues, involve local communities in the process, and promote sustainable and equitable NRM systems. Issues of NRM present special contextual challenges for PR. At the community level, natural resources are governed by complex, overlapping and sometimes conflicting social entitlements, and traditional norms (private versus common property rights, differential security of tenure and use rights, etc.). Social identities, relationships, and roles negotiated along such lines as gender, kinship, ethnicity, status, age, or occupation both shape and are shaped by access to and use of natural resources. Local level resource entitlements are often further complicated by incompatibility with regulations and management practices at higher levels of governance. To be effective for NRM, PR approaches often require collaboration between different levels of governance and the involvement of many stakeholders.

Different stakeholders (within the community and outside) have different values, perceptions, and objectives concerning NRM issues, depending on individual context (how the individual experiences the social and natural environment) and social-cultural identity. This has implications for PR. Representation and meaning of "community" and "community interests" for NRM are "produced in the context of struggles over resources, which form part of the 'practical political economy' through which different parties defend interests and advance claims" (Li 1996, p 508). Underlying power differences between these different actors shape interaction and negotiation between them (both within the community and between the community and outside groups) and this can influence whose "interests" are represented. Participatory processes can provide an opportunity for less powerful groups to contest existing power relations and resource rights. But, they equally provide a forum for more powerful or politically aware groups to further legitimatize status quo wealth and power relations or to assert preferential rights over resources in the name of "community interests" (Scoones and Thompson 1994, p 21). This is especially true for common property or open access resources, for which resource entitlements may be open to interpretation. Participatory research is essentially a political process. Power and social dynamics underlie all participatory activities, particularly group activities; and influence whose perspectives are articulated, especially when conflict exists between interests of groups of disparate power or social status.

Participatory research methods for NRM need to identify the range of stakeholders, illuminate their unique perspectives, and involve them in problem solving and decision making about NRM issues that affect them (Allen 1997, p 634). This approach is rooted in non-positivist and constructivist paradigms (Guba and Lincoln 1989, p 26-43; Pretty 1994; Scoones and Thompson 1994, p 22) that recognize:

(1) The existence, value, and legitimacy of different kinds of knowledge, particularly "popular," "local," and "indigenous" knowledge,
(2) That information and knowledge are not value free, and the selective choice of information or knowledge empowers some people and dis-empowers others, and
(3) That knowledge and information are constructed by context, that no single "explanation" or "theory" exists for a given body of facts, and that the choice of theory is dependent on values

Participatory methods combined with multi-stakeholder approaches can be applied to construct a common understanding among different stakeholders of disparate power and negotiate a common conceptual framework through which to address problems. A fundamental issue for monitoring and evaluating PR for NRM is to assess whether important stakeholders have been identified and whether or not they have participated and how.

Deciding on what is "adequate" stakeholder representation will depend on the nature of the research questions, who are the users of the resource, which stakeholders will be affected, and the nature of property entitlements for the resources being considered. Probably the participation of different interest groups is especially important for common property issues because of the risk that certain marginal groups will be excluded from access to important livelihood resources if their interests are not adequately represented in the research. Not all stakeholders, community groups, or individuals will want or need to have the same level of participation in the research, but they should at least be consulted or they may resent the research, withdraw from the process, or actively undermine it. Usually, stakeholders who need to be represented in some capacity include individuals or groups who:

(1) Can influence the project outcome because of the power they hold, their ability to influence opinion, or the useful knowledge or skills they possess (including leaders within the community, government officials, or other groups),
(2) Will be directly influenced by the research (including less powerful groups that may not be able to participate actively, but whose perspectives need to be considered), and

(3) Are willing or able to play a leadership role in NRM, social and environmental monitoring, problem solving, and conflict management.

Community-based management of natural resources requires local institutions for collective decision making, which can define and ensure local compliance to regulations for resource use. “Institutions” refer to “regularized patterns of behavior” that endure over time, based on underlying rules or social norms (Leach et al. 1997a, p 11). Institutions do not always take organizational shape, and can be formal or informal (e.g., cooperatives versus kinship or friendship networks). They include such social arrangements as marriage, economic systems, patron-client relations, labor exchange, and credit or loan systems. Institutions exist at multiple and overlapping scales (e.g., household, community, and state), and are often interdependent. They are dynamic and change over time as peoples’ behavior evolves according to social, political, or ecological changes. Combinations of institutions often shape environmental change.

Resource management draws upon multiple institutions; and local people support claims to resources or environmental goods based on different institutions that sometimes overlap. In cases where institutions for community-based NRM exist in an organizational form, relations of power and authority usually underlie these. Such organizations frequently exclude the interests of subordinate or marginal groups and act in favor of a particular representation of “community” interests. To represent the diversity of interests within a community, community organizations need to increase representation of marginal groups that may stand to lose from the process, and to encourage participation of individuals or groups with organizational skills, authority, and legitimacy in the eyes of the community.

Participatory research for community-based NRM projects often calls for building, transforming, or strengthening community organizations or institutions. This requires analyzing how local institutions relate to NRM and whether or not these are compatible with the ultimate goals of community-based NRM (whether they support local participation, democratic decision making, equity, poverty alleviation, and resource sustainability or conservation). Explicitly supporting institutions that strategically improve the access and rights of marginal groups to resources will be important to meet goals of equity and improving the conditions of marginal groups (Leach et al. 1997b). Because social institutions are dynamic and evolve according to changing social and natural influences, PR that aims to strengthen institutions demands a learning process approach, which encourages critical reflection linked with action.

Social and natural environments are constantly evolving. For local people to sustainably manage their natural resources, they must understand how their actions affect the ecosystem, and must develop skills to monitor and analyze the ecological and social results of their management decisions and be able to adapt their practices accordingly. Those PR projects involved with NRM must encourage initiation of locally based participatory management and evaluation (PM&E) processes that are accessible and relevant to local people, and encourage them to identify indicators of change and sustainability that are easily measured and sufficiently accurate.

Monitoring and evaluating the PR process can strengthen researcher understanding and awareness of the social dimensions of the community and the underlying power relations and struggles over resource rights that may affect genuine participation and “manipulate” the reality represented. It can also help researchers assess the process of institutional transformation. Information from systematic monitoring and reflection during the research can help researchers guide the process and adapt the methods to better enable articulation of marginal interests, recognize when group activities need to be disaggregated by gender or social group, and progress towards more equitable research results. This type of continual assessment of the research process is particularly important when PR attempts to represent the views of marginal groups and women that the "interests of the community" may submerge (Li 1996, p 505).

The Influence of Context on PR

Many factors influence the outcomes of using PR methods to contribute to community-based NRM that is sustainable and equitable. Some of these factors are project-related (project variables). These include research questions, project design and management, time frames, priorities and needs of the donor and research institution, human and financial resources, participatory methods used and context in which these are applied, choice of which stakeholders to involve, and the attitudes, values, and abilities of the researchers. Other variables lie outside the scope of the project (externalities or context variables) and form the immediate and larger setting in which the project is placed. Such contextual variables include the political context, natural environment, culture, social, and economic situation. Pomeroy et al. (1996) distinguish between three levels of externalities:

(1) Supra-community level (e.g., government legislation, international, regional, and local market forces, security of land rights for indigenous groups, modes of governance, and level of decentralization of decision making),
(2) Community level: intra-community power and patronage dynamics, diversity of different groups, interests in the community (e.g., ethnic, socioeconomic, occupational, and age) and relationships between these groups (e.g., gender relations, resource management institutions and norms, culture, and local land tenure), and
(3) Individual or household level (social identity based on gender, ethnicity, class, economic status or age, workload and livelihood responsibilities, access to and control over productive resources, decision-making power within the household, livelihood roles, etc.).

These variables can either constrain or enable local participation in research by affecting the ability or willingness of an individual or social group to genuinely and honestly contribute to the research process. Certain contextual variables can be addressed during the research if researchers are explicitly aware of them and monitor and assess them. The resulting information can be used to adapt and improve research design and methods by building on enabling factors or by minimizing constraints and risks.

Issues relating to researchers and field workers

Interaction between the researcher and the "participants" shapes the results of the research. Interaction between the researcher and community is defined by underlying power differences, based on such factors as formal education versus popular knowledge, urban versus rural background, differences in social and economic status, and gender roles. Researchers influence participatory processes and outcomes by their choice of questions and methods and by their attitudes, personalities, and facilitation skills (Mayoux 1995, p 245). Researchers often see themselves as experts, and may have difficulty in devolving authority over knowledge, particularly in cultures with rigid social hierarchies.

Researchers' values and understanding of community heterogeneity and social and power dynamics will influence the interpretation of "community" interests and priorities. Researchers may intentionally or unintentionally manipulate the research process and results by favoring certain perspectives (e.g., by focussing attention on more articulate individuals or organized groups). Further, researchers' academic desires for results that will bear peer review and support publications may dissuade them from allowing community members to direct the research and define their own objectives. Together, these "researcher" variables will affect the nature and outcomes of the research process, perceptions of who "owns the research", who in the community it positively or negatively influences, the sustainability of the outcomes, and so on.

Issues relating to community perception of the research

Local people's perceptions of the research process will influence their willingness to participate. Research activities may be perceived as both foreign and highly formal (Mosse 1994, p 505), especially when more powerful stakeholders are present. Local people may be reluctant to express their interests, may give "correct" or "expected" responses, or may present needs that they feel fit the agenda of the researchers. Their responses are often based on perceptions of what they can gain or lose by providing certain information, and suspicions about how the results will be used (Mosse 1994, p 504).

Past community experience with research and development projects, and perceptions of potential benefits can influence community motivation to participate in new research activities and can bias local people's responses. The increasing popularity of participatory approaches and the accessibility of tools for researchers has sometimes led to indiscriminate use of these methods. Further, isolating research from action can negatively affect local people's perception of research. Communities become suspicious if they are involved in many participatory processes with no obvious results ("participation overload" or local burnout). Why should people want to participate in exercises that do not offer them a practical benefit, even if the ultimate "goal" is in their strategic interests (Found 1997, p 118; Goyder et al. 1998, p 7)? Researchers sometimes undervalue the opportunity cost of participation for local people, especially when assuming that participation is in the people's best interests. Participation of marginal groups and women may itself add to their work burden or decrease their leisure time (Mayoux 1995, p 246; Goyder et al. 1998, p 10). The value of local participation to the research and to the local people needs to be critically assessed before a participatory approach is assumed appropriate, and before deciding on the level of local involvement in the research.

Issues relating to research questions, design, methods, and tools

Time and resource constraints imposed by the project, research institution, or funding agency can limit how effective PR is as an empowering process, and place constraints on how much local representation and involvement is feasible. Also, methodologies that encourage community participation may unintentionally overlook the interests of certain groups in the community and may construct the information and priorities presented and the decisions made (Mosse 1994). Power and social relations underlie and influence all participatory processes and their outcomes. Group participatory exercises can provide an opportunity for researchers to observe how people interact and to study power and social relations, but group exercises can also obscure social complexity and legitimize dominant views as community consensus (Goebel 1998, p 279). Bias of results may occur because certain groups do not participate or cannot articulate their perspectives because of underlying social and power dynamics in group activities. Certain groups or individuals (especially women and marginal groups) may be unable (or unwilling) to participate because of livelihood and time constraints, powerlessness, et cetera. Cultural, social, and religious norms may define who attends meetings and makes decisions and fear and shyness may inhibit participation in group activities. Willingness to participate will also be affected by disinterest in the research process or distrust of how the research results will be used (Mosse 1994; Mayoux 1995, p 246-7).

Reliance on the opinions of village leaders, key informants, or existing local organizations to determine who should participate in the research and to identify important issues can lead to a misrepresentation of local interests (Freedman 1997, p 776). Involving such groups is usually necessary, but assuming that they represent the interests of the whole community is naive. Local leaders may use the process as a political platform and may advocate in their own best interests, which may conflict with those of other groups. Also, participatory methods may be biased in favor of information that can be easily gathered by these methods or that can be visually depicted (Mosse 1994, p 517). Research results may also be misrepresented in documentation and summarization, and important minority perspectives may be lost even when special effort has been made to ensure representation of these groups.

Rationale for Monitoring and Evaluating PR

The main clients interested in monitoring and evaluating PR are donors, researchers, and sometimes the community. These different groups tend to have distinct information and evaluation requirements. Three main reasons for evaluating PR include:

(1) Project management – to systematically learn from and adapt the research approach as the project proceeds, according to what has been successful or not and to enabling and risk influences such as social and power dynamics that affect the research process and results.
(2) Conceptual learning – to identify lessons of general applicability, improve the understanding of how different PR approaches and methods influence the outcomes of NRM projects, and identify what approaches work and do not work under different conditions, and what external and methodological factors influence this.
(3) Accountability – to justify the research strategy and expenses to funding agencies through credibly illustrating the link between PR methods and project outcomes, so that researchers can be accountable to donor agencies, and for program accountability to funding bodies (government, tax payers, etc.).

Two overall goals of PR can be considered in monitoring and evaluation. The first is participation as a product, for which the act of participation itself is an objective and an indicator of success. The second is participation as a process to meet research objectives and goals

(Rocheleau and Slocum 1995, p 18-19; Cummings 1997b, p 26). For evaluation purposes, PR generates products of the following kinds.

(1) The participatory process, methods, and tools that were chosen or developed for the research. Who was involved, how, and at what stage of the project will shape its ultimate outcomes and reach. Participatory research approaches developed during the project can be considered both as an objective or output of the project and a means for meeting other project objectives.
(2) Outputs describe the concrete and tangible consequences of participatory activities. They include information and product outputs (e.g., information from participatory baseline analysis or community monitoring, and new agricultural practices or technologies developed with farmers). Outputs also include tangibles such as numbers of people trained, farmers involved in on-farm experiments, and reports or publications produced from the research. "Participation" itself can be considered an output.
(3) Outcomes describe the intermediate impacts that can be attributed, at least in part, to PR. Outcomes result both from meeting research objectives and from the research process itself. They can be negative or positive, expected or unexpected, and encompass both "functional" effects of PR (e.g., greater adoption and diffusion of new farming practices) and intangible "empowering" effects (e.g., improved community confidence or self-esteem and improved local ability to resolve conflict or solve problems).
(4) Impacts describe overall changes in the community (negative or positive) and may include overall social and development goals. Desired impacts of PR for NRM include sustainability of livelihoods and natural resources, empowerment of communities, decreased poverty, improved equity, et cetera. Assessing the impact of a PR project is extremely difficult because development impacts are influenced by many factors external to the project and are often observable only in the long-term. For evaluation purposes, considering outcomes as "intermediate" signs of impact is more realistic.
(5) Reach. The concept of reach crosscuts all PR products. Reach describes the scope of who is influenced by the research combined with who "responds" or acts because of this influence. Participatory research is assumed to influence reach by involving marginal groups and communities throughout the research process rather than treating them as passive "beneficiaries" of the research results. Participatory methods are anticipated to improve equity and appropriateness of results, the distribution of research costs and benefits, and the persistence of behavioral change at the community level.

Indicators can be defined for the different products and stages of PR. In practice, differentiating between process, output, outcome, and reach of PR can be indistinct and artificial because they are often "sequential" and "time-dependent". Therefore, it does not always make sense to differentiate between them in evaluation.

Framework for Monitoring and Evaluating PR

Evaluation of PR for NRM projects must be situated within parameters that influence the appropriateness and feasibility of different participatory approaches. These parameters determine realistic expectations from different PR projects. The parameters include the nature of the research question, the initial "capacity" of local people and researchers involved, the values and motivations for using a PR approach, and external contextual factors, which enable or constrain participation.

Research questions and goals

(1) Is the participatory approach appropriate for the research question?
What are the goals and overall objectives of the research process (functional, empowe transformative, improved farm production, improved decision making for common resources, etc.)?
(2) Is PR the best approach for meeting the research goals and objectives? Who will bene from community participation in the research? What is the **sector of the research** – fisheries, forestry, or farming?
(3) Does the research problem address resource decisions that require individual decision g and compliance, or collective decision making and compliance? What are the **dimens** f the research – economic, social, ecological, or political? What is the appropriate **scal** **scope of participation** – local, regional, or national?
(4) Who needs to be involved (what stakeholders) and are they included in the process?
(5) At what stage do these groups need to be involved?

External context

(1) What are the social, cultural, political, environmental, economic, and institutional vari that are likely to enable or constrain the different PR approaches and methods?
(2) What contextual variables will affect the research? Will they restrict the type of partic approach that is feasible? What are the risks and enabling factors at:
   (a) Community-level (power and social relations, nature of resource entitlements, cu norms, community heterogeneity, conflicting resource use, household dynamics e
   (b) Larger political and cultural context?
   (c) Research institution and donor context (project time lines, expectations for certai of research results, etc)?

Values and motivation

What are the motivating factors and underlying values for engaging in a PR approach:

(1) Of researchers and research institutions? Values and motivation include commitment to a PR approach and to allowing the community to direct the process, attitudes and values regarding local knowledge and people, and focus on empowering or functional goals of PR and culture.
(2) Of the community and subgroups, and possibly other stakeholders? Motivation includes to participate in the process, awareness of problems and the desire to address them, culture, past experience with PR or other projects, expectations of benefit, values towards collective action, values of hierarchy and respect, equity, conservation, and differing interests in negotiating access to resources or power.
(3) Of the donor institution? Values include acceptance of fluid research processes, openness to alternative forms of accountability, and time-frame flexibility.

Capacity

What existing skills and experience with PR do researchers and research organizations have? What is their past experience with participatory methods, training, skills and experience with community facilitation, understanding of social and gender dimensions of research, adaptability and flexibility, et cetera?

What is the existing capacity of the community (institutional and individual) to deal with local natural resource problems and to work collectively? What is the existing level of education and skills, level of organization, traditional forms of NRM, approaches for managing conflict and making collective decisions, history of collective action, et cetera?

The above parameters help establish realistic expectations for PR processes and results. Aspects of the research process that can be considered for evaluation within this context include:

(1) How relevant and effective are the participatory tools and methods? This includes factors such as the stage at which tools and methods are used, the adaptability and progress of the research process according to the context and according to various emerging realities and the adaptation of methods when necessary to enable representation of different perspectives.
(2) What is the scope for social transformation? How much community ownership is there of the research process? How much learning and capacity building has come from the process? What community involvement is there in identifying research priorities, in defining solutions, in action, et cetera?
(3) What is the "quality" of participation? The important stakeholders need to be identified and their level of representation, "scale" of participation, et cetera.
(4) How trustworthy and valid are the research findings? Are the researchers taking measures to ensure their validity?

Considerations in Developing an Approach for Evaluating PR

Approaches for monitoring and evaluation of PR must move beyond a post-project assessment of whether or not research objectives were met. To learn from different PR approaches we need to understand how the participatory methods used contributed to the research results. This requires evaluating the research process and methods and the intermediate and final results - that is, combining process and outcome approaches to evaluation. Ideally, monitoring and evaluation should be built into the research strategy from the beginning, and the information applied to improving the research process as the project proceeds.

Different approaches to evaluation

Evaluate for the unexpected as well as the predictable. Conventional monitoring systems often only inform on results that are expected or predictable, are related to the overall development goals of the research, or were predefined by the evaluation team. This ignores most possible outcomes (Goyder et al. 1998, p 4). Monitoring and evaluation of PR must be open to recognizing unexpected outcomes and to considering negative, unplanned indicators, and not be based only on predetermined indicators of progress.

Evaluate process and outcomes. By nature PR is experimental, and requires that the methods and objectives initially outlined in the proposal are continually redefined and adjusted iteratively in response to contextual influences and input from participants. Therefore, evaluation based on whether or not the expected activities and results initially outlined in the proposal were achieved is not the best approach. More useful is considering how well the research process was adapted to move toward meeting the ultimate outcome objectives, and how the research has progressed towards meeting this. At some point in the project, clear objectives will be set, and relevant indicators for measuring progress towards these can then be determined at that time. Objectives should be stated in such a way that the results can be measured.

Combine qualitative and quantitative approaches. The most important and interesting outcomes of PR tend to be intangible and social in nature, and are best measured qualitatively. However, many evaluations tend to focus on outcomes that are quantitatively measurable. Exclusive focus on this type of information is unlikely to provide a useful analysis of PR projects. Qualitative analysis is important for explaining why changes have occurred, while quantitative analysis is useful in establishing the relevance of changes. Quantitative and qualitative indicators can be used together to validate each other.

Recognize different perspectives. Different individuals or stakeholder groups (within and outside the community) will have different interests in the project, and will interpret and experience the research process and outcomes differently. These groups will have distinct perceptions of what the project outcomes were and which ones were most important, and may have different criteria and indicators for positive or negative changes resulting from the project. This may depend on their level of involvement in the research process, the extent to which the project has directly affected them, and their individual expectations, interests, and values.

For PR projects addressing NRM issues, it will often be necessary to understand outcome from multiple perspectives, some of which may conflict. It is therefore important to establish whose perspectives are needed in evaluation. This will depend on the nature of the NRM project and the goals of the evaluation.

The process of comprehensively understanding the outcomes of a PR project may call for involving various stakeholders in the community in negotiating the terms of reference and indicators for the monitoring or evaluation process. Understanding outcome from the perspective of different groups requires an open-ended, qualitative approach that does not limit evaluation to pre-defined indicators.

Consider the outcome at different scales. Outputs of PR can be considered for:

(1) Different scales of stakeholders in the research process,
(2) Researchers and research institutions (improved research capacity, better understanding of participatory processes),
(3) Community and groups within the community (more equitable decision-making processes, improved management structures for NRM, improved livelihoods, etc.), and
(4) Policy makers (changed attitudes and behaviors, increased openness to community involvement in decision making).

Use locally appropriate indicators. Comparing the effectiveness of different PR approaches by comparing across projects is sometimes useful from a program perspective. However, defining standardized indicators for comparison across projects is difficult because standard indicators often have little meaning in the local context or measure different changes than intended. A better approach is deciding on broader questions for which locally defined indicators and locally relevant criteria might provide information.

Consider logical sequences rather than try to prove causality. Research design inherently assumes that PR activities, outputs, and outcomes are causally linked. However, validating a causal relationship between these is impossible because of the many contextual influences. A central challenge for evaluation is to determine which changes in the project site were caused by factors outside of the project's control and which can be attributed to the project. Also, what the effects of the research were on the area outside of the project site or on non-participants (the "reach" of the results).

Attempts at establishing causality have used "quasi-experimental" evaluation designs for comparing research versus non-research situations, using a community similar to the research site as a control group (Pomeroy et al. 1996; Olsen et al. 1997). Although imperfect, this approach may be acceptable when assessing biological or physical changes. However, involving a "control" community in time-consuming activities to evaluate social changes is ethically questionable when no mandate considers that community's interests. Further, this approach places significant demands on human and financial resources. An alternative approach, which uses "non-participants" or "non-beneficiaries" in the research site as a control group, ignores the fundamental evaluation question of "why" these people did not participate, and whether or not the research had an influence on non-participants. A more feasible and appropriate approach to "quasi-experimental" evaluation is to establish credible relationships between the participatory activities, outputs, and outcomes, through monitoring and evaluating the process and defining simple indicators to measure progress.

Methods to monitor and evaluate PR

"Process evaluation." This approach assesses the process of reaching the final results (how something happens) rather than basing evaluation on whether defined objectives were reached (Patton 1990, p 94). It also encourages the monitoring of intermediate indicators of progress, and therefore can serve to guide the research in process and to facilitate an understanding of the linkage between research process and results. Evaluating the process encourages assessing the research on criteria such as:

(1) How well the researchers were able to adapt the research approach and goals to the context,
(2) Whether the community participated and had a role in shaping the process and design of the research, and
(3) Whether a positive move was made towards desired outcomes.

This moves beyond assessing the attainment of predefined objectives, which ignores the evaluation questions that are the most illuminating for PR projects.

"PM&E" or "self-evaluation." This approach encourages using evaluation as a learning tool and allows perspectives of different stakeholders in the community to be articulated. It also provides information to feed into the research process, enabling researchers in partnership with the community to renegotiate and adapt goals and methods during the project according to emerging issues (see also under ***In-project phase***).

"Responsive and naturalistic evaluation." This method encourages the collection of qualitative responses from different stakeholders, community groups, and individuals who have been influenced by the project influenced. This "constructivist" approach to evaluation recognizes that "truth" and "fact" are subjective and allows different perspectives to emerge and conflicting interests to be articulated (Marsden et al. 1994, p 31; Dugan 1996; Fetterman 1996). The constructions and interactions of the evaluation's stakeholders set its boundaries (Guba and Lincoln 1989, p 42).

Logical framework analysis (LFA). A simple form of LFA can provide a matrix for making explicit assumed causal relations between PR activities, outputs, and impact goals (Cummings 1997a, p 588-590; Olsen et al. 1997, p 6). This can be used both as a project planning tool and as the basis for a preliminary evaluation plan, outlining relevant questions, indicators, and methods for measuring degrees of progress, and designating who will undertake the monitoring activities. Researchers can tentatively develop the LFAs during preparation of the project proposal, and adapt and fine-tune them with monitoring information as the project progresses.

Although LFA matrices provide a useful framework within which evaluation and project management approaches can be developed, these require specific objectives and strategies to be defined at the beginning of the project when the least is known, and often without input from the community. This creates the risk that log frames become a "straitjacket" and an impediment to adaptive learning, which is necessary for effective PR (Olsen at al. 1997, p 10). Logical framework analysis is best used as a planning tool to guide research design being adjusted as the research progresses, rather than as a strict framework for which PR projects are accountable.

Monitoring and Evaluation within the Project Cycle

Participatory research can be monitored and evaluated at different stages of the project cycle (pre-project, in-project, and post-project), and different stakeholders may be involved at each stage (Figure 1).

Pre-project phase (proposal development stage)

Donor agencies can assess the PR approach at the stage of proposal development. The appropriateness and feasibility of the proposed methodology can be roughly anticipated by examining the context (environmental, social, and political), existing capacity of the researchers and research institution, and the goals of the project.

Main factors for donors to consider when assessing PR proposals are listed below.

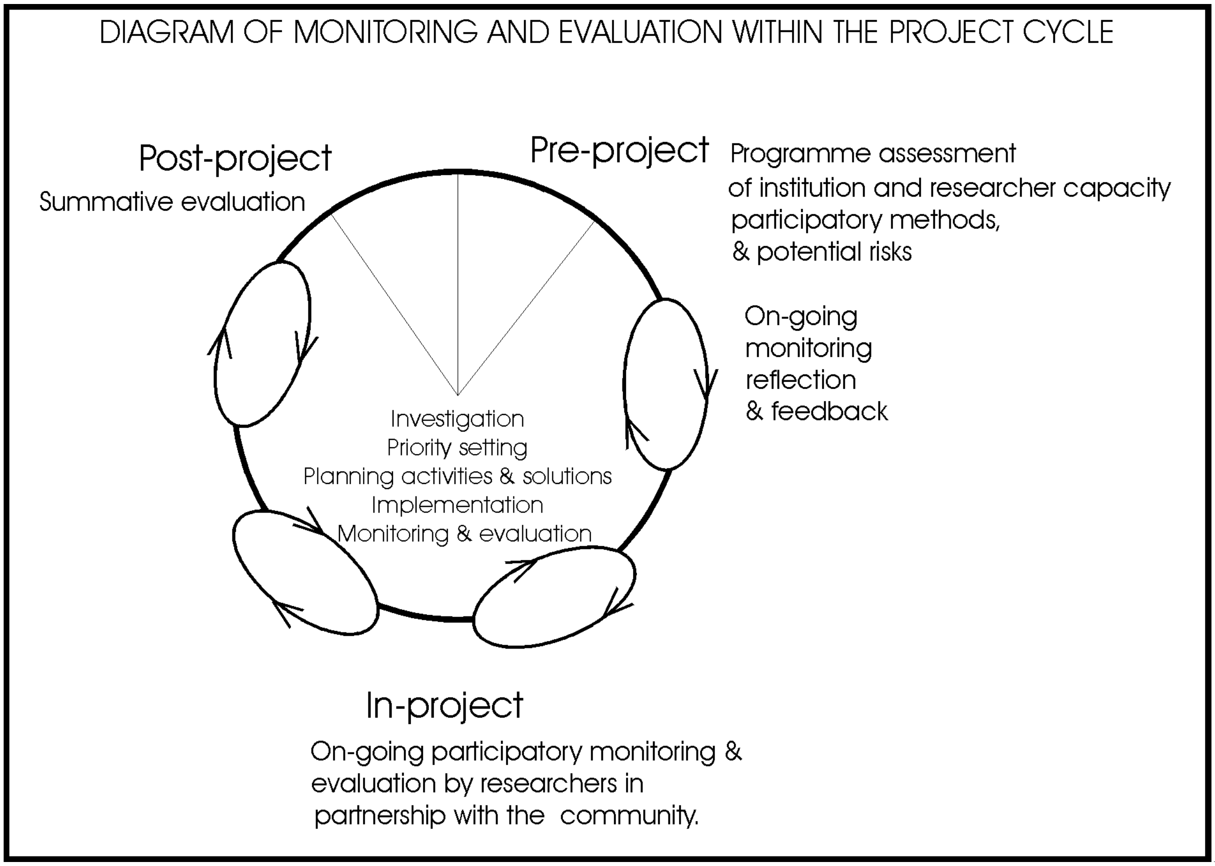

Figure 1. Monitoring and evaluating within the project cycle.

Capacity and motivation of researchers and research institutions. Assessing the existing capacity and experience of the research team and institution for undertaking PR, and their motivation for using a participatory approach, is important to establish training needs and to judge the feasibility of the research strategy presented in the proposal. Questions that can be considered include:

(1) What past experience have the researchers and institutions had with PR projects?
(2) Does the research team include a qualitative social scientist (anthropologist, rural sociologist, etc.)? Does the research team include female researchers?
(3) Have the researchers had training or experience with social or gender analysis, PR tools, evaluation, group facilitation, et cetera? What type of training and experience do they have?
(4) Does the structure and management of the research institution accept participatory approaches?
(5) Is the PR approach outlined in the proposal realistic for the research team to apply effectively, given their capacity and experience and the support of the research institution?

The appropriateness and quality of the PR process and methods. The appropriateness and feasibility of the proposed methodology can be assessed for its relevance to the stated research objectives and the likelihood that key stakeholders or community groups will be identified and their perspectives addressed. Methodological questions that can be considered at the project development stage include:

(1) How do the researchers understand "community," "gender," and "participation" in the project proposal? Does evidence exist that researchers understand the multitude of different interests and possible conflicts that may arise from the research, or is community cohesiveness assumed? Is this understanding evident in the design of the methodology, or only through the use of the "appropriate" terminology?
(2) What is the value of a participatory approach for the research, and is this the best approach? How will the research, and importantly the community or stakeholders, benefit from participation? Are PR activities obviously related and connected with other parts of the research strategy? What types, level, and scales of participation will be most effective or feasible to address the research questions, and does the research methodology support these? Is the proposed methodology "tool-driven" or flexible to focus on reaching project goals?
(3) Is there an attempt to identify the stakeholders or resource user groups who are likely to be influenced by the project? Which stakeholders or community groups need to be involved, and are these included in the research process? How has this been decided? What scale(s) of stakeholders need to be involved for the project to have the desired outcome?
(4) Is the process intended to strengthen local institutional and individual capacity and decision-making ability? If so, does the methodology encourage devolving control of the research process to the community?
(5) As part of the baseline analysis, is the micro-political context to be assessed? Are local institutions to be analyzed (for equity in decision-making and representativeness of different interests)? Are social, power, and gender relations in the local community to be analyzed? How are these relations likely to influence the research methods? Does the methodology outline how the researchers will deal with this (e.g., through disaggregation of methods)? If stakeholders of different scales (community representatives, government, etc.) are to be involved, how will power differences be handled?
(6) Does the project strategy include a mechanism for feedback of information from participation? Is the methodology flexible to adapt methods if they prove ineffective in allowing representation and participation of certain groups, or according to intermediate results? Does a systematic process for communication exist between different researchers, local participants, et cetera to share and reflect on research results and plan research direction (e.g., regular meetings)?

The social, political, and environmental context and associated risks. Although PR can result in significant benefits for local people and marginalized groups, risks associated with the approach are inherent. Two types of risks can be considered: that the research will fail to meet its goals; and that the research, in meeting the objectives or through the research process, will unintentionally cause harm to the community or to specific groups within it.

The potential enabling factors and social risks of PR, or from involving or not involving specific stakeholder groups, can be anticipated before the project begins and can be ranked (high, low, likely, unlikely, on a comparative scale between 1-5, etc.) (Sawadogo and Dunlop 1997, p 601). Recognizing and tracking such factors and risks will also help establish what changes can be attributed to the research and what is beyond the scope of project influence, and helps anticipate the relative importance of representation of different groups and disaggregation of research methods. The costs, skill, and time required for having greater social differentiation and representation in the research process must be balanced against the livelihood risks to certain groups if not adequately represented.

Questions that can be considered for preproposal risk assessment can be outlined as:

(1) Does a risk exist that not involving certain stakeholders will provoke them to obstruct the research process?
(2) Do local participants run security and livelihood risks if they become involved in an empowering process of which the ruling group may not approve (because of national politics and governance, community leadership, local patronage relations that place certain groups in subordinate positions, etc.)? How will the project handle this?
(3) Do researchers or project staff run political or security risks if the participatory process is perceived as a threat to the political or local establishment?
(4) Does the research approach have potential to further disempower certain groups in the process of enhancing the resource rights and livelihood security of the "community"? This consideration is especially important if the project deals with common property resources, and when uses, needs, and interests are conflicting. "Who stands to benefit from the approach and how, and who may be further disadvantaged? Who is enabled or constrained? Whose economic circumstances or security of tenure is at stake" (Li 1996, p 505).
(5) What are the potential risks to the community resulting from inexperienced researchers using PR methods inappropriately? Some examples of such risk could include:
   (a) Exacerbating or initiating conflict in the community by making power relations explicit or by unintentionally directing benefits of the research to specific individuals or social groups,
   (b) Further marginalizing certain social groups by not understanding how the research and participatory process might affect them negatively or by not recognizing them as important stakeholders to include in the process, and
   (c) Inadvertently aiding elite members of the community in increasing their power, access, and rights over resources by further legitimizing their claims through "participatory" activities such as boundary and resource mapping or tree-planting, which may effectively lead to land privatization.
(6) How will the research strategy deal with creating community expectations for concrete development interventions that are likely to arise from local participation in the research? When PR is not linked with concrete interventions, even if researchers are transparent with the limitations of their work, community groups may still anticipate practical benefits. A mechanism must be available within the research strategy to meet certain practical needs early in the process.

In-project phase

During the project, "on-going" and formative monitoring and evaluation can be integrated into the research strategy as part of an iterative and reflective process. Information from systematic monitoring of the process, methods, and intermediate results (outputs and outcomes) can be fed into the research to influence its direction and design. This "adaptive management" approach enables researchers to track research progress by detecting incremental signs of outcome and impact. It also helps them assess which groups are participating and being influenced by the research, and identify and confront undesirable results or constraining factors (Robinson et al. 1997, p 806; Margoluis and Sagafsky 1998).

The PM&E approach involves local people in monitoring and evaluating changes, which directly affect them in the natural and social environment. Local people informally assess changes in their environment and monitor and analyze benefits from changing farming practices, exploring new livelihood options and so on as part of their daily lives. Outsiders usually initiate formal PM&E processes to capture a community perspective of the progress or impacts of a research or development project. Like other PR approaches, PM&E is used broadly to describe different levels of community participation and control over the process. Participation in evaluation spans a gradient from complete community-controlled monitoring of environmental change, to researchers consulting communities on impacts of interventions, to the "participation" of field workers and researchers in evaluation (as opposed to external evaluations by funding agencies), with little focus on community involvement (Rugh 1986; Davis-Case 1990; Marsden et al. 1994; Woodhill and Robins 1998).

For PR, coupling an adaptive management approach with PM&E methods is appropriate to capture community perspectives on research results and to involve the community in directing research design. In the context of a research project, PM&E methods can be used:

(1) As a research tool (e.g., farmers monitoring changes from their own experimentation and sharing the data with researchers),
(2) For project management (e.g., for researchers to track the process and intermediate results and adapt research design accordingly, or for learning and organizational change), and
(3) For facilitating local empowerment and strengthening community capacity to sustainably manage natural resources by helping local people develop systematic methods for tracking the results of their management decisions and activities (Guijt et al. 1998, p 28).

The results of PM&E can complement external evaluations. However, involving local people in monitoring and evaluation can be a time- and resource-consuming process. Further, the process does not necessarily benefit them directly nor contribute to empowerment, and has an opportunity cost in terms of local people's time, which should not be undervalued (Goyder et al. 1998, p 6). The benefits and drawbacks of encouraging PM&E in a research project are outlined below.

Potential benefits.

(1) Researchers and communities benefit directly from the lessons of the evaluation, unlike external evaluations from which the learning tends to be retained with the institution sponsoring the evaluation, and in which the information needs are often different from those of the project researchers and community.
(2) Information from regular monitoring and evaluation is defined by the community's and researchers' needs and used to help direct the project or, if defined by the community for its own purposes, to track environmental and social change and help in decision making.

(3) Researchers and the community have "ownership" over the results, and are more likely to internalize the lessons learned than if an external evaluator were to present them.
(4) PM&E integrated into project research strategy will help strengthen the capacity of researchers and communities in evaluation, and in conducting PR; and
(5) Monitoring and assessing the PR process should encourage researchers to be more reflective about the research strategy and methods. Hopefully it will make researchers more alert as to how these methods enable or do not enable representation of different stakeholders, and to the social dynamics and relations of power that influence the outcomes of these processes.

Potential drawbacks.
(1) PM&E can require significant time commitment both on the part of the researchers and the community.
(2) Programs may question the objectivity of the results of participatory evaluations conducted by researchers, and may challenge their validity for accountability purposes.
(3) By devolving the responsibility of evaluation to researchers and the community, the information gathered risks not meeting the information needs or level of accuracy required by the program or other users (policy makers, etc).
(4) The results of participatory evaluation may not be credible or not meet the needs of governments and policy makers who may also be interested in the outcomes of the research.
(5) Indicators and questions from PM&E will differ between projects if they are defined in a participatory way, which may make it difficult to compare outputs and outcomes of different participatory approaches between projects.

In addition to ongoing PM&E facilitated by researchers, external evaluations during the project provide important outside feedback on how the research can be improved. This may also involve PM&E methods to gain community and special group perspectives. Participatory evaluation exercises facilitated by an external evaluator in ongoing projects can combine "external" evaluation with training of researchers in evaluation tools and PM&E, and can act as an entry point for encouraging more systematic monitoring in the research.

Post-project evaluation

External, post-project evaluations are useful to establish conceptual and practical lessons from different case studies of projects that have used PR approaches. Post-project reflection on what methods worked well or less well in different situations provides important insights for future research design. It may sometimes be useful to evaluate a project that has already been finished for several years (3-5 years later). This can provide knowledge about the longer-term results of the research, such as the persistence of resource-use changes initiated by the project, the sustainability of new resource management institutions, or the continued use and adaptation of farming practices developed in the project. Evaluation several years after project activities have ended may be particularly beneficial for participatory NRM projects because of the lengthy time period for certain benefits to be observable. At the same time, it becomes increasingly difficult to attribute such outcomes to the research as time passes.

Monitoring and Evaluating Participatory Processes and Methods

Monitoring and evaluating methods and processes during the research is important to:

(1) Encourage critical observation and analysis of participatory tools and methods, including analysis of who is participating and how. This will contribute to our understanding of the relationship between participatory methods and representation of different interest groups with the ultimate outcomes and reach of the research.
(2) Encourage observation of signs of intermediate outcome and reach, and improve understanding of the process of generating outcomes such as capacity building.
(3) Provide systematic information for improving project performance and strategy.
(4) Strengthen the competency of the researchers using participatory methods by:
    (a) Increasing their critical understanding of the limitations and benefits of the tools and methods,
    (b) Nurturing explicit observation and awareness of the power and social relations that underlie participatory processes and influence whose perspectives are presented, and
    (c) Improving awareness of how the participatory methods and context in which they are used construct the resulting information and actions.

Monitoring the participatory process and methods during the research should decrease the chance that the research becomes tool-driven and encourage critical understanding of the usefulness of the tools for meeting different research objectives. This will improve researchers' ability to choose and adapt appropriate PR methods, encourage special groups in the community to participate and adapt to or take advantage of enabling or constraining influences. It also helps make more explicit the results-chain that participatory methods and activities set in motion.

The main process issues that need to be monitored and evaluated include:

(1) How appropriate the participatory approach is to the goals of the research,
(2) The "quality" of participation,
(3) How well the researchers were able to apply and adapt the methods,
(4) How trustworthy are the research process and results, and
(5) How effective the methods and tools are for enabling participation, representation, community capacity building and ownership of the process, and for progressing towards the desired research results.

Another aspect of the process that may be important to monitor is the "empowering" or "transformative" potential.

Appropriateness of the participatory approach

The appropriateness of the PR approach to the context and goals of the research is associated with the ethics of the approach (Who will the research benefit and how? What are the local expectations from the research and are these realistic? How are researchers dealing with the issue of raised expectations?), the motivation for local participation, and the flexibility of the approach to be adapted to the local context and respond to community input. Guiding questions to assess this in monitoring and evaluation include those following.

Transparency of the research process. Have the researchers clearly explained the limitations and scope of the PR activities to the local people? Are locals aware of these limitations or do they have unrealistic expectations? Are they aware of and understand the overall goals of the research?

Motivation for participation. Are local people participating? In what way (consultative, active in experimentation or in defining research priorities, etc.) are they participating? Why are people motivated to participate? Is participation voluntary or compliant? Is participation based on getting people to do what the researchers want, or genuinely focussed on establishing local needs and priorities? Do local people perceive that they are benefiting from their participation in the research? How is the research process benefiting from community participation?

Relevance of the methods and approaches to the local context. Is the participatory methodology "tool" driven or focussed on answering research questions and meeting overall project goals? Are the methods and tools effective for encouraging participation and representation, for strengthening local capacity, for enabling community-ownership of the process, for progressing towards the objectives and goals of research? Are field workers making use of existing information sources such as field notes and informal observations rather than relying on participatory tools to gather information that is already documented elsewhere?

Adaptability of the research approach. Is there a process for feedback of information to the research design from participatory processes? Is there a systematic mechanism for occasional interaction between researchers and locals to reflect on the research process and intermediate results? Are the "results" from community participation informing the research design? Are the research goals and methods being redefined and adapted as the research proceeds?

Ability and attitudes of researchers

The researchers' abilities and attitudes are likely to evolve and change over the course of the project because of increasing experience working with local people. Using PR methods is expected to increase researchers' respect of local knowledge.

Researchers' attitudes. Do the researchers respect and use local knowledge? Have the researchers' attitudes to local participation and respect for local knowledge changed since the start of the project? Do they seek local views to include in the research and to inform the research process? Are they seeking input from marginal groups, such as from women?

Abilities of the researchers to adapt the process. Are the researchers modifying the process and methods to meet research needs and in response to community input, or are they following the exact methodologies presented in PR tools manuals? Are researchers analyzing social and gender relations underlying participatory methods, and modifying them accordingly?

Representation, stakeholder involvement, and the effectiveness of participatory methods and tools

Researchers can monitor and document representative and "genuine" participation of different community groups. Indicators of representation must be more revealing than quantitative information such as "how many people" or "who" attends meetings, although these are also important. Monitoring should also record selective and relevant qualitative information such as:

(1) Who speaks? Does one person or group dominate discussions and what is their social status? Do women participate actively in discussion?
(2) Descriptions of the social dynamics of the event, especially conflicts or major arguments, and
(3) Descriptions of how decisions are made, whose views are most valued or listened to, how conflicts are managed and whose interests have been served. Whose views hold more weight? What position do they hold in the village? (Goebel 1998, p 284).

Group participatory events provide researchers with an opportunity to observe and critically assess social and gender interactions between individuals and groups, and so provide information on the nature of social and power dynamics in the community (Goebel 1998, p 284).

Although the importance of segregating different interest groups in PR is becoming increasingly accepted, social and power relations may be based on many aspects – clan, wealth, age, gender, knowledge, occupation, witchcraft, et cetera. Researchers may not always know enough about the community to know these different interests, how people divide differently around different issues, and what form local power relations take. A method for establishing the basis of difference in the community without predefining criteria and groups is presented below. Also, critical analysis of group exercises will help identify different power and interest groups, and provide researchers with important insight about when such groups should be segregated.

Branching tree method for assessing group differentiation in the research process

A method for assessing the extent to which researchers have identified different stakeholder groups and encouraged their participation and representation in different research activities uses a pictorial "branching tree" analogy. The "tree" is the research activity or question, the "tree branches" are the stakeholders and groups of people identified and involved, and the "sub-branches" are subsequent divisions (ethnic groups, gender, etc.) or "subsets" of these groups (e.g., women with and without land) (Goyder et al. 1998, p 8).

Semi-structured interviews can be held with different groups or individuals (including locals who have a stake in the research, but who are NOT participating or who have stopped participating). These can provide important perspectives on why people choose to participate or not, and whether or not they feel adequately represented in the research process. World Neighbors has used participatory ranking methods with local people to score the level of participation of different social groups in each research activity and when different research tools are used (Bandre 1998, p 47).

In addition to the researchers' field observations, local participants can evaluate the effectiveness of different research methods. Local people can provide important feedback about which tools they find understandable, with which they feel comfortable expressing their perspectives, and so on. Participatory methods such as preference ranking can encourage local input on preferred tools, and can provide important insights for adapting these methods to make them more effective or for use in other areas. Such assessment can be disaggregated by social group to consider different perspectives (Goyder et al. 1998, p 18). Guiding questions for assessing the "quality" of participation and representation include those below.

Stakeholder identification, power, and social analysis. Have important stakeholders and community "interest" groups been identified? How were they identified? Were they "pre-defined" or did the groupings emerge from the research process? Has an effort been made to understand and deal with power and social dynamics and assess how these affect relationships between different stakeholders or groups? Has an attempt been made to understand the link between livelihood activity, resource use and entitlement, and the social relationships between different community groups and stakeholders, and to understand how this influences their interests in the research?

Level of representation and disaggregation appropriate for the research. Have different interest groups at least been consulted? Are those who wish to take part able to do so? Are important views being articulated (including those of marginal groups and women, where necessary)? Are the methods being disaggregated when necessary to ensure that all groups affected by the research (including less powerful people) are able to express their perspectives? When appropriate, are perspectives of different stakeholders differentiated in decision making, in conflict management, in needs assessment and planning, et cetera?

Scale of participation and representation appropriate to the research. Is the "scale" of participation appropriate to the research question and the resource management issues being addressed? Do relevant stakeholders (NGOs, companies, government, community, etc.) participate at different levels of governance when this is appropriate? Are all stakeholders who use the resource represented in some way in the participatory process? (At least consulted?) Does a process exist for managing conflicting interests between different scales of stakeholders in such a way that negotiation is not biased in favor of the interests of more powerful groups?

Scope of the PR process for social transformation, empowerment, and persistence of social change

Participatory research is thought to catalyze social change by increasing local awareness of problems and issues, mobilizing local people to develop their own options and plans for dealing with problems, and strengthening local capacity to act on these plans. The short-term goal of mobilizing local people to solve immediate practical problems is intended to lead to longer term shifts in power relations in favor of less powerful groups (Selener 1997). In most NRM projects that use participatory methods, social transformation, in the form of improving local capacity and institutional norms for managing and using resources productively and sustainably, is an important research goal. When considering the "transformative" potential of the research we must also consider how the research has contributed to shifting power dynamics within the community, and between the community and outside groups.

Theories of social change and local empowerment highlight certain stages and criteria that are considered essential for this process to occur. Empowerment must be clearly defined if progress towards this is to be assessed and if indicators of empowerment are to be developed. Indicators of empowerment encompass personal and socioeconomic and political changes, and can be established for groups or communities or at the level of the individual. Processes of PR can be evaluated on whether or not they meet the criteria thought to be important for encouraging social change and contributing to local empowerment. These criteria include the points below.

Strengthening local awareness of issues and options. Has the research process increased local awareness of issues? Have the research process and methods mobilized or facilitated local people to develop local options for improving their situation? Are local people better able to make informed decisions about NRM?

Local people participating in decision making, planning, and "action" to address problems. Is the participatory process facilitating local involvement in decision making and action to address problems? Does an improvement show in their ability to make collective decisions and to "equitably" resolve conflicts between different groups in the community? Do local people have increased ability to act collectively in community interests? Do they have increased understanding of the different needs in the community?

Perceptions of "ownership" of the process. What is the local perception of who the research is for and of its purpose? Who controls the research questions and agenda? To what extent do the researchers (or the community) define the issues and questions? Are local people involved in identifying and defining research priorities and plans, in data collection and analysis, in defining solutions and action plans, in monitoring the results of their activities or experiments and defining their own indicators and criteria for success?

Strengthening existing individual and organizational capacities. Has the research identified and made explicit the existing individual and community-level capacities (e.g., existing resource management institutions, decision-making and negotiation processes, and conflict management skills)? Is the research process strengthening these individual or group capacities and organizational skills? Is it contributing to individual and community awareness of local problems and strengthening their ability to deal with them effectively? Is it strengthening community capacity and motivation to continue activities such as resource management, or is community motivation dependent on mobilization by the researchers?

Creating linkages between stakeholder groups. Have the researchers identified existing linkages (e.g., between local government and community) and areas where linkages need to be made to effectively address the research problem? If appropriate to the research question, have the researchers been able to encourage participation of stakeholders at different levels of governance and create linkages between these stakeholders? Have fora or networks been established for negotiation or information sharing between these different groups, or between groups of similar interests (e.g., farmers)?

Empowerment and social transformation. Has the process changed local people? Do they have an increased awareness of their own situations? Do they have an increased awareness and appreciation of the realities and interests of other groups or stakeholders? To what extent did the investigation prompt action?

Trustworthiness and validity of research findings

Participatory research has been criticized for lack of rigor and accuracy, for being subjective, and for bias in favor of specific local groups or individuals (Pretty 1995, p 178). Researchers are sometimes called upon to justify the approach and establish credibility of the results. Can we be confident about the "truth" of the findings? Can we apply these findings to other contexts or other groups of people? Are the findings reliable (would the results be the same if the research were repeated)? How can we be certain that the biases, motivations, and perspectives of the investigators did not construct the results (Pretty 1995, p 178)? Reliability of the research is implied if certain measures were included in the research process, and this can be considered when evaluating PR. Indicators of reliability include:

(1) Lengthy or intense contact between the researchers and local people to build trust and better understand the research context and local social dynamics and institutions,
(2) Triangulation of process and results by using different methods for the same data, or by having different researchers involved in collecting the same information,
(3) Cross-checking the results of PR with local participants to ensure validity, and involving local people in analysis of results to ensure that the views represented are really theirs,
(4) Peer or external review of results and research process,
(5) Reports that include contextual descriptions and quotations from local people to capture the complex social reality and include multiple local perspectives and experiences, and
(6) Documentation of the research process and keeping of daily diaries reflecting on it.

Monitoring and Evaluating Outputs, Outcomes, and Reach

Many outcomes of PR for NRM are diffuse and long-term, and notoriously difficult to measure and attribute to a particular research project or activity. However, certain outputs and outcomes commonly evolve from such projects. To consider the contribution of the participatory approach to these outcomes, considering their "intangible qualities" in addition to their existence is most interesting (e.g., for community organizations developed as an output, to consider qualitative features such as how representative they are, how decisions are made, etc.). Evaluation of the "nature" of these outcomes rather than their "existence" alone requires a qualitative approach such as semi-structured interviews on key issues with various groups in the community. Further, because different individuals and community groups will have different perceptions of what the outcomes of the research were and which were important, multiple perspectives must often be obtained.

A method for disaggregating impact and output

Methods of PRA such as social mapping and well-being ranking exercises can be used to identify stakeholders and understand differences in well being as part of baseline analysis. Ranking of well being can help identify the marginal groups in the community and establish local criteria for what makes them vulnerable. Disaggregated baseline analysis or semi-structured interviews targeted at different social groups at intervals during the project can help determine differentiated impact as the project proceeds.

Possible tangible outcomes

Baseline information on community situation. These should include:

(1) Livelihood analysis: investigation of community differentiation, how these different groups interact with the environment through livelihood roles or access to resources, and capabilities of different groups,
(2) Ecosystem analysis: assessment of the dynamics of ecosystem transformation, microenvironments and how human action is contributing to environmental change, and
(3) Institutional analysis: assessment of formal and informal behaviors and institutions that govern human interaction with the ecosystem and with each other.

Questions that may illustrate qualities of these outputs that will reflect on the participatory process include:

(a) Whose knowledge and perspectives have been documented?
(b) What was the research context in which the knowledge was generated? (Were groups disaggregated when there were conflicting interests or power differences? Was this information collected from a variety of stakeholders or community groups?)

Community identification, prioritization, and analysis of problems and plans for addressing these. Who in the community was involved? What was the research context in which the knowledge was generated? How were issues prioritized and plans made? Whose perspectives do they represent and how was this negotiated? How were conflicting interests managed?

New technologies or production systems developed in partnership with local people and researchers. These include agroforestry, soil conservation, farming systems, et cetera. Are these based on priorities identified by local people and were local people involved in the development or experimentation process? Have local people adapted the experimental approach in other aspects of their livelihood (evidence of improved capacity)? Have others, who did not participate in the study, taken up the innovation (evidence of reach)? Have people been teaching each other?

Community-level institutions or organizations adapted or created. Were existing local institutions and organizations identified and assessed for whose interests they represent, for compatibility with sustainable resource use, or for democracy in decision making? Did the researchers build upon institutions that strengthen the strategic interests of subordinate people? Who is actively involved in the relevant organizations and how did they participate in the research? Is there an active leadership? Whose interests do the organization or leaders represent? Are the interests of less powerful groups represented? Are the organizations and leaders accountable to the community and do they represent important stakeholders? Are they legitimate in the community's eyes? What is the motivation for involvement? How are conflicts resolved and decisions made?

Community-based management systems. Are local people able to systematically monitor the ecological results of their activities and adapt those that are not sustainable? Can they enforce sustainable practices? Have they the authority to ensure compliance? Is representation equitable? Is there an effective forum or mechanism for conflict resolution concerning use of common resources? Are methods for decision making improved or more representative of various interests? Are less powerful voices included in decisions? Is there strength in the leadership? Is there a system of accountability, and to whom is the system accountable?

Possible transformative outcomes

Capacity building at the community level. Is there increased awareness of issues and problems? Are local people better able to make informed decisions about NRM? Are they able to formally monitor environmental and social change (have they been trained in PM&E methods)? Is there an improvement in their ability to make collective decisions and to "equitably" resolve conflicts between different groups in the community? Do they have an increased understanding of different needs in the community? Do they have the institutional and individual capacity to effectively adapt their management processes for farm or common resources according to changing external and internal pressures? Have their organizations been strengthened? Are local people better able to act collectively in community interests and to access external support for community needs?

Outcomes at scale of researchers and research institutions

Capacity building at the researcher level. Are researchers more conscious of social relations and how these affect the research? Are they better able to adapt participatory tools and approaches to fit the context and the information needs of the research and the people? Are they better able to facilitate participatory processes to enable different perspectives to be articulated?

Conclusions

The many contextual variables, which influence PR processes, make monitoring and evaluating PR multi-dimensional and complex. The diversity of NRM research projects that apply PR methods, and the differences in understanding of what "participation" in research implies, makes it difficult to compare successes and failures between projects or to generalize about successful PR approaches. Further, because the different groups involved in PR projects have different indicators and criteria for project success, it is important to understand whose perspectives are needed to inform on specific issues or outcomes, and to seek these views in evaluation.

Evaluation approaches for PR need to assess the research process and project outcomes. They must be flexible to encourage awareness of unanticipated changes and understanding of different perspectives of results, should be locally relevant, and must consider negative, unplanned indicators. A useful way to monitor and evaluate PR is to integrate this into the project cycle from the project design stage. Ideally, such an approach will benefit the donors, the community, and researchers by improving overall research outcomes and generating better understanding of the applicability and benefits of different participatory approaches in different contexts. Because PR approaches cannot be standardized between projects and need to be adaptable and responsive to the local context, evaluation of the research process is essential for evaluating PR. Further, this approach will systematize researcher learning from monitoring the methods and intermediate outcomes, helping them to improve research strategy, ensure representation of important stakeholders, incorporate community perspectives into the research, and improve progress towards desired research goals.

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CHAPTER 8

PARTICIPATORY MONITORING AND EVALUATION OF A LOCAL DEVELOPMENT PROGRAM: THE CASE OF AS-PTA/PARAÍBA

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Introduction

In 1993, the Assessoría e Serviços a Projetos em Agricultura Alternativa (AS-PTA), a Brazilian nongovernment organization (NGO), began a new activity, the Paraíba Project, involving two organizations of rural workers and several communities in northeastern Brazil. In 1996, a systematic effort was made to implement the monitoring and evaluation of the impact of this process of participatory innovation. For this purpose, a research project was set up in partnership with the International Institute for Environment and Development IIED and Centro de Tecnologias Alternativas de Zona de Mata (CTA-ZM). This project received financial support from the Department for International Development (DFID).

The AS-PTA works in the Agreste, an arid region of Paraíba (considered the poorest state in Brazil) characterized by vast environmental variation, with diverse natural flora and widely varying agricultural systems. Despite this context of great diversity, almost all small-scale farmers have the same basic problems: intense pressure on the natural resources (particularly soil, vegetation, and genetic diversity), and an accentuated decline in agricultural income with the successive disappearance of various cash crops. This last is clearly the first priority of the local farmers.

The Paraíba Project was created to address these problems. It is a local agricultural development program, led by AS-PTA, in the municipalities of Solânea and Remígio and more recently Lagoa Seca. A technical team of six professionals with differing training and experience carries out activities. They work with rural animators who are active members of the Sindicatos de Trabalhadores Rurais (STRs) designated for this task. These STR members dedicate much of their time to sustainable agricultural activities, organizing meetings and exchange visits, visiting farmer-experimenters, training members of the seed banks, et cetera. For this work they receive a small salary from the STR with the help of funds from the Paraíba Project. The STRs are the principal partners of AS-PTA in the project and are indispensable for the sustainability of the work. As the process of agricultural experimentation evolves, they contribute to the discussion of innovations and the diffusion activities. The community associations and groups of farmer-experimenters (organized around subject interest groups) are also actively involved in the Paraíba Project's activities. Those who fund these activities are also important participants.

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Currently the project's main priority is to improve production systems, with the prospect of working with aspects of commercialization and postharvest processing. The work focuses on generating and diffusing innovations for family farms. Innovations include developing technical proposals (e.g., new consortia or techniques for soil preparation) and social innovations (e.g., community seed banks). Institution-building activities for the local organizations and establishing linkages with other actors (e.g., civil society organizations, other NGOs, and government institutions) are also promoted.

Participation and Monitoring in the Paraíba Project

The project works on the principle that farmers (male and female) will be the future administrators of the continuous process of innovation and change. For this reason they are involved in all aspects related to generating and diffusing innovations. Nevertheless, not all of them are equally interested in participating in all these aspects. Thus a team works with three different levels of farmer participation:

(1) A nucleus of about 10 farmers, the animators,
(2) A group of about 80 farmer-experimenters, and
(3) A general "public" of farmers in community associations, currently covering 430 families in 30 communities in three municipalities.

Farmers' participation has been important for the project from its beginning in 1993. In that year, a participatory diagnosis was made of two agroecosystems, conducted with 30 farmers and representatives of the STRs to analyze the crisis of family farms in the region and identify possible solutions. This study served as the basis for project activities in the following years. Since 1994, these farmers—together with the AS-PTA technicians and animators from the STRs—have been developing a process of participatory evaluation and planning. This is done through yearly seminars with some 40 farmers participating. The results of the monitoring feed into this process.

Considering the different levels of farmer participation, how can a process of monitoring that contemplates the interests of the different actors (community associations, interest groups, STRs, and AS-PTA) be made viable? This challenge has faced the project since 1996.

To date, many of the impacts are related to the search for more sustainable agricultural practices for the agricultural activities in the region. Progress has also been made in strengthening the social organization and collective action. The team feels it is on the right track with the participatory approach, without which progress would have been much slower. Meanwhile, results are as yet insufficient both from the standpoint of geographic coverage and of the impact obtained with families.

To complement results, it was decided to set up a participatory monitoring plan (PMP). This involved a series of seminars with the AS-PTA, STRs, and animators participating, where the most important aspects related to setting up the PMP were discussed. The preparation of a monitoring schedule and its constant revision is described later.

The PMP Content

The PMP is divided into two: one part considers indicators and the other does not. Both parts cover the principal work areas of the Paraíba Project, but not all activities are included.

Monitoring based on indicators

Given the many activities, it was decided from the start to prioritize work areas in the fields of generation and diffusion of innovations (Table 1). Within these areas, the most important activities were prioritized: community seed banks, control of the banana beetle (*Cosmopolite sordidus*, a Coleoptera destroying the banana pseudostem), contour lines (diffusion), and animal breeding (generation). Over time, an important difference could be seen between generation and diffusion of innovations when it came to monitoring. These processes are presented in more detail below.

Table 1. Participatory monitoring using indicators – community seed banks as an example in the Paraíba Project, Brazil.

Action areas	Monitoring process used to evaluate impact
Technology generation	Farmer experimenter groups and their own processes; indicators selected individually or collectively by subject interest groups
Innovation diffusion	Based on indicators, conducted by animators and team from Assessoría e Serviços a Projetos em Agricultura Alternativa (AS-PTA)
Strengthening of Sindicatos de Trabalhadores Rurais (STRs)	Quarterly evaluations using the "most significant changes" method, no indicators used
Developing strategic alliances for sustainable agriculture	As above
Participatory methodology with farmers	As above
Contributions toward changing municipal policies for a more sustainable agriculture	As above

Innovation diffusion. Each diffusion activity has a variety of objectives, each of which has a series of possible indicators (short- and long-term) that cannot be totally monitored. For this reason the selections were made based on the key objectives for working with family farms. Even then, despite the effort to prioritize, 22 indicators remained to be followed—a considerable number.

After selecting the indicators, the data-collection tools were defined for each one. Both conventional instruments (e.g., individual interviews) and more participatory ones (e.g., community maps) were used. This was also an interactive process. The IIED facilitator suggested two or more methods for each indicator drawn from a list of possibilities (use of information cards, maps, transects, evaluation matrices etc.).

Next, the group discussed the viability of each tool and selected the most suitable ones, adjusting as required to improve their adaptation to the indicators, the team's skills, and the cultural context. Maps, flow charts, and information cards were selected as the best tools to apply in the initial data-collecting stage. Once the instruments and the indicators were defined, the frequency and programming of data collection and analysis were established. Thus, a "monitoring schedule" was developed with a clear distribution of tasks.

The monitoring of community seed banks is given to illustrate participatory monitoring with the use of indicators (Table 2). The other three activities monitored used a similar model. Table 2 shows that to monitor the three main objectives of this activity, a series of indicators were chosen. In reality, however, some changes had to be made. The indicators related to the organizational aspects and management of the seed banks were not monitored because the data-collection instruments used could not be adjusted to reality. The data obtained with the information cards made it possible to monitor other indicators that had not been prioritized initially. This learning experience led us to incorporate new indicators in the PMP.

Table 2. Objectives, indicators, and instruments for participatory monitoring of seed banks, Paraíba, Brazil.

Objectives	Indicators	Data collection methods	Fieldwork
Community administers well its own seed	Quantity of seed returned in relation to amount distributed	Record of control from seed banks	Animators collect data from the 17 seed banks
	Quality of seed from bank	Seed collected and analyzed at all silos	UFP[a] laboratory analysis; training for 20 farmers and animators
	Quality of seed returned to bank	As above	As above
	Number of members on commission and their work	Not monitored[b]	Not monitored[b]
	Criteria for selecting members and quantity received per member	Not monitored[b]	Not monitored[b]
Decreased costs of farmer-grown seed	Cost of farmer-grown seed for member of bank compared with nonmember (seed money)	Individual harvest records	Animators interview 60 farmers each in communities with and without banks
Ensure sufficient seed for farmers at time of sowing	Proportion of easy or difficult access to seed	Individual collection of information cards	As above

a. Universidade Federal de Paraíba, Brazil.
b. No specific method outlined, use made of indicators already selected, e.g., maps.

Tables 3 and 4 give further insight to the type of information obtained. These data for two indicators for the seed bank were used to evaluate activities developed by the Community Seed Banks. The reflections regarding these activities were mostly made on the basis of the monitoring results.

Table 3. Results of indicators prioritized and measured for participatory monitoring of seed banks, Paraíba project, Brazil.

Indicators	All seed banks		Solânea banks		Remígio banks	
	1996	1997	1996	1997	1996	1997
Quantity of seed returned in relation to distributed (% variation of total seed stock)	25	31	12	25	39	40
Quality of seed from bank (% variation of total seed stock)[a]	G = 86 M = -	G = 89 M = 11	G = - M = -	G = 89 M = 11	G = 90 M = 13	G = 82 M = 13
Cost of farmer-grown seed for member of seed bank compared to nonmember (seed money)[b]	Bank member spends 47% less for seed than nonmember					
Proportion of easy or difficult access to seed	Bank member: seed from bank stored 76%, seed from sharecropping and purchased 24% Nonmember: seed from bank stored 48%, seed from sharecropping and purchased 54%					

a. G = germination; M = moisture; - = no data.
b. The partners decided to monitor these indicators every 2 years.

Table 4. Results of the "new" indicators (not initially prioritized) for participatory monitoring of seed banks, Paraíba project, Brazil.

Indicators	All seed banks		Solânea banks		Remígio banks	
	1996	1997	1996	1997	1996	1997
No. of seed banks	17	17	6	9	11	8
No. of farms receiving seed	416	276	136	153	280	123
Farmers returning seed (%)	66	96	82	95	59	97
Ave. amount seed received by farmer (kg)	23	26	20	25	25	23

In terms of quantity, the Solânea results were more consistent than were those of Remígio. In Solânea, the number of banks and stock expanded although the total number of families did not change. This means an increase in volume of seeds used by each family. Conversely, in Remígio the total seed stock decreased, as did the number of members attended. These facts led to a critical revision of the project. We concluded that the conditions required for managing a large number of banks did not exist because community organization was weak. Therefore we decided to curb expansion of this type of work and concentrate efforts on supporting the management of the existing banks.

Technology generation. With respect to experimentation, only those activities related to feeding livestock were prioritized initially for the PMP. In 1997, however, the interest groups (IGs) for small potatoes and yam were also considered.

When experimental activities were monitored more systematically, a series of objectives and indicators were selected for the livestock breeding IG in 1996. The initial idea was to collect data on forage production at each cutting, and on new forms of postharvest treatment and storage of the forage.

During the process we found that, although a single idea was being tested, farmers were experimenting with a great diversity of proposals. This caused difficulties in collecting and systematizing the data. The indicators selected (e.g., comparison between advantages and disadvantages of the possible forms of producing forage) were not measured because to do so required comparisons among farmers' experiments. How could advantages and disadvantages be compared when experiments varied from one farmer to the next? The solution was to substitute two of the comparison indicators for others that registered the farmers' opinions about the advantages and disadvantages of the different proposals on a yearly basis.

Some of the activities related to the small potatoes and yam IGs were incorporated in the dynamics of the PMP. Monitoring was done on the basis of indicators identified by the farmers. As with the livestock breeding IG, difficulties were encountered with the small potatoes IG given the great diversity of proposals. The contrary was true for the yam IG, which had a proposal for a rotating fund with common objectives defined by the group. It met around a single proposal. This permitted greater clarity in identifying objectives and indicators that served to monitor the experiments of diverse farmers. Monitoring of the concrete work carried out by the other two IGs will require a better definition of the proposals to be implemented.

The above shows that the format for monitoring experiments is not yet satisfactory. The role of the IGs in the process also needs to be defined more clearly to identify strategies for participatory monitoring of their experiments.

Participatory monitoring without the use of indicators

Initially, the PMP monitored much of the diffusion of innovative practices and techniques and, to a lesser extent, the generation of proposals. In 1997, other dimensions of the work were incorporated in the work plan. It was decided to increase areas for monitoring that were also crucial for the development process:

(1) Expanding and strengthening partnerships,
(2) Methodology development,
(3) Design of a new union (STRs) model,
(4) Strengthening the organizations (AS-PTA), and
(5) Intervention in public policies.

The nature of the work developed in these areas is different from that of technology diffusion and generation proposals. Attempting to construct a tree of objectives and specific indicators did not seem a viable methodology. Thus the option selected was to experiment with a methodology used in Bangladesh, which eliminates the need for indicators (Davies 1998). The Christian Commission for the Development of Bangladesh (CCBD), which works to combat poverty on a large scale, has used this method. Its objectives are qualitative in nature and thus difficult to “measure” in concrete terms. The essence of this monitoring method is the response to a set of questions formulated each month. The questions identify what was the most important change that occurred in the diverse areas of work during the period under consideration. Each of the groups involved in the work lists all the changes in relation to each area and then they choose only one as the most important. This information is recorded on paper, describing the “what, where, who, and when” of the event under consideration and explaining why this change was the most important of all. The periodic recording of this information makes it possible to monitor the principal changes occurring in the work area.

We decided to experiment with the “Significant Change” method from December 1997 onward. The AS-PTA and each of the principal partners (STR-Remígio and STR-Solânea) applied the method in separate groups. The responses to the questions were socialized in plenary sessions. Then a report was prepared on the spot and distributed among the partners. The method is being applied every 3 months. The most significant changes in the year will be evaluated in the forthcoming Annual Evaluation Seminar. Table 5 shows the results of the application of the method in May 1998.

The first impression, having applied this method, is that it appears easy to understand and implement; is quick to apply; and has the advantage of causing partners to reflect and facilitates constant re-planning. On the other hand, an overall evaluation of the set of significant changes (or incidences) remains pending. Only with this can we more clearly affirm that this method meets our monitoring needs in the four areas.

Lessons Learned

Who is participating?

Three groups are involved; they collaborate with the monitoring in the sense that they evaluate the development of joint activities:

(1) Men and women farmers,
(2) Representatives of the STRs (most of whom are farmers), and
(3) AS-PTA technicians.

As in the Paraíba project overall, these three groups have for the last 2 years been involved in the diverse activities of the PMP in different ways. The AS-PTA has made an effort to involve the direct beneficiaries—especially the farmer-experimenters—in all phases of the Plan. Nevertheless, we recognize that the individual families that we attend do not automatically become full participants in the project. Thus the plan concentrates on the information needs of the strongest partners—the AS-PTA and the two STRs. Although farmers as a group did not participate as principal actors from the start, the STRs represented them. But, we confirmed that a significant number of farmers are becoming involved. The plan has not found a satisfactory manner of accompanying the experiments being conducted by the IGs. The challenge also remains of involving the community associations in the PMP.

Table 5. Expanding and strengthening partnerships: Most significant changes or events that occurred in the first 5 months of 1998 at three STRs[a], Paraíba, Brazil.

Most significant changes or events[b]		
STR-Solânea	STR-Remígio	AS-PTA
- Frequent meetings with partners with STR and AS-PTA	**- Construction of community headquarters in Malhada**	- Initiation of partnership with church in Solânea
- Meeting of STR with associations and AS-PTA	- Study, training, and approaching student movement (CCA-UFPB)	- Consolidating partnership with CIRAD
- Meetings with commission of seed banks	- Talks with FEAB in Brazil	- Joint actions of the entities in the PTA/NE network on commercialization (initial)
- Integration of STR with the semiarid network		- Partnership with EMBRAPA on peanut research
- Municipal gathering of associations from Solânea		**- Weakening of partnership with the Remígio STR**
		- Closer relationships with CENTRAC
		- Initiation of relationship with the Dept. of Agronomy, UFPE
		- Collaboration with water resources AS-PTA/NE
Highlighted (in bold above) most significant changes justified		
When?		
15 March 1998	Dec 1997 to Mar 1998	March 1998
Where?		
Catequese Center	Malhada de Dentro	Remígio
Who?		
STR, AS-PTA, associations, and others	Community, STR, other support	Directors of STR and AS-PTA
Why the most significant?		
Right time for disseminating all work available in relation to family farming	Served as model for the STR to approach other associations (new ideas)	Uncertain relationships in partnership with STR (new directors)

a. Sindicatos de Trabalhadores Rurais (Rural Workers' Unions).
b. Other acronyms and abbreviations: AS-PTA = Assessoría e Serviços a Projetos em Agricultura Alternativa, CCA-UFPB =Centro de Ciências Agrárias-Universidade Federal de Paraiba, CENTRAC = Centro de Ação Cultural, CIRAD = Centre de coopération internationale en recherche agronomique pour le développement, EMBRAPA= Agropecuária, Brazil, FEAB = Federação dos Estudantes de Agronomia do Brasil, PTA/NE = Projeto de Tecnologias Alternatives-Nordeste, UFPE = Universidade Federal do Pernambuco.

It is tempting to want full participation from all those involved. Nevertheless, not everyone is interested and some do not have the time required, as the different levels of actual participation demonstrate. Some participants are intensely involved in all stages of the process, but others only want to hear about the results. In this sense, our efforts to involve the funding groups more actively in discussions have not produced the expected benefits.

These findings offer several points for reflection. First, sufficient time must be given to developing an initiative of this nature. Working with diverse partners and differentiated groups means that time must be found on the different agendas, and diverse interests must be conciliated. Second, we should learn to live more peacefully with the idea of different levels of participation. To the extent that the different actors mature and become more involved with the overall work, their interest in participating in the monitoring and evaluation phase will also grow.

Being flexible to manage the dynamic reality

Being able to manage a constantly transforming reality is critical for a methodology that facilitates learning, such as our PMP. Frequent changes occur in diverse aspects of the impact monitoring and evaluation process. Within these changes, three stand out:

(1) As the whole process evolves, so the actors involved change,
(2) As the actors change, their roles within the process could also change, and
(3) External factors (e.g., government programs or climatic variations) affect the activities to be monitored, generating distortions.

This situation creates challenges for a focus based on evaluating the temporal evolution of data linked to the same indicator. This means that the partners should have the capacity to continually construct and review what they are monitoring, keeping in mind that this situation creates difficulties in data interpretation.

Who benefits from the impact evaluation?

The question of who is involved bears a certain relationship to that of who benefits from the impact evaluation.

The AS-PTA played an important role in getting the Plan established and used the data produced in reports and texts. The same data have also been of great use in its periodic discussions about evaluation—both internally and with its partners.

What is useful for the STRs? The data have been useful in the discussions evaluating work progress. To cite one example, the decision to reorient the work with the Seed Banks was made after data showed that malfunctions were occurring in the municipality of Remígio. However, it remains to be seen whether the STRs are benefiting from this information in other ways. Are they using the information in their internal discussions? Have the data been useful in their relations with other local actors? We recognize that some benefit has occurred, but we find that it remains far from ideal. What can be done to improve this situation?

We find that the funding agencies have also benefited, because their needs are most probably taken care of through the provision of better quality information. Moreover, they have never informed us of their specific needs.

Finally, we should ask whether it is in the farmers' interests to be involved in the monitoring of impact in a manner that does not contribute directly to their decision-making requirements. Care should be taken to not force their participation nor assume that people will benefit from participating in the monitoring process. The Seed Banks are an example. The banks contain a quantity of seed for meeting the needs of much of the community. Each farmer needs to have seed available at the start of the planting season, but does not need data about the total quantity of seed distributed by the Bank. On the other hand, certain data on the functioning of the Bank are useful for the community. This point should be analyzed case by case. The system that we set up clearly makes sense for the collective or institutional actors (e.g., AS-PTA, STRs, communities, and IGs). This should be taken into account.

How sustainable is the PMP?

We are trying to reinforce the overall learning process, characteristic of the Paraíba Project focus through participatory monitoring and impact evaluation. What we question and what is not yet clear is how sustainable this will be. What part of the monitoring process will be maintained in the future? Should the method be just to develop indicators related to the prioritized objectives or simply out of curiosity, investigate the impact of the work systematically? At what level should the monitoring activities be sustained: groups of farmer-experimenters, the AS-PTA team, the STRs? These questions need to be answered soon to examine monitoring and evaluation in a more realistic and pertinent fashion.

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CHAPTER 9

SELF-EVALUATION AS AN APPROACH TO ASSESSING PARTICIPATORY RESEARCH: AN ASIAN EXPERIENCE

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Background

The Centro Internacional de la Papa (CIP) sponsors the Users' Perspectives With Agricultural Research and Development (UPWARD), an Asian network promoting user participatory approaches in root crop research and development (R&D). Launched in 1990, UPWARD has sought to address three important challenges facing agricultural R&D today:

(1) Linking users and researchers for more effective and locally relevant innovation,
(2) Bringing sustained benefits to small-scale farmers, especially women, in less favored farming areas, and
(3) Working with households and communities as key actors in problem diagnosis and action research.

The UPWARD network has carried out field projects in three areas of root crop R&D: genetic resources conservation and use, crop management, and processing-marketing-consumption. Apart from addressing these problem areas, projects also served as vehicles for field testing and promoting participatory R&D approaches. The network realizes that the best persuasion for promoting wider acceptance of user participatory R&D is to prove its practicality and value via its field application. Over the years, UPWARD researchers have reported varying success in building users' perspectives and participation into the R&D process. They have drawn attention to the strengths and weaknesses of such an approach, while pointing out possibilities for its further rethinking (Campilan 1997). A major program task at hand is to critically review these field experiences as part of program learning.

The mission of UPWARD (1994-98) was to support the participation of technology users in R&D so as to increase the sustainability of root crop agriculture and food systems in Asia. Its goals were to:

(1) Support research that leads to sustainable improvements in Asian root crop agriculture and food systems,
(2) Test, adapt, and disseminate participatory research methods and tools, and
(3) Build the capacity of Asian professionals and institutions in user participatory R&D.

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Assessing the User Participatory Approach

In 1996, a "meta-project" was initiated to conduct a program self-evaluation addressing the following questions:

(1) How were elements of user participatory R&D put into operation in field projects?
(2) Which users and actors participated – in what ways, through what means, and at which phase in the R&D process?
(3) What evidence suggests impact of the user participatory approach on project processes and outcomes?
(4) How did the projects deal with issues and concerns in user participatory R&D, for example, community mobilization, gender sensitivity, incentives and sanctions, and phasing over?

Elements of UPWARD's user participatory approach include user sensitivity, a household focus, a food systems framework, the integration of science and local knowledge, an interdisciplinary approach, multi-agency teamwork, and a problem-based agenda. The self-evaluation approach consisted of:

(1) A multiple case study approach by selecting projects that represent the diversity of program experiences,
(2) Self-assessment methods and tools by involving the various project stakeholders,
(3) Opportunities for comparative analysis and synthesis across projects, and
(4) Concrete use of assessment results in subsequent program planning and implementation.

The methodological framework used for self-assessment is outlined below.

Activity	Methods
On-going monitoring and evaluation ↓	Periodic meetings/consultations, validation workshops, monitoring visits, semi-annual and annual review
Case study approach ↓	Consolidation of monitoring and evaluation results through stakeholders meeting and drafting of case study report
Workshop ↓	Presentation of case studies, discussion of cross-cutting issues, identification of ways to improve report
Case study refinement ↓	Post-workshop consultations with stakeholders, additional data collection, finalization of case study reports
Synthesis and planning	Program-level analysis of field experiences, applying results in strategic planning for next program cycle

The Case Projects

From about 50 projects, in six countries, which UPWARD has implemented since 1991, seven longer running case projects were selected. These projects (Table 1) have accumulated relatively more experience with user participatory R&D, having gone through the three project phases conceptualized by UPWARD:

(1) Diagnosis and assessment – situation analysis, needs assessment, problem identification, and resource inventory,
(2) Action research – planning, development, and testing of feasible technological options to address identified problems and opportunities, and
(3) Local R&D management – scaling up, phasing over, institutionalization, and capacity building.

UPWARD is in the final stage of synthesizing results of the self-evaluation for input to strategic planning in the next program cycle.

Putting the User Participatory Approach into Operation

Interest in the participatory approach is growing, but little empirical evidence exists to show its concrete contributions to agricultural R&D. The UPWARD network made a deliberate effort to field-orient its projects attempting to move from concept to practice and conversely to provide grounding as it "theorizes" inductively from these field experiences. Through the case studies, we could glimpse how researchers assessed the need for and feasibility of putting UPWARD's user participatory approach in a field project setting.

User sensitivity

A participatory assessment of home gardens in northern Philippines revealed the invaluable role that these production systems play in the food security of low-income households. The same study revealed that women were the primary home gardeners and that limited research and development support was given them despite the socioeconomic importance of home gardens to households. In deciding to address this gap, a subsequent action research was carried out, specifically to work with women home gardeners in participatory technology development for introducing improved crop management practices.

Household focus

Taking the household, and not the farmer, as unit of R&D intervention, was most appropriate in a parallel home garden project in southern Philippines. To show the significance of the home garden, its niche within the household's overall food production and consumption system had to be located. A household framework allowed the project to examine the contribution of the home garden to a household's total food production, how home garden practice was influenced by the family's developmental cycle, and how the wife-home gardener's role complemented that of the husband as field cultivator. It also highlighted the interdependence between the sociocultural diversity of households and the biological diversity of gardens.

Table 1. Case projects selected for longer time scale by the Users' Perspectives With Agricultural Research and Development (UPWARD), Manila, Philippines.

Country	Project	Documentation phase	Action research phase	Local R&D mgt. phase[a]
China	Potato production, consumption, and marketing in Zhejiang province	Needs assessment and benchmark survey on potato production, consumption, and marketing (1991-93)	Participatory evaluation and promotion of potato varieties and crop management technologies (1993-96)	Project impact evaluation and institutionalization (1997-)
Indonesia	Sweet potato integrated crop management (ICM) in East and Central Java	Identifying sweet potato integrated pest management (IPM) and IPM training needs (1994-95)	Development and testing of a sweet potato ICM training program (1995-97)	Participatory monitoring and evaluation of sweet potato ICM training and implementation (1998-)
Nepal	Community-based approach to managing potato bacterial wilt in the western hills of Nepal	Diagnostic survey and field monitoring of potato bacterial wilt (1993)	Integrated management of bacterial wilt through community approach (1994-97)	Impact assessment and scaling–up of the community-based approach to bacterial wilt management (1997-)
Philippines	Sweet potato-based home gardens in the northern Philippine highlands	Documentation of rural and urban home gardens in the northern Philippine highlands (1991-92)	Promotion of urban home and school gardens for family food security and nutrition (1992-95)	Institutionalization and impact assessment of urban home and school gardens (1996-)
Philippines	Rural home gardens for household food security and biodiversity	Documentation of rural home gardens in the Manupali watershed, Bukidnon (1994)	Evaluating home garden technologies for enhanced productivity, biodiversity, and nutrition (1994-97)	Institutionalization and impact assessment of rural home garden R&D (1997-)
Philippines	Soil resource management for commercial sweet potato production	Diagnostic survey of sweet potato production and utilization in Dolores, Quezon (1991)	Understanding and enhancing farmers; approach to soil fertility management (1992-96)	Sustaining integrated nutrient management for commercial upland sweet potato production (1997-)
Vietnam	Utilization of sweet potato and canna for starch and transparent noodles production	Survey on opportunities in sweet potato production and utilization (1991)	Development and piloting of sweet potato-canna starch and noodle processing technology (1992-94)	Inter-province survey on root crop utilization opportunities, and diffusion of starch/noodle technology (1994-)

a. Local research and development (R&D) management phase.

Food systems framework

The impact of a specific problem like bacterial wilt on a community's food system was most evident in the Nepal hills where potato is a staple food. To manage the disease, the spread of the pathogen had to be controlled by implementing 3-year rotation and quarantine measures. However, complying with the integrated disease management (IDM) approach, as suggested by researchers, meant that households would somehow be deprived of the opportunity to produce adequate staple food over time and space.

Interdisciplinary approach

In the same project on bacterial wilt management, the need for biological and social science research was necessary to understand and develop solutions to the disease problem. The IDM approach needed expertise in social facilitation and inter-institutional collaboration to mobilize the entire community in enforcing agreed rules and sanctions while being sensitive to their sociocultural and political dimensions. In realizing that bacterial wilt was more than just a technical problem, the project had to build interdisciplinary teamwork, and interdisciplinary thinking by each team member.

Integration of science and local knowledge

For commercial sweet potato farmers, faced with the problem of declining soil fertility, accessing local and scientific knowledge was key to introducing a cost-effective soil management innovation. It meant combining local indicators of soil degradation with standard soil testing procedures done by researchers. Participatory on-farm trials also resulted in identifying a fertilization scheme that combined farmers' practices and the use of externally produced fertilizer as the most feasible technological option.

Multi-agency teamwork

In Indonesia, implementing an innovative yet complex approach such as the farmer field school (FFS) required involving a diverse mix of institutions. To introduce sweet potato integrated crop management (ICM), the project had to involve and capitalize on:

(1) A local nongovernment organization's (NGO's) previous experience with the approach,
(2) The institutional influence of a national root crop research center,
(3) The technical backstopping of a university,
(4) The local influence of village-level political units, and
(5) The interinstitutional networking of an international research center.

Problem-based agenda

Canna is a high-value root crop in Vietnam, being the main source of starch in the processing of transparent noodles among household enterprises. As an annual crop, however, canna supply is limited and farmers are unable to fully meet the volume requirements of processing enterprises. Sweet potato can fill this gap as a potential supplementary and cheaper source of starch, and as a crop of shorter maturity. However, research is needed to develop technologies for combining sweet potato and canna starches that would result in noodles acceptable to the discriminating taste of Vietnamese consumers.

Secondary crop orientation

Rice is a primary crop in southern China, but because of its seasonal requirement, farming households usually leave the paddy idle during the winter months. One project saw this as an opportunity to introduce potato as a winter crop, both to optimize land use and increase farm income, and to enhance soil health through crop rotation. But, modifying the local cropping system required research to evaluate varieties for adaptability, to develop appropriate crop management practices, and to ensure a reliable seed source.

Role of Project Participants

Part of the issue of user participatory R&D is to determine how users can be involved in agricultural R&D. In examining the case projects, three types of user roles were identifiable; corresponding to the R&D phase the project was undergoing.

Users as consultants

Interdisciplinary research teams consulted with users on their perceptions of local systems and needs. Gaining users' perspectives was particularly critical in diagnostic, documentation, and assessment activities.

In the rural home garden project, researchers initially sought to characterize local home garden systems and document local knowledge of crop species and varieties. During a consultation workshop, women home gardeners participated in an exercise to draw maps of their respective gardens, indicating features such as size, location, and crops grown. From the discussion that ensued, researchers were able to delve into local concepts (e.g., "home gardens" and "biodiversity"), develop a typology of home gardens, and identified R&D needs as prioritized by home gardeners.

Meanwhile, to probe into the dynamics of home garden management, the related project in northern Philippines devised record-keeping forms that home gardeners filled on a weekly basis to monitor home garden activities, inputs and outputs, and income and uses. The resulting information allowed researchers to systemically assess the socioeconomic and nutritional contribution of home gardens, while identifying opportunities for R&D intervention.

Users as research partners

Researchers and users jointly generated and validated knowledge to address specific gaps, identify and evaluate technology options, and decide among feasible solutions to address problems. This is a logical next step to the initial diagnostic and assessment activities.

Based on assessment results indicating the potentials of sweet potato for starch and noodle processing, research to develop technology for sweet potato utilization was necessary. The joint research involved food scientists, who evaluated the technical feasibility of producing transparent noodles from sweet potato, local processors, who experimented with different canna-sweet potato starch mixes and adapted traditional processing techniques, and traders and consumers, whose sensory evaluation of final products guided further technology refinements.

Meanwhile, with potato cultivation expanding in a remote county in southern China, a wider range of varieties needed to be evaluated for local adaptability and acceptability. Researchers provided farmers with access to a limited amount of seed of new varieties. Farmers then tried them out on their farms. From one season to the next, farmers discarded some of the varieties and added newer ones in a continuous process of varietal evaluation through the researchers' facilitation.

Users as local R&D managers

The ultimate and ideal goal of user participatory R&D is for users to assume leadership and manage their own research activities, with external R&D professionals facilitating local initiatives by providing complementary expertise and linkages to relevant resources.

The longer-term objective of the FFS in Indonesia was to institutionalize the learning group approach at the community level. A select group of FFS graduates underwent further training to become facilitators of subsequent FFS activities, with the aim of creating multiplier effects. Those who completed the training of trainers' reported an increased level of competencies in the substantive aspects of ICM. However, they felt inadequately prepared to immediately take over the facilitation role, suggesting the need for continued support by researchers and indicating that a much longer "phasing over" period is necessary.

Meanwhile, to institutionalize the community-based management approach for bacterial wilt, the Nepal project facilitated the formation of village committees to oversee implementation of the IDM measures, which were essential in eradicating the pathogen. The critical role of an effectively functioning local R&D system was demonstrated in one village where the pathogen was successfully eradicated through the committee's strict enforcement of crop management guidelines as agreed by the community. In another village, where the committee disbanded, bacterial wilt infection increased instead.

Impact of User Participation on Project Processes and Outputs

The case projects sought to examine evidence of the impact of user participatory R&D on the project by addressing the question: How did user participation influence project processes and outcomes? Rather than starting with a predetermined assessment framework, part of the task was to explore how various project stakeholders, individually and collectively, defined "impact", how projects sought to measure this, and what would be considered as acceptable evidence.

Assessing the impact of user participation

Although each case study project evolved its own specific methods and tools, the following common features characterized the impact assessment of user participation.

(1) Participatory assessment of participatory research.
For any R&D project to rightfully claim being participatory, it has to share with local people the control and influence over all aspects of the project, including monitoring and evaluation. This basic principle governed project efforts in developing an approach to impact assessment of user participation. Thus, impact assessment became part of the case project's participatory monitoring and evaluation (PM&E).

(2) Levels or dimensions of assessment.
Impact was assessed in terms of three levels or dimensions. The first was at the community level, by determining changes in farmer behavior, household dynamics, and on-farm. The second was at the local agency level, by determining changes in capacities, priorities, and R&D practices of community-based agencies (e.g., field offices of government ministries or NGOs) working directly with farmers. The third was at the level of external R&D institutions, by determining changes also in terms of capacities, priorities, and practices, but of R&D institutions sponsoring and/or initiating the projects.

(3) Stakeholders' planning of project PM&E.
Involving users in impact assessment did not begin with implementation, but at the planning stage. A stakeholders' workshop was usually organized to determine the need for project PM&E, identify the expected impacts, decide on impact indicators, determine the target users of assessment results, and explore ways for involving local people in assessment through user-friendly methods and tools.

(4) Shared assessment responsibilities.
In seeking to make the participatory assessment approach operational, project stakeholders needed to agree on sharing responsibilities for carrying out various assessment tasks that had been identified. Usually, stakeholders were willing to be involved only when they were convinced that the assessment results were directly of use to them. As such, researchers realized the need to point out, especially to local people, how impact assessment could benefit them, such as input to farm decision-making.

(5) Regular validation workshops.
A key activity in implementing project PM&E was the regular validation workshop. It served as the culminating activity of a cropping season and/or R&D phase. During a workshop, researchers and users present and discuss results of monitoring activities in the preceding period, and plan future project directions and follow-up activities. Farmer leaders may present findings of a season's on-farm trial while project stakeholders use diagnostic data to conceptualize a subsequent action research phase.

(6) Assessment of technical and socioeconomic dimensions.
As an interdisciplinary research project, impact had to be assessed in both technical and socioeconomic terms. This was most relevant especially for projects aiming at biodiversity conservation or sustainable agriculture, where the combined perspectives of technical and socioeconomic researchers were needed to fulfil standards of science quality as a whole, or for each of the disciplines involved.

(7) Exploring opportunities for "quasi-experiments".
Although an experimental design would have been ideal to establish cause-effect relationships, it often was not feasible (e.g., for ethical reasons) or appropriate (e.g., because of complex multiple causality in the field) when impact assessment was undertaken under a naturalistic setting. The case study approach was usually used instead of having "control" and "treatment" groups. Nevertheless, some instances offered a project opportunities to

conceive of "quasi-experiments", such as by monitoring a comparison group selected *ex ante*, or when a participating village or community dropped out of the project.

Process and outcome assessment

Impact of user participation on a project was assessed in terms of influence both on the processes (i.e., implementation) and outcomes (i.e., results and post-project effects). As an example, Table 2 provides preliminary findings of process and outcome impacts on the case projects included in the self-evaluation.

Table 2. Preliminary findings on impact of user participation on case projects of the Users' Perspectives With Agricultural Research and Development (UPWARD), Manila, Philippines.

Types of impact	Examples[a]
Project processes:	
More in-depth documentation	Local biodiversity status assessed from users' and researchers' viewpoints (Philippines: rural home gardens)
Wider range of technology options	Farmers' practices included as a technology option evaluated to address soil constraints (Philippines: soil management)
Delegation of tasks	Farmers acted as training resource persons enabling project to support more farmer groups (Indonesia: ICM)
Pooling of stakeholders' resources	Projects benefited from stakeholders' resource contributions, e.g. time, materials, and funds (Philippines: urban home gardens)
Social processes becoming a critical factor	Successful IDM implementation hinged on effective community mobilization (Nepal: bacterial wilt management)
Project outcomes:	
Outputs fine-tuned to meet user requirements	Training curriculum designed to accommodate farmer concerns (Indonesia: ICM)
Outputs with potentially more direct and practical use	Technologies developed applied directly to address urgent needs (Vietnam: starch and noodle processing)
Improved user capacities as in-built output	Group learning method applied to address extra-project concerns (Philippines: soil management)
Co-ownership of project outputs	Local community attributed IDM success to their critical contribution to project (Nepal: bacterial wilt management)
A learning experience for technical researchers	Adoption of participatory approach in subsequent research projects (China)

a. ICM = integrated crop management, IDM = integrated disease management.

Issues and Concerns

During the workshop where case studies were presented and discussed, participants also raised issues and concerns relating to impact assessment of user participation (UPWARD 1997). These are listed below under four thematic categories.

Principles and concepts

People and institutions define and interpret impact assessment differently. A first key step is for project stakeholders to arrive at a shared perspective of its underlying principles and concepts. Many researchers do not yet fully appreciate the value of impact assessment as both a learning and management tool.

Participatory research demands participatory impact assessment. Using participatory methods does not necessarily mean that the assessment is less scientific. On the other hand, participation adds scientific rigor because various stakeholders bring in different levels of analysis and views of reality. On the other hand, promoting participatory assessment does not imply a total rejection of conventional approaches. They are complementary and can be used jointly or singly at different stages of the project. When participatory assessment is most useful, and when other approaches may be more appropriately used, must be determined.

Methods

A wide range of methods and tools is already available for doing impact assessment. Projects need to choose methods that are user-friendly to all those who participate in the assessment. Exploring non-conventional methods is especially useful to help participants overcome communication and social barriers and articulate their views more effectively. The methods to be selected are those that help yield information that are of direct and practical use to the project. Often PM&E deals with sensitive, confidential, and even controversial information. Methods must conform to accepted ethical standards in the research and development profession.

Actors

A project seeks to make impact assessment widely participatory, but identifying who should and should not be involved can be difficult. Decisions must be made on which actors are relevant and what group size is optimal for effective assessment.

Impact assessment involves different types of participants, and different levels, modes, and timing of participation. The composition and role of participants can therefore change together with the broader R&D process and project cycle. Moreover, impact assessment is a natural battleground for actors seeking to secure power and influence. Stakeholders bring to the assessment platform their respective agendas and interests. Ideally, impact assessment helps resolve project conflict, but in certain instances it may also create conflict.

Indicators

How indicators are identified, defined, and measured largely determines assessment outcomes. As in the case of many social concepts and phenomena, indicators for assessing “participation” are difficult to establish. Innovative ways are now available for measuring types and levels of participation. However, the process dimension of participation must not be missed.

Projects need to go beyond the conventional indicators of effect and impact. A project may overlook its other significant achievements because they are not adequately covered by the set of indicators usually prescribed for impact assessment. The use of multiple indicators and measures contribute to overall reliability and validity. A project can combine technical and social indicators, as well as scientific and local or indigenous ones.

General

Establishing causal relationships is an unresolved issue that merits attention in subsequent meetings or workshops. Under a naturalistic setting, isolating other factors is deemed inappropriate if not impossible. Researchers should therefore be open to the possibility that project impact is attributable to a confluence of factors including, but not limited to, user participation. Singular impact may be only attributable where a rigorous and simplified set of cause-effect relationships have been established, which on the other hand runs the risk of "oversimplifying" field realities.

In a recent external program review of UPWARD, the reviewers (Guzman and Horton, 1997) concluded that specific effects apparently could not be attributed to specific causes. They concluded that although changes occurred at field level, UPWARD was only one of several forces contributing to them. Therefore these changes are best seen as joint results of the collaboration, and not as "impacts" of UPWARD alone. In the future, UPWARD might want to extend its innovative work in PM&E to developing a new approach for assessing the benefits of its collaboration with individuals and organizations

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PART 4:

MEASURING THE IMPACT OF PARTICIPATORY PLANT BREEDING

CHAPTER 10

FARMER MANAGEMENT OF MAIZE DIVERSITY IN THE CENTRAL VALLEYS OF OAXACA, MEXICO: METHODS PROPOSED FOR IMPACT ASSESSMENT

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Introduction

The varietal and genetic diversity of the maize landraces grown in the Central Valleys of Oaxaca State, Mexico, reflects the management practices of the farmers who have grown them for thousands of years. These landraces are of commercial and non-commercial value today to the farmers who grow them. They are also of global value to future generations of maize producers and consumers, including those who will reside in and far from the region.

Environmental changes, economic development, and changes induced by policies such as those of the North American Free Trade Agreement (NAFTA), may make growing and managing maize landraces less attractive for Oaxacan farmers. But, the predicted decline in maize production following maize price reductions stipulated by NAFTA has not yet occurred. Taylor et al. (1999) show how a fuller understanding of village economies in Mexico can explain this apparent paradox. Farmers are concerned about meeting their needs on a daily basis, and the varieties they choose to grow are not necessarily those deemed most desirable for the conservation of genetic diversity. If we ask farmers to give up the maize varieties they choose to grow to cultivate other maize varieties of greater potential value for conservation purposes, we will be asking them to pay a price today for the benefit of future generations.

Can collaborative crop improvement benefit farmers today while maintaining or enhancing genetic diversity for tomorrow? Can we encourage farmers to conserve maize genetic resources for future generations by increasing the economic return they earn currently from growing landraces? The farmers of the Central Valleys of Oaxaca are already conserving maize genetic resources de facto. Can we reduce their opportunity costs? Some farmers have decided to continue cultivating landraces although modern varieties are available. The adoption of modern varieties in the region is negligible. Some detailed studies conducted in areas of crop diversity (Dennis 1987; Brush 1992; Meng 1997; Bellon et al. 1998a; Perales 1998;) presented evidence of de facto conservation.

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The goal of our pilot project in the Central Valleys of Oaxaca is to determine whether maize productivity can be improved while maintaining or enhancing genetic diversity. The project is funded by the International Development Research Centre (IDRC), the Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), and the Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP). We define maize productivity broadly in terms of yield, stability, or other characteristics of interest to farmers. If maize diversity and productivity can be enhanced, both the individual welfare of farmers today and the future welfare of society will increase. Eyzaguirre and Iwanaga (1996), Riley (1996), and Qualset et al. (1997) proposed linking agricultural development to genetic resource conservation. Figure 1 conceptually depicts this idea, which is central to our project.

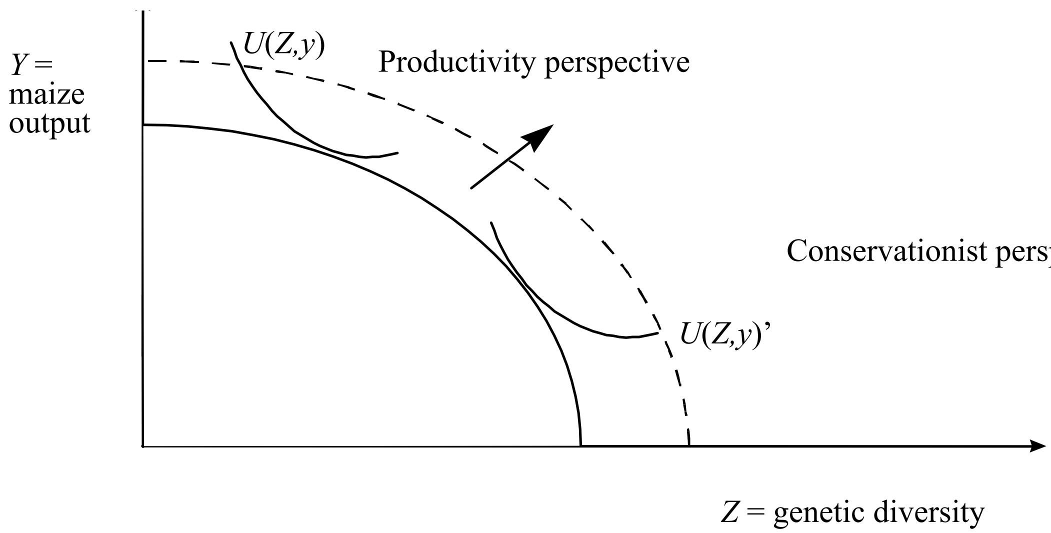

Figure 1. Social utility and aggregate product transformation curve for maize outputs and diversity. Maize output may have other attributes in addition to yield. The product transformation curve is for a fixed area allocated among varieties by farmers in a reference region.

To implement the project, we first need to identify the structure of the crop populations and which crop populations or sets of populations should be conserved. This process involves identifying the crop populations and characteristics that show the most potential for genetic gains, that are of greatest importance to farmers, and that contribute the most to genetic diversity. Second, we need to identify which types of farmers are more likely to conserve crop populations. Finally, we need to determine which participatory strategies should be used to improve the crop populations.

In the first, diagnostic, phase of the project we conducted some of the research necessary for the first two points. The data collected during this phase also constitute the baseline to assess the impacts of our project in the future. The purpose of phase two of the project is to address the third point by comparing three different types of farmer participation in landrace improvement. Welfare impacts will be assessed using economic analysis, farmers' perceptions, and genetic analyses.

Methods Used in Phase One

Identifying maize populations with potential for genetic gains

Samples of 152 maize populations were collected from farmer experts in 15 communities in the Central Valleys of Oaxaca, based on the extensive experience of the INIFAP breeder in that zone. Farmer experts were identified through previous work and by other farmers in the communities. Communities represent well the variation in rainfall conditions of the region (1310 to 1839 masl), and the variation in maize races and diversity of maize uses by farm households.

To measure morphophenological and yield characteristics that serve as the basis for analyzing the genetic structure of these maize populations, trials were established on site and on the Tlaltizapán Experiment Station. Trials included the 152 populations, 17 historical accessions from the INIFAP and CIMMYT germplasm banks, and one improved population of the local landrace. Statistical analysis of the data reveals considerable phenotypic diversity among the populations of the race "Bolita", suggesting a medium to high level of genetic diversity (Taba et al. 1997). Breeders from INIFAP and CIMMYT selected promising materials from these populations based on their criteria (Taba 1998).

Identifying maize characteristics and maize populations of importance to farmers

Landraces contribute to the welfare of farmers and their households by providing a range of attributes or product characteristics that are consumed on the farm as food or feed or sold in the market. Although "yield" is clearly important, it has many components and is not the only characteristic that farmers value. These include attributes related to consumption and production. Farmers also recognize that trade-offs are to be had in choosing varieties because positive and negative traits are often associated. Farmer welfare can be improved by: enhancing the positive and reducing the negative contribution of traits that farmers consider to be important; and decreasing the trade-offs associated with growing certain varieties. To assess this, we need the farmers' own evaluation of their landraces.

We elicited farmers' preferences regarding the maize populations that were collected during visits to demonstrations at several of the sites. Farmers from the region, including the experts who donated samples, were invited to evaluate the 170 populations on site at physiological maturity and harvest. More than 400 people participated in the field days, although not all were maize farmers (defined as any farmer who plants maize). Participants "voted" for as many populations among the 170 as they wished. Farmers' preferences were then related to their key socioeconomic characteristics. To analyze voting patterns, groups were formed by applying a multivariate clustering technique to socioeconomic characteristics. Choices were compared among socioeconomic groups, and between men and women (summarized in Bellon et al. 1998b).

The percentage of votes for each landrace was regressed against a set of agronomic variables measured in the trials, including those that breeders used to rate the landraces, and others we considered to be relevant to farmers (e.g., ear and grain characteristics). The variables used by breeders were good predictors of farmer voting patterns. This suggests that both take into consideration similar traits for their ratings. However, evidence also showed that farmers take additional variables into consideration. The variables tested only explained a part of the variance, which suggests other factors not measured may be important to farmers. Overall, consistency was shown between the materials selected by breeders for improvement and the populations receiving most farmer votes. However, exceptions also occurred, which is consistent with the suggestion that farmers take additional characteristics into consideration. An example was a variety that was highly popular among women farmers, but was not selected by breeders in this first phase, and will be included in the work of phase two.

The information on preferences can be tested and grounded statistically by comparing these responses to those of farmers included in the sample survey, which includes men and women respondents in 240 households (summarized in Smale et al. 1998a). In the sample survey, a rating method was used to elicit information on the extent to which maize characteristics are demanded and supplied by the varieties grown by farmers. The list of characteristics to consider was based on the informal discussions with farmers when seed was collected. Survey findings showed that the most important characteristics to both men and women members of farm households (although their relative rank differed) were drought-tolerance, resistance to insects in storage, grain weight, avoiding low yields, and the taste of *tortillas*. The first four characteristics are notably related to grain yield—which is a complex trait—and the fifth is a characteristic that varies according to subjective evaluations and is therefore difficult to enhance through breeding.

We have also conducted a preliminary assessment of the market for grain of maize landraces in the Central Valleys to determine whether the market values any characteristics. Grain shape and grain health alone appeared to influence price, and vendors of special maize products did not frequently express a preference for using certain types of maize to produce them—often depending on the cheaper, lower quality maize imported into the region (Risopoulos 1998). Because many of the variety characteristics that households care about are not reflected in market prices for shelled grain, their value is implicit and specific to each household. Although shelled grain has market prices in the town markets that are dispersed throughout the region, only an estimated 5% of production of maize landraces enters these markets. This implies that it does not make sense at present to choose characteristics for improvement based on hedonic valuation with market prices, as might be the case under other circumstances (Unnevehr 1986).

Identifying maize populations of importance for conservation of genetic diversity

Combining participatory plant breeding with a goal of on-farm conservation requires the identification of the most genetically desirable maize populations. They are not necessarily those of importance to farmers. The populations that are the least costly to support in an on-farm conservation program would be those of greatest current importance to farmers, because farmers have reasons for growing them. To identify the most suitable candidates for on-farm conservation, we must combine information about the relative importance of crop populations to the farmers who grow them with the results of genetic analyses (Figure 2; Bellon and Smale 1998). Genetic modeling and genetic diversity analyses based on data from a subset of survey farmers are planned for the second phase of the project.

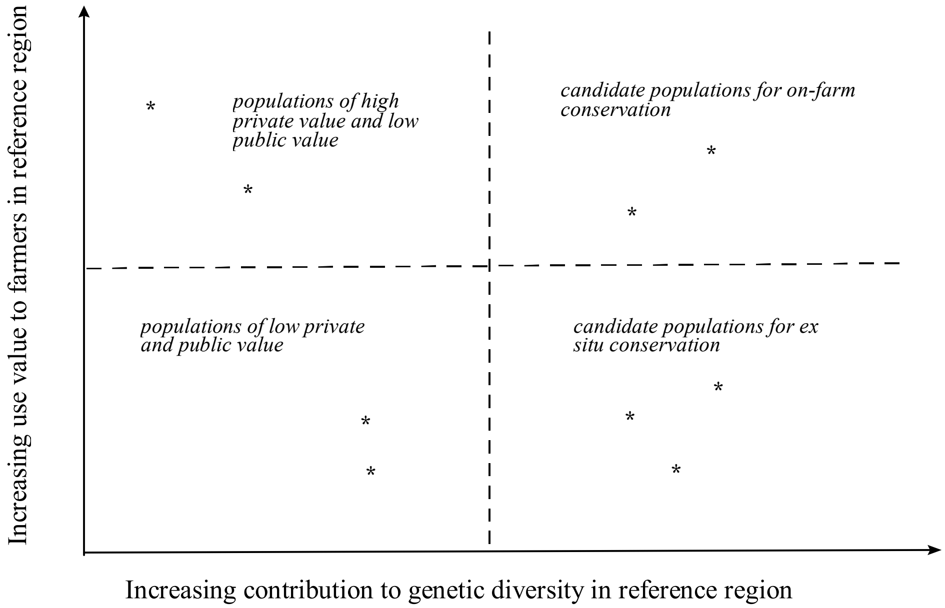

Figure 2. Framework for choosing crop populations to conserve on-farm and *ex situ* in a given reference region.

Identifying key farmers

The sample survey data have helped us identify homogeneous groups of farmers in terms of their management of maize diversity. Farmer management of diversity includes variety choice, seed procurement, supply and exchange, and seed storage practices (Bellon et al. 1997). A critical feature of farmer management of maize diversity in Mexico is that farmers have different strategies for procuring seed (Louette 1994; Aguirre 1999). Strategies include both saving seed from the previous season's harvest and mixing, exchanging, and replacing it with the seed of the same variety obtained from other farmers. These management strategies affect the intra-varietal genetic diversity of maize, and have implications for the type of participatory breeding strategy most likely to produce genetic gains that farmers can realize.

The survey data, combined with the qualitative information from the monitoring survey, deepen our understanding of the way seed is exchanged among farmers and helps us identify "seed curators", "seed suppliers", and seed distribution systems in the community. Such key farmers may serve as the basis of a local seed industry for the products of participatory plant breeding. We will continue to identify them during phase two of the project, as farmers do or do not decide to participate and we learn more about them.

Identifying participatory breeding strategies

We have chosen three types of farmer participation in landrace improvement to compare in phase two of the project.

Participation type 1. Farmers are consulted about which landraces and which characteristics should be improved. Relatively few landraces are chosen from the original set. The breeder decides which breeding methods to use to achieve genetic gains. The materials that result are grown in farmers' fields and evaluated in the field with them.

Participation type 2. Farm households are exposed to a wider array of landraces, including the improved materials resulting from participation type 1. They are also provided with information about the performance of these landraces in different locations and circumstances (e.g., under drought and adequate moisture). They are invited to take seed samples for experimentation from those populations they find interesting.

Participation type 3. Farmers who express interest are trained in seed selection and management techniques and in principles to help them maintain the characteristics of their landraces. In designing and developing the techniques with farmers, particular emphasis will be given to selecting and improving maize for resistance to storage insects.

Measuring Impact

Impacts have multiple dimensions and can be documented in different ways. In this project, we have chosen to assess the welfare impacts of the three types of farmer participation in landrace improvement using:

(1) Farmers' perceptions of germplasm and knowledge gained through participation,
(2) Analysis of genetic diversity using phenotypic characteristics and molecular markers, and
(3) Economic analysis of efficiency and the distribution of benefits among socioeconomic groups.

Farmers' assessment

We also intend to compare farmers' evaluation of landraces and their characteristics before and after participation and by type of participation. In the baseline survey, we asked farmers to rate the landraces they grow with respect to characteristics of interest, and to rate the importance of the characteristics in meeting their objectives. Characteristics included both consumption and production traits. The rating for any population with respect to each characteristic expresses the extent to which it "supplies" characteristics. Weighting these scores by the relative importance of the characteristics enables us to determine the extent to which supply meets the "demand" of the farmer. A scalar "attainment index" can be calculated for each maize population, serving as an indicator of its utility or use value to farmers. Estimated attainment indices can be compared between time periods. A difference in attainment indices may express either change in the supply of the characteristics resulting from breeding, or shifts in the demand for the characteristics resulting from changes in farmers' preferences. We can analyze changes in the "demand" or "supply" of characteristics separately and assess their independent contribution to changes in the attainment index. In this project, we are initially most interested in estimating changes in the "supply" of characteristics as it relates to the three types of farmer participation. However, changes in "demand" also determine the effect of project activities on farmer welfare, and we cannot assume that the demand parameters are static. We will also calculate variety attainment indices for men and women. Because of the different responsibilities that men and women have within the household regarding seed procurement and exchange as well as seed selection and management, all evaluations must be conducted from the viewpoints of both men and women participants.

Genetic diversity

There is no single most accurate or most appropriate indicator of diversity in crop genetic resources. There are many indicators, from the number of farmer-named varieties to indices based on molecular data (Meng et al. 1998). In our project, as already mentioned, a primary interest is the use of molecular markers.

A major practical issue in assessing the potential to conserve genetic diversity on-farm is how to link farmers and their management strategies to the evolution of specific maize populations that can be sampled and monitored over time. To develop this linkage, we have grouped the farmers from our sample survey into homogenous groups with respect to management of diversity using a multivariate clustering technique (Franco et al. 1998). From each of these groups a random subsample of farmers has been selected, and from each farmer we will collect samples of all the maize populations grown every year for the next 5 years. Other types of experiments and data collection will provide information of a more general scientific nature regarding the role of participatory crop improvement in on-farm conservation.

Economic analysis

Private economic returns. Economists mostly believe that farmers need an "incentive" to use new varieties or seed—a net benefit in terms of resource expenditure and returns to resources utilized in that activity. Each type of participation requires farmers to invest time and money. Will farmers be rewarded by earning additional yield?

CIMMYT has funded some pilot studies related to whether or not farmers find it worth their time to use improved methods of mass selection (a participatory crop improvement strategy) for maize in Mexico. Our results are sufficient to question the strategy for three reasons:

(1) Frequent seed loss and farmer practices of mixing seed for the same variety from the harvests of different farmers suggest that genetic gains may not be realized, because genetic gains require the retention of the generations of the same seed from successive harvests (Rice et al. 1998);
(2) Large environment-induced variation confounds genetic effects for some traits (Cleveland et al. 1998); and
(3) Farmers may not perceive it as a viable means of modifying maize varieties under their conditions (Louette and Smale 1998).

These findings are not at all conclusive, but are suggestive. First, improving methods of mass selection, in the form (for maize) of seed selection from the plant in the field, is only one participatory crop improvement strategy. Second, the methods promoted may not always have followed “best” scientific practice, although they may have followed optimal practices in terms of simplicity and the time investment of farmers relative to the value of potential returns under their own conditions.

Further, not all farmers need to adopt the practices or landraces we are studying for genetic diversity impacts to be realized. A loss of seed by one farmer does not necessarily translate into a net loss to the community. One farmer can take advantage of the genetic gain produced by other farmers in the community by purchasing or being given the seed. At least **some** farmers will need to benefit from the activities, however, to keep producing the genetic gain embodied in the improved seed and associated seed selection or management practices. This underscores the importance of understanding local seed systems for maize landraces.

Other sources of economic value. Other economic values are associated with this project. Maize genetic diversity is a public good externality of farmer choice of maize varieties (Smale et al. 1998b). This means that:

(1) More than one farmer in the project region can benefit from maize genetic diversity simultaneously; and
(2) Farmers make the choice of the varieties they grow without being able to know or fully consider the effects of their decision on the genetic diversity of the maize grown at the community or regional level.

Evaluating this source of value with any degree of accuracy is exceedingly difficult. The project’s goal is to enhance the economic return that farmers can earn from growing landraces today as a means of encouraging them to help conserve maize genetic resources for future generations, including their own descendants and other producers and consumers. The project addresses equity between generations, or how much this generation pays for the benefit of future generations. The fact that this project addresses other types of economic value is important given the common misperception that economic models relate only to pecuniary or monetary issues so that questions of the distribution of income among social groups (equity) and across generations (intergenerational equity) must be dealt with separately (Alston et al., p. 298).

Social equity. Economic theory provides some principles to begin the analysis of the distribution of benefits among socioeconomic groups. If the project is successful enough to shift the supply of grain from maize landraces and reduce the price of grain, the most critical issues determining the distribution of benefits among social groups are:

(1) Whether the market for the grain of maize landraces in the project area should be considered as an open (to trade) or closed economy;
(2) Whether the government has a producer price support policy, either in the form of buying grain stocks or providing support payments; and
(3) The supply and demand elasticities in maize markets, and land and labor markets.

When either (1) or (2) holds, the world determines market prices exogenously. Any shift in the supply of maize that results from the use of new practices will not be accompanied by a change in prices received by farmers or paid by consumers. All benefits are transmitted to farmers who sell more maize than they consume (net producers or commercial farmers), as compared to those who buy more than they produce (nonfarm households or net consumers) (Akino and Hayami, 1975).

If the economy is open (no. 1 holds), but the government supports the price (no. 2 also holds), the entire economic gain is captured by the innovators and fixed factors in agriculture, namely those who use the practice first and are land owners (Sadoulet and de Janvry 1995). How benefits are distributed among producers depends on elasticities in land and labor markets, and factor shares in production, which factor is used more intensively as practices change, and ownership of factors (Helmberger and Chavas 1996).

When neither (1) nor (2) holds, prices are determined endogenously. Consumers reap most of the benefits from lower grain prices and expanded production. Non-farm households and households unable to meet their grain needs benefit unambiguously from more output at a lower price. Adopting farm households who are net consumers, or net consumers who become net producers after adopting, gain. Those who do not adopt the innovation and produce more than they sell, lose. Adopting farm households who are net producers may gain or lose, depending on the supply and demand elasticities for maize (Renkow 1994). Elasticity is just the percentage change in quantity for a percentage change in price. It refers to the extent of the response of consumers and producers of grain or inputs to price changes. The more elasticity the greater the quantity response to a change in price. Net consumers gain differentially, depending on the demand elasticities for maize and the share of maize in their budget (Pinstrup-Andersen 1977). The higher the quantity consumed and the larger the absolute value of the price elasticity of demand in lower income groups, relative to consumption and elasticities in the higher income groups, the more favorable is the distribution of benefits for the lower income strata. When producers gain benefits, they are distributed among producers according to factor ownership, factor shares, the factor intensivity of the technical change, and supply and demand elasticities in factor markets.

Information needs. To estimate the total private benefits and relative economic efficiency of the practices, the following information is needed, for each type of participation:

(1) An estimate of the yield gain or savings per hectare that is associated with the strategy, in farmers' fields,
(2) An estimate of the cost of achieving that yield gain or savings, both in terms of project investment and the time invested by farmers,
(3) Appropriate prices to value the yield gain and the time invested by farmers,
(4) The incidence of use of the strategy, among farmers and over time,
(5) An understanding of which factors shift the demand and supply of local maize in the Central Valleys, including migration, changes in income, and long-term trends in maize area and yields, and
(6) An understanding of how current maize policies in Mexico affect the demand and supply of local maize in the Central Valleys.

To investigate the distribution of benefits, or equity of the project, the following type of information is also needed:

(1) Items 1-4 above, disaggregated by social group,
(2) Estimates of supply and demand elasticities for local maize markets, labor, and land markets, and
(3) Estimates of the share of total maize produced and consumed by social group.

Other approaches of economics. Alston et al. (1995) presented the most comprehensive methodology for evaluating the impacts of agricultural research using the economic surplus approach, on which the method summarized above is based. A participatory crop improvement activity might also be evaluated more simply using a special case of this approach—standard cost benefit analysis. For example, we can use this approach to answer questions such as: What is the minimum use of new practices that would be needed to cover the costs of labor, management, and materials invested in each type of participation? This type of question is easier to answer with limited data and a brief time period of observation, although the assumptions on which it is based are restrictive.

Conclusions

We have completed the diagnostic phase of the project in which we collected data that forms a basis for assessing the project's impacts. We identified which types of farmers are more likely to help in the conservation of crop populations.

The next phase of the project compares three different kinds of farmer participation in landrace improvement using economic analysis, farmers' perceptions, and genetic analyses. If, as we expect, maize productivity is enhanced and genetic diversity maintained or improved, then:

(1) Participating farmers earn economic benefits from the activities,
(2) They perceive that their varieties have improved or their knowledge has expanded, and
(3) The methods employed have no effect or positively affect the genetic diversity of the maize grown in the region.

The success of the project would secure economic value from the conservation of maize for future generations of farmers and consumers residing in and far from the project region. The distribution of benefits among different socioeconomic groups participating and not participating in the project can be analyzed. Methods that have been developed previously for other types of research can be adapted to analyze the impacts of this participatory crop improvement project.

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CHAPTER 11

PARTICIPATORY BREEDING: DOES IT MAKE A DIFFERENCE? LESSONS FROM NAMIBIAN PEARL MILLET FARMERS

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Introduction

Farmer-participatory breeding is a new approach to variety development, in which farmers are involved, more closely and at earlier stages than before, in the process of variety selection and breeding. Closer interaction with farmers allows breeders to understand exactly what characteristics farmers look for in new varieties. Breeders can then pick out germplasm with these traits, and use them to improve local varieties or develop new ones. Varieties developed using this approach are more likely to be adopted and lead to increases in productivity than those developed through conventional methods.

This chapter describes several methods used by the Southern Africa Development Community (SADC)- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Sorghum and Millet Improvement Program (SMIP) to involve farmers in cultivar development.

Participatory Breeding and Farmer Knowledge

Adoption of improved cultivars will depend on whether or not they meet farmers' needs and have qualities that farmers consider important. Breeders must therefore understand farmers' needs for specific plant characteristics (such as maturity period) and their preferences and priorities for specific plant and grain traits (such as color and taste). To develop cultivars that are "better" than the farmers' or those that meet farmers' expectations we need to understand to what varieties farmers have access at present, their characteristics, and uses. This need not be checked every year, because farmers' varieties usually do not change frequently. However, an evaluation at regular intervals of 4 to 5 years is advisable.

Conventional breeders have tended to evaluate farmers' varieties without obtaining farmer input, an approach that is time-consuming and expensive (finding and collecting the varieties, planting them out, studying their growth habits, etc.), and often leads to incomplete or inaccurate information, particularly relating to the end use of a cultivar. Involving farmers directly to generate the information is faster and less expensive (Hardon and de Boef 1993; Sperling et al. 1993). This also results in more complete information. A recent workshop on farmer

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participation in plant breeding held in Namibia highlighted the potential benefits of this new approach (Heinrich and Monyo 1998). For example, out of the roughly 1000 pearl millet germplasm accessions from Namibia, farmers recognized three major groups—"Shawana", "Shangula", and "Ekishi" (Table 1). They could clearly distinguish differences between the groups in maturity, palatability, stalk strength, and other characters. This is exactly the type of information sought in germplasm evaluation exercises and much of which the farmers already had!

Table 1. Assessment of farmers' current varieties by structured group interviews (50 women, 9 men), Namibia, 1995.

Variety or group	Positive attributes	Negative attributes
"Shawana"	Long panicles, strong stalks	Late maturity >110 days Poor threshability
"Shangula"	Medium-long panicles, stores well	Late maturity>110 days
"Ekishi"	Large grain size, white to cream color, palatable, threshes well, stores well, matures early (100 days)	Poor seed set, low yields

Thus, involving farmers in the evaluation of promising genetic materials will help identify material that appeals to the farmer, thereby reducing the danger of spending scarce research funds on duplicating what the farmer already knows, or developing products that might be rejected.

Methods Used and their Benefits

The SMIP has tried several methods of soliciting farmer input to the breeding program. These approaches involve one, or a combination of, the following methods:

(1) Structured group interviews,
(2) Participatory rural appraisal (PRA) - matrix scoring and ranking of varieties,
(3) PRA – pairwise scoring and ranking,
(4) Direct observation, including group interviews, and
(5) Use of morphologically diverse nursery for trait selection by farmers.

Structured group interviews and PRA

Both the group interview approach and the PRA technique of matrix scoring and ranking involve working with farmer groups. The main difference is that matrix scoring and ranking provide an organized framework in which farmers develop and synthesize their own information rather than researchers having to extract and synthesize it. As such, we found the PRA technique less prone to researcher bias.

Experience has taught us that when trying to get information from a group, it is important to ensure that group members are knowledgeable about the subject being discussed. For example, during the workshop in Namibia, matrix scoring and ranking was done by two groups of "farmers". One group was composed of 10 older men, and the other of seven younger women from a local women's group. Both groups were from the same community. The men knew more about local varieties than did the women, and were in more agreement (within their group) regarding the names and characteristics of different varieties. The women, on the other hand, were more knowledgeable about food quality and the processing traits of the varieties. Consequently, information on types, number, and agronomic characteristics of varieties grown in the community was easily sourced from the men, whereas information on processing and food quality traits was more easily sourced from the women.

Direct observations including group interviews

Direct observation of cultivar performance, either on-farm or on the research station, can also be useful, particularly for obtaining quantitative information (e.g., days to maturity or plant height). However, normally, direct observations are more useful together with group interviews or matrix scoring and ranking, rather than either method alone. The primary information can be gathered quickly through discussions with farmers, and can be quantified and verified over time through direct observation.

We consulted over 200 farmers who participated in a field day organized at Mahenene Research Station, in the major grain-producing area of northern Namibia, during the 1993-94 season. Many of the participating farmers were also hosting on-farm trials in the area. These farmers were interviewed individually and in groups. They were asked to select their preferred varieties from more than 150 under the national testing program at the station. Of the six varieties that were on demonstration and also under on-farm verification, most farmers selected Okashana-1 and SDMV 92040. Both these varieties are early maturing, drought tolerant, and have large grains and good threshing characteristics. SDMV 90016, which came third, was not bold-seeded, but had cream-colored, medium-sized seed (1000 kernel mass 10-12 g, compared to 12-14 g for the other two). Interestingly, a few experienced farmers commented that they thought SDMV 90016 would be less susceptible to storage pests because of its seed shape (wedge). During a later study examining relationships between grain physical characteristics and storage pest resistance, we found that SDMV 90016 was one of the most resistant varieties (Table 2). ICMV-F 86415 was the least preferred variety. It succumbed to drought, had poor seed set, displeasing color, did not thresh well, and performed poorly in sandy environments.

Pairwise scoring and ranking

Pairwise scoring and ranking is an effective method for obtaining information on farmers' priorities. Researchers set the objectives of the exercise, but farmers do the investigation, analysis, and presentation of results, while the researcher plays a facilitating role. We first used this method when looking for a pearl millet ideotype for Namibian farmers (Ipinge et al. 1996b). To come up with an ideotype, farmers were asked to list all the positive traits they would like incorporated into future varieties. Farmers and researcher then went into the field to evaluate varieties for these priority traits. Each variety received a rating score for each of the traits after a discussion among the group to agree on scoring. The positive traits in all varieties with highest scores were listed, and these again prioritized pairwise (Tables 3 and 4).

Table 2. Testing farmers' hypothesis on the relation between kernel shape and resistance to storage pests for pearl millet, Namibia.

Variety name	Grain shape	Total weevil progeny	Rank
SDMV 89007	Globular	283	31
SDMV 92026	Globular	257	30
SDMV 89002	Obovate	237	28
PMV-2	Obovate	213	25
SDMV 87001	Lanceolate	131	3
SDMV 93002	Lanceolate	123	2
SDMV 90016	Lanceolate	115	1
Farmer's local	Lanceolate/elliptical	178	15
Mean (31)		184	
SE (±)		14.16	
CV (%)		13.30	

Table 3. Identification of farmer preferences[a] for a pearl millet ideotype, Namibia.

Trait(s)	Okashana-1	SDMV 92040	Local variety
Grain color	2	4	4
Large grain	5	5	2
Ease of processing	4	4	4
Taste	3	4	3
Early maturity	4	4	2
Drought tolerance	4	4	2
Storability	3	3	4
Good yield	4	4	2
Stalk strength	2	3	5
Tillering	2	3	1

a. Method: participatory rural appraisal (PRA) – matrix scoring and ranking of varieties by farmers, best = 5, poorest = 1.

Table 4. Prioritizing farmer preferences[a] for a pearl millet ideotype, Namibia.

Traits	Grain size(3)	Early(4)	Color	Drought(5)	Stalk (1)	Storage (2)
Grain size (3)	x	Early	Grain size	Drought	Grain size	Grain size
Early (4)		x	Early	Drought	Early	Early
Color			x	Drought	Stalk	Storage
Drought (5)				x	Drought	Drought
Stalk (1)					x	Storage
Storage (2)						x

a. Method: Participatory rural appraisal (PRA) – pairwise scoring and ranking; number in parentheses indicates preference, with the most preferred being cited most.

From this exercise it became clear that the pearl millet ideotype for Namibia will have the following characteristics – early maturity, drought tolerance, large hard grains (for resistance to storage pests), and will thresh well. It will be preferably taller than Okashana-1, but with strong stalks that will not lodge (Ipinge et al. 1996b). In fact the Namibian farmer prefers an "Okashana type" variety with improved storage pest resistance and improved lodging resistance (Monyo et al. 1996) (Table 4).

Choice of methods

Both methods (i.e., direct observation and pairwise scoring and ranking) involve working with groups of farmers, who identify their needs and preferences for specific plant and grain traits. Pairwise scoring and ranking, however, provides a framework in which farmers themselves develop a priority ranking for preferred traits (e.g., whether early maturity is more important than grain yield or grain color). The researcher's perspectives are also less likely to present bias. Scientists of ICRISAT in southern Africa and their National Agricultural Research Systems (NARS) partners have combined these two approaches to develop morphologically diverse nurseries for farmer trait selection.

Morphologically diverse nursery for trait selection by farmers

This approach used by SMIP has been particularly successful. The nurseries contain many lines – local landraces, traditional varieties from elsewhere, and improved varieties. These are deliberately chosen to represent the full spectrum of variation in several important criteria, for example, height and seed size. Farmers are invited to view these nurseries, rank their preferences, and discuss their rankings in detail with breeders. Some farmer groups visit the nurseries every fortnight throughout the season, providing continuous and detailed feedback. For example, this approach helped us quantify farmers' preferences for large grains. Less than 1.1 grams per unit length was considered small (unacceptable), 1.1 to 1.4 grams medium (acceptable), and large (desirable) grains weighed above 1.4 grams per unit cm length.

Broadening the local germplasm base

Another benefit from this approach is that of broadening the local germplasm base by introducing exotic material containing specific farmer-preferred traits. Farmers usually conduct their own "breeding programs", practicing selection to improve yield or specific traits (Richards 1989). Once breeders understand (through participatory evaluation) exactly what traits the farmers are seeking, they can introduce a variety or germplasm line that has the specific characteristic, and farmers can introgress into local varieties. For example, Namibian farmers wanted bold-seeded pearl millet, but their landraces were almost invariably small-seeded. Large, bold-seeded *iniadi* germplasm was introduced by ICRISAT from Togo that led to the development of the first pearl millet variety ICMV 88908, locally known as Okashawa 1 (Witcombe et al. 1995). Gradually, the frequency of bold seeds in the local germplasm has been increasing through introgression between *iniadi* and local landraces.

Participatory development of a composite population

Namibian farmers were seen to deliberately plant Okashana-1 alongside local cultivars, aiming to exploit natural cross-pollination to introgress traits (e.g., grain hardness and stalk strength) from landraces into Okashana. The resultant "outcrosses" were more vigorous than Okashana-1, with larger heads and stronger stalks, and farmers deliberately selected them to provide seed for the following season. A woman farmer, Maria Kaherero, used this approach for 4 seasons, from 1989 through 1992. In 1992, breeders selected a group of these improved plants from her field. During the same season, over 200 farmers visited an especially designed morphologically diverse nursery and several elite nurseries at the Mahanene Research Station looking for "ideal" varieties and identifying preferred traits. Eventually, breeder and farmers jointly selected 30 varieties. These were then intercrossed with the original Maria Kaherero plants for three seasons to create a participatory breeding composite population, named the Maria Kaharero composite (MKC).

A detailed analysis was made comparing MKC with two other composite populations, the farmer's germplasm composite population (FGC) containing local germplasm and NC90, which were developed using conventional methods. The FGC population required on the average 71 days to reach half bloom, compared to 63 days for NC90 and 62 days for the MKC population. Table 5 presents means and ranges for maturity, kernel size, and yield for the three populations.

Table 5. Mean performance and ranges for farmer desirable traits in three populations of pearl millet developed with and without participatory breeding methods, Namibia.

Composite or trait[a]	Mean	Range
Farmer germplasm (FGC):		
Days to bloom	71.07	58 - 89
Kernel size (kernel wt g)	1.227	0.575 - 2.720
Grain yield (t/ha)	0.74	0.37 - 1.26
Conventional breeding population (NC90):		
Days to bloom	63.38	57 - 72
Kernel size (kernel wt g)	1.300	0.647 - 3.298
Grain yield (t/ha)	2.03	0.30 - 4.05
Participatory breeding population (MKC):		
Days to bloom	62.13	55 - 69
Kernel size (kernel wt g)	1.441	0.523 - 3.848
Grain yield (t/ha)	2.05	0.01 - 4.19

a. FGC = farmer germplasm composite population, containing local germplasm; NC90 = population developed using conventional methods; MKC = Maria Kahero composite population, from 30 selected varieties intercrossed with original Maria Kahero plants for three seasons.

Figure 1 shows the maturity frequencies in the three populations. The frequencies of early maturing types (<65 days) was low in FGC, accounting for only 20% of the accessions, but as high as 85.5% in NC90 and 97.9% in MKC. This instance showed that joint selection by breeder and farmer was stricter on earliness as a selection criterion than selection by the breeder alone. Up to 14.5% of the material in NC90 required more than 70 days to reach half bloom, compared to only 2.2% in MKC.

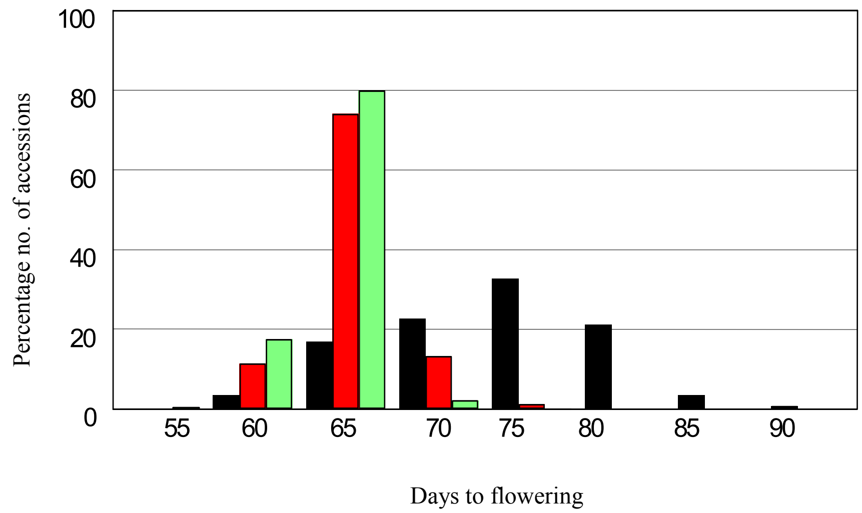

Figure 1. Maturity frequencies (as indicated by days to flowering) in three composite populations derived from three different sources: Farmers' germplasm population (FGC), conventional breeding methods (NC90), and participatory breeding methods (MKC).

FGC NC90 MKC

When NC90 was being developed (using conventional breeding procedures), grain size was not considered a particularly valuable trait. As a result, the seed size distribution in this composite – unlike MKC – did not contain a significant large-seed fraction, and was almost similar in this respect to the FGC population (Figure 2).

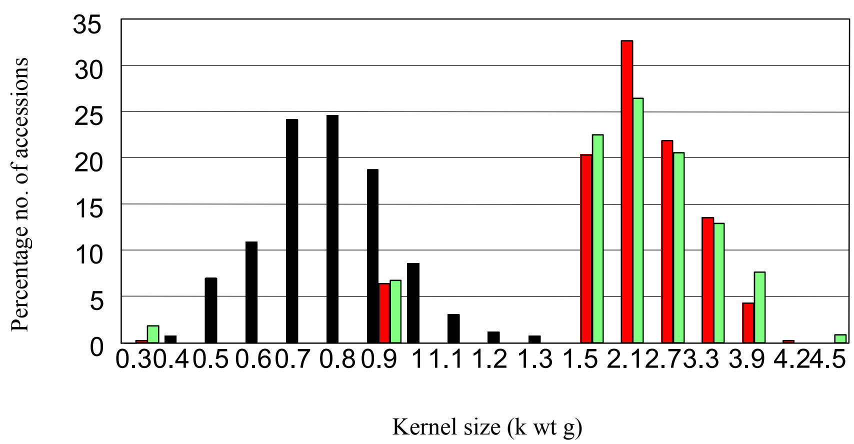

Figure 2. Kernel size frequencies in three composite populations derived from three different sources: Farmers' germplasm population (FGC), conventional breeding methods (NC90) and participatory breeding methods (MKC).

FGC NC90 MKC

Mean kernel sizes for the FGC and NC90 populations were medium (1.227 g and 1.300 g), and MKC had large kernels (1.441 g) (Table1). Most accessions in FGC (40%) and NC90 (42%) had medium-sized kernels. However, most accessions in the MKC population (51%) had large kernels. Small kernel size in the MKC population accounted for only 12% compared to 36% in the FGC and 28% in the NC90 population (Figure 2).

Figure 3 shows grain yield distribution in the three populations. The MKC population was as good as NC90, with grain yield distribution ranging from 0.01 t/ha to 4.19 t/ha. This is a significant improvement over the FGC population. The frequency of high-yielding accessions (i.e., yield >3.30 t/ha) in MKC (21.6%) was higher than in NC90 (18.2%). The highest-yielding accession in FGC yielded only 1.3 t/ha. Thus, compared with the NC90 population developed through conventional breeding methods, the MKC population developed through participatory breeding was better overall in the distribution of early-maturing and high-yielding accessions, and showed significant improvements in seed size. MKC was far superior to the local germplasm population—on the average, MKC varieties matured 10 days earlier, gave double the yields, and had grains that were 17% larger than FGC varieties.

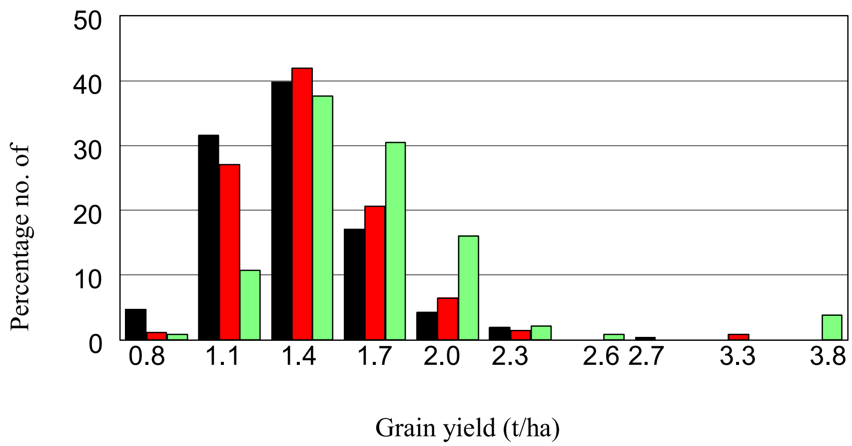

Figure 3. Grain yield frequencies in the three composite populations derived from three different sources: Farmers germplasm population (FGC), conventional breeding methods (NC90), and participatory breeding methods (MKC).

FGC NC90 MKC

Impacts of Participatory Variety Selection in Namibia

The main contribution of participatory variety selection to Namibia's pearl millet breeding program was provision of early maturity pearl millet varieties that often provided higher average grain yields, and improved the probability of harvest when rainfall is poor. These varieties have allowed farmers who plant with the first rains to obtain a grain harvest up to 1 month earlier than is possible with traditional varieties. The new varieties have also enabled farmers to distribute their labor through multiple plantings and performing different crop management practices on a more timely basis because they can obtain some harvest even by planting late in the season. From the start, Namibia's national breeding program had participatory breeding as an important component and involving farmers in the determination of new varieties for the country was mandatory (Ipinge et al. 1996a). Since its inception in 1990, the national program has released three pearl millet varieties, all with farmer participation. These are Okashana-1 (released in 1990) and two new ones, Okashana-2 and Kangara both released in 1998.

The rapid adoption of pearl millet varieties in Namibia shows the value of involving farmers in the process of selection. By 1998, improved pearl millet varieties accounted for about 45% of the nation's pearl millet area. The internal rate of return to public investments in the development and dissemination of new pearl millet varieties in Namibia is calculated at 60% (Rohrbach et al. 1999). This high rate of return in Namibia was attributable to three major factors.

(1) Okashana-1 was quickly identified from ICRISAT nurseries as adapted to Namibia's needs and agroecologies.
(2) National scientists had the foresight to consider the preferences of small-scale farmers from the earliest stages of variety selection. The farmers quickly recognized the value of early maturity as a complement to their late maturing traditional varieties. From the time of first nursery introduction to the release of the variety took only 3 years.
(3) The rapid adoption of improved pearl millet varieties in Namibia was stimulated by public investments in seed production and dissemination with strong donor and government support.

The success of the pearl millet improvement program for Namibia has increased the confidence of the public research and extension services in their capacities to promote technological change. Small-scale farmers have started to demand even better varieties and have gone to the forefront in pursuing this through their active involvement with researchers in new cultivar development. Farmers are now involved from the stage of identifying parents to actual development of composite populations and derivation of new varieties from these composites. Ongoing monitoring of investment returns will ensure that this foundation laid down through researcher farmer partnerships remains productive.

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CHAPTER 12

BREEDING BETTER RAINFED RICE VARIETIES THROUGH FARMER PARTICIPATION: SOME EARLY LESSONS FROM EASTERN INDIA

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Introduction

Almost 45% of the world's rice land is rainfed (IRRI 1997). These areas depend solely on rainfall and runoff for water supply. Rice yields are low and fluctuate widely because of highly variable rainfall patterns. The rural poor of Asia are concentrated in rainfed areas. Rice is their staple food and rice production is their major economic activity. Reducing poverty for these populations will require a major increase in agricultural productivity, which entails, among other factors, a higher and more stable rice yield. A challenge facing the agricultural research sector is to develop rice varieties for these complex rainfed environments and make them available to farmers.

Classical breeding approaches for developing improved rice varieties have been highly effective in the relatively homogenous irrigated ecosystem. In contrast, the success of such an approach has been limited in rainfed environments because of high levels of agroecological diversity. Farmers' social and economic environments are diverse and interact with biophysical factors resulting in a multitude of rice-based systems, each demanding specific management strategies. Despite continued effort to develop suitable varieties for these environments, the adoption rate has remained low and farmers rely predominantly on traditional rice varieties. The limited impact of breeding

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programs is relatively well quantified in some areas (Kshirsagar and Pandey 1995) and less documented in others.

Poor adoption of varieties released for these environments may be caused by several factors such as poor adaptation of improved varieties, limited access to seeds, and a range of socioeconomic constraints (Figure 1). Obviously, the problem of limited access to improved varieties reflects institutional impediments and is better addressed through institutional and policy reforms. However, if the modern varieties currently available are poorly adapted to these rainfed environments, the breeding strategies utilized need to be re-examined.

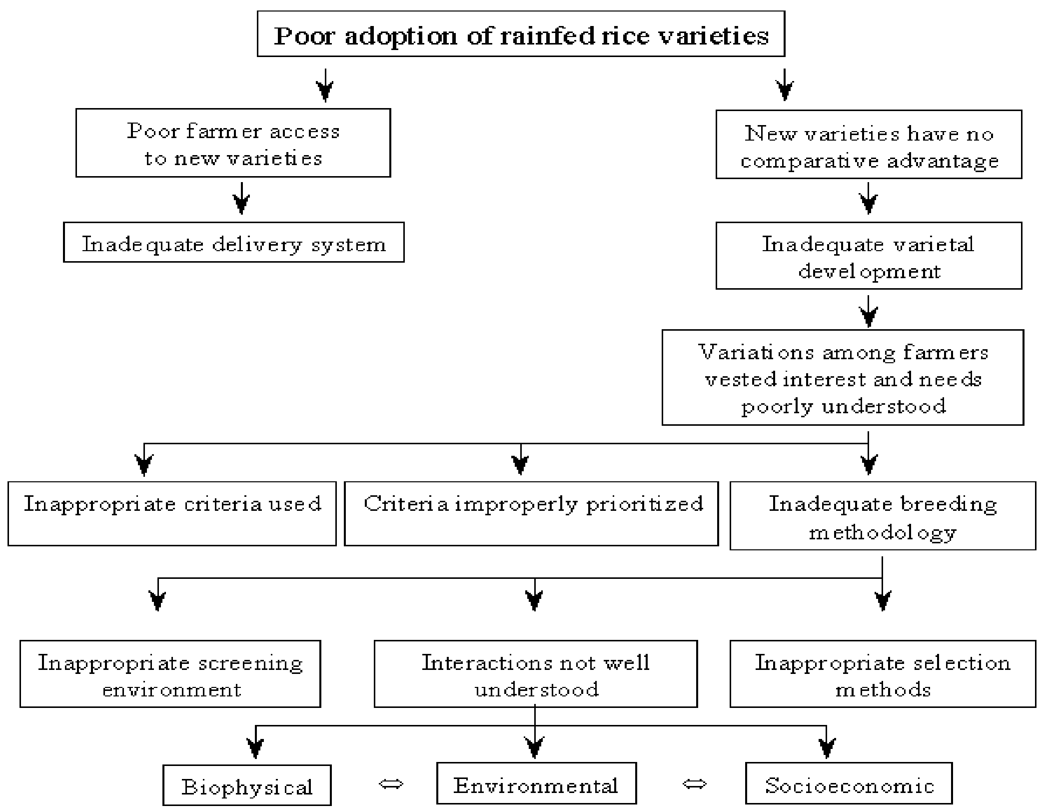

Figure 1. Problem tree for poor adoption of rainfed rice varieties.

Rationale for the Project

The world's largest concentration of rainfed rice is in eastern India (Assam, Bihar, eastern Uttar Pradesh, Madhya Pradesh, Orissa, and west Bengal). This region grows nearly 58% of India's 40 million hectares of rice. More than 80% of the total rice area in eastern India is rainfed. An estimated 450 million people in the region depend on wet season, rainfed rice as their major source of livelihood (Singh 1991). In this region of Asia the potential impact of better rainfed varieties can be the highest.

In India, rice research institutions or universities manage the genetic improvement of rainfed rice varieties. The system has multiple actors and is strongly regionalized. The process has started to change in recent years with the introduction of new breeding approaches like the shuttle breeding program of the Indian Council of Agricultural Research (ICAR)-International Rice Research Institute (IRRI). However, the breeding programs they conduct are mostly classical. Two major features of conventional breeding programs are relevant in the current context. These elements are (1) selection is undertaken mainly on research stations, and (2) the limited participation of farmers.

High genotype x environment (G x E) interactions that characterize rainfed environments call for a decentralized approach to breeding. Conventional breeding programs are conducted at research stations that are meant to be representative of the target environments. However, research stations represent only a small proportion of the target environments. Breeders working in these stations tended to focus on one part of the environment population, usually the one dealing with the most favorable conditions, where impact is easier to achieve.

Little farmer input has occurred in defining selection criteria. In the best situations, these criteria are defined through discussions with social scientists, extension agents, and farmers, although this consultation seldom takes a structured or systematic form, nor are results formally analyzed. The conclusions that breeders reach from these discussions may be erroneous because of poor sampling, unconsciously biased use of questions, and lack of rigorous analysis of farmer's input. Agroecological variations are generally taken care of in setting up the goals of the breeding program, but farmers' divergent needs and priorities, which vary according to their social groups (ethnicity, cast, gender) or degree of market integration (subsistence versus commercial orientation), are seldom formally taken into consideration. Because of genetic correlation between traits, breeding work involves trading off one trait against another. This trade-off strongly influences the end product. The trade-off criteria for farmers and breeders might be different. However, farmers' trade-off among different criteria is rarely captured in these breeder-driven programs.

In the body of the classical breeding programs, participation has been basically absent. Breeding work involved hybridization between complementary varieties. Parents for hybridization are chosen that carry the traits identified in the above-mentioned informal consultation. Using breeding stations breeders then select from among the segregating generations the progenies that combine traits of interest and simultaneously fix the lines through successive selfings. After a few generations, these reasonably fixed lines are tested, first at the breeding station, then at substations representative of different subecosystems, and lastly in farmers' fields, under researcher or farmer management. So farmer participation occurs in the last steps of the process, but most of the on-farm testing is done late in the process with a limited number of very advanced lines, when the variability within and between lines has been reduced. Moreover, on-farm testing seldom involves the farmer as a serious, intellectually active, participant. It is more in the form of using farmers' fields as the testing site with farmers not having any decision-making role regarding crop management.

A farmer participatory breeding program for rainfed rice was developed to address these intrinsic limitations of conventional breeding programs. The project's objectives are to:

(1) Test the hypothesis that farmer participation for rainfed rice breeding can help develop suitable varieties more efficiently, and
(2) Identify stages along a breeding program where farmer interfacing is optimal.

Project Overview

The current project is a research project with two major components:

(1) Plant breeding, with objectives to develop and evaluate a methodology for participatory improvement of rice for heterogeneous environments, and to produce and improve adoption of material suiting farmers' needs, and
(2) Social science, with objectives to characterize cropping systems, diversity of varieties grown, and crop management practices of rice farmers, and to elicit farmers' selection criteria and their reactions to a range of cultivars and breeding lines.

These objectives are intermediate steps for achieving the final objective—to identify cost-efficient mechanisms to incorporate farmer participation in plant breeding and evaluate their effectiveness in improving farmers' adoption of modern germplasm.

The project involves farmers and scientists working in participatory mode. Scientists come from a range of disciplines (economy, anthropology, gender specializations, and breeding). Figure 2 presents the project structure and its linkages with other related projects.

The project sites

The project is based in eastern India. It involves two rice ecosystems and four different sites:

(1) Hazaribagh, Bihar – chosen to represent the upland ecosystem,
(2) Raipur, Madhya Pradesh – for the rainfed lowland ecosystem, represents the "shallow - drought prone" environment,
(3) Faizabad, Uttar Pradesh – for the "shallow - drought and submergence prone" environment, and
(4) Cuttack, Orissa – the "coastal - submergence prone" areas of the state.

Breeding stations are situated at these four sites, and collaborative breeding projects among these stations and between these stations and IRRI, were already on-going (shuttle breeding projects, rainfed lowland and rainfed upland rice research consortia). The existing partnership facilitated the rapid establishment of this diverse and complex project.

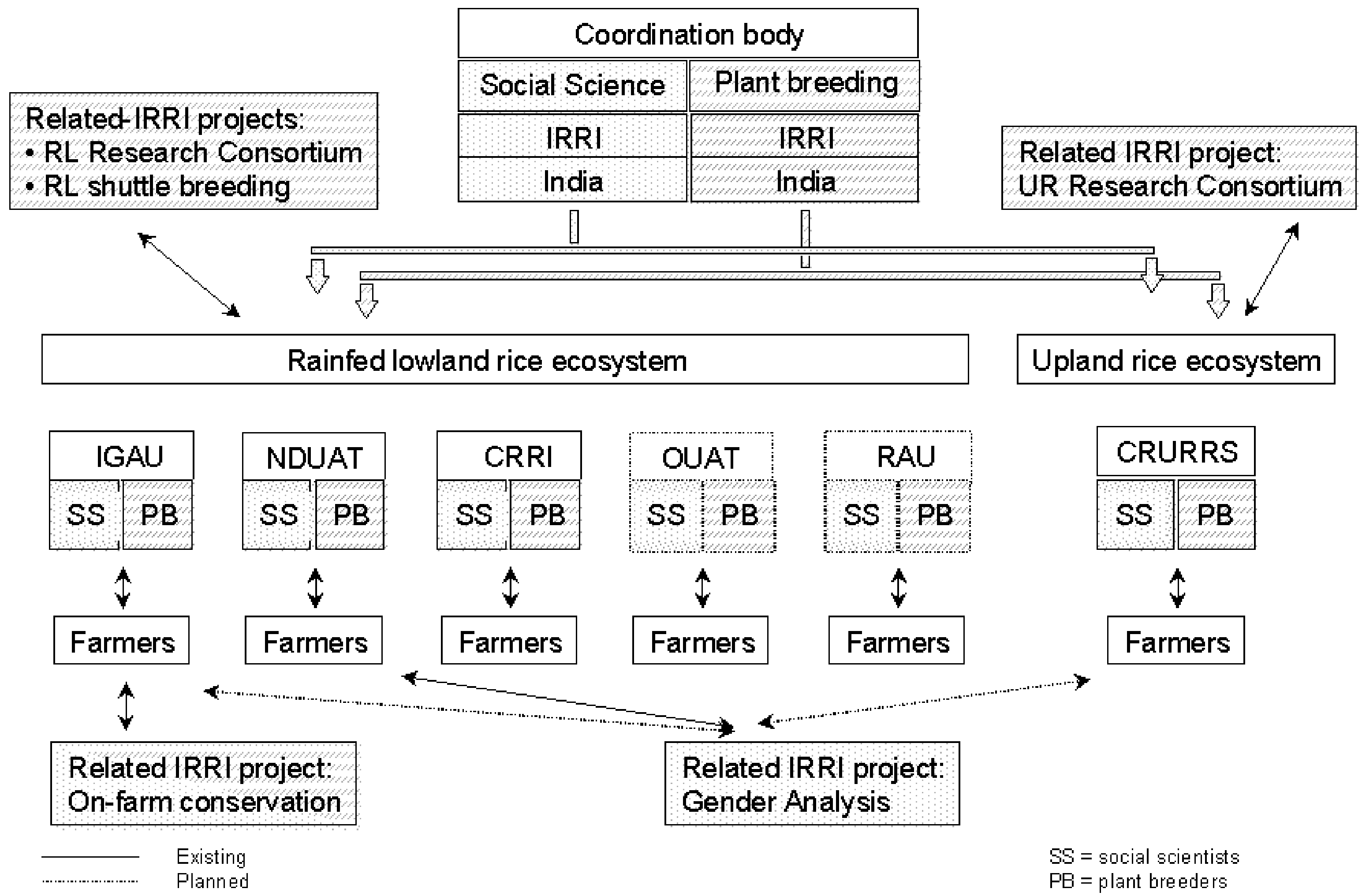

Figure 2. Organizational chart of the project. For acronyms see page XXX.

At each site, two to three villages were selected to cover the existing diversity in the area (Table 1). The bases for selection were the dominant agroecological conditions and especially the hydrology, the extent of adoption of modern varieties, the degree of market integration, and the ethnic composition of the population.

Table 1. Information on villages[a] involved in the farmer participatory breeding program for rainfed rice, eastern India.

Center[b], city, state	Village	Distance from market (km)	Agroecology	Relevant socioeconomic factors	Extent of adoption of modern varieties (%)
NDUAT, Faizabad, Uttar Pradesh	Sariyawan	2	Drought prone	High population density, mixed castes	55
	Mungeshpur	3	Drought prone	High population density, mixed castes	50
	Basalatpur	5	Submergence prone	Lower population density, mixed castes	<20
IGAU, Raipur, Madhya Pradesh	Tarpongi	5	Drought prone	Mixed castes, resource poor	40-50
	Saguni	5	Drought prone	Mixed castes, resource poor	40-50
CRRI, Cuttack, Orissa	Samantarapur	2	Submergence prone	Mixed society, resource poor	10-20
	Kolar	6	Submergence prone	Mixed society, resource poor	10-20
CRURRS, Hazaribagh, Bihar	Chichi	13	Forest	40% literacy	20
	Handio	25	Forest	90% literacy	90
	Khorahar	33	Open	25% literacy	10

a. The villages in Hazaribagh, Bihar State have an upland ecosystem; all others in the table have a rainfed lowland ecosystem.
b. NDUAT = Narendra Deva University of Agriculture and Technology, IGAU = Indira Gandhi Agricultural University, CRRI = Central Rice Research Insitute, and CRURRS = Central Rainfed Upland Rice Research Station.

In each village, a variable number of farmers was selected based first on their willingness to participate in the project. When more volunteer farmers than needed were found, criteria involving the importance of agriculture and more specifically of rice for their household, their cast, gender, and education were used.

The breeding component

We decided to tackle problems sequentially to optimize the utilization of resources. **To allow an easier scaling up of this type of project in the future, we needed to delineate what operations ought or ought not to be participatory**. If better selection by farmers within well-chosen existing varieties or advanced breeding lines (participatory varietal selection [PVS]) was enough to substantially increase the rate of adoption then farmers' participation in the breeding process itself might be unnecessary. We considered PVS as having possibly a high payoff in such situations. Also, it would serve as a starting point for developing a methodology for interaction between farmers and breeders for a fully-fledged participatory breeding program (PPB). However, PVS will not improve adoption if "off the shelf" varieties that are attractive to farmers do not currently exist. To deal with such situations, a PPB component in which farmers selected from segregating materials was also included in the project. The PPB involved testing of F_4 or F_5 material derived from diverse genetic backgrounds, including as a parent traditional varieties that are generally locally adapted, to create suitable material *de novo*. While PVS was conducted at all sites, PPB was carried out from the first year in the rainfed lowland sites and from the second year in the upland site (Table 2).

Table 2. Breeding component in the farmer participatory breeding program for rainfed rice, eastern India, for the 1997 wet season.

Center[a]	Village	Participatory varietal selection[b]	Participatory plant breeding
NDUAT:			
on-station	Faizabad	15 lines	60 F_5 lines
on-farm	Sariyawan	15 lines X 3	60 F_5 lines
	Mungeshpur	15 lines X 3	
	Basalatpur	15 lines X 3	
IGAU:			
on-station	Raipur	16 lines	98 F_4-F_5 lines
on-farm	Tarpongi	16 lines X 2	98 F_4-F_5 lines
CRRI:			
on-station	Cuttack	20 lines	116 F_4 lines
on-farm	Samantarapur	20 lines	116 F_4 lines
	Kolar	20 lines	
CRURRS:			
on-station	Hazaribagh	15 lines	-
on-farm	Chichi	15 lines X 2	-
	Handio	15 lines X 2	
	Khorahar	15 lines X 2	

a. NDUAT = Narendra Deva University of Agriculture and Technology, IGAU = Indira Gandhi Agricultural University, CRRI = Central Rice Research Institute, and CRURRS = Central Rainfed Upland Rice Research Station.

b. X 2 or X 3 means 2 or 3 trials in 2 or 3 different fields in the village.

Benefits from involving farmers in a breeding program arise in two ways. First, testing of varieties on farmers' fields rather than at a research station means that selection is done in a more representative environment. This is the effect of **decentralization**. Second, involving farmers in determining the goals of the breeding program and in determining the selection criteria and actual selection of preferred germplasm could make developed varieties more relevant to farmer conditions. This is the effect of **participation**. These two types of benefits are not mutually exclusive as both can be realized through a carefully designed participatory program. The framework developed permits separating the effects of decentralization per se from farmers' participation. The effect of decentralization is examined through a comparison of materials selected by breeders from experiment station trials and farmer field trials. The effect of farmer participation is judged by comparing the materials that farmers and breeders select in the different locations.

Similar sets of material were tested on station and in farmers' fields to allow comparison of farmers' and breeders' choices in two of the steps of a breeding program (evaluation of advanced lines and selection in segregating generations). In the upland site, another dimension was taken into account by comparing farmers' management to breeder's management in farmers' fields, still with the same set of varieties.

Farmers were provided with a diary and a pen to write down their observations on the different varieties at any time of the crop growth. To complement these individual evaluations, group visits were organized for each site two or three times during the cropping season at relevant phenological stages. Farmers and breeders were asked to evaluate the materials and indicate on what criteria they based their choices. Farmers were also encouraged to see other varietal trials during their visits to the research station and to express their preferences on the material to be included into the next season PVS set.

Farmers' and breeders' selection criteria were compared in two different ways. First, traits of varieties that they selected from varietal trials were compared. This comparison depends on the nature of material evaluated. Second, farmers' and breeders' selection criteria were elicited directly using the survey method. This approach provided a more general basis for obtaining selection criteria. Comparing the two sets of results also permitted a check on how consistent the groups were in applying selection criteria derived from this method.

Although the principle of parallel on-farm and on-station runs was retained for the PPB component, only one farmer's field was used at each site (Table 2). A limited number of farmers, chosen for their expertise, participated in this activity. At some of the sites, some training on the principles of plant breeding was given to the farmers involved. Farmer and breeders performed separate selections. The selection criteria applied were the same as those chosen for evaluating the fixed lines. Material selected one season by a given group (farmers or breeders) and at a given site (on-farm or on-station) was replanted the next season for further selection at the same site by the same group of people, and so on up to fixation of the lines. The divergence of the four sets of material will be evaluated at the end of the project.

The first annual report of the project (IRRI et al. 1998) gives specific details per site on implementation of PVS and PPB.

The socioeconomic component

To capture the diversity of rice production systems, a two-stage stratified sampling approach was used for village and farmer participant selection. In the first stage, the survey villages were selected on the basis of the criteria described above (i.e., extent of adoption of modern varieties, degree of market integration, and ethnic composition of the population). Within each of the selected villages, farmer selection was conducted to capture the diversity of production systems, based on farm size, ethnicity, caste, gender, educational status, subsistence/commercial orientation, and access to inputs.

The selected farmers were interviewed more thoroughly. The survey was based on their memory recall. Social scientists and plant breeders jointly designed a set of three questionnaires, which were pre-tested in several locations. The first questionnaire recorded the general characteristics of agricultural systems, the second collected information on rice production practices, and the third elicited farmers' selection criteria and their perceptions regarding the varieties they grew.

A proper analysis of participation by gender was considered necessary, because farmer perspectives on varietal characteristics are likely to differ by gender. To achieve this, a mix of both female and male farmers was selected, and linkages were developed with an on-going project on gender analysis, which is being implemented at some of the research sites. Questions on participation by gender in rice production and decision making were included in the questionnaire.

A range of methodologies to evaluate material and selection criteria and disaggregate gender effects will be explored. A methodology that will be tested is the use of graphics depicting a number of different traits, and asking women and men to rank the traits according to their importance. Another method will be the use of seed samples when ranking (relative and absolute) the rice varieties. Women and men will also evaluate the cooking and eating qualities of the rice lines and varieties tested on their fields.

Results

Participatory varietal selection

Except in Cuttack, where there were exceptional rains and submergence problems, the experiments were successful and both agronomic observations on the varieties and farmers' and breeder's opinions on their performances and attributes were collected. The villages chosen covered the diversity of local agroecological conditions, but were mostly situated within a radius of 50 km around the breeding station. Even in such small regions, location appeared to be a major source of variation for yield: for example, large differences occurred in behavior of the varieties between sites in Faizabad (Table 3). An analysis of the G x E interactions between the different villages and the station remains to be made to quantify the extent of these variations for different traits.

Only preliminary conclusions can be drawn from comparing farmers' and breeders' opinions on the varieties grown in these trials because of incomplete statistical analysis of the results and the absence of connection with the social science data. The results from Hazaribagh where three on-farm and one on-station trials were scored by 15 farmers and two breeders showed an excellent consistency among farmers' opinions measured by a highly significant Kendall coefficient of concordance for all trials (Table 4). The coefficient of concordance among breeders was higher than among farmers, but not always significant because the significance of this statistic is highly affected by the number of rankers. The concordance between farmers' and breeders' opinions varied from trial to trial, from excellent on-station and in one village to poor in the two other villages.

Table 3. Mean performance of the varieties tested in the participatory varietal selection trials at three locations[a], Uttar Pradesh, India, 1997 wet season.

Varieties	Days to 50% flowering				Plant height				Yield (t/ha)			
	Site I	Site II	Site III	Average	Site I	Site II	Site III	Average	Site I	Site II	Site III	Average
NDR-1	126	119	132	126	140	121	122	127	6.0	7.6	2.6	5.4
NDR-4	119	116	121	119	133	127	140	135	6.0	8.2	4.3	6.2
NDR-6	123	115	127	122	133	129	125	129	5.6	6.2	5.3	5.7
NDR-12	119	114	124	119	135	124	131	130	6.3	6.9	4.2	5.8
NDR-15	118	114	122	119	136	128	131	131	6.1	6.0	4.3	5.5
NDR-20	116	114	118	116	128	118	110	119	5.8	7.7	3.1	5.3
NDR-10	117	102	120	118	130	126	128	138	5.7	6.7	3.1	5.2
NDR-26	120	109	123	117	135	137	141	138	5.0	5.5	4.5	5.0
NDR-25	117	103	122	114	133	135	142	136	5.2	5.6	4.3	5.0
NDR-23	110	115	118	114	162	162	154	157	3.9	5.0	3.2	4.0
Janki	130	129	132	130	157	158	189	168	3.5	3.7	2.6	3.3
Jaishree	121	119	127	122	143	136	167	149	3.3	3.7	4.3	3.8
Vaidehi	131	132	129	131	178	169	178	175	3.0	3.8	4.2	3.6
PSR 3025	123	119	128	123	123	140	134	133	4.8	3.9	4.6	4.4
PSR 1119	122	115	126	121	124	111	126	120	4.5	4.3	2.9	3.5
SEM var.				1.6				4.7				0.5
LSD var[b]				5.7				13.8				1.6
Ave. site	121	116	125		139	135	141		5.0	5.6	3.8	
SEM site				0.9				2.1				0.3
LSD site[b]				2.5				6.0				0.7

a. Site I = on-farm, Mungeshpur, Faizabad district; Site II = on-farm, Basalatpur, Siddarthnagar district; Site III = on-station, Masodha, Faizabad district.

b. $P = 0.05$

Table 4. Kendall coefficients of concordance[a] among and between groups of rankers[b] for Hazaribagh, Bihar, 1997 wet season.

	Chichi	Handio	Korahar	On-station
Concordance between farmers	$W = 0.400$ $P = 0.000$	$W = 0.350$ $P = 0.000$	$W = 0.160$ $P = 0.003$	$W = 0.330$ $P = 0.000$
Concordance between breeders	$W = 0.700$ $P = 0.011$	$W = 0.450$ $P = 0.167$	$W = 0.690$ $P = 0.013$	$W = 0.810$ $P = 0.073$
Correlation between mean ranks of farmers and breeders	$r = 0.240$ $P = 0.371$	$r = 0.540$ $P = 0.031$	$r = 0.040$ $P = 0.883$	$r = 0.840$ $P = 0.000$

a. A highly significant *W* indicates a good agreement between the rankers.
b. 15 farmers and two breeders.

The agreement between farmers and breeders is better when obvious differences between varieties are observed, as in Cuttack where a situation of extreme submergence stress was encountered. The way the ranks are attributed, with rankings of only the preferred varieties (a solution often favored by farmers) versus ranking of all varieties, also affects the results as observed in Raipur. The rankings at the different sites were not always well correlated to the observed agronomic performances of the varieties indicating that yield was not the only factor that farmers or breeders took into account.

Socioeconomic surveys

Although the data from socioeconomic surveys have not yet been fully analyzed, some preliminary findings on varietal choice and adoption of improved varieties are worth discussing. A major factor that determines varietal choice is the conscious attempt of farmers to match varieties to the environment. For rainfed rice, this means an adaptation to the hydrological conditions of their fields. Each field position in the topo-sequence corresponds to a risk of drought or submergence. The drought risk increases from the bottom to the top of the topo-sequence and submergence risk decreases along the same path, associated with progressively lower water depth and earlier recession of the water. This translates into different ideotypes for the different situations, especially in terms of resistance to abiotic stresses and duration: long duration, photoperiod sensitive varieties are well adapted to the bottom lands, but the photoperiod-insensitive upland varieties have to be early to escape the terminal drought. Plant height is also important: a tall variety would work better in high water depth and a semi-dwarf variety would fit in shallow-depth medium lands. Clearly the topo-sequence location is the main determining factor for varietal choice. The more variation between their fields, the more varieties the farmers grow. The number of varieties grown under strict upland conditions is lower than in the lowlands, probably because the upland area constitutes a more homogeneous agroecological zone (e.g., Hazaribagh, Bihar, Table 5). The general pattern is to have a few dominant varieties for each hydrological situation and a significant number of secondary varieties, with some grown by only one farmer. Such a situation indicates a risk of biodiversity erosion because these rare varieties can more easily be lost. The finding that the varietal choice of rice is driven by hydrological conditions is hardly a surprise and vindicates the strategy of existing breeding programs organized according to this parameter.

Table 5. Rice varieties grown in different land types (pooled results of the villages of Chichi, Handio, and Khorahar, Bihar, India (43 respondents).

Land type[a]	No.	Rice varieties
Upland (*Tanr*)	7	Black gora, Brown gora, Dani gora, Karhani, Sathi, Vandana, White gora
Shallow lowlands (*Don* 3)	12	Bhuianlisa, Chain gora, Charka Jonga, CR 306, Haskalma, IR 36, Karahani, Mainathor, MW 10, Saket 4, Sathi, Vandana
Medium land (*Don* 2)	25	Bokhadan, Chodui, CR 314, CR 306, Dghio, Dhushri, Dudharice, Haskalma, IR 36, Jonga, Kalyani, Karanga, Karhani, Kiran, Lalka, Nardha, Raisdhan, Rangi, Ratgoli, Ratna, Saket 4, Sathi, Sita Nata, Tilasar, Vandana
Bottom land (*Don* 1)	27	Adasol, Baghpazar, Bherakabar, Bokadhan, Charkadhan, Dhushri, Dudhkandar, Garibsol, Haldiphool, Haskalma, Jhingasol, Jonga, Jornasol, Kalamadani, Khairasol, Khirdat, Lalka, Mahavirsol, Nardha, Rangi, Ratan, Ratgoli, Rehadadhan, Sita, Sitasol, Tilasar, TN 1

a. Local names for land types in parentheses.

A second determining factor in varietal choice is the adaptation to different user needs: food, livestock fodder, thatching, and cash. Different varieties fulfill different functions. Evidence suggests that these different qualities might be difficult or impossible to combine in one unique variety because of genetic correlations. Creating different varieties rather than trying to produce multi-purpose varieties might better provide for different needs. Considering the diversity of varieties cultivated this is clearly a solution favored by farmers when land resources are non-limiting.

The extent of adoption of improved varieties varied. Adoption was found to be higher in the lowlands than the uplands. The pattern of changes in the number of varieties grown over the past 10 years in a given village showed variable trends. In some cases, the number has increased over time, and in others it has decreased. Nevertheless, the varietal situation is not static and varieties turn over considerably (e.g., Faizabad, Table 6).

Impact Issues and Lessons Learned

Impact assessment is a process of judging the extent to which the project goals have been achieved. As project goals tend to be hierarchical, impact indicators also are hierarchical. In the context of rice breeding, the ultimate project goal is to increase farmer income and welfare in a sustainable way through the development of varieties that are adapted to farmer conditions. An intermediate indicator of impact is thus the extent to which farmers adopt such varieties. As adoption and diffusion of varieties among the target group of farmers can take several years, a short-run indicator of project achievement is a better definition of ideotypes valued by users and development of varieties corresponding to those ideotypes.

The project has been underway for only 1 year. As none of the above indicators can be used to assess "impact" in such a short time, we have instead chosen to discuss the issues and lessons learned during the course of the project to date. These can be viewed as early indicators of potential for impact and a documentation of how the project strategy has evolved over the year.

Table 6. Variations in the number of farmers growing the most popular rice varieties in the past 10 years in three villages of eastern Uttar Pradesh, India.

Rice varieties	Basalatpur			Sariyawan			Mungeshpur		
	1986	1991	1996	1986	1991	1996	1986	1991	1996
Anjani	0	0	0	0	0	0	10	0	0
Ari	0	0	0	2	6	10	0	0	6
Aswani	0	0	0	0	0	0	0	0	4
Bagari	0	0	0	3	2	2	16	9	2
Bengalia	8	14	27	0	0	0	0	0	0
China 4	0	0	0	0	0	0	10	0	0
Farmbagari	6	3	0	0	0	0	0	0	0
Gharbharwa	0	0	0	0	0	0	0	0	12
Indrasan	0	0	0	0	0	1	0	2	6
Jallahari	0	0	0	0	0	0	0	0	3
Jarhan	0	0	0	0	0	0	15	1	0
Kalanamak	6	5	8	0	0	0	0	0	0
Kawari Mahsuri	2	2	9	0	0	0	0	0	0
Lalbagara	0	0	1	0	0	0	5	4	1
Lalmati	0	0	0	0	0	1	0	0	0
Madhu	0	0	0	0	0	0	0	0	6
Mahsuri	25	40	35	0	0	1	8	30	32
Malasia	4	7	29	0	0	0	0	0	0
Motibadam	5	8	7	0	0	0	0	0	0
Mutmuri	0	0	0	9	1	2	20	10	2
NDR-30	0	0	9	0	0	0	0	0	0
NDR-118	0	0	0	1	2	1	0	0	4
NDR-359	0	0	0	0	0	1	0	0	2
NDR-80	0	0	0	4	4	4	0	0	10
NDR-97	0	0	0	0	1	1	0	0	5
Oriswa	2	4	5	0	0	0	0	0	0
Padni	8	0	0	0	0	0	0	0	0
Pant 10	0	0	0	0	0	0	0	0	3
Pant 4	0	0	0	0	0	0	0	0	3
Rajshree	0	0	0	0	0	0	0	0	2
Rambhog	17	5	1	0	0	0	0	0	0
Saket 4	0	0	0	12	8	3	10	10	4
Sarjoo 52	1	0	1	5	30	40	6	10	25
Sarya	22	19	5	0	0	0	0	0	0
Other varieties	0	1	1	0	3	0	1	6	1
Total no. vars. grown	13	11	12	14	8	15	10	14	20

Farmers' versus breeders' selection criteria

At some sites, farmers' and breeders' selection criteria closely matched and at others they differed. The value of farmer participation may be rather limited when selection criteria used by breeders and farmers are similar. It is thus essential to understand the conditions under which the criteria converge or diverge. Our early results indicate that the convergence was closer in areas where production systems are more market-oriented. In subsistence-oriented systems, the higher diversity of farmer goals can lead to a divergence in criteria. The results highlight the need for prior characterization of production systems for judging whether or not participatory breeding is useful.

Biodiversity

Farmers seem to respond to a multiplicity of concerns and needs by growing a range of varieties in rainfed systems. For example, some varieties are valued for their straw quality, some for grain quality, some for earliness and some for high yields. Similarly, varieties are also valued for their adaptation to a specific agrohydrology. The survey results indicate that some farmers grew as many as 12 varieties. Studies have shown that using a diverse range of varieties is a rational strategy in highly variable rainfed environments. Because a single or only a limited number of varieties cannot be relied upon to address a range of farmer concerns, varietal improvement programs that are geared towards generating a broad range of options are likely to be more successful in these environments. An important challenge is to predict which traits will continue to be valued by farmers as production systems undergo changes and become more closely integrated with the market.

Farmer participation

An issue in participatory research is to define when the degree of farmer involvement and commitment is adequate for the project purpose. Sometimes, participation is equated with the use of farmers' fields although farmers and researchers may have little or no interaction. To encourage a truly participatory interaction between farmers and breeders, we included only those farmers who were willing to be involved in the project purely on a voluntary basis. Although some of the breeders felt that farmers also stand to gain by interacting with the breeders (through access to new seeds, information, etc.), not all farmers considered participation as being rewarding in that way. Although participation may be voluntary, whether or not some form of compensation should be given to farmers (especially to small-scale farmers) is an ethical question if some of the experiments failed. Sustainability of a purely voluntary participation through the breeding cycles could also be a concern. Also, voluntary participation can lead to a bias if voluntary farmers have characteristics (such as educational status and wealth) that may not be representative of the target group. On the other hand, participation induced by pecuniary or non-pecuniary benefits can result in other types of biases.

Involving farmers with different socioeconomic characteristics is desirable so that the range of variability can be captured, but social contexts often make this difficult to achieve. For example, involving women farmers in the project was difficult at many sites because women were rather reluctant to participate in activities that required continuous interactions with researchers who were mostly male.

Extent of interventions imposed by researchers

To provide optimum growth conditions and to facilitate comparisons, researchers recommend certain practices that farmers do not currently use. Such recommendations create potential difficulties for farmers who are unfamiliar with these practices. At some sites, planting density was low because farmers attempted to follow the recommendation of planting in a row, despite a lack of familiarity with this method. Obviously, a balance needs to be attained between what may be desirable for scientific analysis and what is feasible for farmers.

Voluntary testing by farmers

At some sites, farmers have indicated their desire to voluntarily expand the area under lines they evaluated as superior. This is an early indication that the project may have led to identification of suitable varieties in the ecosystem tested. Of course, the extent to which farmers respond and persist with such enthusiasm remains to be seen.

Transaction costs

Developing a methodology for an effective partnership between breeders and farmers is a major objective of the project. The framework developed is comprehensive enough to permit the testing of several hypotheses regarding the potential value of farmer participation in breeding programs for rainfed rice. The project was implemented simultaneously at several locations so that the possible value of participatory breeding in a range of environmental conditions could be assessed. Implementing such a comprehensive methodology at a number of sites simultaneously meant that researchers and farmers had to deal with various types of issues, such as:

(1) Organizing dialogue between breeders and farmers,
(2) Assuring the timely supply of seeds,
(3) Arranging and participating in multisite trial establishment,
(4) Management and evaluation, and
(5) Coordinating the overall activity.

These partnerships have considerable transaction costs, which, although often not valued in money terms, are real and non-trivial. A fully functional participatory breeding program would have to somehow find ways of reducing these transaction costs. Our experience in the project agrees with the view expressed by Bentley (1994) that effective farmer participatory research requires both institutional and personal commitments on a sustainable basis.

Time frame

A project of this type where alternative breeding approaches are being assessed needs to be continued for several years because the differences between the lines selected by farmers and those selected by breeders will take that long to be clearly observable and for the traits to stabilize. This longer time requirement, which is a typical feature of breeding programs, thus requires a long-term commitment of both breeders and farmers. A risk exists of farmers losing interest in continually participating in the experiment.

Institutional impact

An early “impact” of the project is manifested in terms of a changing mind-set of the breeders. The interaction with farmers and with socioeconomists involved in the project has helped breeders to better appreciate the multiplicity of farmer goals and the complexity of the environment. Although breeders were aware of these factors before, the project provided them with a systematic framework for interacting with farmers and for factoring in their concerns into the breeding program. The institutional impact of improved communication facilitated by the project among all three groups (farmers, breeders, and social scientists) could be a long-lasting outcome of the project.

Acknowledgement

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PART 5:

MEASURING THE IMPACT OF PARTICIPATORY NATURAL RESOURCE MANAGEMENT

CHAPTER 13

DEVELOPING INTEGRATED PEST MANAGEMENT WITH KENYAN FARMERS: EVALUATION OF A PILOT PROJECT

Michael Loevinsohn, Gerdien Meijerink*, Beatrice Salasya***

Introduction

The farmer field school (FFS) is a group learning approach to building capacity among farmers in integrated pest management (IPM) and other aspects of natural resource management (NRM). This chapter reports on an evaluation of a pilot project in Kenya, one of the first to adapt to African conditions the approach pioneered in Asia. International partners in the project are: the International Institute of Biological Control (IIBC), the Kenyan Ministry of Agriculture and Livestock Development (MOALDM), the Coffee Research Foundation (CRF), the Kenyan Institute of Organic Farming (KIOF), and the Kenyan Agricultural Research Institute (KARI). The Global IPM Facility provided financial support.

Two purposes motivated the evaluation. First, Kenyan and international partners in the project were considering a follow-up to the pilot phase and needed to understand what it had accomplished. Second, the evaluation serves as a case study within a wider review of different types of participatory research and development. It is intended to provide policy makers of the national agricultural research systems (NARS) with greater insights into the costs, benefits, and institutional implications of the choices they must make when taking up participatory approaches.

The FFS: Process and Context

The project was motivated by concerns over the environmental, health, and economic effects of the expanding use of pesticides in the Kenyan highlands. It developed an FFS model drawing on available IPM knowledge, trained trainers from MOALDM and KIOF, and over a 6-month period in 1996 conducted FFSs in four districts of the coastal and central provinces. The FFSs focused on two crops within a diverse agricultural system – coffee and vegetables (cabbage or kale and tomato) – that typically receive the greatest applications of pesticide.

The FFS aims to enlarge the concepts and principles that farmers have at their disposal as they manage their agroecosystems. This is done through experiment-based learning, in groups usually of 15-20, which meet in and around farmers' fields. Among the IPM principles that are emphasized are the promotion of natural biological control, the link between crop nutrition and tolerance to pests and diseases, and the careful observation of field and environmental conditions before taking soil or pest management decisions. The group discusses management options before testing them in a common "IPM field". The importance of trying out options, whether

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proposed by extension or by the farmers, and of continuing such experimentation after the FFS, is repeatedly stressed. Front-line extension workers led the Kenyan FFSs, which continued for an entire crop season, meeting once a week. Important elements of the Kenyan FFSs included a preliminary participatory rural appraisal to focus the curriculum at each site on local concerns, visits among the groups to stimulate innovation, and farmer contribution to the FFS's costs.

Participatory research and development (R&D) in the area of NRM typically has one of two objectives.

(1) "Discovery"-oriented efforts work with farmer experimentation to find solutions to specific resource management problems to which no one has a clear answer.
(2) "Literacy"-oriented initiatives, on the other hand, attempt to build farmers' and communities' capacities to manage resources on a continuing basis. Of course, this entails solving problems, but these are largely problems for which solutions already exist, somewhere. In essence, the groups concerned rediscover them. The Kenyan IPM project was conceived as a pilot effort for a wide scale literacy-type program. However, as we shall see, farmers and trainers at times confronted problems that were more than locally new.

Participatory R&D initiatives can also be distinguished in terms of the scale of resource management they employ. The Kenyan IPM project focused on management at the level of the individual farmer and on the decisions she makes over the resources in and around her fields. Although group learning was a central feature of the FFSs, collective decision making was not featured. However, as farmers and trainers found, several common property aspects demand attention and may be critical for the long-term success of efforts aimed at promoting IPM.

Evaluation Framework and Methods

Figure 1 illustrates the framework that guided the evaluation. Participatory R&D interacts with the local, farmer-led innovation system and attempts to stimulate and often to focus it. The intervention may be to some extent separated from the innovation system, as in the FFS, or it may be immersed in it, in the fields, pastures, forests, et cetera where innovation takes place. This evolving system rests on the five basic processes that underlie any Darwinian system. In agriculture, they are driven by the actions of farmers, whether alone or in concert:

(1) Invention: Farmers decide to alter a practice and proceed to try these variants or options ("variant and "option" are used interchangeably in this chapter). Variants may also be introduced from elsewhere.
(2) Recombination: Farmers combine variant practices in more complex innovations. This may happen after watching how new practices perform in their own or others' fields, reflecting, and discussing with other practitioners.
(3) Movement: Farmers move within their communities and beyond, carrying with them knowledge of their existing variants and examining others that they encounter.
(4) Selection: Farmers decide to try in their own fields a variant that they encounter or themselves devise. They may also decide to abandon a variant they currently use. The first act can be seen as adding members to the population of users of that variant (i.e., births), the second as reducing it by deaths.

(5) Preservation: Variants are remembered and taught. Rules or traditions may reinforce them.

Farmers' selective choices, in aggregate, give rise to birth, death, and dispersal rates of these variant practices and, over time, to change in land use practices at the level of landscapes (for a fuller treatment, see Loevinsohn 1998; Loevinsohn and Simpson 1998). In turn, these changes have impacts in the social, environmental, and economic realms.

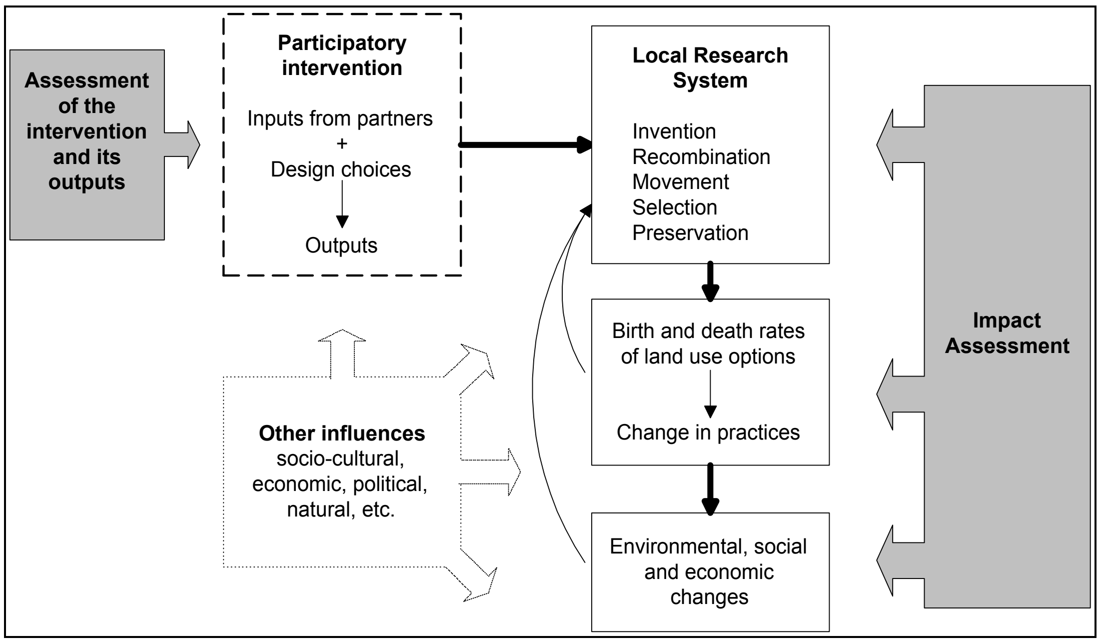


Figure 1. Framework for evaluating participatory research: the local level.

Assessment can occur at the level of the intervention considering the contributions that the various actors made to it and its outputs, for example, in terms of knowledge gained. This was essentially the focus of a participatory evaluation conducted with graduates 5 months after the FFSs ended. The current evaluation drew on this and concentrated on the projects' impacts in the seasons beyond the FFS. The immediate level of impact is on the five basic processes: here assessment considers, for example, how successful the FFSs were in influencing graduates' decision making on their own farms (selection), in affecting the diffusion of ideas (movement), in introducing and stimulating innovation (invention), et cetera. A further level of impact, on farmers' land use practices, integrates the above effects. Finally, impacts can be assessed in terms of social change, enhancement of the environment and natural resources, and improvement in the economic situation of households and communities.

How impacts at these three levels are assessed depends on the intervention's objectives. A literacy-oriented project like this one values changes in the five basic processes that make it possible for farmers and communities to respond creatively to changed conditions or new opportunities. Equity, the evenness with which different social groups are affected, is another perspective on impacts and was also valued by the project partners. A discovery-oriented initiative would likely assess changes differently, for example, putting a premium on the novelty of land use options that result from the intervention. Some of these different perspectives are examined in more detail in Loevinsohn (1998).

Figure 1 does not indicate how the insights from evaluation are used and how they feed back into the local innovation system. In the present study, impact assessment served the interests of the institutional partners and the International Service for National Agricultural Research (ISNAR). Clearly, however, many graduates wished for more immediate use, notably in terms of developing follow-up to an initiative that they considered unfinished. We return to this issue later.

Evaluation methods

The evaluation took place over a 25 day period in late 1997, just over 1 year after the end of the FFSs. Graduates of the FFS and a control group of nearby farmers of similar characteristics (e.g., age, sex, and wealth) were interviewed individually. More focused interviews on gender effects and economic impacts were conducted in an FFS site (Githunguri) and a nearby village. We also interviewed each of the four FFS groups (for details see Loevinsohn et al. 1998).

Evolution of land use practices: birth, death and diffusion. We asked farmers what planned changes they had made in any management practice from one year to the next (Okali et al. 1994). We asked them the source of these changes – whether from their own invention, borrowed from another farmer, or taken from the FFS – and whether they had modified or subsequently abandoned them. We also inquired to whom the farmers had spoken of their experiences in the FFS and who had shown real interest. We then followed up with a sample of these "diffused farmers" to assess what use they had made of what they saw and heard. Demographic methods (Loevinsohn 1998; 1999) were used to analyze changes in specific practices and to project their spread within and beyond the FFS communities.

Capacity to manage resources. This was addressed specifically with respect to pest and crop management, and was defined as the ability to make better decisions in situations beyond that in which the FFS took place, and on a continuing basis. "Better" is judged from the farmer's perspective, in relation to his or her management objectives. We assessed capacity in terms of several indicators:

(1) The extent to which IPM principles and practices were applied to crops other than those targeted in the FFSs,
(2) Farmers' responses to hypothetical, but realistic, situations that required the independent application of IPM principles, and
(3) The extent to which farmers' drew on their own ideas in experimentation.

At the community level, we looked at capacity in terms of the role the FFS groups play in diffusing and further modifying IPM principles and practices, and in tackling common problems, such as marketing. Equity in terms of the spread of knowledge among men and women and among different age classes was also determined.

Social effects of changed practices and capacity. An in-depth study in the all-women's group in Githunguri sought to determine what effect FFS participation has had on household-level decision making and women's status.

Environmental effects. These were assessed in relation to the workdays lost that farmers attributed to pesticide poisoning, and their perceptions and indicators of soil productivity changes.

Economic effects. Changes in production costs and the value of the harvest were assessed in a financial cost-benefit analysis from the farmer's perspective. On the basis of the pilot program's results, the viability of an expanded IPM program was assessed by cost effectiveness analysis.

Impact and prospects within partner organizations. Finally, to gain an understanding of institutional impacts and prospects, we interviewed officers of MOALDM, CRF, KARI, and KIOF at field, supervisory, and national levels. We used a framework for institutional analysis that directs attention to factors influencing institutional capacity, motivation, and performance. We do not elaborate on these findings in this chapter because of lack of space, but they can be found in Loevinsohn et al. (1998).

Impact of the Farmer Field Schools

Evolution of land use practices

The FFS appears to have had significant impacts on innovation by graduates. Figure 2 shows that they have made significantly more planned changes in their farming practices than have nearby control farmers. Importantly, the changes are apparent both on crops that were and were not dealt with in the FFS, suggesting that graduates are not just blindly applying what they learned. The most frequent changes have been with respect to non-chemical pest management practices, particularly in the uptake of botanical, physical, and cultural controls. Also widespread have been changes in soil and nutrient management practices, notably increased use, improved preparation, and more focused application of manure and compost. Mostly these practices were introduced and experimented with in the FFS, but some existing practices (e.g., the "9-hole" planting system in which organic material is placed in pits that also serve to retain moisture) spread from group to group during exchange visits organized by the FFS.

The changes in farmers' pest and crop management practices are reflected in a substantially reduced reliance on agrochemicals, including synthetic fertilizers, insecticides, and fungicides. Again, the effects are visible on both the crops that were and were not targeted in the FFS. Figure 3 shows that, in comparison to control farmers, graduates use much less fungicide on potato, which was severely attacked by blight in the heavy rains of the El Niño year of 1997. Many FFS graduates relied on a locally developed control measure based on milk powder that is said to delay disease progression.

Graduates have usually found that the options explored in the FFS perform adequately on-farm. However, some measures (particularly non-chemical pest control) have shown themselves problematic in certain conditions. This has resulted in several farmers abandoning options. Others have modified them or recombined them with other measures. For example, the milk powder solution against blight is said to work well under low disease pressure, but under high humidity, farmers have found they can only achieve adequate control by supplementing it with a synthetic fungicide.

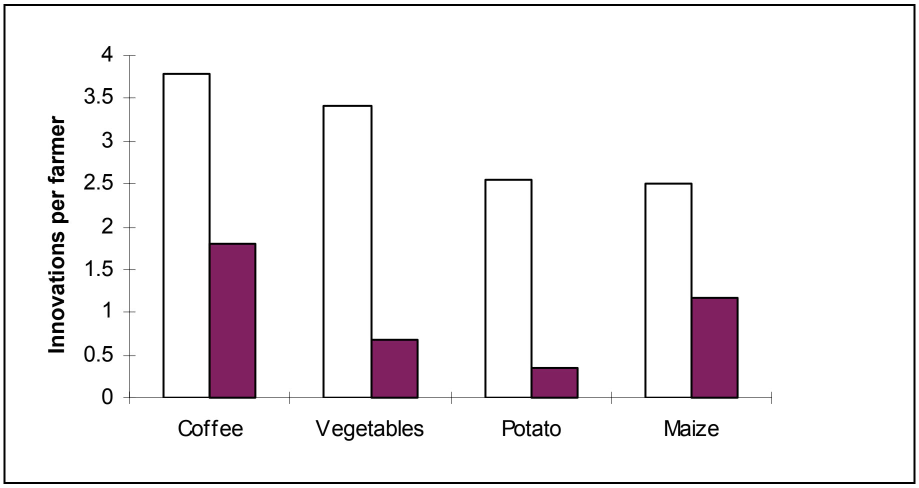


Figure 2. Planned innovations by farmer field school (FFS) graduates and control farmers on crops treated in the FFS (coffee and vegetables) and two other major crops (maize and potato). 1996 and 1997 combined. ☐ = FFS ■ = non-FFS.

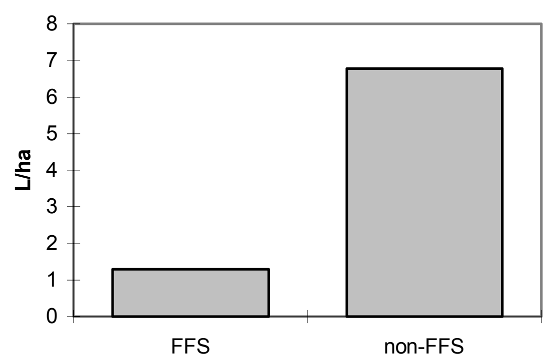
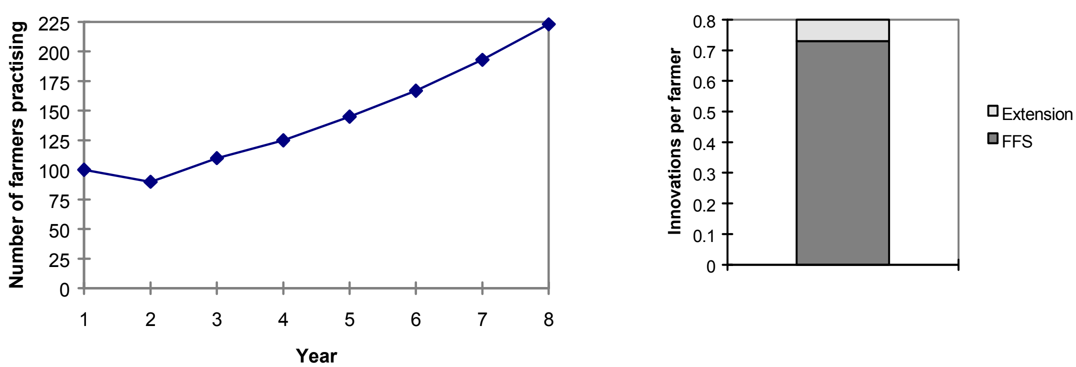


Figure 3. Fungicide use by farmer field school (FFS) graduates and control farmers on potatoes, 1997.

Graduates have spread what they learned during and after the FFS to other farmers, both within and outside their villages. We found that, on the average, graduates had spoken with about four persons who showed “real interest” in the innovations with which they were working. Of contacts, 30% lived outside the FFS village, suggesting a potential for rapid spread. The “diffused farmers” in turn implemented some of the ideas they had seen and heard of, and many were intending to put others to use.

These results show that variants of agricultural practices are being taken up, abandoned, modified, and diffused to varying extents in different situations. What is the overall effect of these actions? Demographic analysis can be used to analyze the dynamics of practices, projecting into the future on the basis of these initial findings, 18 months after the FFS. These analyses must be interpreted with caution. They assume that the options will continue to be born and die at these same, initial rates. Clearly, this cannot be true indefinitely, if only because diffusion must eventually saturate the pool of potential practitioners. Nevertheless, the demographic approach provides a useful assessment of the early fate of new options, whether they are likely to expand soon, or whether they are headed for local extinction.

Figure 4 illustrates the projected use pattern of improved coffee pruning, one of the most popular of the crop management options that farmers were exposed to in the FFS. Abandonment of the option has so far been limited and diffusion slow, but significant. On this basis, the option is expected to spread (Figure 4A). When we asked farmers about the source of their innovation, all responded that it had originated in the FFS, or in one case from extension (Figure 4B). Thus, improved pruning appears to be following a classic adoption process (Rogers 1983). The option, invented elsewhere, is being taken up with little evidence of modification or further experimentation (although farmers did have a chance to examine the practice in the FFS plot). Some other soil and crop management practices appear to be following similar patterns.



(A) (B)

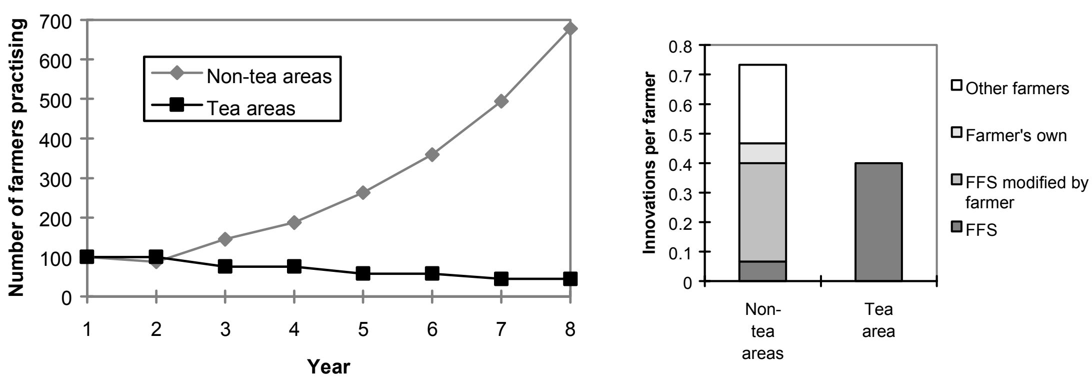
Figure 4. Dynamics of improved coffee pruning practices in the farmer field school (FFS) communities. (A) Projected use based on birth and death rates calculated from interviews with FFS graduates; (B) Sources of innovation in coffee pruning cited by the graduates.

The pattern is different for many of the non-chemical pest management practices. As mentioned earlier, farmers have encountered some problems including lack of efficacy under some field conditions and labor constraints. Figure 5A indicates that botanical pesticide practices are, on current trends, likely to evolve differently in the tea and non-tea growing areas. In the latter (Githunguri, Wundanyi, and Karigu'ini), diffusion is outstripping abandonment and the practice (more accurately suite of options) is set to spread. The sources of farmers' innovations are diverse

(Figure 5B): some use what they tried in the FFS, others have modified these options (a few significantly), some use their own ideas, and others have taken up the ideas of other farmers.

The situation in the tea growing area (Othaya) contrasts markedly. Here, the demands on family and especially on women's labor are much greater. Several women told us that they do not have time to collect plants and prepare the pesticides, largely because of the time needed for harvesting tea. This is reflected in a high rate of abandonment of the options. As the model shows, they are set to die out if present trends continue. We see from the source of innovation analysis that fewer graduates innovate with botanical pesticides than in the non-tea areas and that all of these take their ideas unmodified from what they learned in the field school. A contributing factor to the failure of local innovation is that the FFS group no longer meets in Othaya and does not serve as a forum to discuss ideas and practices and to promote recombination as it does elsewhere. Even if different farmers were trying different variants, an important point of exchange of information on their performance is absent, slowing the technical evolution that the graduates, and those in contact with them, can realize.

Farmers, particularly women farmers, in the tea zone do not appear to have ideas and options within their reach that meet their needs in vegetable pest management. In this situation, a literacy-oriented approach is out of place. What is needed is one focused on discovery that seeks to develop and refine more time-efficient control methods (e.g., through augmentation of natural biological control, or by extending the shelf life of botanical formulations). This would require a more engaged participation of research-minded persons who can make available the most up-to-date thinking and options.



(A) (B)

Figure 5. Dynamics of botanical pesticide innovations on vegetables in the farmer field school (FFS) communities. (A) Projected use based on birth and death rates calculated from interviews with FFS graduates; (B) Sources of innovation in botanical pesticides cited by the graduates.

Impact on capacity

The foregoing discussion provides important evidence regarding the ability of graduates and to some extent their communities to employ what was learned in the FFS in different situations. Graduates have applied principles and adapted practices to other crops than those treated in the FFS (some report that they have also used them in their animal husbandry). They have, in at least some of the sites, modified and recombined options that were not performing well. They have also shown and explained options and principles to many other farmers. The FFS cannot be held responsible for all these effects. For example, the FFS did not create the dedication with which some graduates have gone about educating their neighbors, in one case organizing a training session for another women's group. The most that can be said is that the FFS provided new ideas, which farmers have found useful, that it encouraged experimentation, and that by working through groups it buttressed farmers' adaptation of practices and principles.

Can anything be said, however, about the capacity to apply principles and adapt practices **on a continuing basis**? It might be thought that an evaluation 18 months after the FFS would have little to show on this score. However, attention to the health of the basic evolutionary processes can provide some important indications of the likely future performance of the local innovation system.

Invention. Although overall rates of innovation (birth rates of new options) are much higher among graduates than control farmers, the number of innovations that originated from farmers own ideas is lower (Table 1). In principle, the FFS gave equal weight to ideas put forward by farmers and those presented by trainers: testing and trying options is a value that the FFS attempts to convey. But, testimony from farmers suggests this was not always the case. However, although the FFS possibly devalued farmers' ideas, another explanation must be considered, namely that farmers in 1996-97 were already occupied with so many new ideas coming from the FFS that they did not have time to work on their own. Further evaluation, once graduates have had a chance to work through these ideas, will help clarify whether the FFSs have indeed had any lasting effect on farmers' inventiveness.

Table 1. Innovations by farmer field school (FFS) graduates and control farmers that were said to originate from their own ideas, 1996-97 (number per farmer).

Crop	Non-FFS farmers	FFS graduates
Coffee	0.83	0.25
Vegetables	0.61	0.58
Maize and potato	0.76	0.32

Selection. Testimony from graduates during the participatory evaluation suggests that some of the FFS trainers did not always encourage experimentation by farmers. Experiments that had been run in the Training of Trainers course were in some cases repeated in the FFSs, even when farmers made it clear they were inappropriate (e.g., tomatoes grown out of season). However, farmers also stated that other trainers were more successful in these terms. Among the indicators we used to gauge the impact of the FFS on farmers' decision making were graduates' reactions to the following hypothetical situations.

(1) A company salesman was recently (in a nearby village) promoting a new pesticide, which he says kills (local name for the diamond-back moth) better than (a popular insecticide). What will be your reaction if he brings the same message here?
(2) What will you do if, next season, you find an insect you have not seen before eating the leaves of your maize crop?

The answers were assessed in terms of how far they indicated (a) reliance on farmers' own resources (e.g., exercising independent judgement, trying first on a small scale), and (b) the application of IPM principles (e.g., primary reliance on non-chemical methods, ensuring plant nutrition). In both terms, graduates scored significantly higher than did control farmers (Figure 6). Together with other indicators, this suggests that on the whole the FFS has had a real and beneficial effect on graduates' decision making.

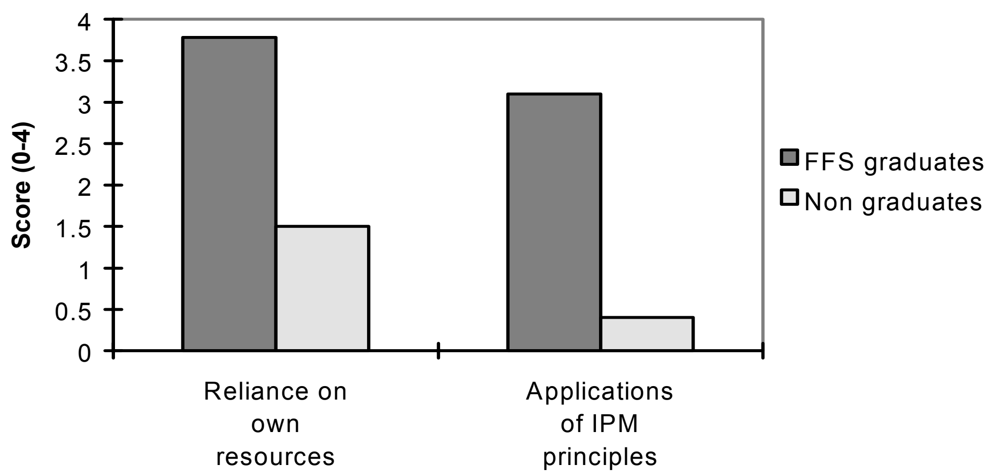


Figure 6. Scores of farmer field school (FFS) graduates and control farmers in hypothetical situations designed to assess decision making in crop management.

Movement. Diffusion of IPM principles and practices has, on the whole, been relatively rapid in the period since the FFS, and men and women can be seen to have contributed equally to this. However, the process has tended to be rather gender-specific: men were found to diffuse primarily to men and women to women (Figure 7). In theory, this could lead to highly unequal benefits going to men and women farmers unless care is taken to ensure equal representation in the FFSs. In practice, much will depend on the extent to which knowledge is shared within the household. Evidence on this score is mixed: some graduates claim the flow has been efficient, others that new ideas have encountered resistance. Further follow-up will be needed to assess the effect of gender-specific diffusion.

Potentially more worrisome is the evidence regarding age class-specific diffusion. Neither men nor women graduates reached out much to the young: farmers under 30 years of age constituted only 10% of the "diffused" group. The composition of the FFSs was also skewed against the young: only 5% were farmers under 30 years of age.

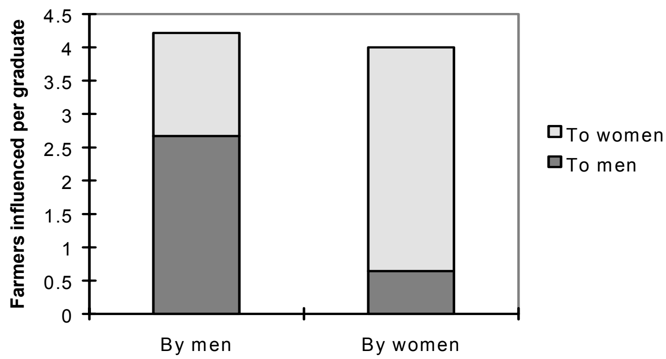


Figure 7. Number of farmers contacted by farmer field school (FFS) graduates who showed "real interest" in their innovations.

Local institutions: group processes and collective action. The FFS groups remain active in three of the four villages and continue to play roles in stimulating invention and recombination. It seems unlikely, however, that these functions alone will be sufficient to maintain active interest if an input of new ideas on which to work is not available, from whatever source. The extension system has yet to provide this, and continuing links with other groups have not been maintained. However, at least two of the groups are branching out in new directions, in particular running credit schemes drawing on members' savings. Such multiple functions may be critical to the groups' survival.

Several of the groups believe that real progress is only possible if they move beyond their current level of exploitation. Marketing is a particular area where they see opportunity for this. Local consumers recognize the quality of their vegetables (taste and appearance are more important than low pesticide residues), but are not prepared to pay a higher price. Links with quality and nascent organic markets in the cities have not been established and marketing issues and skills did not figure in the FFS curriculum. The groups' reputation for quality produce can be seen as a common property resource that can be intelligently managed for the benefit of their members. Attaining an adequate scale of production will be critical, and groups may find an advantage in developing marketing arrangements jointly.

Taking together the evidence regarding the capacity of graduates and their groups to make better management decisions in different situations, and on a continuing basis, it can be said that the FFSs have had some real impact, but that important gaps exist. The importance of following up on the brief intervention is clear.

Effects of changed practices and capacity

Social effects. Men and women farmers were about equally represented in the FFSs and, after graduation, have innovated in similar ways on their own farms. As we have seen, however, graduates, particularly women, have considerably abandoned labor-intensive crop and pest management measures in the tea zone suggesting that benefits to this group will be limited. Githunguri, where the intensive study was conducted on the consequences for women of participating in the FFS, is not in the tea zone and hence could not shed light on this issue. However, particular attention was paid to the effects on women graduates of the coffee-related aspects of the FFS. Coffee in Kenya has traditionally been a man's crop, as they dominate in its management and hold title to the trees. The skills that women graduates acquired appear to have had two effects. First, some women have engaged in contract labor for coffee pruning — unheard of before the FFS. This has given them an extra source of income, besides the selling of vegetables, which is the most common income generating activity for women in the region. Second, women have also increased their role in coffee management on their own farms (Figure 8), because many husbands have recognized their expertise and come to value their opinion. The fact that many Githunguri men find off-farm employment in nearby Nairobi has likely facilitated these changes.

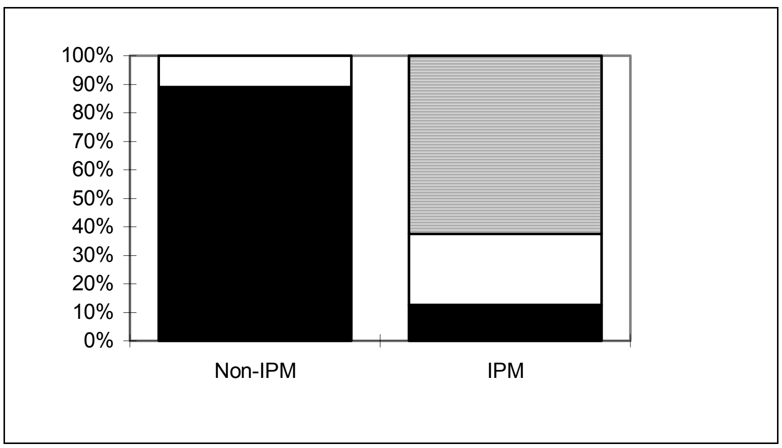


Figure 8. Gender division of labor in pruning coffee, Githunguri. ▭ = Women ■ = Men ▤ = Both.

What effect this greater role in management has had or will have for the women is not clear. The coffee trees and their proceeds remain in the men's hands, as does membership in the coffee cooperative, which brings with it some privileges. These relationships have not changed, nor did the project aim at affecting them. It may be that with time, and in combination with other secular trends, women's greater role in coffee management will erode some of these structural inequalities. A nearer term prospect is that they will gain more influence in household decisions over the use of coffee revenues, decisions that are already taken jointly to some extent in many households. Follow-up investigation will be needed to clarify this.

Environmental effects. As noted above, farmers' use of pesticides have been substantially reduced. A single indicator of pesticide-related health effects was assessed: days lost to illness that farmers attributed to pesticide poisoning. Although many reported days lost in previous years, only two non-FFS farmers reported 5 days lost in 1996-97, compared to one FFS graduate (2 days). The difference is of course not statistically significant. However, over a wider area and a longer time, reductions in pesticide use of the magnitude found here would be expected to yield substantial benefits in terms of chronic and acute illness (Rola and Pingali 1993; Kishi et al. 1995).

Farmers have also increased their use of manure and compost. All FFS graduates (20) reported that their soils had improved in quality over the past 2 years. In support, they cited a range of evidence, including increased abundance of certain indicator plants and improved soil texture. In comparison, only 45% (10 out of 22) of control farmers thought their soils had improved. Some graduates cited specific benefits; for example, better tolerance of mid-season droughts from improved moisture retention.

Economic effects and projections. The economic benefits from these changed practices are significant. Considering only the savings from reduced agrochemical use, they amount to Ksh 8600 per year ($145 per year per household). They are likely complemented by other economic and environmental benefits to which assigning an accurate monetary value was not possible. A financial analysis that makes conservative assumptions about how long these benefits last (3 years), and the rate at which IPM practices spread and are taken up by neighboring farmers, suggests that the project repaid its costs ($48,000) with just the four FFSs that it conducted. Trainers in Asian countries typically conduct two FFSs per year, and if we assume the Kenyan trainers worked at this rate and that these field schools had the same benefits ($12,800) and costs ($4500) as the initial ones, the benefit-cost ratio after one more year would be 2.2. The greater intensity of supervisory involvement in the pilot phase is among the factors that need to be weighed in projecting results to a wider scale (Loevinsohn et al. 1998).

Lessons Learned

What has worked in participatory R&D?

Among the design elements of the participatory process that our evaluation suggests have been most successful has been the impetus given to the movement of ideas by organizing group visits. This has resulted in the rapid spread of several options, particularly in the areas of soil and nutrient management. However, in the aftermath of the FFS and without outside support, the groups have yet to find the means to continue the visits or to identify other groups with whom exchange might be worthwhile. Also successful has been the discovery-based learning that went on in the FFSs. Through observation and simple experiments, farmers learned key principles, such as the importance of natural biological control and the capacity of crops to tolerate substantial early defoliation, which have in turn given rise to a range of innovations, including several attempts by farmers to enhance biological control. We also witnessed the confidence with which farmers showed insect parasites to visiting extension officers, who were clearly taken aback.

What has not worked?

Consistent and effective encouragement to farmer experimentation is the design element of the FFS that has proven most problematic. The confidence of graduates in experimentation clearly varies considerably, a variation that doubtless predated the FFS. Similar variation was evident in the skill with which some of the trainers took on the facilitation of the FFSs. Encouraging farmers to find solutions to their own problems, rather than providing them answers, represents a considerable departure from the usual extension practice and requires more than a single Training of Trainers course and a season-long FFS to master. An expanded project should pay particular attention to improving trainers' skills in this area and seek to assure quality.

What has worked in impact assessment?

Several difficulties beset the impact assessment of FPR, indeed of any significant intervention of this kind. These include the problem of linking action to effect in a complex environment in which many factors intervene, and the risk of presenting a highly partial view of impacts based on an evaluation conducted at only one point in time (particularly as here, relatively soon after the intervention ended). In the present case, problems of the first sort have been eased by the use of a control group of nearby farmers, making it possible, for example, to rule out price changes or weather as explanations for the marked decrease in pesticide use by graduates.

The evaluation framework, based on evolutionary theory, has also proved useful with these problems. It helps in attributing effects to the participatory intervention by setting out a path between them, and indicating intermediate points where consistent results should be sought. For example, the economic benefits that graduates realize from reduced expenditure on synthetic pesticides on a range of crops can credibly be linked to the FFS because innovation in and spread of alternative control measures are evidenced and because farmers appear to be making their selective decisions differently. Conversely, where benefits are not being achieved, as among women farmers in the tea zone, the framework helps elucidate where the problem arises. In this case, the pest control options themselves are being selected against, and local innovation to adapt them appears strongly limited, possibly because of a breakdown in the group processes.

The framework also helps with the problem of evaluation "snapshots". We learn not just how many people are using a particular option at one point, but also how many users are "dying" and how many are being "born", thus making it possible to project use patterns into the near future. More sophisticated models incorporate the spatial dimension of spread, based on information of where the "diffused" farmers reside. But, beyond the quantitative, demographic analysis, careful attention to the "health" of the five basic evolutionary processes provides a basis for assessing the continuity of innovation, which is critical to the ability of rural communities to respond to accelerating change, and central to any meaningful definition of sustainability.

How could the approach be improved?

A problem we encountered in the evaluation was in censusing farmers' innovations and assessing their experimentation. Farmers' initial responses in an interview often understate the range of new options they are trying. More is involved than finding a common vocabulary. Some innovations are recalled only after a time, after the memory is jogged. Some are forgotten. We also met graduates who seemed reluctant to admit they had modified an option introduced in the FFS, apparently because they felt it might be somehow disloyal. Would a more participatory approach to monitoring and evaluation, in which farmers themselves were asking or noting, in a more immediate fashion than we were able to achieve, help overcome these problems? Possibly, but would farmers have an interest in doing it? Would they be interested by the health of their innovation system, that is, beyond the emergence of particular innovations? And can the framework be made sufficiently accessible to them? These questions remain to be explored.

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CHAPTER 14

TOWARDS PARTICIPATORY MANAGEMENT OF NATURAL RESOURCES: EXPERIENCES FROM THE CALICO RIVER WATERSHED IN NICARAGUA

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Introduction

The Hillsides project

In this chapter we present the work in progress of the CIAT Hillsides project, which is action-oriented. It aims to develop strategic knowledge and a series of methodological instruments to support and improve decision making about the management of natural resources through collective action at the landscape level, more specifically in fragile hillsides environments.

The four specific objectives defined are to:

(1) Develop an information management system that is accessible, interactive, and dynamic,
(2) Identify indicators and design methodological instruments to introduce, test, adapt, and replicate "change factors," including technologies, policies, and organizational forms,
(3) Strengthen inter-institutional relationships and improve coordination of activities, and
(4) Diffuse project results among national and regional institutions and provide training in the use of the methodological instruments developed.

The project combines participatory research methods at the community, micro-watershed, and watershed levels to develop alternative land management scenarios. Methods include participatory technology testing with farmer groups, diagnostic studies, gender analysis and research on organizational processes, Geographic Information System (GIS) tools, policy research focussed on testing new incentive schemes and ex-ante analysis of alternatives, and modeling. Fieldwork is carried out in different watersheds in the hillside areas in Colombia (since 1993), Honduras (since 1994), and Nicaragua (since April 1997). This chapter focuses on the research efforts developed in Nicaragua.

Developing a set of methodological instruments

To date, nine interrelated methodological instruments have been developed and used. For each tool, a methodological training guide was produced in Spanish. This set of instruments is currently being presented and validated to a broad audience in a series of workshops in Honduras and Nicaragua (Barreto et al. 1998; Vernooy, 1998a). The guides are:

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1. Participatory method for identifying and classifying local soil quality indicators at micro-watershed level (Turcios et al. 1998).
2. Photographic analysis of land use tendencies in hillsides (Lopez 1998).
3. Participative mapping, analysis, and monitoring of natural resources in a watershed (Vernooy et al. 1998).
4. Methodology for analyzing groups of interest for collective management of natural resources in micro-watersheds (Westermann et al. 1999).
5. Identifying levels of well being to construct local profiles of rural poverty (Baltodano and Méndez 1998).
6. Atlas of Yorito and Sulaco, Yoro (Honduras) (Barreto et al. 1999).
7. Identifying and evaluating market opportunities for small-scale rural producers (Ostertag 1998).
8. Use of simulation models for ex-ante evaluation (Estrada et al. 1999).
9. Developing processes of organization at local level for collective management of natural resources (Beltrán et al. 1998).

In assessing the overall use and utility of the methodologies, answers to the following questions will be sought:

(1) Do people use the guides?
(2) Which people use them—men, women, poor farmers, rich farmers, technicians, policy makers?
(3) How many people use the guides?
(4) For what kind of decisions are they used?
(5) Has the quality of these decisions improved?
(6) As a result, has a positive impact been made on the natural resource base?

Different techniques are used or being developed to assess (monitor and evaluate) the progress of the various research activities, the involvement of different user groups, and the usefulness of the methodological instruments.

The research area

The area of research in Nicaragua is the watershed of the Calico River, located in the southern part of the department of Matagalpa, about 125 km northeast from the capital, Managua. The Calico River is a tributary of the Great Matagalpa River. The watershed covers about 170 km^2, including the municipality of San Dionisio (145 km^2) and small parts of the neighboring municipalities of Matagalpa, San Ramon, and Terrabona. It forms part of the central hillsides range of the country and is characterized by a semi-arid climate (1100-1600 mm of rainfall per year). Altitude ranges from 350 to 1250 meters above sea level. Agriculture is mainly small-scale farmer production systems based on a combination of maize-beans, dual-purpose livestock, and coffee in the higher altitude zones. Land tenure is highly uneven, with an important number of landless households estimated at about 15% of the families (Baltodano et al. 1997).

The major problems confronting the population are poverty, lack of health and educational facilities, poor housing conditions, dependence on maize and beans (no or few production alternatives), soil degradation, scarcity of water, and deforestation. According to a 1996 poverty study using income and expenditure indices, 76% of the population in the San Dionisio municipality is estimated to be poor; and the municipality is among the group of poorest municipalities nationwide (Arcia et al. 1996). Our own findings, based on the elaboration of rural poverty profiles using **local** perceptions of well being, confirm this high percentage of families living under conditions of poverty. People in the watershed identified key factors contributing to this situation (Baltodano et al. 1998) as:

(1) The scarcity of both animals and land, which causes many farmers to rent land,
(2) The difficulty in constructing a proper and decent house, and
(3) The low income obtained from farming, which forces many to work additional hours as day laborers.

Identifying problems and opportunities

A participatory workshop was held on watershed management in September 1997 involving a mixed group of 30 watershed inhabitants (women, men, farmers, nongovernment organization (NGO) staff, and representatives of ministries and the municipal government). They analyzed key problems affecting the watershed landscape and the livelihood of the population at various levels (community, micro-watershed, and watershed) as being land degradation, deforestation, and water scarcity and pollution. The participants also identified the existence of several conflicts between neighboring communities about access to (drinking) water, and between community members more generally and the Natural Resources Ministry about the illegal cutting and extraction of lumber. Conflicts about land also persist (Vernooy 1997).

The organizational situation encountered at the start of project activities, could be characterized by the uncoordinated presence and interventions of some NGOs:

Programa Campesino a Campesino (PCC),
Cooperative for American Remittances Everywhere (CARE),
Proyecto de Desarrollo de San Dionisio (PRODESSA)-Union de Campesinos Organizados de San Dionisio (UCOSD),
Organización de Desarrollo Sostenible Agricola (ODESAR), and
The Indigenous Association of Matagalpa.

Each of these operates in one or more of the seventeen rural communities in the Calico River watershed providing technical support (e.g., soil conservation techniques, reforestation, diversification, and postharvest treatment), credit, and marketing support and training, sometimes serving simultaneously, but independently, the same rural households.

San Dionisio has a Comité de Desarrollo Municipal (Municipal Development Board [CDM]), mainly dedicating itself to infrastructural work. It is made up of representatives of the ministries at the municipal level (i.e., Health, Education, Water, and Social Action until 1996), the municipal council, and the PCC. At the community level, Drinking Water Committees in charge of maintaining the rural drinking water system, Parent Committees (attached to rural primary schools) and a variety of church groups are active. Conversely, the Ministries of

Agriculture and Livestock, Natural Resources and the Environment, and Agrarian Reform are scarce or almost non-present in the area.

We defined this situation primarily in terms of an opportunity for action, for:
(1) Contributing to improved participation at the municipal (San Dionisio) and watershed levels, in particular by people from rural areas,
(2) Stimulating better coordination and thus increasing the impact of efforts and avoiding duplication,
(3) Facilitating harmony contributing to conflict resolution, and
(4) Exploring options for the development of an integrated management plan.

In meetings and conversations with staff of NGOs and members of the CDM, we learned that they were aware of the lack of coordination, duplication of efforts, and the opportunities for more concerted actions. However, as several of those interviewed pointed out, no initiatives were undertaken to do anything about this situation.

Working principles

We took these problems into account and considered lessons learned from other project experiences (Vernooy 1998a) to define some working principles (or hypotheses) to guide the research steps. The working principles are based on the assumption that improved participation by local people is a prerequisite for improved resource management. They are:

(1) Building and involving local organizations is used as a means of changing the ways in which local groups interact with each other and with the broader society (Uphoff 1992). Here the goal is to attain greater and more equitable control over resources (Claridge and O'Callaghan 1997) to:
   (a) Amplify the range of options of the less privileged (e.g. women, ethnic minorities, and the landless),
   (b) Enhance their involvement in policy-making processes at the regional or national levels,
   (c) Provide space for more people to make their voices heard, and
   (d) Improve the quality of their involvement.

(2) Watershed resources are used by a variety of direct and indirect users with different and sometimes opposing or conflicting interests, or stakes—hence the concept of stakeholders (Malanson 1993). This is particularly true in the highly agroecologically diverse hillsides environments such as can be found in Central America (usually with high population densities). To organize for sustainable management at the watershed level we must therefore identify these stakeholders and recognize that stakes could change over time. This requires a continuous analysis of the configuration of stakeholders and stakes (Cernea 1989; Anderson White and Ford Runge 1995).

(3) A forum is provided for analysis, discussion, and negotiation where ideas can be exchanged and initiatives planned. This is important to allow stakeholders to participate. The building of trust is essential, but may take time and patience. Recognizing the strengths and

weaknesses (comparative advantages) of different players is also a key principle that helps build the required trust.

(4) The process of organizing needs to focus on defining (new) rules and norms for equitable resource use (Bromley and Cernea 1989). This will require informed communities (user groups, stakeholders) with the capacity to engage in dialogue and to undertake particular tasks. This in turn requires an appropriate level of community or grassroots organization, based on managerial capacity at the local level involving both rural institutions (with rules and regulations) and organizations (Campbell 1994).

(5) Local-level monitoring of resource use is required to ensure compliance and regulation (Ravnborg and Ashby 1996). To achieve better resource management practices through cooperative actions, rules, and sanctions, local people and those cooperating with them must have a good understanding of the resource dynamics (e.g., soil dynamics, nutrient flow, and water cycles). Monitoring will help raise awareness among local decision makers about the interdependencies of resources and, if carried out collectively, can easily create ownership, skills, confidence, and credibility.

(6) Building linkages between local communities and the level of national institutions and policy makers helps local actors exert a demand for services and influence policy agendas. This includes the integration of government into the local planning process so that interests and concerns are taken into account, and the sourcing of technical assistance and expertise transfer.

(7) Integration and working in concert are important objectives of the organizing process. The ultimate goal of developing more sustainable management practices is to integrate planning efforts from the level of farm to micro-watershed to watershed. This requires bringing together the direct users of the resources who are living and/or working in the watershed. However, outside or external users of the resources may also exist, and efforts will need to be made to likewise involve them in planning efforts. They may have different interests compared to the users living in the area; this would require bridging or negotiating internal versus external interests in the watershed (Ashby et al. 1998).

Results and Impacts

Paving the way: Research underway

Research was or is being carried out on a series of interrelated subjects. A project objective is to develop indicators and procedures for the local management and monitoring of the natural resource base, with a focus on the micro-watershed level. Two activities are underway to achieve this objective:

(1) Identifying local soil indicators as an input for the design of a "soil quality score card", and
(2) Participatory mapping and analysis of the natural resource base at the micro-watershed level as input for the design of an indicators set for resource base monitoring.

The aspiration behind these activities is to develop more manageable yet sensitive indicators for diagnosing and monitoring the local resource base.

Identification and ranking of local soil indicators

In 1997, based on fieldwork in the Cuscateca watershed, Danli, Honduras (Burpee and Turcios 1997), a preliminary "soil quality score card" was developed using **locally** determined indicators of soil quality. The card was designed using the results of a series of workshops in which farmers define and rank, as a group, sets of local indicators that define soil quality. Subsequent workshops in Yorito, Honduras and San Dionisio, Nicaragua provided additional results allowing a refinement of the methodology. In Nicaragua, the work on local soil indicators is carried out in close cooperation with the Universidad Nacional Agraria (UNA). The refinement includes:

(1) An analysis of soil formation factors and processes,
(2) Practical guidelines for the organization of a *Feria del suelo* or Soil Fair, during which farmers themselves analyze a number of physical and chemical soil characteristics or properties such as pH, organic matter, texture, structure, consistency, and color, using soil samples from their farms, and
(3) The differentiation between indicators that on the one hand define (more) permanent characteristics, which are therefore difficult for intervention and, on the other hand, changeable or manageable soil characteristics (at the short- or medium-term), which would allow farmers to intervene more easily by changing agricultural practices (Turcios et al. 1998).

Reactions from farmers and technicians who participated in the workshops in Honduras and Nicaragua have been strongly positive. Through verbal feedback and written evaluation questionnaires, which were handed out at the end of each workshop (see below for an example), they have manifested that this methodology is useful to better understand soil dynamics, including soil depletion, and that it should be diffused widely at the community level.

<u>Evaluation questionnaire at conclusion of workshop</u>

How did you like:

- The work with the soil samples (Soil Fair)?
- The presentations about soil quality?
- The integration of local soil indicators with the analysis of diagnostic properties?

And

- Did you understand what the researchers explained?
- Do you believe that other farmers should learn this methodology?

A challenge ahead is the revision of the draft "score card". The revision will take into account recent results, "score card" distribution at the community level, and the monitoring of its use and utility by different farmers (men and women) with land in different parts of the watershed, different soil types, and production systems.

Participatory Mapping, Analysis, and Impact Monitoring of Natural Resources

Recently, we completed a series of participatory micro-watershed analyses and related workshops to present the methodology and results (Espinoza and Vernooy 1998; Vernooy et al. 1998). This activity involved small groups of local key informants, men and women, in each of the fifteen identified micro-watersheds—farmers and/or local technicians, promoters, or assistant-mayors who know the area well. These analyses include gender-"sensitive" resource mapping and a description of land use (agroecological zones), the state of forests, water resources, crops, wildlife, domesticated animals, pastures, soils, and the identification of limitations and opportunities for agricultural production and NRM in the area. Based on the findings of these analyses, a preliminary set of natural resource indicators was developed and validated that will be used for monitoring purposes and for comparing the state of the natural resource base in the different micro-watersheds.

The aim is to present the results of these analyses to key local decision makers, such as the mayor of San Dionisio, state agencies, and NGOs operating in the watershed and to the recently created Association of Community Organizations (which is considered a key stakeholder "in the making," see below). The results will allow decision makers to identify priority zones for action: because natural resources are already degraded or may critically become so soon, or because areas offer opportunities for alternative management practices.

Based on findings of verbal and written evaluations at the end of workshops, we may conclude that local people have successfully participated in and assessed the development of this methodology. A key assessment factor will be what use local decision makers at the micro-watershed and watershed levels make of the tool in the assignment of resources and activities.

Strengthening existing and developing new organizational forms and processes

In terms of strengthening organizational processes in the area (an objective of the Hillsides project), in 1997 the CIAT Hillsides team came to an agreement with the PCC in San Dionisio to form Comités de Investigación Agrícola Local (CIALs), or local agricultural research committees. The idea is to provide local communities with a methodology to carry out a participatory research process focussing on and solving a locally felt NRM problem (to be identified in a participatory problem analysis); and as such enhancing local organizational capacity (Ashby 1990; Ashby et al. 1997). Simultaneously, CIALs are seen as potential building blocks for an organizational process and structure at the micro-watershed and watershed levels dealing with cross-boundary NRM problems and opportunities. CIALs could become involved in carrying out experiments at the landscape level dealing with, for example, pest management, soil erosion, or fire and fire control.

Four CIALs were formed in 1997 and have functioned relatively well during the first cycle of experiments, according to evaluations carried out by the CIAL members themselves. These evaluations included an auto-evaluation form that each committee members completed on:

<u>How do you evaluate?</u>

- Your experience as a member of the committee
- Your experience with the management of the rotating CIAL fund
- The completion or accomplishment of tasks
- The results of the experiment
- The participation of community members in meetings
- The knowledge of community members about the experiment
- The technical support received

Written presentations were also prepared for a regional workshop in San Dionisio, in February 1998 (*El primer encuentro de los CIALs de San Dionisio*, or the first gathering of the CIALs of San Dionisio). For the presentations, we asked each committee to present what they had learned so far, what their future plans were, and what they expected or demanded in terms of training and technical support (Vernooy and Espinoza 1998). The following summarizes their evaluations:

<u>CIAL-Piedras Largas</u>
"It was good to learn about new seed varieties...
The community was not very supportive of the CIAL...lack of motivation...
Continue experimenting with beans and maize....
To motivate the community to increase the number of people participating in the experiments.....
We need training in integrated pest management, organic fertilizers."

<u>Women's CIAL-El Jícaro</u>
"The experience helped us improve...
It helped us tell the community about our ideas...
Despite our bad results we learned new things each day."

<u>CIAL-Wibuse</u>
"The experience motivated us to work together...
We have learned how to experiment and select (seeds)...
We did not receive much support from the community...
Increase people's motivation...
Improve the organization of the committee...
We would like to receive stronger technical support."

<u>CIAL-El Jícaro</u>
"We received good support from the community...
Now we are better organized...
The farmers strongly want to improve their practices...
Improve and consolidate our organization and production...
Work on soil and water conservation, and reforestation of creeks and wells...
We need more regular technical support."

In addition to the auto-evaluations, we are monitoring the impact of the CIALs considering the following criteria or indicators (see also Humphries 1998):

(1) The number of people involved and the quality of their participation in the different stages of the research process (represented by an *escalera* or ladder),
(2) The degree to which CIALs and community members see experiments carried out as successful (viable solutions for identified problems or the identification of new opportunities such as promising, unknown varieties of maize and beans),
(3) Commitment to continue experimenting in 1998, for example, on a larger scale or involving more farmers or integrating soil conservation measures,
(4) The number of new farmer-leaders emerging (men, women),
(5) CIAL involvement in watershed level initiatives,
(6) CIAL linkages with one another (exchange of ideas and results within the watershed), and
(7) CIAL linkages with other research and technology entities, such as the Instituto Nacional de Tecnología Agropecuaria (INTA).

In 1998, four more CIALs were formed. The eight CIALs together decided to organize themselves into a regional association.

A reforestation project

A second activity in the organizational area has been the formation, facilitated by the CIAT team, of an inter-institutional committee to reforest the Calico River borders. Members of this committee were selected from the CDM and include, among others, representatives from the Ministries of Health and Education, and the PCC. Upon suggestion from the CIAT team, one CIAL member and a farmer owning land along the Calico River were invited to join the committee. The committee prepared a project proposal based on a diagnostic study coordinated by the PCC and CIAT. The Hillsides Project provided seed funds to start the project allowing for the establishment of a tree nursery. Recently, additional (core) funding was obtained.

To assess the project's progress and the functioning of the inter-institutional committee, which is expected to put into practice some of the working principles identified, a participatory monitoring exercise of the organizational process was carried out with committee members in June 1998. The exercise identified strengths and weaknesses, which simultaneously could be considered as impact indicators (Beltrán et al. 1998).

<u>Strengths</u>
Project is a locally born initiative
Participation of most local organizations/institutions
Farmers accepted the initiative
Funds were obtained
A tree nursery established on time and efficiently
Maintenance of the tree nursery
Regular meetings
Two kilometers along the riverbed planted with trees
Participation of students and children

First phase objectives achieved: nursery established, plan of activities defined, and financial reports elaborated

Weaknesses
Project initiative not effectively diffused, local population ignorant of the project
Weak participation of some committee members
Coordination and communication among the committee members were not optimal
Lack of punctuality at committee meetings
More local organizations could be involved
A better coordination between the organizations and farmers is needed
Farmers should have a stronger say in committee affairs
Organization representatives lack time to participate actively in executing the project
Lack of personnel for seedling transplanting
Transportation problems (of tree seedlings)
Insufficient funds

In addition to this analysis, the committee agreed to write a case study of their initiative with the support of the CIAT team. This case study will be used, among others, as part of a training guide on developing organizational processes at the local level.

Strengthening local community organizations

A third organizational initiative concerned the formation of a multi-stakeholder-based Association of CIALs representing a variety of interest and user groups, such as the Drinking Water Committees, church-based groups, the network of community healthcare workers and community midwives (*parteras*), the CIALs, and the PCC network promoters.

This Association, called "*Campos Verdes*" or Green Fields (still setting its early organizational steps) will as a first function support initiatives at local, user-group, or community-based levels to improve water, soil, and tree management with the support of a small-grants fund provided by the Hillsides project. At the same time, we expect that the association will provide space for a more demand-driven process of technology development and development assistance as well as for management and managerial capacity building. Members of the association have expressed interest in creating chapters of the association at the community level also. To assess the achievements of the Association a set of indicators will be developed together with Association members allowing us to keep track of progress, failures, strengths, and weaknesses. Themes or topics that could be assessed, taking into consideration once more the seven working principles, are (with possible indicators in parentheses):

(1) Community participation (representation by sector or territory, ability to articulate and defend local demands, input into decision making, and participation of women),
(2) Coordination (capacity to share information, number and quality of proposals developed by more than one participating organization, and number and quality of agreements achieved),
(3) Leadership and management capacities (ability to organize meetings, accounting capacity, number of new community leaders trained, and number of resolved conflicts), and
(4) Linkages (participation in other decision-making bodies such as the CDM).

Building on these activities, plans were made for late 1998 to organize a participatory planning workshop about organizational and institutional aspects, decentralization, and policy making at the watershed level. The intention is to look at what organizational activities and structures exist (community-, NGO-, and government-based), where they operate, what they do and do not do, and if and how an organizational process and structure at the watershed level could be built upon these. This would facilitate more participatory, effective, and efficient natural resource planning and management. In terms of impact assessment, the aim here also is to define a set of indicators that participants can use to monitor progress in terms of organizational process and in terms of achieving defined goals.

Lessons Learned

It is too early to measure the final impact of the development of the methodologies and the (new) organizational forms that are emerging in the Calico watershed, but so far people have taken on the ideas and methodologies with enthusiasm and made considerable efforts. New paths are being explored to deal with issues that affect people's livelihoods and a sense of "a watershed that unites" (i.e., the **social** construction of the watershed) is emerging. The research process in participatory action gives local people the opportunity of collectively analyzing and reflecting on their own situation and of discovering linkages (and gaps) among various levels of the ecological and socioeconomic organization within the watershed. It also provides space to formulate alternatives for problems being faced and to test these alternatives in practice, at the community, micro-watershed, and watershed level.

The preliminary lessons learned can be divided into methodological and organizational ones, both of which we believe have a wider applicability.

Methodological lessons

We need to develop a variety of methodological tools that local people can use themselves to map and analyze resources and resource use; to plan, organize, and execute collective action; and to monitor and measure progress and impact. Developing these tools requires time and continuous validation through direct user involvement in the testing of the methodologies and through validation and evaluation workshops. A combination of auto-evaluation techniques, such as questionnaires, case-study presentations, analysis of strengths and weaknesses, and sets of local indicators, has shown to be effective and useful.

Combining diagnostic research, such as the agroecological mapping and zoning of the watershed and the identification of critical areas for intervention, with participatory action-oriented research (e.g., the CIALs and the formation of multi-stakeholder-based committees) enables a focus on providing information about the state of the resource base at various levels. This is seen as a prerequisite for involving users of these resources in problem and opportunity analysis to facilitate actions that can be developed quickly.

Natural resource management research requires an inter-disciplinary perspective (e.g., soils and micro-watershed analyses need to be placed within the socioeconomic context of user-groups and multiple interests). It also requires the understanding of the interconnectedness of different levels: plot, farm, community, micro-watershed, and watershed.

Dealing with different organizational levels at once (through an iterative process) is useful in deciphering interdependencies between community, micro-watershed, and watershed levels (e.g., effect of water flow and soil erosion). Working with the CIALs, the participatory resource mapping with small groups of key informant and the strengthening of community organizations are examples of how this could be done.

Organizational lessons

Making an early start is useful, by setting activities in action to bring people together and to learn by doing (e.g., presenting ideas, working together, collectively planning, and participatory monitoring). Create space for discussion about problems and solutions and for assuming responsibilities for new initiatives (e.g., the reforestation project). A starting point here is the strengthening of local groups and the building of bridges among them.

The CIALs have shown to be a good starting point. They present a means for local people to organize themselves around a specific topic (research) and solve a locally felt problem. More support is needed for these kinds of local initiatives, and to involve these local organizational forms also in municipality and watershed affairs, such as land use planning, reforestation, and water distribution.

"Horizontal" and "vertical" linkages need to be strengthened simultaneously and thus fill the institutional gap. Examples are links among CIALs through the formation of a regional association, and between CIALs and the national research and technology transfer centers, and links between organizations operating at community level and between them and NGOs, ministries, and the municipality.

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CHAPTER 15

IMPACTS OF USING PARTICIPATORY RESEARCH AND GENDER ANALYSIS IN INTEGRATED PEST MANAGEMENT RESEARCH

Sarah Hamilton, George W. Norton∗

Introduction

Integrated pest management (IPM) focuses on biological and management-intensive multidisciplinary solutions to pest problems. It is thus a logical candidate for participatory research. Finding better means for solving pest problems is high on most farmers' agenda, and farmers often have significant pest management knowledge and an interest in IPM experimentation. Gender analysis is also a logical component of IPM research, because women make, and are affected by, pest management decisions. For these reasons the Integrated Pest Management Collaborative Research Support program (IPM-CRSP), a global IPM program funded by the United States Agency for International Development (USAID), has taken a participatory approach to IPM and has incorporated both a gender-analysis research component and gender-equity programming.

The program, now in its fifth year, has developed sizable research programs in seven countries in Africa, Asia, and Latin America and the Caribbean, and has built an impact assessment component into each. The purpose of this chapter is to describe the experience to date in assessing the impacts of participatory IPM (PIPM).

Participatory IPM Research

Although IPM research has always tended to be participatory among large commercial farms, participatory IPM research with smaller farms is a relatively recent phenomenon (Bentley 1990). Among small farms, PIPM research has focused to a great extent on a farmer field school (FFS) model through which farmers and specialists discuss IPM philosophy and approaches throughout a growing season. Farmers are encouraged to share their indigenous knowledge and to design their own experiments (van de Fliert 1993). Although not rejecting the FFS model for downstream research and training, the IPM-CRSP has explored ways of linking farmer participation to more upstream or basic research, and has emphasized the linkages among farmers, scientists, consumers, bankers, marketers, and policy-makers. This newer PIPM continues to emphasize farmer participation in setting the research agenda and in conducting on-farm experiments, but also recognizes that many factors influencing the generation and adoption of IPM technologies and strategies are off the farm or research station, and these factors can also require client-driven research.

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The PIPM process (Figure 1) begins by identifying site collaborators and other stakeholders, gathering secondary information, and designing both a baseline survey and a participatory appraisal (PA). Site collaborators and other stakeholders help identify possible foci for the program, geographic sites for experimental work, possible commodities, and so forth.

Three types of activities are used to establish IPM research priorities. The first type is a baseline survey, which serves to identify farmers' pest perceptions, pest management practices, and decision-making processes, socioeconomic characteristics of farm households, and other information depending on the additional institutions surveyed. Care is exercised to include both male and female heads of households. This survey provides a baseline against which evaluation can occur downward. The second type of activity is a PA, which is undertaken following a training session on PA methods for both natural and social scientists. This training is relatively brief and to the point, and takes place the day prior to going into the field for the analysis. The PA itself takes from 1 to 2 weeks and—together with the baseline survey and a brief priority-setting workshop following the PA—helps to develop a preliminary assessment of research priorities. The PA is not confined to farmers and community leaders, but includes bankers, marketers, agricultural professionals, policy makers, and others. A community advisory council is established and asked to participate in setting priorities. The third type of activity is the field monitoring of pests and beneficial organisms. Farmer collaborators are selected for the first set of experiments, and monitoring is conducted on their fields for two seasons to help refine pest priorities. These collaborators include both women and men.

While monitoring is underway, farmers and scientists work together to design, test, and evaluate IPM strategies and systems. In some cases, pot, greenhouse, or micro-plot experiments are conducted first, but in all cases, basic farm-level experiments of IPM practices and strategies are conducted. Social science research is undertaken on policies, institutions, and social and gender factors that may affect pest management decision making and the development and adoption of IPM.

As research output is produced, outreach and information exchange takes place. Scientists may interact with a national extension service or with nongovernment organizations (NGOs), in addition to direct contact with collaborating farmers. Increasingly, information is spread electronically in addition to publications, workshops, field days, and other more traditional means. The FFS approach is an excellent way to both generate and spread information if sufficient resources are available to reach large numbers of farmers. Community advisory councils can be useful for spreading IPM information if proactively empowered.

Impact assessment is an essential part of the PIPM process. Assessing the economic, environmental, and social implications of alternative technologies feeds directly into recommendations for farmers and policy makers. Gender analysis is an important component of impact assessment. More aggregate assessments can also help set priorities and justify an IPM program to funding sources.

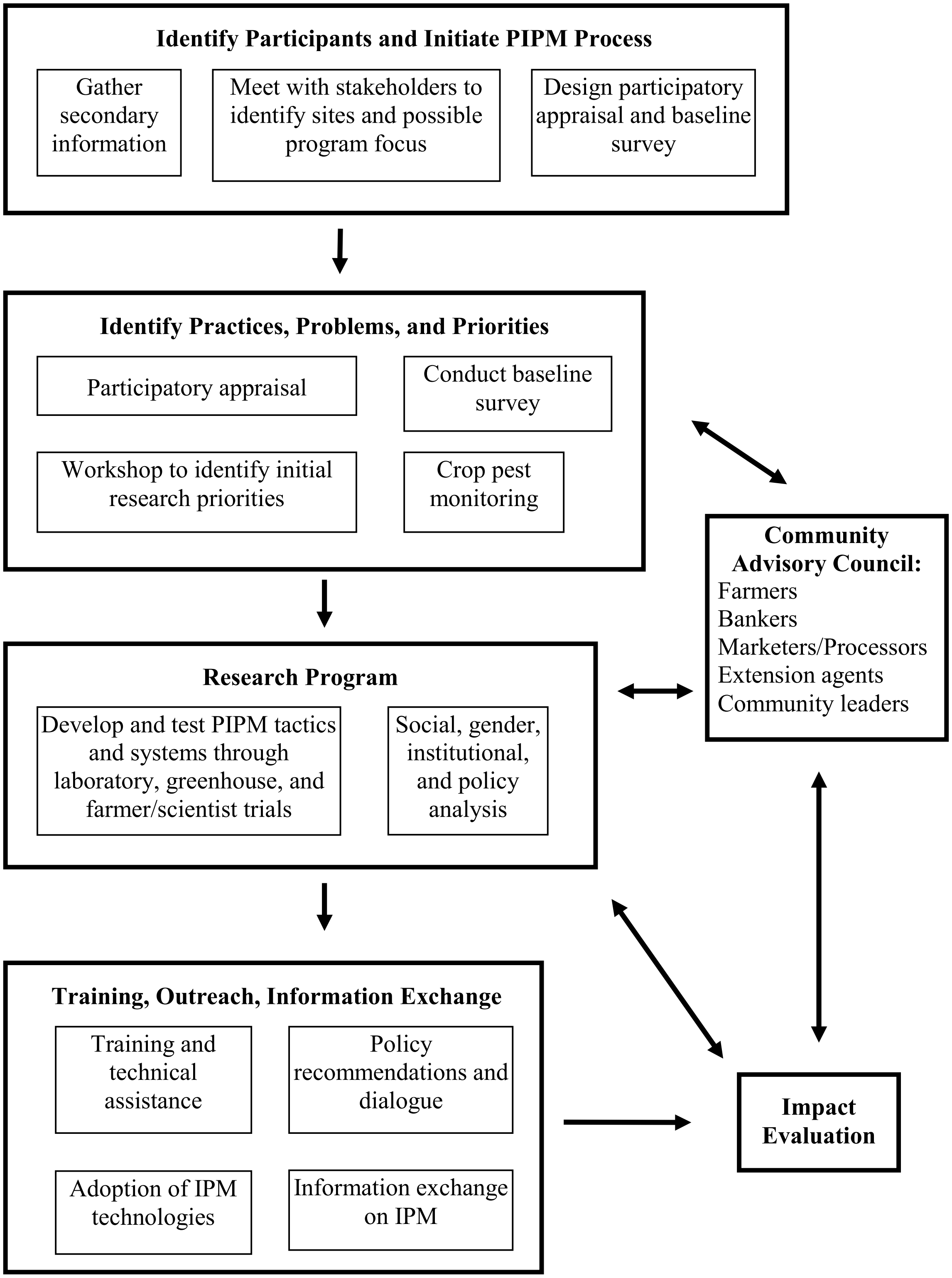

Figure 1. Suggested participatory integrated pest management (PIPM) process (from Norton et al. 1999).

Implementing PIPM and Gender Analysis on the IPM-CRSP

The IPM-CRSP is a global program that by mandate focuses at least 50% of its resources on horticultural export crops and at least 35% on transitional production systems. This two-part mandate has resulted in variation among the types of farmers and collaborating institutions incorporated in countries where the CRSP is working. In Guatemala, for example, the stakeholders' meeting and PA led the CRSP down a path of close collaboration that began with farmers, but continued up the marketing/regulatory chain through local export cooperatives, government inspection agencies, and US supermarket chains. The Instituto de Ciencia y Tecnología Agrícola (ICTA), the Universidad del Valle, a technology transfer NGO (Altertec), a horticultural export promotion firm (EXPRONT), and the Escuela Agrícola Panamericana (EAP) at Zamorano are involved, among others. Purdue, Ohio State, Virginia Tech, and the University of Georgia are primary US collaborators. Protocols have been developed that begin with farmer-driven IPM research, but carefully specify residue tolerances and other product specifications that facilitate passage through export channels to the United States. Gender analysis has focused on the impacts of export crops on women's labor, decision making, and income.

In Mali and Uganda, much of the IPM research has focused on pest problems of food crops for local consumption. Differences in the gender-segregated division of labor and male versus female use of pesticides were found between Mali and Uganda, and research has helped identify determinants. Local institutions have been primarily the national agricultural research systems and local universities, whose capacity levels require much more institution-building than in Guatemala. In the Philippines, the IPM program includes both food and export crops in a rice-based vegetable system. The level of development of the local institutions, which include the Philippine Rice Research Institute, the University of the Philippines at Los Baños, the National Crop Protection Center, and the International Rice Research Institute, is higher than those in Africa. The sites in the country include one where farmers are not organized among themselves and another where they are cooperatively organized. The primary focus has been on integrated systems approaches to pest management, including a significant policy component, but with less concern for export market protocols (because the products do not enter the US market).

The above discussion provides only a brief introduction to a few of the sites on the IPM-CRSP. It illustrates, however, that impact assessment of participation and gender analysis must differ across sites, because the nature of participation of off-farm institutions differs. Over the past 5 years, some outputs have been produced on the CRSP, including IPM systems and technologies and institutional changes. Evaluations have been undertaken and others are currently underway. Although gender analysis is an integral part of the PIPM approach, relatively little evaluation of the impact of gender research has been completed. Consequently, the remainder of this chapter focuses on evaluating participation.

Evaluation of PIPM on the IPM-CRSP

Evaluation of PIPM research includes both qualitative and quantitative dimensions and approaches. The quantitative evaluations contain both rough indicators and more detailed analyses. A major rationale for taking a participatory approach is to have more widespread and sustainable impacts. Therefore, impacts of participatory research, including PIPM, should not be qualitatively different than impacts of other research, except that they should be larger, reach more people (of both genders), and last longer. The techniques for assessing the overall research itself should be similar to those for non-participatory research. Extra steps are required, however, for separating out the effects of the participatory approach. Separating out the impacts of participation requires impact analysis of a with-and-without or a before-and-after situation. In the case of the IPM-CRSP, the before-and-after situation is relevant to Guatemala, which had a vegetable IPM program before the IPM-CRSP. In the case of the Philippines, the IPM-CRSP introduced the first vegetable IPM program in the site, even though a rice IPM program existed, including FFSs. Therefore the evaluation approaches must be different for assessing the impacts of participation or gender analysis in the two sites.

Qualitative evaluations focus on factors that may be difficult to quantify, yet are important to the long-run success of the research program. They often involve assessments of impacts on institutions and beliefs. Examples are those made under the IPM-CRSP as to whether the research systems involved in the program have institutionalized the PIPM approach such that it will continue after the CRSP no longer provides financial support. This evaluation for the Philippines site included an assessment of the degree to which:

(1) PhilRice has established an IPM unit within the institution that is an integral part of the institution,
(2) The unit follows a participatory approach,
(3) The core budget of PhilRice is gradually picking up the components, activities, or particular expenses that CRSP initially funded,
(4) The number of employees sent out for training have returned and are part of the program, and
(5) The private sector supports the PIPM program, in money or in kind.

Qualitative evaluations with farmers are also important and are based on both baseline surveys and participatory appraisals. Farmers are asked in an initial baseline survey about their pest management practices and their perceptions of pests and benefits. Follow-up surveys are then used to track changes in those practices and perceptions.

Quantitative impact evaluations of PIPM research include simple indicators of the type that funding agencies increasingly call for, and more detailed assessments. The former include items such as number of participants adopting, changes in per capita income or pesticide use, or number of women farmers attending a training program. The advantage of these indicators is that they are relatively easy to obtain even if they only indicate a potential correlation with an impact rather than an actual impact. A simple indicator that was used on the IPM-CRSP was the dollar value of the reduction in snow pea exports to the United States when Guatemalan snow peas were rejected at the US border. The IPM-CRSP undertook research and developed a protocol that the US Animal and Plant Health Inspection Service (APHIS) accepted so that snow peas were again allowed into the United States.

Indicators that carefully track cause and effect and involve more extensive data collection and multi-step analysis are potentially more accurate. That every result from every piece of research will be quantitatively evaluated is seldom expected; often, subjective information can be included as part of the information used in the evaluation. On the IPM-CRSP, participatory research is used to develop and extend IPM systems to increase farm incomes and improve environmental quality and health. Therefore, impact evaluations are underway to measure changes in incomes as well as the size and value of environmental and health improvements. Because the program is just under 5 years old, only partial evaluations have been completed and many of them involve projections of future impacts as research pays off over a long period of time. The Global Bureau of USAID funds the program, so results are expected to have impacts beyond the specific country where the research is undertaken, necessitating estimation of cross-country spillovers of benefits. A challenge in assessing impacts of participation is to accurately assess the effects of research participation in one region on other regions where participation is less intense.

Quantitative impact evaluations on the IPM-CRSP begin with the baseline survey so that changes in practices can later be identified. Then, for every intervention developed on the CRSP (such as biological control techniques and changes in cultural practices for pest control), inputs, outputs, and prices are recorded for basic budget analysis. Farmer participants also evaluate the interventions to assess acceptability for consumption, competition for time, etc. Particular attention is devoted to measuring change in pesticide use. Secondary information is also gathered on total production and prices in the country and region for the commodities affected by the research. Price responsiveness is estimated (i.e., elasticities are obtained). For some commodities (in two countries) we have begun to use geographic information systems (GIS) to map out potential areas of adoption based on a series of characteristics.

For aggregate impact evaluations, the models used are relatively simple economic surplus models. The first of these analyses on the CRSP was completed in the Philippines and provides information on the total direct economic benefits. Because there is no before-and-after the CRSP case in this site, sorting out the portion of the aggregate benefits caused by participation and gender analysis will have to be based in part on comparing the timing and extent of spread in villages with and without participation. An initial baseline survey was completed in villages where participatory research eventually took place on the CRSP and in villages where it did not. A follow-up survey will be used in 1999 to track differences and help assess the benefits of participation. The benefits of gender analysis are measured primarily through the economic value of the increased adoption of IPM interventions. Assessing the extent of that increased adoption will be based on structured surveys backed by participatory appraisals. Also in the Philippines, a detailed assessment of the health and environmental (H&E) benefits of the technologies developed on the IPM-CRSP is nearing completion in a PhD dissertation. The H&E benefits of participation can later be apportioned from the total H&E benefits through making use of survey information on adoption.

Results of PIPM impact Assessments

Many of the impact assessment activities on the IPM-CRSP, such as the follow-up baseline surveys, are programmed for 1999 (at the end of year five), and several assessment activities have been initiated. Some preliminary results are available for the five research sites that received most attention during the first 5 years (the Philippines, Guatemala, Jamaica, Mali, and Uganda). In the Philippines, these assessments include qualitative and some quantitative indicators, and in the other sites the results are primarily qualitative. Several outputs and impacts during the first 4 years of the IPM-CRSP are summarized in IPM-CRSP (1998).

The Philippines

Among qualitative impact indicators, PhilRice established an IPM research unit within the institution that draws on scientists from each division, but has its own research assistants. The unit conducts research in the fields of about 25 collaborators and established a strong working relationship with the largest onion growing cooperative in the country. The cooperative also provided a tract of land to the IPM program for long-term experiments. The planning and reporting procedures established for the IPM unit in PhilRice influenced the procedures employed elsewhere in PhilRice, according to its director. PhilRice puts a significant amount of its own resources into the IPM program and is funding the entire farmer-training component. Four Philippine scientists received PhD-level training and one MS-level training on the CRSP. Also, several others received short-term training. The initial participatory appraisal proved essential for establishing priorities in the first work plan and targeted appraisal activities since then were particularly helpful in identifying gender-differentiated decision making with respect to pest management.

The Philippine institutions and farmers received the participatory approach well. Members of the cooperative were particularly receptive, indicating the importance of the local institutional setting in facilitating agricultural research. The IPM-CRSP generated some promising results, and farmers who were involved in the CRSP were the first to adopt them, as might be expected. Because only in the last year or so have IPM-CRSP research results been available for adoption, farmer adoption is in its initial stages. About 125 farmers can be identified as having adopted results thus far, which is only a tiny share of the potential audience. Training materials and programs to reach a wider audience are being prepared and initiated. Fortunately, PhilRice has a strong farmer training program in rice and thus including vegetable IPM in the program should enable relatively rapid dissemination. Clearly for widespread adoption, no matter how participatory the research program is, linkage to a farmer training programs is crucial.

Quantitative economic assessment of the PIPM program included a budgeting out of all the inputs and outputs associated with all experiments conducted in the program. This budgeting helped first in identifying the profitability of the interventions, so that factors other than yield differences or pesticide use could be considered when making recommendations to farmers. The cost changes derived per unit were also available for aggregate impact assessment when combined with information on actual or potential adoption. A working paper is in preparation with the specific impact results.

The value of H&E benefits of IPM-CRSP interventions are being assessed using the results of a contingent valuation survey conducted a few months ago in the region where the IPM-CRSP is working. Household members were asked questions that enable us to assess how much they would be willing to pay for pest control measures that reduce H&E problems. This information is being combined with estimates of the extent of pesticide reductions that is projected to be associated with IPM-CRSP interventions. Details of the analysis and results will soon be available.

An aspect of the participatory approach that did not work well in the Philippines was the community advisory council. Feedback from farmers and others who were involved directly in the research was much more helpful in modifying the research program. The council seems to be rather an artificially constructed entity and it has no real power, while the cooperative and other farmers have a direct, day-to-day stake in the research results.

Guatemala

In Guatemala, less emphasis was placed on farm-level activities during the participatory appraisal and more on discussions with the whole range of actors in the marketing chain. The focus crops are non-traditional horticultural exports, thus the stringent demands of the international market, with respect to crops and to phytosanitary conditions, heavily influenced both crop selection and pest management practices.

A target crop is snow peas. In 1996, Guatemalan small-scale farmers lost an estimated US$5.7 million because their snow pea shipments to the United States were rejected because of a leaf miner problem detected at the US border. Some IPM-CRSP researchers identified the leaf miner as already being present in the United States, and they worked with APHIS to have the ban on Guatemalan snow peas lifted while simultaneously conducting research to solve the problem. Participation of personnel from ICTA (the primary government agricultural research institution), the major snow pea processors and exporters, growers, regulatory and other government agencies, a local NGO, and other institutions contributed to solving the leaf miner problem in a timely fashion. The previous establishment of a PIPM program, which brought all these organizations under one umbrella, was an essential ingredient to success and demonstrates the importance of including organizations beyond the farm gate, particularly when export crops are involved.

The PIPM program has been well institutionalized in Guatemala, with the government supporting half the program’s costs. The program also included the participation of several undergraduate students at the EAP, Zamorano, Honduras, who have completed undergraduate theses. The PIPM program demonstrates the high value of student participation in an on-farm agricultural research program, because students graduate with an appreciation for participatory research. The Guatemala site has produced useful scientific results under the PIPM program. Quantitative assessment of their value is not yet complete.

Jamaica

Lessons can be learned from the Jamaican site on the IPM-CRSP. The initial PA was probably the most extensive of all sites, and a textbook approach to participatory research was followed at the outset. Subsequent progress was slower than in the Philippines or Guatemala, however, despite the advantages of proximity to US scientists and a strong set of collaborators at the Caribbean Agricultural Research and Development Institute (CARDI), the regional organization responsible for much of the agricultural research in the region. It appears that despite careful PA, scientists were slow in developing a sense of cohesion among themselves. The lengthy initial workshop on PA methods may have alienated some of the scientists; some reported that training in and use of all available PA tools was both unnecessary and inappropriate to the field setting.

The US collaborators to the site tended to visit Jamaica individually rather than together in a carefully thought out pattern. At each site on the CRSP it has been important to pay careful attention to experimental design even though the experiments are in farmers' fields. The Jamaican group was slow to recognize this fact, although they have subsequently remedied the situation and have produced some useful IPM interventions. The bottom line is that success with participatory IPM research requires a cohesive group of scientists who pay attention to the science and to the participatory methods.

Lessons Learned

Key components in the success of the participatory approach on the IPM-CRSP include a flexible and expandable concept of potential stakeholders and the building of linkages among them, together with the recognition that effective incorporation of participants does not substitute for good science. A basis for sustainable IPM programs in IPM-CRSP countries has been provided by:

(1) The three-part problem identification and prioritization component,
(2) On-farm statistically-valid experimentation,
(3) Linking to local-level institutions such as cooperatives,
(4) Linking to financial, marketing, regulatory, and other policy entities,
(5) Linking to public and private technology-transfer mechanisms such as FFSs, and
(6) Incorporating economic impact, policy, and gender analyses.

The inclusively participatory aspect of PIPM, together with the formal scientist-farmer interaction, has enabled highly applicable basic research and potential sustainability.

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APPENDIX II

LIST OF ACRONYMS AND ABBREVIATIONS USED IN TEXT

Acronyms

ACF	Australian Conservation Foundation
ADO	Agriculture District Office, Rupandehi District, Nepal
ADRAO	Association pour le développement de la riziculture en Afrique de l'Ouest (French acronym for WARDA)
AGRITEX	Agricultural, Technical and Extension Services Department, national agricultural extension service, Zimbabwe
AID	Agency for International Development
AIRC	Agricultural Implement Research Center, Birgan, Nepal
APHIS	Animal and Plant Health Inspection Service, US
AS-PTA	Assessoría e Serviços a Projetos em Agricultura Alternativa, Paraíba, Brazil
BBA	Beej Bachao Andolan, farmers' group, India
CARD	Coordinated Agricultural and Rural Development Programme, Zimbabwe
CARDI	Caribbean Agricultural Research and Development Institute
CARE	Cooperative for American Remittances Everywhere
CBNRM	Community-Based Natural Resource Management programme, South East Asia
CCA-UFPB	Centro de Ciências Agrárias-Universidade Federal de Paraiba, Brazil
CCBD	Christian Commission for the Development of Bangladesh
CDM	Comité de Desarrollo Municipal, San Dionisio, Nicaragua
CENTRAC	Centro de Ação Cultural, Brazil
CEPCU	Centro de Estudios Pluriculturales, Ecuador
CGIAR	Consultative Group on International Agricultural Research
CIALs	Comités de Investigación Agricola Local, Colombia
CIAT	Centro Internacional de Agricultura Tropical, Colombia
CIFOR	Center for International Forestry Research, Indonesia
CIIFAD	Cornell International Institute for Food, Agriculture, and Development, of Cornell University, USA
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo, Mexico
CIP	Centro Internacional de la Papa, Peru
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement, France
CITESGAN	Centro Internacional de Tecnologia de Semillas y Granos, EAP, Honduras
CNPMF	Centro Nacional de Pesquisa de Mandioca e Fruticultura of EMBRAPA, Brazil
CONSERVE	A community-based native seeds research center, Philippines
ConTill	Conservation Tillage for Sustainable Crop Production Systems Project, University of Zimbabwe
COOPIBU	A nongovernment organization in Rwanda

CORPOICA	Corporación Colombiana de Investigación Agropecuaria
CPRO-DLO	Centre for Plant Breeding and Reproduction Research-Dienst Landbouwkundig Onderzoek, Neths
CRF	Coffee Research Foundation, Kenya
CRRI	Central Rice Research Insitute, India
CRSP	Collaborative Research Support Project of USAID
CRURRS	Central Rainfed Upland Rice Research Station, India
CTA-ZM	Centro de Tecnologias Alternativas de Zona de Mata, Minas Gerais, Brazil
DFID	Department for International Development, UK, previously ODI
DRC	Democratic Republic of Congo
EAP	Escuela Agrícola Panamericana, Honduras
EARO	IDRC regional office for Eastern and Southern Africa
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária, Brazil
FAO	Food and Agriculture Organization of the United Nations, Italy
FEAB	Federação dos Estudantes de Agronomia do Brasil
FESODEU	Femmes solidaires pour le développement de Burhale, Rwanda
FPPB	Farmer Participatory Plant Breeding project run by IRRI
GRAAP	Groupe de recherche et d'appui pour l'auto-promotion paysanne
GTZ	Deutsche Gesellschaft für Techische Zusammenarbeit *(German Agency for Technical Cooperation*)
IAE	Institute of Agricultural Engineering, Zimbabwe
IBTA	Instituto Boliviano de Tecnología Agropecuaria
ICAR	Indian Council of Agricultural Research
ICARDA	International Center for Agricultural Research in the Dry Areas, Syria
ICLARM	International Center for Living Aquatic Research Management, Philippines
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, India
ICTA	Instituto de Ciencia y Tecnología Agrícola, Guatemala
IDB	Inter-American Development Bank, USA
IDRC	International Development Research Centre, Canada
IFPRI	International Food Policy Research Institute, USA
IGAU	Indira Gandhi Agricultural University, India
IIBC	International Institute of Biological Control
IIED	International Institute for Environment and Development, UK
IIM-A	Indian Institute of Management, Ahmedabad
IIRR	International Institute for Rural Reconstruction, Ecuador
ILRI	International Livestock Research Institute, Kenya
INIAP	Instituto Nacional Autónomo de Investigaciones Agropecuarias, Ecuador
INIFAP	Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias, Mexico
INRA	Institut National de Recherche Agronomique, France
INTA	Instituto Nacional de Tecnología Agropecuaria, Nicaragua
IPCA	Investigacion Participativa en Centro America project
IPGRI	International Plant Genetic Resources Institute, Rome
IPRA	Investigación Participativa en Agricultura, CIAT

IRD	Institut de recherche pour le développement, France
IRRI	International Rice Research Institute, Philippines
ISNAR	International Service for National Agricultural Research, Neths
ISSAS	Institute for Social Studies Advisory Service, Neths
IT	Intermediate Technology
ITDG	Intermediate Technology Development Group, Zimbabwe
KARI	Kenya Agricultural Research Institute
KIOF	Kenyan Institute of Organic Farming
LIBERD	Local Initiatives for Biodiversity, Research and Development, Nepal
LUPE	Land Use and Productivity Enhancement project, Honduras
MARP	Méthode active de recherche et de planification participative
MINGA	Alternative Approaches to Natural Resource Management in Latin America and the Caribbean project
MKC	Maria Kaharero composite population
MOALDM	Ministry of Agriculture and Livestock Development, Kenya
MSSRF	MS Swaminathan Research Foundation, India
NAFTA	North American Free Trade Agreement
NARC	National Agricultural Research Council, Nepal
NAT/C	Nucleo de Apoyo Tecnico y Capacitación of INIAP, Ecuador
NDUAT	Narendra Deva University of Agriculture and Technology, India
NECOS	Nepal Community Support Group
NRI	Natural Resources Institute, UK
NWRP	National Wheat Research Program, Bhairahawa, Nepal
ODESAR	Organización de Desarrollo Sostenible Agricola, Nicaragua
ODI	Overseas Development Institute, UK, formerly, now DFID
OUAT	Orissa University of Agriculture and Technology, India
PAMFORK	Participatory Methodologies Forum of Kenya, Nairobi, Kenya
PCARRD	Philippine Council for Agriculture, forestry and natural Resources Research and Development
PCC	Programa Campesino a Campesino, Nicaragua
PRODESSA	Proyecto de Desarrollo de San Dionisio, Nicaragua
PROINPA	Programa de Investigación de la Papa, Bolivia
PRMPO	Poverty Reduction and Economic Management Network, World Bank, WA
PTA/NE	Projeto de Tecnologias Alternatives-Nordeste, Brazil
RARS	Regional Agricultural Research Station, Bhairahawa, Nepal
RAU	Rajendra Agriculture University, India
REST	Relief Society of Tigray, nongovernment organization, Ethiopia
SACCAR	Southern Africa Center for Coordination of Agricultural Research
SADC	Southern Africa Development Community
SAVE	Sustainable Agriculture and Village Extension Project, CARE
SDC	Swiss Development Cooperation
SLM-IM	Sustainable Land Management-Impact Monitoring, Berne, Switzerland
SMIP	Sorghum and Millet Improvement Program of SADC-ICRISAT
SNV	Netherlands Volunteer Service
SOH	Seeds of Hope project

SRISTI	Society for Research and Initiatives for Sustainable Technologies and Institutions, India
SRN	Secretaria de Recursos Naturales, Honduras
STR	Sindicatos de Trabalhadores Rurais (Rural Workers' Unions), Brazil
TFT	Training for Transformation program, developed in Kenya
UCODEP	Unity and Cooperation for Development of Peoples Movimondo, Italy
UCOSD	Union de Campesinos Organizados de San Dionisio, Nicaragua
UFPE	Universidade Federal do Pernambuco, Brazil
UNA	Universidad Nacional Agraria, Nicaragua
UNDP	United Nations Development Programme
UPWARD	Users' Perspectives With Agricultural Research and Development, Manila, Philippines
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
UVTT	Unidad de Validacion y Transferencia de Tecnologia, of INIAP, Ecuador
WARDA	West Africa Rice Development Association
WCED	World Commission on Environment and Development
WRI	World Resources Institute, WA

Abbreviations

DAP	diammonium phosphate
FFS	farmer field school
FFT	farmer field trial
FGC	farmer germplasm composite population
FPR	farmer participatory research
FSR&E	farming systems research and extension
G x E	genotype x environment
GIS	geographic information systems
H&E	health and environmental benefits
HYV	high yielding variety
IARCs	international agricultural research centers
ICM	integrated crop management
IDM	integrated disease management
IG	interest group
IPM	integrated pest management
IPRs	intellectual property rights
LFA	logical framework analysis
M&E	monitoring and evaluation
MVs	modern varieties
NARMS	natural resource management by self-help promotion
NARS	national agricultural research systems
NGO	nongovernmental organization
NRM	natural resource management
OFCOR	on-farm (client-oriented) research
PA	participatory appraisal

PALM	participatory analysis and learning method
PB	plant breeders
PGRFA	plant genetic resources in food and agriculture
PIPM	participatory IPM
PM&E	participatory monitoring and evaluation
PMP	participatory monitoring plan
PPB	participatory plant breeding
PR	participatory research
PRA	participatory rural appraisal
PRGA	participatory research and gender analysis
ProM	process monitoring
PTD	participatory technology development
PVO	private voluntary organization
PVS	participatory varietal selection
RAAKS	rapid assessment of agricultural knowledge systems
R&D	research and development
RL	rainfed lowland rice
RRA	rapid rural appraisal
RRFH	regular research field hearings
SS	social scientists
SWP	systemwide program
TD	top dressing
TOT	transfer of technology
TQM	total quality management
UR	upland rice
WSM	watershed management

INDEX

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