Working Document

CGIAR Systemwide Program on Participatory Research and Gender Analysis

PRGA

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FUTURE HARVEST

No. 17

Characterizing and Measuring the Effects of Incorporating Stakeholder Participation in Natural Resource Management Research:

Analysis of Research Benefits and Costs in Three Case Studies

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Johnson, Nancy C.
Characterizing and measuring the effects of incorporating stakeholder participation in natural resource management research : analysis of research benefits and costs in three case studies / Nancy Johnson, Nina Lilja and Jacqueline Ashby. – Cali, Colombia : Consultative Group on International Agricultural Research, System Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation, 2000.
132 p. (PRGA working document ; no. 17)

English Descriptors :
1. Participatory research. 2. Case studies. 3. Crop management. 4. Innovation adoption. 5. Soil fertility. 6. Soil conservation. 7. Cost benefit analysis.

I. Tít. II. Lilja, Nina. III. Ashby, Jacqueline Anne. IV. Consultative Group on International Agricultural Research. V. Participatory Research and Gender Analys. Vi. Ser.

Descriptores Español :
1. Investigación participativa. 2. Estudios de casos prácticos. 3. Manejo del cultivo. 4. Adopción de innovaciones. 5. Fertilidad del suelo. 6. Conservación de suelos. 7. Análisis de costos y beneficios.

AGRIS material category: A50 Investigación agraria

Classification LC: S 540 .8 .C6 J6

CHARACTERIZING AND MEASURING THE EFFECTS OF INCORPORATING STAKEHOLDER PARTICIPATION IN NATURAL RESOURCE MANAGEMENT RESEARCH:

ANALYSIS OF RESEARCH BENEFITS AND COSTS IN THREE CASE STUDIES

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EXECUTIVE SUMMARY

This study assesses the impacts of incorporating user participation and gender analysis in natural resource management research. Four types of benefits and/or costs are considered: (1) impact on the technology developed and its adoption, (2) strengthening of human and social capital among participating individuals and communities, (3) establishment or strengthening of feedback links to formal research, and (4) costs of research. A typology of participation at different stages of the research process is used to develop type- and stage- based hypothesis for each of these four impacts. The hypotheses are evaluated in the context of three participatory NRM research/development projects. The three projects are: the design and development of integrated crop management (ICM) sweetpotato technologies by the Centro Internacional de la Papa (CIP) and partners in Indonesia (1994-97); participatory testing of legume based soil fertility technologies by the International Center for Research in the Semi Arid Tropics (ICRISAT) in Malawi (1997-2000); and World Neighbors's (WN) use of farmer experimentation to adapt and diffuse soil conservation practices in Honduras (1981-1989).

Fieldwork and analysis of the three case study projects was done between August 2000 and February 2001. Both qualitative and quantitative data were used, including existing project documentation; open-ended interviews with project staff, farmer participants, and other key informants including community leaders and policy makers; and statistical and econometric analysis of survey data. Staff of the three projects participated actively throughout the process.

The main findings of the study are summarized below by type of impact:

Impacts on technology and adoption. In all cases, farmer input influenced the technology development process. Farmer impact on the technologies developed by the projects was greatest when farmer input came early in the research process (CIP) or when technology testing was done in a collaborative (empowering) way that gave scope for significant farmer contribution (CIP, WN). In all cases, user participation contributed to greater awareness of the technologies among farmers. In two of the three cases (CIP and WN), user participation is linked to increases in adoption of project technologies. In the CIP case, detailed production data show that exposure to the ICM technologies is associated with higher levels of income.

All cases used some type of gender analysis. In two of the three cases (CIP and WN), gender analysis revealed that women were not important stakeholders in the NRM activities that the projects were promoting. Only in the ICRISAT case were women specifically targeted as beneficiaries and deliberately incorporated into the project as participants. Disaggregation of participant input by gender did not reveal significant gender differences in overall ranking of the technologies tested, however there were some important differences in perception of specific characteristics of the technologies that could be useful in designing gender-sensitive diffusion strategies.

Human and social capital impacts. Large human capital impacts were observed among participants in the two projects that used collaborative participation at the testing stage (CIP and WN). Where technology testing was consultative (functional) (ICRISAT), useful agronomic and economic research results were obtained, but increases in participant capacity and skills were small. Significant human and social capital impacts at the design stage of the research process were not observed, even where empowering participation was used. In general, human capital impacts were more prevalent than social capital impacts. This may be due to the fact that the technologies being developed and diffused were all essentially plot-level and did not require significant collective action for implementation.

Since increases in human capital were only observed among direct participants in the projects, if women do not participate directly in project activities they will not obtain these benefits.

Feedback to formal research. In all cases, feedback to formal research and development institutions was observed. These impacts were stronger for IARCs and NGOs than for NARS. While some of the feedback was technical in nature and influenced institutional research priorities (CIP), most was methodological, such as information about barriers to adoption (ICRISAT), which is likely to benefit future research and extension efforts. In all cases, the projects stimulated some researchers in their own and/or other institutions to adopt more participatory methods. Feedback to formal research occurred with both consultative and collaborative participation.

Costs of research. Incorporation of user participation was generally associated with four types of additional costs: communications/workshops; farmer participant costs; researchers field work costs; and training of researchers. Only in the first case do the costs necessarily imply an increase in overall project expenditure. Farmer costs were observed to replace (and sometimes reduce) researcher/research assistant costs at the design, testing, and diffusion stages. Spending time in the field is a critical part of participatory projects, however researchers must also spend time in the field to get good results in conventional on-farm trials. Some of the observed cost increases may be more associated with quality than with participation. In all projects, researchers increased their own capacity and skills, either via formal training or learning-by-doing. These are essentially start-up costs incurred because the methods for collection and analysis of data from participatory research processes are often new to researchers. Over time, as more researchers gain experience in participatory research methods, these costs should decline. Neither conducting gender analysis nor intentionally incorporating women as project participants (ICRISAT) increased project costs.

Available data only allowed us to make a rough cost effectiveness estimate for the WN project. Cost per hectare of land under soil conservation practices for the WN project was estimated to be US$208. Similar per hectare costs for comparable projects that did not use the same empowering participatory methods were between US$845 and US$6000. The difference is the high and sustained adoption levels achieved by WN.

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CHAPTER 1:

METHODOLOGY OF CASE STUDIES

Nina Lilja, Nancy Johnson and Jacqueline Ashby

Introduction and Objectives

Scope of the Study

Scientists using participatory methods have observed the success of this approach in a variety of situations, and have documented the results in a number of case studies (e.g., Hinchcliffe et al 1999). However, the impacts and costs of using participatory as opposed to more conventional approaches are rarely systematically analyzed or reported. Until we have a better understanding of the tradeoffs associated with using participatory methods, scaling up or institutionalizing participatory approaches will be difficult within agricultural and natural resource management (NRM) research institutions.

By analyzing three research/development projects that used participatory methods in applied research on NRM, this study aims to improve our understanding of the costs and benefits of using participatory research. Using a shared conceptual framework, the incorporation of participatory methods in each case is evaluated in terms of its impact in the following four areas (for more detailed conceptual framework for impact analysis, see p.1-22 in Lilja et al 2000):

(1) Adoption and impact of the technologies developed,
(2) Strengthening of human and social capital among the participating individuals and communities,
(3) Establishment of feedback links to formal research, and
(4) Costs of doing research.

What we seek to evaluate in this study is not the overall impact of a research project that used participatory techniques, but rather the incremental effect on impacts and costs that can be attributed to incorporating stakeholder participation. Therefore, in each case study the impacts are assessed against an appropriate conventional research counterfactual.

Participatory research can be done in many ways, and different methods may have very different implications for outcomes and impacts. Selecting the appropriate approach will require anticipating how participation will impact on both project structure and goals. Based on a typology of participation, we developed a comprehensive set of hypotheses that link the incorporation of different types of participation at different stages of the innovation process to the four impact areas identified above. In each case study, the relevant hypotheses are tested within the context of the specific project. Taken together, the results will provide some empirical evidence upon which to evaluate both project impacts and the usefulness of the typology as a tool for project design, implementation, and evaluation.

A final objective of the study is to look at the implications of participatory research for different stakeholder groups, particularly women and the poor. In each case, the methods of gender analysis used in a project are identified, and the impacts desegregated by gender.

This project does not seek to reach general conclusions about which type of participation is appropriate in what area; nor will we have the last word on whether or not the targeting of women is cost effective. Much more experience in both the implementation and evaluation of participatory research methods in many contexts will be needed before these kinds of questions can be answered in any definitive way. What we hope to provide in this study is a set of examples with sufficient diversity that a broad range of researchers, research managers, and others can find similarities to their own work. It is through their representativity of processes rather than their combined statistical power that these studies will be useful in beginning to understand and evaluate the impacts and costs of using participatory methods in agricultural and NRM research.

Objectives

The specific objectives of this study are to:

(1) Assess what the incorporation of stakeholder participation in NRM research contributes to the magnitude and distribution of project impacts and costs in three case studies,

(2) Develop a general framework for relating different types of participation at different stages of the innovation process to impact, and

(3) As far as possible, evaluate the framework developed in (2) within the context of the three cases.

Conceptual Framework for Impact Analysis of Participatory Research: Types of Participation and Their Implications for Impact

Types of Participatory Research

The expected impacts of incorporating stakeholder participation in research are contingent upon the nature of approach used. Lilja and Ashby (1999a) develop a typology of participation based on who makes decisions that permits analysis at different stages of the research process. However, the research process is understood as being iterative rather than linear. The typology defines the two decision-makers as "scientists" and "farmers." A generic term "farmers" is used to describe any target group and the term "scientists" for outside agencies, extension systems, or formal research agencies. Underlying this typology is the assumption that differences in who makes a decision will result in differences in what decision is made. This need not be the case; however, cases where the assumption holds are the most appropriate for participatory research methods. The following is extracted from their framework.

Stages of innovation

The innovation process can be divided into three stages – design, testing, and diffusion.

- In the **design stage**, 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. They 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 about where and how it is done. This stage results in recommendations to intended users about the innovation or technology 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.

Farmer participation at different stages of innovation can have different impact on the technology or innovation design, as well as on the potential adoption or acceptance among the intended users. Farmer participation early in the design stage helps reduce the likelihood that the technologies being developed are ultimately unacceptable to farmers. Their participation in planning and setting goals may help steer the research in a more focused fashion and more directly towards farmers' priority needs. Commonly, farmer participation steers research into completely unanticipated directions. Similarly, who participates at different design stages may lead to different priorities being identified for different beneficiaries.

Who makes the key decisions in the participatory process?

In characterizing the participation in an innovation process we are concerned with organized communication between or among the groups. By organized communication we mean a well-defined procedure (such as informal surveys, group interviews, transect walks, and formal surveys). Organized communication is not an ad-hoc opportunistic event. We also differentiate between **one-way communication**, which is always scientist initiated and where farmers respond to scientists' inquiries, and **two-way communication**, which may be scientist- or farmer-initiated, and scientists make sure that farmers understand their opinions and ideas or their proposals and objectives, and vice versa.

"Who makes decisions" is one way of deciding the balance of power in a participatory process. We define five different types of participatory approaches depending on who makes the decision at various stages in the innovation process. A different type of participation is possible at each of the three stages of innovation (this builds on the previously known work on "categories" of participation, for example see Biggs and Farrington 1991.)

(1) **Conventional (non-participatory)**: Scientists make the decisions alone without organized communication with farmers.
(2) **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 them. Scientists may or may not let this information affect their decision. The decision is not made with farmers nor is it delegated to them.
(3) **Collaborative**: The decision is shared between farmers and scientists, and involves organized communication among them. Scientists and farmers know about one another's opinions, preferences, and priorities through organized two-way communication. The decisions are made jointly; neither scientists nor farmers make them on their own. No party has a right to revoke the shared decision.
(4) **Collegial**: Farmers make the decisions collectively in a group process or through individual farmers 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.
(5) **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? If outsiders or scientists make all the key decisions without farmer participation in the early stage of an innovation process, 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, hence increasing the likelihood that the farmers' top priority is addressed. Participatory research has a very different outcome if farmers make all the planning decisions and only consult scientists late in the process when problems arise.

Implications for Impact

The expected impacts of incorporating participatory research approaches at different stages of the innovation process are described in the following sections. Again, we are interested in the impact of stakeholder participation on economic benefits from technology adoption; the impacts of human and social capital benefits from participation; and feedback to research and the cost of research. The second and third impacts are examples of **process** impacts that occur as a result of the participation itself rather than as a result of the technologies developed via participatory research methods. In the case of process impacts, the type of interaction between scientists and farmers directly affects the kinds of impacts that occur. Therefore, the hypotheses related to these impacts vary by type as well as by stage.

Technology impacts

The economic benefits associated with technologies developed using participatory research are dependent on many factors including the specific technologies, agroecological environment, input supply, and farmer and household characteristics. However, some general hypotheses about how stakeholder involvement at different stages might influence the adoption are given below.

Design stage:

(H1) *The proportion of the targeted beneficiary group that could potentially be reached by the project increases because the priority topic chosen for research is more relevant to the needs and priorities of targeted farmers.*

Testing stage:

(H2) *The number of potential adopters within the target group increases because the specific technology*[1] *selected for recommendation is more appropriate given farmers' criteria and constraints.*

Diffusion stage:

(H3) *The probability increases that potential adopters for whom the technology is appropriate will be aware of it, and that adopters will be willing and able to adopt and recommend it to others.*

Social and human capital impacts (among beneficiaries)

It is hypothesized that through the process of interacting with researchers, the human and social capital of participating individuals and communities can be strengthened. These

[1] For the sake of grammatical simplicity, in the text we will refer to "a research topic identified" or "a technology tested or recommended." In reality however, participatory research processes often identify more than one priority problems, possible solution or appropriate technology.

impacts would only be anticipated as a result of empowering participation, meaning collaborative or collegial.

Design stage:

(H4) *Collaborative: 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.*

(H5) *Collegial: Farmers/communities improve their ability to interact with outsiders, particularly their ability to attract the interest and support of researchers for farmers' problems and priorities.*

Testing stage:

(H6) *Collaborative: 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 recommendations with other stakeholders who may have different opinions.*

(H7) *Collegial: 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 convince researchers of the validity and relevance of farmers' results.*

Diffusion stage:

(H8) *Collaborative/collegial: Farmers/communities learn what is involved in mass diffusion of technology, particularly the complexity of adoption decisions and the importance of complementary inputs such as seed, credit, or information.*

A final hypothesis relates to the fact that, in many cases, participatory projects involve farmers working together with other farmers as well as with researchers.

(H9) *The increased communication among farmers may result in better information and in information sharing among farmers and within the broader community, strengthening community social capital.*

Feedback to formal research impacts

The previous section looked at the process impacts of participation on the beneficiaries. In this section, we look at the benefits for the formal research process, specifically on researchers' access to information about farmers. These impacts can occur with any type of participatory research, either functional or empowering.

Design stage:

(H10) *Consultative: Researchers learn about farmers' priorities and solutions.*

(H11) *Collaborative: Researchers understand farmer priorities and solutions—including any new shared priorities or solutions that farmers and researchers identify as a result of working together—and incorporate them into their work.*

(H12) *Collegial: Researchers learn about farmers' priority problems and solutions by observing their decisions about problems, solutions, and innovations.*

Testing stage:

(H13) *Consultative: Researchers learn farmer criteria for evaluating technologies.*

(H14) *Collaborative: Researchers understand farmer criteria and methods for testing and evaluation of technology—including any new shared criteria or methods that farmers and researchers identify as a result of working together.*

(H15) *Collegial: Researchers learn about farmers' testing and evaluation methods and criteria by observing their actions.*

Diffusion stage:

(H16) *Consultative: Researchers learn about the factors that affect farmers' adoption decisions and what these imply for the diffusion process.*

(H17) *Collaborative: Researchers learn about farmer-to-farmer diffusion practices and about what kinds of information and skills both farmers and extension workers need to support this spontaneous diffusion.*

(H18) *Collegial: Researchers may learn about spontaneous farmer-to-farmer diffusion through observation of farmer activities.*

Finally, a general hypothesis that would apply at all stages is that:

(H19) *Researchers begin to understand that working with farmers may require new types of skills such as facilitation and conflict resolution that were not as important when research was carried out entirely on-station.*

This would be expected to increase as participation moves from functional to empowering.

Cost of research impacts

As with the impact on economic benefits, the impact of participation on research organizations' costs is largely an empirical question. Several general hypotheses are possible, however.

(H20) *Moving from conventional to consultative or collaborative forms of participation generally increases formal research organizations' costs at the particular stage where it is incorporated; however, it may reduce cost at subsequent stages.*

(H21) *Collegial research reduces research costs to formal research organizations at the stage where it is implemented because costs are transferred to farmers.*

(H22) *Participation without compensation increases farmers' costs unless it relies exclusively on those farmers (often a small and unrepresentative group) who already experiment on their own with new technologies and practices.*

Gender Analysis in Participatory Research

Technological, policy, or other changes often have different impacts on different stakeholder groups. One group that is often differentially affected is women. The systematic disaggregation of data and analysis by gender is referred to as gender analysis. Gender analysis and the targeting of women can be carried out in both participatory and non-participatory research. Three common methods of doing gender analysis in the context of agricultural research and technology development are[2]

(1) **Diagnostic gender analysis**. Gender differences in the client group(s) for the research are described, and different problems or preferences are diagnosed. 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 adoption of technical solutions for men or women members of the client group.

(2) **Design-oriented gender analysis**. In addition to describing gender differences in the client group with respect to their problems and preferences, different research and development (R&D) 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.

(3) **Transfer-oriented gender analysis**. In addition to describing gender differences in the client group with respect to 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. Transfer-oriented gender analysis results in the same technologies being disseminated to men and women in different ways.

If diagnostic gender analysis results in the conclusion that gender differences are important, the project can choose to target women specifically. Targeting can occur in either the development of the technology, or in the design of the dissemination strategy. In participatory research, attention to gender can go beyond targeting women as beneficiaries to deliberately incorporating women into the research process. Design-

[2] Extracted from Lilja and Asbhy 1999b.

oriented gender analysis would be consistent with the incorporation of women at the design and testing stages. In transfer-oriented gender analysis, women could be incorporated at the dissemination stage.

Different ways of targeting women as beneficiaries and/or participants have different implications for impact. Specifically, if women are not participants, then they will be excluded from the process impacts described in the previous section. Whether or not women must be participants in order to be beneficiaries of technology impacts is an empirical question that will be examined in each of the cases. The cost impacts of including women will also be examined.

Selection of Cases

Criteria for Selection

Three cases were selected for analysis of the costs and impacts of incorporating farmer participation in NRM research. Several criteria were used to select the projects. The first criterion was to identify projects that had documented impact or that had been operating long enough to generate intermediate or final impacts. Additional criteria were to include a range of geographical areas, types of NRM technologies, and implementing organizations. The projects selected are outlined below.

The Centro Internacional de la Papa (CIP) development of integrated crop management (ICM) technologies and practices for farmer field school (FFS) for sweet potato in Indonesia (1990s)

During 1995-97, CIP, with support from UPWARD[3], and in collaboration with public and private sector groups, implemented a project to develop a protocol for a sweet potato ICM-FFS in Indonesia. Collaborators were Mitra Tani, a local nongovernmental organization (NGO); the National Research Institute for Legume and Tuber Crops; and Duta Wacana Christian University. Project activities were implemented in major sweet potato growing areas in East and Central Java, where it is grown as an important cash crop throughout the year, mostly in rotation with rice. The project strategy relied on participatory approaches and methods at all stages: needs assessment and project design; R&D of ICM technologies and practices; design of farmer learning protocols applying the FFS approach; pilot-scale implementation of the sweet potato ICM-FFS; and monitoring and evaluation. To institutionalize the sweet potato ICM-FFS model that was developed, and allow for large-scale farmer learning and implementation, staff from the National IPM Program (NIPMP) and 30 local NGOs underwent FFS facilitators' training; NIPMP staff in June 1997, NGO staff in April 1998. These local extension organizations implemented and funded follow-up programs, and a second research project was initiated to evaluate their activities during a 2-year period (1998-99). Mitra Tani carried out the work, with methodological and financial support from CIP and UPWARD.

3 The Users' Perspectives for Agricultural Research and Development (UPWARD) is a CIP-affiliated network of Asian researchers conducting participatory R&D projects in root crop systems.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) work on models for the participatory testing of soil fertility technologies in Southern Africa (1990s)

The ICRISAT Mother–Baby (MB) trial model is an upstream participatory research methodology designed to improve the flow of information between farmers and researchers about technology performance and appropriateness under farmer conditions (Snapp 1999b). The methodology was initially developed and implemented to test soil fertility management technologies in Malawi that were legume-based, and was later expanded to Zimbabwe. The trial design consists of two types, mother and baby trials. The mother trial is researcher-designed and conforms to scientific requirements for publishable data and analysis. A baby trial consists of a single replicate of one or more technologies from the mother trial. A single farmer manages each baby trial on his or her own land. A typical implementation of the methodology would include a single mother trial and numerous baby trials within a village. The MB trial methodology has three goals. The first is to generate data on which to assess technology performance under realistic farmer conditions. The second is to complement the agronomic trial data with farmers' assessments of the adoption potential of technologies. This information helps researchers understand how the technologies fit into farmers' broader farming and livelihood strategies. The third goal is to encourage farmers to actively participate in the trials, and is expected to stimulate farmer experimentation with, and adoption of, new technologies and practices.

World Neighbors (WN) soil conservation work in Honduras (1980s and early 1990s)

This project, supported by WN, the Coordinating Association of Resources for Development (ACORDE), and the Ministry of Natural Resources of the Government of Honduras, promoted improved soil conservation practices in south central Honduras from 1981-1989. The project worked in 41 communities in three municipalities – Guinope, San Lucas, and San Antonio de Flores – in the state of El Paraiso. The project's approach went beyond strictly increasing agricultural productivity through the adoption of soil conservation practices, to improving economic, social, and ecological conditions via agriculture (Plan del Programa). Although the project was primarily one of development, it had a significant capacity building component, teaching farmers the principles of soil conservation technologies, training them to experiment and adapt technologies, and imparting knowledge about selection and improvement of genetic materials for green manure. The project carried out these activities in the context of community groups, and trained local farmers to take over extension jobs after several years. The purpose of these activities was to build social as well as human capital, while strengthening organizational capacity and the capacity and commitment to share knowledge within the community. The project methodology was that described in Bunch (1982) that advocates a combination of 80% practical training and 20% theory. Significant increases in adoption were observed in the study areas during the course of the project. According to WN reports, nearly 1400 farmers tripled their basic grains' yields as a result of adopting soil conservation practices. Subsequent follow-up studies indicate that further adaptation and adoption continue (Bunch and Lopez 1999). Increases in productivity were also observed, as were increases in farmer experimentation, and the exchange of information among farmers. After several years working mainly on agriculture with men, the project added a component for women. This focused on sanitation, home gardens, and food preparation.

Representativity of Cases and Types of Participation[4]

Of the three cases, one (WN) was NGO supported; the others are International Agricultural Research Center (IARC) cases. The important actor that is missing here is the National Agricultural Research System (NARS). In each of the cases, NARS were partners in the implementation, but did not undertake the work directly.

The type of organization appears to be associated with project design and implementation. The NGO project is essentially an extension program that incorporates farmer testing and experimentation as a dissemination mechanism. In the IARC projects, in addition to working with farmers on a specific technology, methodologies were developed for systematically implementing similar work with other farmers. In these cases, the methodology itself is an output, not just the specific technologies developed in given field sites.

Table II-1 represents an attempt to place the cases within the framework of the typology presented in the previous section. This task was harder than expected. Analyzing the cases in the context of the framework presented several challenges.

Table II-1. Types of participation used in the three case studies[a].

Stage	Conventional (non-participatory)	Functional Consultative	Empowering		Farmer Experimentation
			Collaborative	Collegial	
Design	WN, ICRISAT	CIP	CIP		-
Testing	-	ICRISAT	CIP, WN		-
Diffusion	(ICRISAT)	(CIP)	CIP, WN		CIP, WN ICRISAT

a. WN = World Neighbors – Honduras, CIP = Centro Internacional de la Papa – Indonesia, and ICRISAT = International Crops Research Institute for the Semi-Arid Tropics – Southern Africa. Parentheses indicate an activity that is planned, but remains to be executed.

Overall, the table shows that at the design stage, participation tends to be slightly more consultative, with farmers giving input, but researchers making decisions. Only in the case of CIP did stakeholder participation substantially change researchers' agendas, budgets, and work plans. Where significant research expenditures will occur, it appears that control still rests with the researcher, largely reflecting the sectoral nature of R&D funding.

4 An analysis of the representativity of the cases will be done when the analysis of the NRM inventory is complete.

As mentioned earlier, classifying project activities as either testing or diffusion was difficult. It appears that traditional, planned diffusion now begins in the testing stage, where researchers hope that by involving farmers in trials, both participating and non participating farmers will gain awareness of the technologies. This change may be related to the fact that the information-intensity of NRM practices requires farmers to learn something about how the technologies work. It may not be possible to adopt a technology off-the-shelf with no adaptation. Traditional diffusion may occur at the level of the methodology for facilitating adaptation rather than the technology itself. This is a subject that will be examined in more detail in the context of the case studies.

Use of Gender Analysis

All three of the projects undertook diagnostic gender analysis. In two of the cases, CIP and WN, it was decided that women did not play a significant role in the principal activity being addressed in the project. World Neighbors responded by implementing a separate set of activities for women focused on nutrition and health. Women were not excluded from the soil conservation activities, but self-selection of participants resulted in few women being involved.

Some Issues in Empirical Analysis

Before presenting each case study in detail, this section discusses some of the common empirical challenges associated with analyzing the impact of participatory NRM research. Each case study had to address the issues in some way in the empirical analysis.

Controlling for Selection Bias

Selection bias is an issue in any analysis where the treatment groups (study communities) were not randomly selected. When projects choose to work with specific individuals or communities, they may be doing so for reasons that may also be associated with the observed impacts. For example, interventions based on local collective action are often implemented in communities that have high levels of social capital. Failure to account for this could result in a project taking credit for social capital when in fact social capital contributed to the project's success. Further, even if the project did have a measurable impact on such a community, it would be difficult to extrapolate about what the impact of a similar project might be in an area where social capital is not so high. Knowing how communities were selected is important so that appropriate control communities can be identified. The ideal situation is to collect pre- and post-project data for many replications of the project in different types of communities as well as in sites where no intervention occurred. This allows us to look at changes associated with the project and to control for the influence of other factors on observed outcomes. Without this, extrapolating beyond the specific project site(s) is difficult.

In addition to researcher-selection bias, self-selection bias is also likely to occur in participatory projects. Because participation is voluntary, people can choose to participate or not. In any given situation, the people who choose to participate are likely to be different from those who choose not to do so. For example, the type of individual who wants to volunteer his or her time to be part of a local agricultural research group is likely to be someone who already has an interest in experimentation, or someone who has a high level of commitment to working for the good of the community. The consequences of self-selection bias are similar to those of researcher-selection bias. However, it is harder to control for because the criteria for selection are largely unobservable and uncorrelated with observable characteristics such as age, education, or income. Extrapolation of impacts from self-selected participants to the broader population may not be appropriate.

Identifying the Appropriate Counterfactual

As mentioned earlier, the goal of this analysis is to look at the impact of incorporating stakeholder participation on the costs and impacts of developing and disseminating NRM innovations. This implies that the counterfactual is the impact that would have occurred if the project had used only conventional methods. In this study, the conventional research and/or extension counterfactual is only used when comparing technology impacts and research costs. We are making the assumption that non-participatory projects do not have impacts on human or social capital or on the research process. These impacts—which we refer to as process outcomes—result from the interaction of researchers and farmers; thus they could not occur in a non-participatory project.

The extent to which this counterfactual can be achieved in each case study varies. In some cases, participatory methods were either not part of the original project plan or resulted in major changes in project activities. In these cases, we have enough information to use the original project plan to construct a hypothetical counterfactual. In other cases, we will need to identify an appropriate comparison with a project that addressed a similar problem in a similar community using non-participatory methods. This may be another project by the same or a different organization.

The Definition of Technology and Adoption

In every project farmers were encouraged to experiment and make changes to the technologies. This was an important goal of the projects. However, it complicates impact assessment because it is not always clear whether an innovation is really an adapted version of a project technology or something entirely unrelated. This type of outcome is common, and getting at the causality of these impacts may require more qualitative and participatory methods of data collection than conventional impact studies that have clearly defined technologies and definitions of adoption.

CHAPTER 2:

THE CIP DEVELOPMENT OF INTEGRATED CROP MANAGEMENT (ICM) TECHNOLOGIES AND PRACTICES FOR FARMER FIELD SCHOOL (FFS) FOR SWEET POTATO IN INDONESIA (1990s)

Nancy Johnson, Elske van de Fliert and Nina Lilja

Introduction

In 1993, CIP began to explore the possibility of establishing a research program on integrated pest management (IPM) of sweet potato in Indonesia. Initial rapid rural appraisal activities and stakeholder consultations resulted in the development of a project based on a broad interpretation of the definition of IPM, and a novel participatory research methodology where researchers, farmers, and extension personnel worked together in an iterative process to assess problems, design and disseminate solutions, and monitor impact (van de Fliert and Braun 2001). The first phase of the project (1994-97) consisted of a detailed needs' assessment, basic and applied research to fill gaps in existing knowledge, pilot implementation of FFSs to design an adapted diffusion mechanism, and a series of workshops with farmers and policymakers to analyze and disseminate results and set priorities for future activities (Table II-2). As a consequence of needs' assessment and farmer input, the project focus changed from IPM to ICM, encompassing a much broader range of activities including varietal and seed selection; soil, pest, and nutrient management; and marketing and utilization. The second phase of the project (1997-1999) consisted of a participatory evaluation and impact assessment of the implementation by the national IPM program and several NGOs of the sweet potato (SP) ICM FFS curriculum developed by the project.

The CIP project was invited by the PRGA to be one of a series of case studies on the impacts and costs of incorporating user participation in research on NRM. Particular emphasis was placed on assessing impacts on women and the poor. Staff of the PRGA and CIP-UPWARD jointly conducted the impact analysis.

Table II-2. Overview of the Centro Internacional de la Papa (CIP) - Users' Perspectives with Agricultural Research and Development (UPWARD) project activities.

Activity	Season[a]									
	Phase I						Phase II			
	A	B	C	D	E	F	G	H	J	K
Needs' assessment and baseline[b]	PRA, RK, FO	RK, FO	RK, FO							
Technology development[c]		8	17 (3)	14 (6)	12	6				
FFS development and institutionalization[d]		FFS pilot in SP	Write modules	SP ICM FFS pilot	Revise modules	ToT NIPMP		ToT NGOs		

a. Phase 1: A = 1994-95 wet, B = 1995 dry, C = 1995-96 wet, D = 1996 dry, E = 1996-97 wet, and F = 1997 dry. Phase II: G = 1997-98 wet, H = 1998 dry, J = 1998-99 wet, and K = 1999 dry.

b. PRA = participatory rural appraisal, RK = season-long record keeping, and FO = field observations.

c. Number of farmer-managed trials; number of researcher-managed trials in parentheses.

d. FFS = farmer field school, SP = sweet potato, ICM = integrated crop management, ToT = training of trainers, NIPMP = National Integrated Pest Management Program, and NGO = nongovernmental organization.

Conceptual Framework for Assessing the Impact of Participation

Types of Participation

The CIP-UPWARD project with its iterative processes and parallel activities (Figure II-2) presented a first real empirical challenge to the relatively simple typology on which the conceptual framework is based. In the typology development, it was anticipated that projects might use different types of participation at different stages, and different types in various steps within each stage.. Repetition of stages of the research process was also contemplated not well thought out in the typology. We recognize that although the typology maybe be useful, it may have reduced precision in distinguishing among type- and stage-based hypotheses. Re-evaluating the conceptual and empirical usefulness of the typology for NRM research is part of the PRGA's future research agenda. This series of case studies will contribute to that process.

According to the typology, at the design stage of a research process, problems and potential solutions are identified and prioritized, and decisions are taken about how to proceed with technology development. The CIP-UPWARD project used a combination of consultative and collaborative methods at the design stage. The activities on needs and opportunity assessment and informal interviews conducted in communities prior to setting the research agenda constitute consultative participation because farmers give input, but do not share authority for interpreting results. During the first few seasons of the work, intensive production data were collected. While researchers designed protocols, farmers pre-tested the methods, gave input for revision, collected the data, and together with researchers analyzed data and reached conclusions collaboratively. A season-long pilot FFS was held in one community to further test its appropriateness and identify needs for adaptation for sweet potato. Farmers participated not only in the FFS, but also in its evaluation and modification.

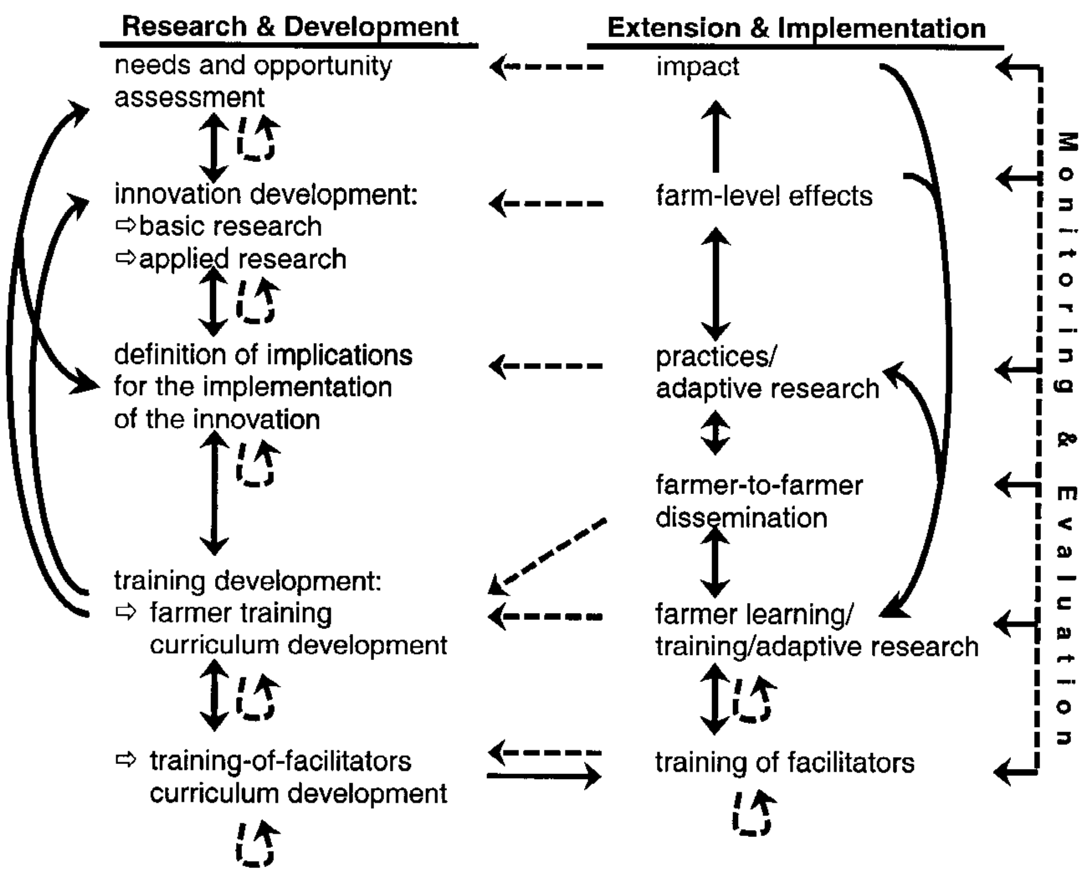

Figure II-2. Framework for the sweet potato project on integrated crop management and farmer field schools (based on van de Fliert and Braun 2001).

At the technology development and testing stage, participation was essentially collaborative. Project staff and a group of eight farmers (subsequently referred to as farmer-researchers) designed and implemented trials, collected data, analyzed results, and formulated recommendations for further research and/or for diffusion. Actual trials of technologies and practices were carried out either by farmer-researchers in their fields or by researchers on-station and on-farm. Periodic workshops were held to present and analyze results. Testing activities began in the second season of the project, overlapping with activities of both the design and diffusion stages. Results and lessons from each stage influenced subsequent work in others.

Diffusion activities went beyond the traditional design of an extension program in support of a particular technology. First, the project had to identify an appropriate mechanism for diffusion of the ICM results, which proved to be the FFS. In a collaborative process, researchers and farmers then assessed the mechanism, content, and potential implementers for appropriateness in the context of sweet potato and ICM. Specific learning activities and a tailored curriculum were designed, field-tested, and documented. National program and NGO staff were trained in facilitating the SP ICM FFS. In the second phase of the project, the national program and NGO project staff, farmer-researchers, and FFS participants collaboratively monitored and evaluated the actual implementation of the ICM FFS on a limited scale. Participatory research requires placing information and prototype technologies in farmers' hands in the early stages of the research process, thus spontaneous information and/or technology diffusion can begin to occur as early as the testing stage. For example, farmer-researchers shared the results of their experiments with neighbors.

In this study on the impacts and costs of incorporating farmer participation, a subset of CIP-UPWARD project activities is the focus of analysis. Results on impact of the FFSs are used to investigate implications of farmer input into their design and development. van de Fliert et al 2001 analyze the impact of implementing the ICM FFS.

Gender and Poverty in the CIP-UPWARD Project

As part of the needs' assessment, the project included diagnostic gender. The results indicated that although women participate in nearly all aspects of sweet potato production, they usually do so in a supporting role. Particularly in East Java, it is considered a men's crop and the women interviewed reported that they were too busy with other jobs on the farm to spend time on training activities relating to sweet potato. In Central and West Java, women are more involved in sweet potato cultivation and more interested in learning about the crop. Men's and women's opinions did not differ significantly with regard to identifying problems and solutions.

Based on this information, the decision was made not to target women specifically in subsequent project activities. None of the farmer-researchers was female; however, women did ultimately participate in several of the FFSs, particularly in West and Central Java. The FFS curriculum contains a gender analysis activity in the participant selection procedure to better target FFS implementation. In this study, quantitative data on impact include both men and women, and results are disaggregated by gender wherever possible.

In terms of targeting the poor, early project documentation reports that a criterion for site selection was that the farmers should be relatively poor, and that the villages should not be located on the main road, nor be beneficiaries of other development-oriented projects (van de Fliert and Asmunati 1995, p 3). This poverty criterion was not mentioned again, however, and subsequent papers (Braun and van de Fliert 1997, p 6) list the criteria as:

- At least 50% of agricultural fields are planted to sweet potato during one or more of the three yearly cropping seasons.
- Farmers experience problems with pests and diseases.
- Farmers are interested in participating in an IPM program for sweet potato.

- Village government is interested in supporting the development of an IPM program for the crop.

The communities ultimately selected were not well off by local standards, but neither were they the poorest. One village (Ngargoyoso) had no electricity during the first phase of the project. None of the villages had paved roads other than the main road passing through the village. None had running water.

Observation and interviews with village-level authorities and key informants rate the principal participants (farmer-researchers) as average within their communities in terms of status, income, land ownership, and farming abilities. However, because communities and researchers were selected for their interest in the project, selection bias is possible and caution should be used in extrapolating results. Later sections deal with the selection criteria for participants and communities and the implications for interpreting results.

The following impact analysis is based on extensive project documentation, the project's own monitoring and evaluation data collected in Java, and on a 3-week visit to Java in August-September 2000. Because original data were only collected in Java, where the NIPMP FFSs were carried out, information on the NGO ICM FFS implementation is from secondary sources. A Belgian umbrella NGO, the Flemish Organization for Assistance in Development (FADO), which sent many participants to the training-of-trainers (ToT) will do an evaluation study on their partners using UPWARD funding this year.

Technology Impacts

Impact Hypotheses

It is hypothesized that user participation affects the characteristics of the technology, and that they in turn affect its diffusion pattern and impacts. Based on the typology of participation described earlier, specific hypotheses about the nature of those impacts were developed (*H1* for the design stage, *H2* the testing stage, and *H3* the diffusion stage).

Participation in the design and testing stages would be expected to affect both the topics selected for research and the specific technologies and practices developed, tested, and ultimately recommended for diffusion. User input would be expected to increase the number of beneficiaries in two ways: by increasing the size of the pool of people for whom the problem is relevant (design stage impact), and the size of the population for whom the specific technology is appropriate (testing stage impact). At the diffusion stage, the impact of farmer participation would be that people for whom the problem is relevant and the technology appropriate would be aware of it and have the knowledge and other complementary inputs necessary to benefit.

The Impact of Farmer Participation on the Design, Testing, and Diffusion of the SP ICM FFS Curriculum

The most significant impact of farmer input was the shift from sweet potato weevil IPM to ICM (Braun and van de Fliert 1997). Researchers learned that although pest and disease problems were generally considered important in sweet potato cultivation, they were not necessarily the main constraints on yield, income, or risk from sweet potato production. Farmers perceived the main factors influencing yields and income as: market price, variety, water management, fertilization, and pest attack (van de Fliert and Asmunati 1995). Existing information and technologies for sweet potato crop management under Indonesian conditions was lacking. This meant that the project would have to identify promising areas for improving productivity within current production systems, generate basic ecological and agronomic information, and use that information to formulate recommendations and guidelines to be included in the FFS.

Farmer input into identifying, developing, and evaluating appropriate ICM topics occurred in several ways. The most intensive farmer interactions were through the nine farmer-researchers who were selected to work with researchers throughout the process to identify topics, design and test solutions, and formulate the final product – the ICM field guide. As part of the needs' assessment work, these nine farmers supervised an intensive data collection effort through farmers keeping season-long records. They also conducted routine field observations in their communities to assess current production practices and constraints. During the development stage of the technology component they conducted a series of experiments, most of which were of their own design. Finally, pilot field schools were held during two dry seasons to identify how the form and content of the FFS might need to change to better accommodate the ICM approach and sweet potato farmers, and to test out the new guidelines, practices, and learning activities developed in the project.

Design

Initial needs' assessment data combined with researcher and farmer opinion generated a preliminary list of relevant and researchable topics (see below).

Of the list of eight topics, the top three were selected for further research during the first technology development season, with researchers taking charge of the design of the first experiment (sex pheromones) and farmers the second and third (varieties and nitrogen fertilizer). This list shows the range (beyond sweet potato weevil) and type of topics in which farmers were interested. Overall these remained constant throughout the project; however, the process of identifying priorities for further research was iterative. As new results from data collection and experimentation came in, topics were refined, added, or discarded (Table II-3).

Priorities identified by farmers in first workshop

Priority	Topic
1	Sex pheromone for sweet potato weevil control (proposed and designed by CIP researcher, managed by farmers, processed by researcher, analyzed collectively)
2	Varietal types
3	Nitrogen (urea) doses
4	Effect of different types of fertilizer (urea, TSP, KCl)
5	Time and frequency of fertilizer application
6	Planting method (ridges vs. beds)
7	Effect of pesticides on pest occurrence
8	Effect of water management on weevil damage

Table II-3. Experiments conducted by farmer-researchers in the International Potato Center (CIP) project.

Season	Topic	Treatment	No. of sites
1995 dry	Varieties	Five top local varieties from four sites	4
	Urea dose	100, 150, 200, 250 kg ha^{-1}	4
1995-96 wet	Variety	Five previous, three new improved varieties	4
	Urea dose	100, 150, 200, 250 kg ha^{-1}	4
	Vine lifting	One, two, three times per season	4
	Manure and KCl	With/without manure/KCl	3
	Fertilizer type	Combination of N-P-K	1
	Planting method	Straight/bend 0-90 degrees	1
1996 dry	Variety	Three new improved	4
	Fertilization	Manure, N-P-K	4
	Vine lifting	One, two, three times per season	1
	Urea dose	50, 100, 150, 200 kg ha^{-1}	1
	Intercropping	Four densities of maize	4
1996-97 wet	Variety	Selection	2
	Fertilization	Manure, N:K ratio, P	5
	Improve soil structure	Dolomitic/carbonate lime	3
	K application time	Basal side dressing	1
	Intercropping	Four densities of maize	1
1997 dry	Soil preparation	0-20 days rest after plowing	1
	Fertilization	12 treatments with varying levels and combinations of manure, N-P-K fertilizers	5

SOURCE: van de Fliert 1996a, 1996 b.

Because CIP used both consultative and collaborative methods of participation at the design stage, we can assess the relative contribution of each. Clearly some of the lessons from participation, such as the importance of non-pest issues or the opportunity for improving the efficiency of nutrient management, emerged in both consultative and collaborative analysis. In fact, the consultative analysis may even have identified more constraints. Although farmer-researchers were initially reluctant to believe some of the researchers' conclusions from needs' assessment, over time and as a result of experimentation activities, they came to do so. Collaborative participation was important in refining issues and in developing and testing technologies, but as regards their contribution to identifying problems and priorities, collaborative participation at the design stage did not appear to be better than consultative and may even have been less effective.

Testing

Essentially three types of testing were carried out within the project. First were the farmer-researcher experiments, which farmers themselves designed and implemented, with researchers acting as facilitators and resource persons. Researchers initially played an important role here because farmers lacked experiment skills and capacity. Over time, they were able to take more and more initiative and responsibility, and the role of researchers declined. The second type of experiment, exemplified by the sex pheromone experiment, was designed and managed by researchers, but carried out in farmers' fields with farmers involved in regular field observations and the final analysis. In the third type of experiment, farmers and researchers identified problems together, but researchers designed and carried out the experiments on their own, on station. This was done because in some areas farmers lacked the interest and/or technical resources for the experiments. The topics of these on-station experiments included: sweet potato weevil mating behavior, methods of land preparation, selection and treatment of planting material, sweet potato weevil control by inundation, and identification of viruses (van de Fliert 1995).

Farmers made contributions to all three types of trials, but their main input was in the farmer-researcher trials. During the first year, these trials focused on simple comparisons of local varieties and nitrogen doses; by the second season, (1995-96 dry) the list of experiments had expanded considerably (Table II-3). Farmer-researchers wanted to continue working with the varietal and nitrogen experiments, but they also wanted to incorporate new topics such as fertilizer combinations, and the effects of cultural practices such as the vine lifting and planting method, about which little was known. Farmer-researchers also decided that in order to accommodate a broader range of topics, they would not all work on the same experiments, but would choose which were most relevant to their location-specific needs.

Three factors caused the expansion in topics. First, as a result of their experience, farmers increased their confidence and capacity to do more complex experiments. Second, the results of past experiments suggested new areas for further work. For example, the lack of significant differences in the nitrogen trials led farmers not only to repeat the trials in the wet season to test the robustness of the result and adapt the treatments, but also to look at other fertilization issues such as manure and potassium. Farmers identified potassium as being potentially important in sweet potato cultivation from an analysis of needs' assessment data, information from the literature (conveyed by the resource persons), and during discussions at the seasonal evaluation and planning workshops. They verified their hypothesis with their nitrogen experiments, and initiated a trial on fertilizer combinations.

Finally, the results of the on-going data collection on production practices yielded new topics for further examination and confirmed the importance of existing topics. These results showed that big differences existed among farmers in the same villages in terms of both practices and outcomes, suggesting that opportunities for improving efficiency in production lay in refining existing practices. Of particular interest was the lack of a significant relationship between fertilizer dose (urea or TSP) and yield, confirming that opportunities exist for improving fertilizer management (van de Fliert 1996a). Specific extension recommendations for sweet potato fertilization or other aspects of sweet potato cultivation do not exist in the region. Farmers generally apply recommendations developed for rice.

The farmer-researcher trials produced the results that follow (van de Fliert 1997a, 1997b).

Variety trials

Given the great variation in yields because of other factors, no clear results emerged regarding superior varieties among farmers' local varieties. One variety consistently performed better in all locations, but the eating quality was not appreciated everywhere. The other varieties often performed best in their area of origin. A comparison of local with four improved varieties from the Research Institute for Legumes and Tuber Crops (RILET) also failed to identify any outstanding varieties across all villages. Some farmer-researchers appreciated two varieties for specific characteristics, and two other varieties were unanimously rejected. Overall, farmers prefer their own to the improved varieties. As a result of these trials, no clear recommendation regarding varietal selection is made in the ICM manual because of the location-specificity of how different varieties perform in different places and how criteria vary from place to place. Rather, it is suggested that farmers carry out experiments focused on the characteristics important to them.

Fertilizer trials

The fertilizer trials yielded a solid set of information and guidelines, which appear in the ICM manual and are being prepared for submission to a refereed journal. The guidelines are based on expected yield and the type of organic manure used, and imply the following proportions at an expected storage root yield of 40 tons per hectare.

Organic manure should be applied at a minimum of 4 tons per hectare. Urea dose can be drastically reduced or even eliminated when chicken manure is applied. No application of TSP is needed if sweet potato is grown in rotation with rice, which receives TSP.

Potassium chloride should be applied at a level of 50-100 kg per hectare unless other potassium sources are available (e.g., ash, volcanic dust, and chicken manure).

Overall, the guidelines depend strongly on the farmers' circumstances and their other cropping practices. The only real recommendations to farmers are that they apply as much organic fertilizer as possible and that they experiment to determine the appropriate levels of additional nutrient sources.

Cultural practices

Vine lifting. Many farmers have the habit of lifting vines to prevent the sprouting of secondary roots. The belief is that diligent farmers—those who are most likely to frequently practice vine lifting—obtain higher yields. Nothing was known about optimal frequency of lifting, so this was studied. What farmer-researchers observed was that if soil was moist, vines were more likely to grow secondary roots and therefore vine lifting was important. Where soils were not moist, no difference was observed so an investment of time in vine lifting was not necessary. This guideline appears in the ICM guide.

Planting methods. Data on production practices showed considerable variation in methods of planting cuttings. Some farmers plant them vertically and others at a 90º angle. Experiments showed no difference so this was not included in the curriculum.

Intercropping. No significant differences were found; therefore no specific recommendation is made about intercropping.

Farmer-researchers' trials yielded results that were usable in developing the ICM curriculum, either because they could be included (varieties, fertilizers, vine lifting) or confidently excluded (planting methods, intercropping). Below is a list of the topics in SP FFS from the ICM Field Guide.

Chapter	Topics	Chapter	Topics
1	Intro to ICM FFS	14	Pesticides: medicine or poison?
2	A healthy soil	15	Fertilization
3	Experimental methodology	16	Vine lifting
4	Healthy seed	17	Field area measurement
5	Observing the crop and its environment	18	Sweet potato stem borer
6	Economic analysis	19	Sweet potato weevil
7	A healthy crop	20	Cropping pattern
8	Natural enemies	21	Variety selection
9	Sweet potato pests	22	Harvesting and marketing
10	Defoliation experiment	23	Storage
11	Sweet potato diseases	24	Sweet potato utilization
12	Weeds: friends or foes	25	Evaluation of SP FFS
13	Aphids and other tiny insects	Appendix	Group dynamics' exercises

Diffusion

In addition to FFS content, farmers had input into how it should be structured and promoted.

A pilot field school and the experience with farmer-researchers led to some fundamental changes in the way the curriculum for sweet potato ICM was designed compared to the traditional rice IPM FFS. These included an overall focus on "health" and emphasis on teaching principles and experiment methods for both learning and adaptive research purposes. More specific contributions from farmers include larger intervals between sessions during the second half of the season, less emphasis on observation (something that is highly pest oriented), and more emphasis on special topics and group dynamics' exercises to develop more skills and improve the group's ability to work together (van de Fliert 1996a). The dramatic decline in sweet potato prices and profitability that occurred midway through the project led farmers to place more importance on the economic aspects of sweet potato production, thus researchers developed components on economic analysis and marketing.

With regard to diffusion strategy, farmers supported the making of a video to help facilitators explain what farmers could expect from an SP ICM FFS and hence raise interest in enrolling. Because of farmers' concerns about establishing interest and credibility among other farmers, project partners decided that it would be best to leave responsibility for widespread implementation to the national IPM program and NGOs rather than become directly involved in extension activities (van de Fliert 1996b). Original project plans had called for developing institutional capacity to independently diffuse the ICM technologies.

Assessing the Impact of Farmer Participation on Adoption and Impact

The previous section documented how farmer participation resulted in changes in the project's priorities, practices, findings, and diffusion strategy. This section attempts to link these changes to the adoption and impact of the SP ICM FFS. Data for the analysis come primarily from the CIP-Mitra Tani-conducted evaluation of the impact of the NIPMP's implementing the ICM FFS.

The Data

Impact assessment activities were carried out in six communities where SP ICM FFSs were held as part of a pilot project run by NIPMP in 1997-98. Because the pilot FFS implementation program was funded by the NIPMP as part of its follow-up FFS activities, these field schools were all in villages where rice IPM FFSs had been held. The participants were rice FFS alumni. This could complicate the analysis because of the confounding of the effects of the two FFSs, but it also allows farmers to compare the two experiences. In addition, unless efficient rice farmers are also efficient sweet potato farmers, the decision to work with only rice IPM farmers could reduce the selection bias in choosing sweet potato farmers for the SP ICM FFS. Four of the six districts in which field schools were held were also sites of CIP-UPWARD project research. In two, the SP ICM FFS was held in the same village, thus the influence of farmer-researcher activities may also be present.

Detailed production data were collected from farmers who attended the SP ICM FFS and from those who did not. Only five of the six communities are included in the quantitative analysis because in one community no data were collected on non-participating farmers. Farmers were randomly selected, with the condition that they were planting sweet potato at the time the survey began—a time of low prices, which limited numbers in some cases. There are 125 observations, 58% from those who attended ICM FFS (subsequently referred to as ICM farmers) and 42% from those who did not (subsequently referred to as non-ICM farmers) (Table II-4).

Table II-4. Distribution of farmer sample in 1998 monitoring and evaluation study.

Village	Number of observations		Percentage that attended integrated crop management farmer field school
Mojokerto	23		61
Magetan	28		61
Karanganyar	28		64
Sleman	26		54
Kuningan	20		50
Total	125	Overall	58

Women make up 10% of the whole sample (12 of 125). All the women in the sample are from just two communities—Sleman, where they comprise 19% (5 of 26) and Kuningan, where they comprise 35% (7 of 20) (Table II-5). All the women in the survey attended FFS, while none were included in the non-FFS sample, reflecting the low levels of interest and involvement in sweet potato production, especially in Eastern Java. This limits our ability to look at some gender-specific impacts of the FFS.

Production data were collected on inputs, yields, cultural practices, and prices. Respondents were also asked about their knowledge of sweet potato production and of the ICM FFS. Attendees of ICM FFS were asked about diffusion practices, including to whom they had given information about the SP ICM FFS, and what they said. These qualitative data are particularly useful in linking the contribution of farmer participation in the research process to adoption and impact.

Table II-5. Gender distribution of farmer sample in 1998 monitoring and evaluation study.

Village	Number of observations		Those attending integrated crop management farmer field school (%)	
	Men	Women	Men	Women
Mojokerto	23	0	61	0
Magetan	28	0	61	0
Karanganyar	28	0	64	0
Sleman	21	5	42	100
Kuningan	13	7	23	100
Total	113	12	-	-

We have no baseline production data, but we do have the production data collected as part of the project's needs' assessment work during 1994-96. These data were collected in eight hamlets (in four villages), two of which ultimately had NIPMP-conducted SP ICM FFSs. We have information on which farmers in the survey subsequently participated in the ICM FFS, and we can use this to see whether systematic differences existed between ICM and non-ICM farmers prior to the ICM FFS. Analysis of the data reveals that in the 1994 wet season and 1995 dry season, farmers that did not go on to participate in SP ICM FFS had significantly higher net incomes than those who did. In the 1995 dry season, yields were not significantly different, but non-ICM farmers had higher gross and net incomes.

These results are useful because of the high probability of selection bias in participatory projects. Only certain farmers are invited to participate, and only interested farmers actually do so. If the characteristics that influence whether a farmer is invited and/or participates are correlated with outcomes such as yield or income from sweet potato production, then observed differences between farmers who did and did not attend FFS cannot be attributed to the FFS alone. Selection bias is usually assumed to result in better-than-average farmers participating in projects, leading to an overestimate of what project impact would be on the overall target population. In this particular case, the results suggest that incomes between ICM and non-ICM farmers might actually underestimate the true impact of the project if ICM farmers had lower incomes at the start.

Impact of ICM FFS on production and income from sweet potato

According to the impact assessment data collected in 1997-98, some significant differences are found between farmers who attended the SP ICM FFS and those who did not. The ICM farmers have significantly higher net incomes per hectare than do non-ICM farmers (Table II-6). The ICM farmers also spent significantly more on fertilizer inputs than did non-ICM farmers. No difference showed between the two groups in terms of land rental, use of hired labor, or price received for their crops. No data were collected on use of family labor.

Table II-6. Differences in inputs and outputs by participation in integrated crop management (ICM) farmer field school.

Variable[a]	ICM farmers[b] (n = 74)	Non-ICM farmers (n = 52)
Area planted to sweet potato (m^2)	2,274	1,877
Percentage owning land	77	69
Yield ($t\ ha^{-1}$)*	20.9	19.5
Value of hired labor per hectare (IDR[c])	822,705	889,019
Value of fertilizer use per hectare (IDR)*	421,277	340,977
Price received ($IDR\ t^{-1}$)	52,314	44,921
Net income per hectare (IDR)**	3,414,572	2,374,440

a. * *P* = < 0.05 and ** *P* = < 0.01.
b. Among ICM farmers, value for men is significantly higher than for women (*P* = < 0.05)
c. 1 USD = 10,063.00 IDR

Among ICM farmers, women's plots (1120 m^2) were less than half the size of men's plots (2476 m^2), and they spent nearly twice as much on fertilizer per hectare as men did. This may suggests a scale effect, where a small plot is farmed more intensively than a larger one. With respect to all other variables such as yields and income per hectare, no significant differences were observed between men and women in the sample.

For a better view of ICM-FFS impact on the overall profitability of sweet potato production, a profit function was estimated. The dependent variable was net income per hectare. Independent variables included expenditure on fertilizer and hired labor per hectare, and dummy variables for land tenure status, for whether the farmer attended ICM FFS, and for water management practices used. Community dummy variables were also included to control for the influence of local conditions. A Cobb-Douglas functional form was assumed.

The results of the analysis show that participation in ICM FFS is significantly and positively associated with net income from sweet potato production (Table II-7). One reason for this could be that the ICM-FFS participants were already better farmers than were nonparticipating farmers. However, the baseline production data collected before the development of the ICM technologies do not support this explanation.

Participants in ICM FFS have higher net incomes than non-participants, after controlling for other factors that affect income. Land ownership and routine rather than sporadic irrigation both positively influence income. The community dummy variables are significant for Kuningan and Karanganyar. These are the communities with the most favorable ecological conditions for sweet potato production, and where the response to the ICM FFS was most enthusiastic. Neither fertilizer expenditure nor hired labor costs were significantly associated with the profitability of sweet potato production. As mentioned earlier, ICM farmers use more costly K-fertilizer, but less N-fertilizer than do non-ICM farmers. An earlier version of the gender analysis was included as a dummy variable; however, it was not significant and therefore is not presented here.

Table II-7. Results of estimation of sweet potato profit function coefficients; dependent variable is log of net income per hectare (n = 81, adjusted R^2 = 0.50).

	Standardized regression coefficient	*P*
(Constant)		0.000
Log of hired labor costs per hectare	0.089	0.335
Log of fertilizer costs per hectare	-0.102	0.375
Water management dummy (= 1 if irrigation is routine as opposed to sporadic)	0.290	0.002
ICM participation dummy (= 1 if attended ICM FFS)[a]	0.271	0.002
Land rental dummy (= 1 if rents)	-0.382	0.000
Karanganyar dummy	0.387	0.001
Kuningan dummy	0.452	0.000
Magetan dummy	-0.059	0.553

a. ICM = integrated crop management, and FFS = farmer field school.

To sort out potentially confounding effects of ICM and gender, two slightly modified versions of the model were also run to check the robustness of this result. In both cases, the results were essentially the same. In one case, only male farmers were included in the sample, and ICM and fertilizer use continued to be significantly positively associated with net income from sweet potato production. The model was also run for only ICM farmers (male and female), and in this case, sex was not a significant determinant of net income.

Farmer participation and impact

The results of the profit function estimation clearly show a relationship between participation in the SP ICM FFS and an increase in net income from sweet potato production. The econometric results show nothing about causality, however. To establish a cause-effect relationship, we need to look more closely at changes in specific practices. A more detailed analysis of production practices and farmer knowledge of SP ICM FFS can also help identify whether or not the farmer-researcher input in the technology development process contributed to impact.

Based on available production data, a major difference between ICM and non-ICM farmers lies in their use of fertilizer. The data show that ICM farmers use more fertilizer than do non-ICM farmers, and that they use different types of fertilizer (Table II-8). The ICM farmers are significantly more likely to use KCl than are non-ICM farmers ($P < 0.1$), and they have higher average use rates. The importance of potassium for sweet potato is one of the lessons of the ICM FFS. Further, according to the production data collected during the 1994-96 needs' assessment, use of KCl (only two out of 87 farmers) was virtually unheard of when the project began. These results support the hypothesis that participation in the ICM FFS led to changes in fertilizer use that contributed to increases in yield and income from sweet potato production.

Table II-8. Use of fertilizer (kg ha^{-1}) by integrated crop management (ICM) and non-ICM farmers.

Type of fertilizer[a]	ICM farmers (n = 73)	Non-ICM farmers (n = 52)	General recommendations from ICM field guide at expected yield of 40 t ha^{-1}
KCl first application*	7.1	1.7	50 (max)
KCl second application*	13.1[b]	5.3	50 (max)
Manure first application	137.0	97.0	4000 (min)
Manure second application	42.0	101.0	-
TSP first application**	36.8[b]	13.8	0 (unless not applied in previous rice crop)
TSP second application	42.4[c]	44.2	-
Urea first application	74.0	62.0	0
Urea second application	148.0	180.0	100 (max and depending on type of manure used)

a. * $P <= 0.1$, and ** $P =< 0.05$.
b. Among ICM farmers, women's average is significantly higher than men's ($P < 0.07$).
c. Among ICM farmers, men's average is significantly higher than women's ($P < 0.07$).

Table II-8 shows that farmers are using much lower levels of fertilizer than is recommended. This is probably because the price of fertilizers has risen substantially since the economic crisis while the relative price of sweet potato has dropped, and with it farmers' willingness to invest in its production. Nonetheless, ICM farmers seem to be using a more balanced approach to fertilization than are non-ICM farmers, even if neither is approaching optimal levels.

Among ICM farmers in the two communities where women participated significantly in the FFS, they were significantly more likely than men to use KCl ($P < 0.05$). They also have higher average use levels. This suggests that the benefits of the FFS are available to women who participate, and that they are using these advantages, perhaps even more so than are men.

Farmers identified fertilization practices as offering opportunities for productivity improvement. This supports the hypothesis that farmer participation in research design improves the ability of projects to identify relevant research topics. In addition, farmers through their experimentation verified the importance of KCl and organic fertilizer under prevailing conditions to sweet potato production. This supports the hypothesis that farmer involvement in testing improves the ability of projects to select appropriate technologies among those tested.

What farmers told others about the ICM FFS provided another means of assessing its importance to them. Of ICM FFS participants, 68% reported talking to others about the experience; however, communities varied widely on this point (Table II-9). In five of the six communities, over 90% of participants reported having talked about it with others. In one community, Magetan, only 41% did so. Research activities had been most intensive in this community, which might have caused a certain level of fatigue/saturation and, hence, influenced FFS farmers' communication. On the average, each participant talked with about three people. Men and women are equally likely to discuss ICM with others, but men do so more frequently. On the average, men told about three people and women told about two, a difference that is statistically significant ($P < 0.05$). Nearly all these exchanges occur either in the fields (53%) or in home/group meetings (42%). No difference is shown between men and women regarding where they exchange information.

Table II-9. Farmer-to-farmer diffusion of knowledge gained in integrated crop management (ICM) farmer field school (FFS).

Community	Participants who talked to others about the ICM FFS (%)	Average number of people told
Mojokerto (n = 16)	94	3.9
Magetan (n = 17)	41	3.1
Karanganyar (n = 18)	100	3.3
Magelang (n = 16)	90	--
Sleman (n = 14)	93	2.5
Kunignan (n = 10)	90	2.3
Total (n = 91)	68	3.1

Men and women do differ significantly regarding whom they talk to regarding their FFS experiences. Men talk more with neighbors, while women talk more with relatives. These differences could imply very distinct patterns of diffusion of FFS information.

When FFS participants discuss their experiences, they mention many different aspects of the course, including nutrient management, seed selection and health, field preparation, and pests and diseases. Although men and women show some differences in the frequency with which they mention certain topics, none is statistically significant, suggesting that they found the same aspects important. The most common single topic mentioned was seed, including both varietal selection and selection of healthy planting materials. Of the respondents, 26% said that they told others about seed; 30% said that it was the first topic raised with others. The second most common topic was fertilization; 23% of FFS participants discussed with others what they learned about fertilization.

The third most common topic of discussion, pests and diseases, was talked about by almost 15% of FFS farmers, but only 6% mentioned it first when discussing FFS. This suggests that if the project had not changed its focus from IPM to ICM, many farmers, both men and women, would have found it much less relevant. Fertilizer and seed were what most interested the farmer-researchers in the development of the ICM curriculum, and these are the most important areas for ICM farmers as well.

Diffusion

To assess the impact of farmer input into the design of the diffusion strategy for the ICM FFS technologies, we use information collected from focus group discussions held with farmers who participated in the SP ICM FFS in five communities. Because most of the participants had also participated in the rice IPM FFS, they were asked to distinguish between the two approaches. Overall, farmers did not perceive fundamental differences in implementation between the two. They consistently and correctly identified differences in specific activities, for example pest observation in rice IPM, and fertilizer and seed selection for ICM; and several people mentioned the ICM's broader emphasis on aspects such as soils. However, no one mentioned differences in the way activities were carried out, for example different types of experimentation or more group dynamic activities. Rather they tended to differentiate between FFS and other types of extension activities.

In two of the five communities (Kuningan and Mojokerto), participants specifically mentioned that they were able to apply what they learned in SP ICM FFS to other crops such as onion, chili pepper, and ginger. A similar outcome was observed in the implementation of the ICM FFS methodology by NGOs. In addition to training NIPMP staff to implement the ICM FFS, the CIP-UPWARD project also provided training to some NGO staff. Several of the NGOs that received training work on the island of Flores, and a field assistant from one of the CIP-UPWARD project partners visited five communities on Flores in 1999 (Gego 1999). Gego found that in four of the five NGOs at least one ICM FFS had been carried out, but only one had been for sweet potato. The other ICM FFSs focused on cashews, cacao, garlic, shallots, and beans. In all but one community these were the first FFSs ever implemented.

That the SP ICM FFS curriculum lent itself so easily to adaptation to other crops is consistent with its stress on building experimental and analytical capacity rather than giving recommendations. The experiments in the ICM FFS are not designed to teach, but rather to discover, which makes them more easily transferable to other subjects. The project focus on strengthening experimental capacity and basic agroecological principles was associated with the participation of farmers and other non-research-oriented partners such as the NGO, Mitra Tani.

Human and Social Capital Impacts

It is hypothesized that through the process of interacting with researchers, the human and social capital of participating farmers and communities can be strengthened. Human capital is understood to include the development of project-specific and general analytical skills, as well as the empowerment of participants to use the skills to address problems outside the context of the project. Social capital includes the formation and/or strengthening of networks and organizations, enhancement of community capacity to work with external organizations, and reduction in conflict. By definition, these types of impacts would only be expected to occur with empowering participation, defined here as collaborative or collegial. The relevant hypotheses for CIP-UPWARD's research and technology development activities are those for the collaborative approach at design (*H4*), testing (*H6*), and diffusion (*H8*) stages.

In the case of the SP ICM project, we would expect social and human capital impacts to occur at two levels. The strongest impacts would be expected to occur among the farmer-researchers who worked intensively with project staff over a period of several years. To a lesser extent, we might also expect to find human and social capital impacts among the participants in the ICM FFS. The reason is that the SP ICM FFS curriculum is focused on discovery-based learning and on teaching principles that have broad application. Farmers are taught experimental methodology to enhance their adaptive research capacity. In this analysis, the main focus is on the farmer-researchers (see van de Fliert et al 2001 for a detailed analysis of impact on FFS attendees).

Assessment of changes in human and social capital is based primarily on interviews conducted over a 2-week period in September 2000 with five of the nine farmer-researchers. Interviews were also conducted with village officials and others in the communities. This information was supplemented by interviews with CIP-UPWARD project staff, and with secondary data from extensive project documentation.

Selection of the Farmer-Researchers

Project staff selected the farmer-researchers on the basis of their interest and qualities as observed during preliminary informational meetings held in the villages. The selection process was admittedly subjective, with the goal being to identify individuals who were (1) interested, (2) capable, (3) likely to participate actively without being dominant, (4) not major village officials, and (5) active farmers.

All farmer-researchers had a background in agriculture, although not all had their own farms at the time they were selected. Of the five we interviewed, two young men had been to (agricultural) high school, but were working on their parents' farms. One had just returned from migrant work in Sumatra, and said he became involved in the project because he was between jobs. Village heads said that the ones who farmed were average farmers before becoming involved in the project.

Although the farmer-researchers were generally considered average in their communities in terms of economic and educational criteria, they do have some individual characteristics that make them different from the rest of the community. Therefore it is not appropriate to assume that impacts observed among these farmer-researchers would be the same for other individuals if they were to participate in the same process.

General Impressions of the Farmer-Researchers

None of the farmer-researchers had had experience with agricultural research or development projects before, and therefore had some difficulty explaining why they decided to join this one. The most common response was that they were interested in sweet potato production. They could not clearly say what their expectations were, but all said that the project was not what they expected. The overall consensus was that participation in the project involved more work than they had envisaged. One said that he thought he would learn together with project staff, but had not expected to work with them, a comment which can be interpreted as meaning that it was hard work, but also that he was involved in a more active and substantive way than he expected to be.

Farmer-researchers were unanimous in that the experience was highly positive. They said that they enjoyed working with the project staff and especially with the other farmer-researchers. They agreed that they learned a great deal about sweet potato production and about experimentation. They all reported sharing this information with other farmers in their villages, and said that others were adopting the practices and reaping the benefits. Village officials and project staff observations confirm this.

The farmer-researchers appear to have gained increased status in the communities because other farmers seek them out for advice and information, something that did not occur prior to their participation in the project. The farmer-researchers say this was unforeseen. Overall, they enjoy the change except when they are asked questions that they cannot answer or when farmers do not believe their answers.

In the case of the two young farmer-researchers who were not farming at the time the project began, both are now actively involved in agriculture in their communities. One was recently made a village official. Both link their interest and willingness to be involved in agriculture and in local activities to their participation in the CIP-UPWARD project.

Design Stage

Work at the design stage involves identifying problems, generating and assessing possible solutions, and selecting the most viable for further testing and evaluation. Simply including farmers in a discussion of these issues (consultative participation) could be beneficial if it stimulates them to focus attention on priority issues and potential solutions. In collaborative participation, farmers and researchers do these activities jointly and share responsibility and authority for the decisions. As a result, the process might involve debate, negotiation, and compromise, which could potentially make it a more enriching and empowering process for all involved.

Both project staff and farmer-researchers reported an increase in the farmer-researchers' skills and ability to work with one another and with project staff over time (Braun and van de Fliert 1997). The project's organization, particularly the end-of-season evaluation and planning workshops with a rotating venue, was a valuable mechanism not only for participants to gain skills and confidence, but also for project staff to assess the development of the farmer-researchers at regular intervals. Workshop progress reports repeatedly note improvements in their personal capacities. A concrete example is their ability to identify more and more sophisticated research topics, and to design experiments. The fact that the design and testing stages were iterative in this project probably contributed to this process because better testing skills increased the ability to analyze problems. The ease with which farmer-researchers interacted with our interview team and were able to respond to questions, analyze issues, and articulate opinions was striking during our fieldwork.

Despite being clearly able to increase their skills and abilities to work with project researchers, there is little evidence that they have been able to improve their interactions with one of the most important external agricultural organizations with which they work—the extension service. When asked about their interactions with the extension agents, all but one of the farmer-researchers was dismissive. Several of the farmer-researchers had tried to approach extension staff—one even going to a staff member's house—but extension personnel were not responsive. Two farmer-researchers reported that extension workers are happy to take information from them, but did not appreciate their research. The incentive system for extension officers is based on credit points, which are accredited for certain activities, and which they need in order to advance in salary scale. Visits to farmers yield relatively low points compared with attending in-service training or writing reports. This might be a reason why extension officers are not particularly interested in farmers doing their own research and sharing results with other farmers, and might even perceive it as a threat to their authority.

Only one local extension agent has become seriously involved in the project in any of the communities. No one in the communities spoke highly about the extension service, saying that extension workers rarely visit and even those that do visit lack training in anything except rice and so cannot help with other crops such as sweet potatoes. In one community, the farmer-researcher, who was young and educated, gave the impression that he rejected the extension staff rather than the other way around. He said that they respected him, but did not understand what he was doing. They invited him to a course, but he did not attend because he did not think he would learn anything new.

In the project community in Magetan sub-district, the local extension agent who had initially been skeptical later became receptive to project activities and linked his work with the sweet potato work. The farmer-researcher reported that because the project worked in the village, the extension agent was able to revive farmer groups in the community and direct several other projects there. In this case, it does appear that the project contributed to the ability to capture outside resources; however, this was the exception rather than the norm.

All farmer-researchers said that getting to know and work with others was one of the greatest benefits they received from participation. The exchanges with farmers from other villages were highly useful to them. During their biannual evaluation and planning workshops, they used the time outside of working hours to exchange information on other aspects of agriculture outside the scope of the project. All spoke of how much they would like to get together with the others again, and a few have actually visited one another at their own expense since the project ended.

Despite the good relations that developed among the farmer-researchers, it is not clear that they enhanced their skills with regard to working in groups or managing conflict. In the interviews, no one mentioned enhanced capacity or willingness to work in groups, and little information was available on it in the project documentation on conflict and/or conflict resolution among participants. Overall, internal conflict regarding sweet potato cultivation is rare in the communities. Improvement in the capacity to work together and to manage conflict would be an expected impact where collective action was necessary to deal with problems such as pesticide drift or inequities in water distribution. The project generally focused on plot-level productivity issues, where the need for collective action is not as strong.

Although farmer-researchers worked as a group during the workshops, on returning to their own villages they worked alone or in pairs (there were two per village), except when specific experiments called for replications or data collection from multiple fields. Since the project ended, most continue to conduct experiments, but all say they work alone on problems that they themselves identify. Two farmer-researchers said that they had suggested setting up experiments with fellow farmers who asked them for advice, but in both cases the other farmers were not interested either because they did not understand the idea or because they wanted answers quickly.

Testing Stage

At the testing stage, the main impacts on human and social capital would be expected to be an improved ability to design, implement, and analyze experiments. Again, if work is done collaboratively, negotiation skills can be enhanced in the process.

Farmer-researchers clearly improved their understanding of experimentation and analysis. They identified learning to “test things for themselves” as having been a benefit of the project, and in talking to them they clearly understand the principles of experimentation and data analysis. In one community, the farmer-researchers criticized a RILET-conducted experiment because it did not have replications and the concern was only with yield and not overall profit. In another community, we arrived unexpectedly at a farmer-researcher’s house and noticed that he had a spare record-keeping book hanging on the wall where he was using it to keep data that he was collecting about his chili crop.

When farmer-researchers were asked about whether they continued to experiment, all but one said yes. Only one said he did systematic experiments comparing results across fields or seasons before the project, so this is clearly an impact. Most of their subsequent experiments were variations on what they had done in the projects (e.g., varieties, fertilizer, spacing, and soil preparation); however, they were working with other crops such as maize, tomato, and chili. They were all quick to point out that, although they continue to experiment, they do things slightly differently because they are "doing it for themselves now." Some of the changes, such as smaller plot size or not weighing the foliage after an experiment, are not necessarily significant. However, most said they had also dropped replications and "weighing inputs as well as outputs" since they left the project, which would have implications for the quality and reliability of the conclusions derived from the experiments. We cannot assume, however, that the level of sophistication of experimentation has declined. A farmer-researcher reported having purchased an implement to measure soil pH.

As mentioned earlier, farmer-researchers usually carried out their experiments alone. Other farmers in their communities probably benefited from their knowledge and results, but they do not appear to have benefited from what farmer-researchers learned about the experimentation process. Several farmer-researchers said that other farmers did not always understand the purpose of their experiments, and one said that he was sometimes criticized when an experiment "failed."

All farmer-researchers reported that other farmers come to them for information and for advice. Farmer-researchers actively disseminate their findings and knowledge. However, they say that they usually wait until someone comes to them with a question because to disseminate more aggressively is not a culturally appropriate way to spread information; this clearly has implications for the pattern of diffusion, especially among the sexes. When asked, farmer-researchers said that they shared their knowledge with women.

Nonetheless, some examples show how the farmer-researchers were able to use their increased knowledge for the good of the community. One farmer-researcher said that a farmer had come to him about a scab problem. He could not solve the problem, but was able to convince both the farmer and the local trader that scab would not affect yields. As a result, the farmer still got a good price for his standing crop. Improving bargaining power with traders is an area where collective action by sweet potato farmers could be beneficial.

Diffusion Stage

The types of benefits that would be associated with farmer participation at the diffusion stage involve farmers' increasing their knowledge of issues related to the diffusion of innovations; for example, the factors that affect adoption decisions or the role of complementary inputs such as information, skills, or credit. As described in the section above, farmer-researchers along with other farmers participated in designing a diffusion program for the project. This included the identification of an appropriate mechanism

(FFS), the presentation of the content (ICM field guide), a strategy for promoting it to farmers, and a training course to prepare facilitators to implement it.

Because of the knowledge and experience they accumulated as part of the project, and because of their demonstrated capacity for personal development, the farmer-researchers were logical candidates to become FFS trainers. Several of them did participate in the training-of-trainers' courses, which included practice facilitating group activities. The conclusion on the part of both project staff and the farmer-researchers themselves was that they were not suited to be FFS trainers. Despite their success as researchers, they were not confident, enthusiastic, effective trainers. Although the experience of failure was difficult for some, an important lesson was learned by both farmer-researchers and project staff about the differences in personal qualities and capacities required to carry out research versus implement extension programs, even when these, as in the case of SP ICM FFS, have an adaptive research focus. Some of the farmer-researchers continue to act as resource people for FFS, a role that seems well suited to their interests and experience.

Although it may simply be that farmer-researchers were not suited to extension type activities, it may also be the case that they did not have the same incentive to be FFS trainers as they did to be researchers. The results of the research and technology development activities were directly relevant to them and their communities. Their incentives to act as trainers, even if they were compensated, are less clear, especially because they can already transmit the knowledge they had gained to their own fellow farmers in other ways. This explanation for their lack of success as FFS trainers is supported by the fact that none of the farmer-researchers became involved in any other for-profit activities broadly related to diffusion of the results of the ICM research, for example provision of seed, varieties, fertilizer, or marketing assistance. In one community, the farmer-researcher was approached by an extension official to help disseminate some new varieties in his community; however, he was able to determine that the planting material being offered was not of high quality, and declined to become involved.

Feedback to Formal Research Impacts

Introduction

In this section, we look at the benefits of user participation for the formal research establishment, specifically at researchers' access to information about farmers. A major goal of participatory research is to improve researchers' understanding of farmers' priorities, preferences, and constraints regarding technology development. This information could lead not only to adjustments in the priorities and activities of a specific research project, but also to changes in policy and practice within institutions, and to more efficient and effective inter-institutional arrangements.

The specific hypotheses regarding the types of feedback to research that would be expected in the CIP-UPWARD project are those for the collaborative approach at design (*H11*), testing (*H14*), and diffusion (*H17* and *H19*) stages. Consultative and collaborative participation in the design of a research project would be expected to increase researchers' understanding of farmer priorities and preferences for possible solutions. If researchers and farmers test technologies collaboratively, researchers may improve their understanding of specific criteria and methods that farmers use to evaluate innovations. Collaborative participation in the design of a diffusion strategy for a new technology can improve researchers' understanding of how farmers make adoption decisions and what factors are most influential. A better appreciation of farmer-to-farmer diffusion can be particularly useful in understanding how and why technologies spread. Participation at any stage of the research process may lead researchers to conclude that working together with farmers requires different skills, especially interpersonal skills, which were not important when research was carried out on station.

Design Stage

The earlier sections of this report document how farmer input changed the project's priorities and activities with regard to which aspects of sweet potato production were most appropriate for research interventions and how that research was to be conducted. Evidence shows that the lessons learned in this project are also having an impact at a broader level within CIP. CIP divested on weevil research in Asia in part as a result of the project (Walker, 2000). Sweet potato breeders decisions to focus on both scab and dry matter content—important for processing--were re-enforced by the project's findings.

Impacts can also be noted at the methodological level (Thiele et al 2001). In 1995, a project on sweet potato varieties in Uganda also took an ICM approach. In 1996, the leader of CIP's largest and most prestigious project, Late Blight, visited the Indonesia project and learned more about its method and results. The idea of incorporating IPM principles to late blight management had had a few supporters since the mid 1990s; however, it only recently became a central element of a late blight research program that had previously focused almost exclusively on varietal improvement. At a center level, an ICM working group was formed in "response to the need from different projects to coordinate their inputs into ICM and share methodologies, information, and project outputs".

Although participatory research methods have not taken hold across the center, attempts are being made to move them beyond specific projects, and the SP ICM FFS project has contributed to this effort as well. This year, a center-wide working group on participatory research was established with the project leader of the SP ICM FFS project as coordinator.

CIP is making a commitment to FFS as an "articulating element" for participatory research. The experience of the SP ICM FFS project, among others, is helping CIP take a critical look at the different ways in which FFS can be used, and their implications for outputs and impacts. The SP ICM FFS project offers an example of one way in which

FFS can be used. Initially, the project faced resistance at headquarters for being too extension-oriented. Over time, however, it was able to show that it was focused on "the development of a learning model that responded to farmers' needs, and the establishment of a mechanism for the large-scale implementation of this model" rather than extension itself. Project staff of the SP ICM FFS have also used their experience to make a conceptual contribution to understanding how FFS can be used to do participatory research and extension, and this has been useful for scientists both inside and outside CIP (van de Fliert and Braun 2001, Braun et al 2000). The scientist who facilitated the establishment of the SP ICM FFS project in 1994 now works full time on methodological issues for participatory research in NRM.

Less impact is observed on RILET, the national research organization that participated in the project. This organization breeds sweet potato, and tested some of its improved varieties in the farmer experiments, where they performed poorly according to farmer criteria. The RILET scientist who worked with the project was unavailable on a visit there, but it would appear that he was not highly committed to participatory research in practice and has changed little as a result. The nature of incentives and constraints within the national program may have contributed to this outcome.

Although significant impact on the national research program was not observed, the NGO working on the project was profoundly affected in many ways by the experience. Mitra Tani is an NGO based in Java. According to Wiyanto, a Mitra Tani staff member who worked on the ICM project, Mitra Tani projects used always to enter communities opportunistically, working on a single topic such as irrigation or rat control. From this point, they would move on to other aspects. As a result of their experience with this project, all Mitra Tani projects now do an initial needs' assessment in every community in which they work. Together with the community they develop an integrated proposal and specific action plans. Research is now part and parcel of all their projects.

Mitra Tani interacts with the extension service and other external actors in this process, and report that extension's response to this way of working has been mixed. Wiyanto said that of the five extension agents in the area where he currently works, three are supportive of this way of working and two are not. The problem is not necessarily that they do not agree with having to do needs' assessment and work as partners with communities, but rather that it goes against their specialized mandates and traditional ways of operating.

Wiyanto said that because Mitra Tani has a long history of working with the government extension service in several communities, it will continue to work with/on the extension service to make them more responsive to farmers' needs. When asked whether they could exert pressure on research agencies in a similar way, he said that they are not currently working with national research agencies (for reasons discussed below), but that if they are successful with the extension service, perhaps they could influence research organizations through them.

Testing Stage

Impacts at the testing stage are hypothesized to involve researchers learning about farmers' methods of experimentation and criteria for assessing outcomes. The project leader reported that the project made her recognize that doing experiments with farmers is not a standard process that can serve several purposes at the same time, but rather that experiments should be carried out for one specific purpose at a time, such as knowledge and/or technology generation, validation, discovery learning, or demonstration. The different purposes influence the design, output, and learning process associated with the experiment, which means that clearly defining the purpose of the experiment with all involved in advance is critical.

Wiyanto reported that this project was the first time that his organization had worked with a research organization and done experimentation. In the past, their work focused on community organization and facilitation, but without the technical background. They were highly impressed with the farmer experimentation and its results in this project, and want to include experimentation and technology development in their other projects. According to Wiyanto's experience, farmers do not experiment systematically on their own; however, once involved in a project they may learn and continue to do so.

To be able to develop technologies as part of their projects, Mitra Tani recognizes that it will have to develop closer links with research institutions. Currently they are trying to form links with both national research organizations and universities. In the short run, they see more possibilities working through students in universities because they seem more open to new ideas and more willing to work collaboratively and share their results.

Diffusion Stage

As discussed earlier, the participation of the farmer-researchers in the training-of-trainers' activities provides an important lesson to both the farmer-researchers and the project staff about the differences between farmer effectiveness in a participatory technology development process versus a formal technology diffusion program. As a result of this and other concerns raised by the farmers about the importance of getting farmers to take the ICM FFS seriously, the project shifted from a plan to establish its own diffusion program to one of working with other institutions such as the NIPMP and NGOs with existing capacity in these areas. It was recognized that a more formal funding and implementation mechanism was needed to carry the effort to a satisfactory level of expansion that would not have been possible by multiplying the effort through an initial group of eight farmer-researchers.

The Indonesian version of the manual (1000 copies at the first press run and an additional 500 copies at the second) was distributed among national IPM programs and agricultural extension service staff in sweet potato growing areas, NGO networks, and private companies collaborating with the Directorate of Root crops. The Directorate of Root crops is planning another round of training of trainers to make possible wider implementation of SP ICM FFS throughout the country.

An English version of the manual was produced as a basis for adaptation of the ICM and FFS protocols for (and translation into the languages of) Vietnam, the Philippines, and China, where CIP works on sweet potato IPM/ICM. Research efforts in these countries involved less technical research, but rather field-testing and adaptation of the Indonesian model. Alternatively, the identification of appropriate diffusion mechanisms was done at a much earlier stage and the relevant organizations were involved in the FFS development research.

The English SP ICM FFS manual was soon considered and promoted as a source book on ICM FFS in general, and requests for copies came from all over the world, from national and bi-lateral IPM programs, NGOs, the Food and Agriculture Organization (FAO) Global IPM Facility, international training centers, universities, and private companies. The English manual totaled 1000 copies at the first press run and an additional 500 copies at the second. Presently, a Spanish version (500 copies) is in press.

Cost of Research Impacts

Participatory research would clearly be expected to have an impact on the costs of doing research. Unlike the other impacts discussed above, the cost impacts are not necessarily tied to a particular stage in the innovation process. Rather, the hypotheses (*H20* and *H22*) relate to the type of participation used. Where the stage might be important would be in the case that using participatory research in one stage reduced costs in a subsequent one.

The total budget of the technology development phase of the CIP-UPWARD project was about US$54,000. Personnel costs are the largest category of expenditures, ranging from 62% in the first year to 44% in the third (Table II-10). Travel was the second largest category, at just under a third of the total budget each year.

Table II-10. Centro Internacional de la Papa (CIP)- Users' Perspectives with Agricultural Research and Development (UPWARD) annual project expenditures, by category (%).

Category	1994-95	1995-96	1996-97
Personnel	62	56	44
Travel	27	28	30
Services	3	5	8
Supplies	8	11	18
Total	100	100	100
USD total	14,000	14,000	26,000

In the first year, project activities consisted mainly of village profiling, season-long record keeping, and field observations, and (during the second season) eight fairly simple experiments carried out by farmer-researchers. This would explain the higher proportion of costs on salaries. In the second year, some data collection and a pilot FFS were done, but the bulk of the work was in experiments. Farmer-researchers carried out 31 experiments, while researchers carried out nine. In the third year, farmer-researchers carried out 18 experiments, while researchers did two. The third year also included the training-of-trainer activities.

Analyzing the impact on costs implies a counterfactual, namely what costs would have been with less or no participation. A possible counterfactual would be a typical CIP IPM project without the focus on participatory research or the FFS. According to project staff, the main costs associated with farmer participation were the workshops. Other costs such as those related to needs' assessment and to experimentation costs would have been incurred in a less participatory project. Given that farmer-researchers were only reimbursed for some of their costs, it might be the case that experimentation through farmer-researchers was less expensive than it would have been had researchers done it themselves. Quality difference must certainly be considered in comparing researcher- and farmer-generated data; however, the fact that the data from the farmers' fertilizer experiments were suitable for scientific analysis and yielded usable results suggests high quality.

Because the project essentially used both consultative and collaborative participation at the design stage, we can compare costs and results of the two approaches. The consultative activities consisted of initial characterization of the research sites, cultivation constraints, and opportunities. The collaborative activities consisted of farmer participation in the methodology revision, implementation, and analysis and interpretation of the data collected. The message from both approaches was similar; for example, that pests were not the main constraint and that fertilizer use did not appear to be efficient.

The research costs of the SP ICM FFS project could also be compared to the cost of developing an extension-oriented FFS, without the focus on research. Information on the magnitude and structure of costs for the FAO Community IPM FFS in SE Asia were provided by Andrew Barnett (2000). In FAO community IPM FFS, needs assessment is done by field staff based on field studies and secondary data. These usually come from Indonesia and are adapted for application in other countries. Curricula are developed during a week-long curriculum development workshop carried out with facilitators using technical manuals and guides for content. The workshop can be national, regional or loca, and usually costs between US$2000 and $5000. Once the curriculum has been developed, a training of trainers is conducted. This costs of this are between US$20,000 and US$70,000 depending on the country. FAO has been working on developing an FFS for other areas like soils.

To facilitate the comparison of costs and cost structures, Table II-11 presents the specific activities conducted by the SP ICM FFS projects. The purpose of the table is to show the different activities included in the different types of project, and what implications they have for the structure and size of costs. For each stage, some advantages and disadvantages of the particular approach are noted.

Table II-11. Activities and costs of the Centro Internacional de la Papa (CIP) integrated crop management (ICM) farmer field school (FFS) project and counterfactuals.

Activity	Sweet potato (SP) ICM FFS
Needs' assessment (1994-96)	Quantitative and qualitative data (three seasons) collected to better understand SP production system and role of SP weevil and other pests. Costs: *Researcher* time in the initial participatory rural appraisal (PRA) and data collection activities (US$9200 for first 7 months of project that were primarily devoted to project design, preparation of methodologies, and needs' assessment data collection and processing). *Data* collection by nongovernmental organization (NGO) staff and farmers: (including farmer-researchers payment at US$20 per month): 1994-95 wet season: $6150 1995 dry season: $4060 1995-96 wet season: $4150 *Time* of one full-time field support personnel (US$225 per month) plus expenses. Pros: Enhances relevancy to the farmers of the topics chosen. Cons: By identifying issues that researchers are not well equipped to address.
Training and methodology pre-testing workshop (Dec 1994)	1-week workshop for farmer-researchers US$710
Evaluation and planning workshops (Apr 1995, Sept 1995, Mar 1996, Oct 1996, Mar 1997, Oct 1997)	Six 3-5-day-long workshops held to analyze the needs' assessment data, identify research areas, and plan, design, and evaluate farmer-researcher experiments. Costs: US$ 780 – 700 – 810 – 1000 - 755 – 350, respectively for all direct costs such as transport, per diems, etc. Time of project scientists: 5 days 2 persons Pros: Interaction of all project participants was good not only for the analysis, but also for building relationships and strengthening farmers' skills. Cons: Costly

Continued.

Table II-11. Continued.

Activity	Sweet potato (SP) ICM FFS
Farmer experimentation (1995-97)	Farmers implemented experiments designed and analyzed during the workshops. Costs: Cost of materials and farmer-researcher time: 1995 dry season: $1500 1995-96 wet season: $1150 1996 dry season: $1250 Farmer-researchers were paid about US$20-50 per month, depending on how much time was allocated. Field staff personnel salary was about US$225 per month. Pros: Provides data under farmer conditions, probably at a lower price than typical on-farm research. Strengthened farmer capacity. Cons: Level of sophistication of experimentation may have been lower, especially initially.
Researcher experimentation (1995-97)	Experiments carried out by researchers on station and in a consultative way in farmers' fields to supplement information available from other sources. Costs: Pheromone traps donated by producer, researcher time in design, implementation and analysis, farmer time (uncompensated). Field costs were about US$500 for that experiment.
Researcher experimentation (1995-97)	Pros: (When done as a complement to farmer participatory research [FPR].) Certain experiments are too complex for farmers. Also, farmers are not interested in doing all experiments. Cons: Experiments may not be priority topics for farmers.
Curriculum development workshop for farmer-researchers (Jan 1996)	Curriculum outline was formulated during 2-day workshop with selected group of farmer-researchers based on the needs' assessment and experiments. Costs: Farmer-researcher and project staff time, transportation, lodging, per diems. Direct costs: US$80 per workshop Further in-depth discussion of curriculum and modules during the evaluation and planning workshops.
Two pilot IPM FFSs (dry seasons 1995 and 1996)	First using the rice IPM model to test appropriateness of FFS model for sweet potato and learn how to adapt it - US$950. Second field-testing the draft version of the SP ICM FFS model, and simultaneously serving as training-of-trainers for seven farmer-researchers - US$2100. Both FFSs were run during an entire season in Turi village.

Continued.

Table II-11. Continued.

Activity	Sweet potato (SP) ICM FFS
Two pilot IPM FFSs (dry seasons 1995 and 1996)	<u>Costs:</u> Materials and salaries. Farmer-researchers earned about US$30 per month during this period. Time of project scientists. <u>Pros:</u> Gives farmers a chance to see the methodology and assess its appropriateness for the content. <u>Cons:</u> All was done in the same village and this resulted in project fatigue.
Analysis of research results and writing of publications	Researchers and their staff analyze results and write publications, donor reports, etc. This was often done with input from farmers and other participants. <u>Costs:</u> Analysis costs (computers, laboratories), researcher time. <u>Pros:</u> Includes user farmer perspectives. <u>Cons:</u> Could take longer to analyze or requires new skills of farmer. Generated data are of lower quality or more complex (e.g., ranking or preference data).
National workshop (Oct 1996)	To present findings and curriculum to policymakers, and decide on a national diffusion mechanism for SP ICM FFS. <u>Costs:</u> Direct costs US$1000.
Two training of trainers' (ToT) workshops (Jun 1997 and Apr 1998)	The first ToT was for facilitators and farmer trainers of the National IPM Program (NIPMP) (40). The second ToT was for staff and farmer trainers of NGOs (42). <u>Costs:</u> NIPMP: US$6130 NGOs: US$3100 (excluding US$4120 own contribution for transport and per diems of participants). <u>Pros:</u> Led to decision to use existing training capacity of other organizations and therefore saved projects from investing in large-scale training

Summary and Conclusions

This study assessed the contribution of farmer participation in the research and technology development activities associated with development of an ICM FFS for sweet potato in Indonesia.

Farmer participation had a significant impact on the technologies produced by the project. As a result of farmer input, the scope of the project was broadened from IPM of a single pest (the sweet potato weevil) to ICM. Farmers' input led to the identification of plant nutrient management as an area where production efficiency could be improved. Farmers' input in the design of a diffusion strategy resulted in the project decision to work through existing extension networks rather than establish independent diffusion capacity. In addition, in response to farmer input, the SP ICM FFS was focused more on strengthening experimenting capacity and farm enterprise management skills than a traditional FFS.

Farmer input was also associated with the impact of the technology. In an analysis of the impact of the implementation of six SP ICM FFSs by the NIPMP, participation in ICM was associated with higher net income from sweet potato production. A main area where ICM farmers differed from non-ICM farmers was in their use of fertilizer. They did not use more, but they used different combinations, including more KCl. This was a major lesson of the FFS. Fertilization and varietal and seed selection were also the most common topics that farmers mentioned when they talked to others about the FFS. Pests and disease was the third most common topic, suggesting that if farmers had not been involved in the design of the FFS content, it might have been much less relevant. No women participated as farmer-researchers, but some participated in the ICM FFS and benefited equally.

Although farmers who attended both SP ICM FFS and rice IPM FFS did not perceive major differences in the methodologies of the two courses, ICM farmers reported having applied what they learned to other crops. This was also the case with several NGOs who actually adapted the SP ICM FFS to ICM FFS for cashews, onions, garlic, and other crops. This adaptability is consistent with the focus on experimentation and teaching of principles rather than guidelines, and can be considered an impact of farmer participation in the project.

Another type of impact that was examined in the study was that of participation on the participants—in this case the farmer-researchers. Project documentation and open-ended interviews with the farmer-researchers, key informants in their villages, and with project staff revealed large increases in human capital among these nine farmers. They have greatly increased their understanding of the agroecology of sweet potato production, their capacity to design and conduct experiments, and their effectiveness in interacting with other farmers and researchers. We found less impact on their ability to interact with other local organizations such as the extension service, largely because of the lack of interest and presence of the latter. Social capital in the farmer-researchers' communities appears to have already been high, and the communities benefited from this because it facilitated diffusion of what the farmer-researchers learned.

Researchers and staff from other organizations involved in the project also benefited from their interactions with farmers. The project experience has contributed to changes in CIP's breeding programs, and to increases in the importance of both ICM and participatory research in CIP and other international institutions. Mitra Tani, the NGO involved in the project, also changed its practices as a result of its involvement and now includes research components in all its activities with farmers. No significant impact was observed on the national research program involved in the project.

In the needs' assessment phase of CIP's project, activities most closely associated with the participatory approach were 7 months of researcher time in project design, methodology development, data collection, and analysis. Farmers and field staff collected three seasons of production data at a cost of US$15,000. A workshop was also held with project staff and the eight farmers who would take part in the testing, at a cost of about US$700. Between 1995 and 1997, farmer-researchers carried out a series of trials costing about US$1250 per year. Farmers usually address two to three topics per season. The research-led trial on which farmers implemented cost US$500; however, the manufacturer donated some of the inputs. In addition, six workshops were held to present and evaluate results and plan future trials. Each workshop cost about US$800. Finally, a short workshop costing about US$80 was held at which the project staff and farmer-researchers formulated the outline for the curriculum of the FFS. Of these costs, the only ones that would not have been incurred in a non-participatory project are the workshops. Researcher time, data collection, and costs for on-farm trials would represent a cost to any project. Because farmers rather than project staff did much of the fieldwork, the costs were reduced even with compensation. The project was completed on time, which means that the participation did not cause it to go on longer than planned.

CHAPTER 3:

ASSESSING THE IMPACT OF USER PARTICIPATION IN RESEARCH ON SOIL FERTILITY MANAGEMENT: THE ICRISAT MOTHER-BABY TRIALS IN MALAWI[5]

Nancy Johnson, Nina Lilja, and Sieglinde Snapp

Introduction

The ICRISAT Mother–Baby (MB) trial model is an upstream participatory research methodology designed to improve the flow of information between farmers and researchers about technology performance and appropriateness under farmer conditions (Snapp, 1999). The trial design consists of two types of trials, mother trails and baby trials. The mother trial is researcher designed and conforms to scientific requirements for publishable data and analysis. A baby trial consists of a single replicate of one or more technologies from the mother trial. A single farmer on his or her own land manages each baby trial. A typical implementation of the methodology would include a single mother trial and numerous baby trials within a village. A field assistant manages the mother trial and provides technical support to, and collects data from, the baby trials. Baby-trial farmers follow a strict trial protocol to ensure comparability of the results. However, they carry out tasks such as land preparation, weeding, and harvesting themselves. Individual variation in the way tasks are performed, along with the specific conditions on farmers' plots, can help provide an idea of how the technologies perform in farmers' fields. The fact that baby-trial managers have experience working directly with the technologies in their own fields rather than just observing them in on-farm trials is expected to improve their ability to provide useful and relevant feedback.

In Malawi in 1997, ICRISAT, funded by the Rockefeller Foundation, initiated a project using the MB methodology to test legume-based "best bets" for improving soil fertility management. Declining soil fertility is a significant problem in southern Africa, where many poor smallholders produce crops in semi-arid, low fertility conditions. Fertilizer use is limited because of both its high cost and the inappropriateness of existing fertilizer recommendations that do not take into consideration the severe resource constraints and risky crop production environments that characterize much of the area where smallholders are located. Organic-based options for increasing soil fertility, such as legumes or manure, have been known and promoted for many years, but adoption rates have been low because of the high labor and land investments that these technologies require (ICRISAT 1999) However, given the recent increases in fertilizer prices and a falling maize price in real terms, the area-specific fertilizer recommendations developed in the 1990s (Snapp 1998, Snapp et al 1998) are no longer economic. These changes in the economic environment, combined with the availability of improved legume varieties, signal an opportunity to revisit some of the organic-based technologies. The use of participatory research methods may also help address the past lack of adoption of

[5] The authors gratefully acknowledge the helpful contributions of David Rohrbach, Joseph Rusike, and Steve Twomlow.

legume-based soil fertility technologies by identifying farmers' preferences for soil fertility technologies and constraints to their adoption (ICRISAT 1999).

Two types of mother trials were implemented in Malawi. The first, carried out at six sites with associated baby trials at three sites (Chisepo, Dedza, and Mangochi), tested legume-based "best bets" that were selected to be useful for farmers who were not able to buy fertilizer. The specific technologies included in the trial were selected during a workshop for researchers from national and international centers. They include a groundnut-pigeon pea intercrop followed by maize, a maize-pigeon pea intercrop, and a maize-*Tephrosia* intercrop. Table II-12 shows the baby-trial plot design for each year of the 2-year rotation. The mother trial consisted of four replicates of each of the technologies. Although the number of baby trials varies by site and year, about 20 new trials were initiated per mother trial each year. The year after ICRISAT began working the villages, The International Maize and Wheat Improvement Center (CIMMYT) also MB trials to test some of the same soil fertility technologies.

Table II-12. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) baby trial plot design[a].

Year 1		Year 2	
Maize-pigeon pea intercrop	Maize-*Tephrosia* intercrop	Maize-pigeon pea intercrop	Maize-*Tephrosia* intercrop
Groundnut[b]-pigeon pea intercrop	Maize (control)	Maize	Maize (control)

a. The Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT) trial was slightly different. It had two additional plots (improved maize and mucuna), and the second year planted only maize.

b. Soya was substituted for groundnut in some sites because of the climate conditions.

The second type of mother trial investigated the use of manure and small quantities of fertilizer and was implemented after farmers who had access to some fertilizers expressed interest in learning how best to use the small quantities of organic and inorganic fertilizer available to them. The trials consisted of maize (control), maize with manure, maize with fertilizer; and maize with manure and fertilizer. They were conducted at two sites, Chisepo and Mangochi along with a few baby trials.

The PRGA selected the ICRISAT project as one of three case studies in an analysis of the impacts and costs of using participatory methods in NRM. Impacts on technology selection and adoption, on human and social capital among participants, on feedback to the conventional research system, and on the structure of costs were assessed. Particular emphasis was placed on assessing impacts on women and the poor. The impact analysis was conducted using both qualitative and quantitative data from primary and secondary sources. Both PRGA and ICRISAT staff participated in the analysis.

Much of the analysis was carried out using project data and documents. Interviews were conducted with staff from ICRISAT and its collaborating institutions. To assess community level economic, human, and social impacts, open-ended interviews and a survey were carried out in Chisepo, one of three project sites that used the MB methodology. Chisepo had several advantages as a site for evaluating impact. First, it was one of the original sites, which increases the probability that sufficient time has passed for impact to be observable. Second, the PRGA is interested in assessing impact on women, and the CIMMYT trials in Chisepo had a focus on women. Finally, ICRISAT and CIMMYT field staff still at the site facilitated the data. After the PRGA fieldwork in Chisepo in September and October 2000, ICRISAT staff conducted focus group interviews at several of the sites in spring 2001. Insights from these interviews, especially regarding sites other than Chisepo, are also included in this report.

Conceptual Framework for Assessing the Impact of Participation

Types of Participation

The conceptual framework for the PRGA study is outlined in the earlier methodology section. According to this common framework for analysis, cases are categorized according to the typology, and then the relevant hypotheses regarding each of the four impacts are examined.

Because farmers did not participate directly in selecting the technologies to be tested, design stage participation was conventional (ICRISAT 1999).

The MB trial methodology as used in this project is essentially one of consultative participation at the testing stage (see Table II-1). Although individual farmers do in some sense manage the baby trials, they receive and are expected to adhere to detailed trial protocols designed to ensure comparability of results across sites. Nonetheless, farmers were able to provide input into the design of trials and evaluation of technologies. For example, when farmers identified that some technologies were associated with weed suppression, the protocol was modified to include data collection on weed counts. Because of this opportunity for input, the MB trials are considered consultative participation.

Although spontaneous diffusion is expected to occur as a result of the baby trials, the idea is to use the MB trial results to identify “best bet” solutions that will be widely disseminated via conventional mechanisms. The results of the trials have contributed to the preparation of some extension materials (ICRISAT-MAI 2000), but no “best bet” technologies have yet been identified or promoted as part of a large-scale technology transfer initiative. Therefore, except for the spontaneous adoption/diffusion that is always expected in participatory projects, we cannot say with certainty which type of participation will be used in the diffusion phase.

Gender and Poverty in the Chisepo Mother Baby Trials

The ICRISAT project is targeted specifically towards the poor, who are those least likely to be able to buy fertilizer to improve soil fertility (ICRISAT 1999). Although women initially were not a specific target group, the choice of crop implied their significant involvement because legumes are traditionally women's crops. A follow-up project investigating both soil fertility technologies and different types of participatory research methods in Malawi and Zimbabwe will be explicitly targeted towards identifying best bet technologies for women (Snapp 1999a).

Despite the implicit focus on women from the start, the original baby trials involved few women, mainly because of selection bias. Village headmen initially selected participating farmers, with the result that few women were selected and those who were usually had some kind of kinship tie to the headman. The participation of women increased over time, however, as each year new baby trials were added in order to see the performance of different stages of the rotation under different agroecological conditions. Data from Chisepo show that in Mbingwa village, women comprised 12% of baby-trial managers in the first year, 25% in the second, and 23% in the third. In Santhe, where trials were established a year later than in Mbingwa, the percentage of participating women rose from 0% in the first year to 20% in the second.

The CIMMYT MB trials, which began in Chisepo the year after the ICRISAT trials, took a different approach to selecting participants. They deliberately targeted women, and female-headed households in particular (Kamanga, 2000). In Mbingwa village, CIMMYT baby-trial managers were 55% women in the first year and 50% in the second. When asked why women's participation was so high in the CIMMYT trials, several female trial managers responded that it was an equity issue. The CIMMYT trials were for women because the men got the ICRISAT trials. It should be noted that discussions with participants revealed that often the women selected for participation in the CIMMYT trials were in fact wives or relatives of men involved in the ICRISAT trials.

Technology Impacts

Impact on Technology

It is hypothesized that user participation in the research process can result in changes in the technologies identified, tested, evaluated, and/or recommended for dissemination. These changes may have implications for both the pattern of diffusion/adoption and the distribution of benefits from the new technologies. Clearly the nature and magnitude of these impacts will depend on the type of participation used and when it occurs in the research process.

In the context of this project, we evaluate the impact of consultative participation in the testing stage of the research process. The relevant hypothesis is (*H2): The number of potential adopters within the target group increases because the specific technology selected for recommendation is more appropriate given farmers' criteria and constraints.* To evaluate this hypothesis, we first need to see whether farmer input influenced test design, evaluation criteria, and/or final recommendations for the technologies that were tested in the MB trial. Then we need to look at whether this farmer influence at the testing stage was consistent with identifying technologies that were better suited to farmers' needs and therefore more widely adopted. Because no final recommendations were made, this analysis is based on documented farmer input into the research process, and on the results of the evaluation on spontaneous adoption and diffusion in and around the villages where trials were conducted.

Farmer influence on trial design and results

Farmers were given the technologies selected for testing and the protocols for test design, so in theory their scope for substantial input was fairly limited. In practice, in some cases farmers did make significant changes to the protocols, either deliberately or because of lack of inputs of appropriate supervision. The field assistants who were responsible for data collection varied in the way they treated these deviations. In some cases they were left out of data collection, but in others they were included as if they had followed the protocols, which lowers the quality of the data. In no case did researchers systematically evaluate farmers' adaptations and include the results in analysis (Heinrich et al 2001).

In all cases, farmers were asked for their opinion on the results of the trials. Because of farmer observations and practices, several changes were made to the trial protocol and data collection after the first year. In addition to the weed suppression example mentioned earlier, when researchers realized that farmers were not routinely incorporating legume residues, researchers specifically included this as part of the protocol for crop management.

Analysis of baby trial data show that the technologies generally performed as expected, which is consistent with their being basically technologies already proven to improve soil fertility, and hence the resulting yields, prior to being included in the MB trials. On biological criteria, all technologies tested outperformed mono-cropped maize without fertilizer. On economic criteria, the expected profit from the new technologies was also greater than mono-cropped maize (Snapp 1999c, 2000a).

Researcher and farmer perceptions of technology

Some interesting differences occurred in the way that researchers and baby-trial farmers ranked the different technologies in terms of adoption potential, suggesting that farmers are not basing decisions on biological or profit criteria alone (Table II-13). Baby-trial managers tended to reverse the order of the first two technology choices in their evaluations. Baby-trial farmers ranked maize-pigeon pea highest because, even though it had a lower yield gain (0.3 to 1 t ha^{-1} over sole maize vs. 0.5 to 1 t ha^{-1} for the groundnut-pigeon pea-maize rotation), they felt it reduced risk. Baby-trial managers ranked maize-pigeon particularly high in the Mangochi area, which has the driest and most risky environment of all the sites. The groundnut (or soybean)-pigeon pea intercrop followed by maize was recognized as promising; however, it was deemed more appropriate for commercial farmers who had enough land to do rotations (Rusike 2001).

Table II-13. Researcher and baby-trial farmer rankings of technologies (n = 59).

Technology	Research rankings[a]		Baby-trial farmer ranking
	Well-off farmers	Poor farmers	All farmers (n = 59)
Maize control	1.5	2.0	0.5
Maize-pigeon pea	2.0	3.0	2.2
Groundnut-pigeon pea	3.0	3.5	1.8
Maize-*Tephrosia*	3.0	1.5	1.4

SOURCE: Snapp 1999c.

a. Research rankings on a scale of 0 to 4, where 0 = worst, 4 = best.

For a better understanding of the criteria that baby-trial farmers considered when evaluating the technologies, Table II-14 presents the list of positive and negative traits identified by baby-trial managers in their open-ended evaluation of the technologies. These traits clearly go far beyond the yield and profit data that scientists traditionally use to evaluate technologies, and demonstrate the importance of including farmer preference data in technology selection.

In terms of gender differences, men and women differently rated the technologies tested. However, the differences are not statistically significant and their overall ranking of the technologies is the same (Table II-15). Although men and women find the same technologies acceptable, they may be doing so for different reasons. This information may be important both for designing dissemination programs to target technologies towards specific user groups, and for future technology development research.

Table II-14. Positive and negative traits identified by baby-trial farmers (percentage of farmers who noted the trait).

Trait/technology	Sole maize	Maize-pigeon pea	Groundnut-pigeon pea	Maize-*Tephrosia*
Positive traits:				
Less labor/two crops	-	25.0	25.0	0.0
Easier to weed	-	25.0	41.7	19.4
Less land/two crops	-	16.7	25.0	0.0
Fewer weeds, pests	-	8.3	5.6	0.0
Early harvest	30.6	16.7	25.0	0.0
Increased food security	16.7	58.3	69.4	25.0
Fuelwood produced	-	16.7	2.8	13.9
Early emergence	19.4	-	-	-
Low labor requirement	22.2	2.8	11.1	
Soil fertility improved	-	38.9	36.1	36.1
Cash sales potential	-	30.6	33.3	16.7
Negative traits:				
Weed control problems	25.0	-	-	36.1
Pest problems	11.1	16.7	5.6	8.3
Seed availability	5.6	19.4	41.7	22.2
No affordable fertilizer	11.1	0.0	0.0	16.7
Reduced food security	58.3	13.9	8.3	61.1
Soil fertility decline	11.1	-	-	-
Low grain legume price	-	8.3	30.6	-
Late harvest or slow growth	-	16.7	33.3	-
Livestock damage	-	27.8	19.4	-
Limited market access	-	11.1	19.4	5.6

SOURCE: Snapp 2000a.

Table II-15. Gender disaggregated technology preferences[a].

Technology	Baby-trial farmer rankings					
	Chisepo		Dedza[a]		Mangochi[a]	
	Men (n = 17)	Women (n = 1)	Men (n = 13)	Women (n = 7)	Men (n = 34)	Women (n = 25)
Maize control	0.64	2.00	0.07	0.00	0.41	0.72
Maize-pigeon pea	1.65	1.00	2.38	2.43	1.88	1.80
Groundnut-pigeon pea	2.00	2.00	2.23	2.14	2.15	2.24
Maize-*Tephrosia*	1.70	1.00	1.31	1.43	1.56	1.24

a. Data from 1997-98 growing season. Numbers are average ranks received in pairwise comparisons, 0 = worst and 3 = best.

b. None of the gender differences is statistically significant in pairwise comparisons or rank order.

So far the data presented on farmers' preferences in technology is from data collected each season from baby-trial managers. In 1999, ICRISAT project staff carried out a survey of farmers in three regions of Malawi where baby trials had been conducted. The purpose was to collect information about farmers' practices and perceptions, and the constraints to technology adoption. The data would also serve as a baseline for the DFID project. These data also show differences between men and women with regard to the importance they place on different constraints to the adoption of legume-based, soil fertility technologies (Table II-16). However, as in the previous analysis, none of the differences is statistically significant. In pairwise comparisons of the percentage of men and women who identified each constraint, only in Chisepo were they close to being statistically significant (*P* values between 0.10 and 0.15). A chi-square test showed that in none of the communities was there a difference between the order in which men and women ranked traits. These data support the validity of the MB trial results regarding gender differences.

Table II-16. Constraints to adoption of legume-based soil fertility technologies (percentage of farmers identifying the constraint).

Constraints	Chisepo[a]		Dedza[a]		Mangochi[a]	
	MHH (n = 100)	FHH (n = 19)	MHH (n = 42)	FHH (n = 48)	MHH (n = 87)	FHH (n = 33)
Lack of seed or cash to purchase	62	57	50	57	53	49
Lack of labor	22	33	19	25	8	14
Low yields	3	3	17	11	30	32
Land shortage	5	4	10	6	7	3
Limited market	5	4	0	1	2	3
Other	3	0	4	1	0	0

a. MHH = male-headed household and FHH = female-headed household.

Impact on Technology Adoption/Diffusion

This section looks at whether and how farmer input may have contributed to the diffusion and adoption and impact of the technologies. Because no formal dissemination program has been based on the results of the trials, we can only look at spontaneous local adoption and diffusion in the communities where the trials took place. Although lack of a diffusion program that addresses constraints such as credit and seed availability may limit observed adoption, spontaneous local adoption is usually a good indicator of the adoption potential of a technology. No spontaneous local adoption would suggest low probability of success even with a well-designed extension program. In addition, by looking at how knowledge is spreading within the communities, we can see how the MB methodology might affect technology dissemination directly or indirectly.

In October 2000, a survey was carried out in Chisepo in the north central plain region of Malawi to discover whether or not knowledge of the soil fertility technologies is being spontaneously disseminated as a result of the MB trials. Data were collected in two project villages, Mbingwa and Santhe, and two control villages. Eighty households were surveyed, 25 each in Mbwinga and its control (Mkwela), and 15 each in Santhe and its control (Kantimbo). The different sample sizes were because of different population sizes in the villages. The control villages were selected because they were similar to the project villages and close enough to reasonably expect exchange of information and seed between the two. The project selected Mkwela as the Mbwinga control and baseline data were collected there in 1999. In the case of Santhe, the initial control village was Kabala, but CIMMYT trials were recently initiated there so a new control had to be identified. The new control village, Kantimbo, is about 5 kilometers from Santhe. Tables II-17 and II-18 summarize the number of baby trials in each of the project communities by type of trial and gender of trial manager.

Table II-17. Number of baby trials in Mbingwa village, Chisepo region.

Farmer participation[a]	ICRISAT[b]- best bets		ICRISAT[b]- fertilizer		CIMMYT[c]-best bets	
	Men	Women	Men	Women	Men	Women
Third year (1997-98)	8	2	7	0	0	0
Second year (1998-99)	11	3	1	0	9	11
First year (1999-2000)	10	3	0	0	5	5
Total no. of participants	29	8	8	0	14	16
Total no. of trials	56	15	23	0	23	27

a. Years in parentheses refer to when farmers first participated in the project.
b. ICRISAT = International Crops Research Institute for the Semi-Arid Tropics.
c. CIMMYT = Centro Internacional de Mejoramiento de Maíz y Trigo.

Table II-18. Number of baby trials in Santhe village, Chisepo region.

	ICRISAT[a]- best bets		ICRISAT[a]- fertilizer	
	Men	Women	Men	Women
Third year (1997-98)	6	0	0	0
Second year (1998-99)	8	2	1	0
First year (1999-200)	0	0	0	0
Total no. of participants	14	2	1	0
Total no. of trials	34	4	2	0

a. ICRISAT = International Crops Research Institute for the Semi-Arid Tropics.

Because of our interest in gender impacts, we selected the sample by first choosing a random sample and then weighting it with the addition of some female-headed households. In each community, a random sample was selected; then an additional number (five in Mbingwa and its control, and three in Santhe and its control) of female-headed households were added. In the non-female-headed households, in half the cases interviews were conducted with the men and in half the cases with the women. Both were able to answer questions about crop production on all fields, but splitting the sample allowed us to get both men's and women's separate responses on knowledge and perceptions of the MB trials and agricultural technologies. Previous experience gained interviewing in the communities showed that it was preferable to interview husbands and wives separately to ensure individual and unbiased opinions.

Table II-19 gives some basic information about the four communities. Although the Santhe control village appears on the average to be better off than the others, the only difference between this village and the rest of the sample that is statistically significant is the average number of goats per household. This difference is also significant between Santhe and its control. Apart from that, no significant differences show between the project and control villages, or between each village and its control. For these reasons, the samples are pooled in subsequent analysis.

Table II-19. Characteristics of sample communities in the adoption study.

Communities	Characteristics[a]						
	No. of FHH	No. in the MB trials	Land owned (acres)	Education (years)	Goats	Poultry	Goods ownership index
Mbingwa (n = 25)	5	12	4.4	4.8	2.2	6.9	1.2
Mbwingwa control (n = 25)	7	0	6.3	5.4	1.4	5.7	1.4
Santhe (n = 15)	3	2	6.4	4.3	1.3	6.8	1.7
Santhe control (n = 15)	5	0	8.7	5.2	4.6	10.2	2.0
Total (n = 80)	20	14	6.2	5.0	2.2	7.1	1.6

a. FHH = female-headed households, MB = mother-baby trial. Goods ownership index is based on ownership of bicycle, ox cart, radio, and glass windows (taken from International Crops Research Institute for the Semi-Arid Tropics [ICRISAT] baseline).

Female-headed households are often assumed poorer than the average. In the data reported in Table II-19, this hypothesis is only supported by the ownership of goods index. However, this result should not necessarily be interpreted as a difference in wealth level, but rather a difference in expenditure patterns. Several empirical studies suggest that men and women differ in expenditure preferences, and that relative to women, men spend a greater proportion of their income on luxury goods, such as alcohol and tobacco. Women are more likely to purchase goods such as food and medicine, which directly benefit the well being of household members (Folbre 1986, von Braun 1988, Guyer 1988, Bruce 1989, Haddad et al 1994). The "goods index" here tends to measure expenditure on consumer items, which is typical of male consumption patterns at low income levels. Women on the other hand are shown to spend more on education and nutrition rather than consumption. In addition to differences in male-female expenditure patterns, male and female household financial responsibilities also follow traditional rules, and expenditures related to housing and consumer goods are often reported as male responsibilities. Female-headed households have significantly less education than the rest of the sample; however, when compared only to other women the difference is not significant. In terms of land and ownership of goats and chickens, female-headed households are not significantly different from other households.

Adoption of technologies

To assess spontaneous adoption, respondents were asked what they were planning to plant in the next season. Because the survey was done a few weeks before planting time, the responses were expected to be accurate. The survey results showed only two cases of adoption of legume best-bet technologies tested in the MB trials, both of the maize-pigeon pea intercrop. A household in Mbingwa was to plant a quarter of an acre and another in Santhe 1 acre. In the Mbingwa household, the wife had a baby trial. Households were also asked what they planted the previous year, and in this case two households reported planting 1 acre each of maize-pigeon pea intercrop. One was the same household from Santhe and the other was from the Santhe control. This year the Santhe household is planting maize, and the Santhe control maize-soya on their plots.

Regarding the practice of incorporating legume residues, of the 75 plots planted to either beans or groundnuts, 30 respondents (40%) reported that they would incorporate the residues. Use of combined organic and inorganic fertilizer was low in both project and non-project communities; the combination would be applied on 5% of fields in both project communities and controls. Nearly all fertilizer was applied to either maize or tobacco.

Knowledge of the technologies

Although adoption of technologies tested remains limited, knowledge of the technologies is much more widespread. Based on data from respondents who did not participate directly in the baby trials, Table II-20 shows the percentage of people who knew about each technology in the project and control villages. As expected, knowledge of the technologies is significantly higher in the project villages than in the controls; however, the knowledge is high in control villages as well.

Table II-21 presents the sources from which respondents reported having learned of the technologies; for every technology, the main source was the MB trials. The second most common source of information was from friends and relatives. This may mean that people who participate in or visit the baby trials are spontaneously diffusing the knowledge. None of the technologies was tested for the first time in the MB trials, and several people reported having learned of them from other sources such as the extension service. However, no other programs were promoting the technologies in the study area.

TableII-20. Knowledge of the technologies tested in project and control villages.

Technology	Percentage in project villages	Percentage in control villages	*P*-value
Incorporating legume residues	45	36	0.064
Intercrop groundnut-pigeon pea	85	58	0.014
Intercrop maize-pigeon pea	96	70	0.003
Intercrop maize-*Tephrosia*	96	60	0.000
Mucuna	81	53	0.014

Table II-21. Where all farmer respondents learned about the technology.

Technology	Where technology learned (%)	
	From MB[a] trials	From friends or relatives
Incorporating legume residues (n = 59)	51.0	18.6
Intercrop groundnut-pigeon pea (n = 45)	73.3	17.8
Intercrop maize-pigeon pea (n = 53)	67.9	22.6
Intercrop maize-*Tephrosia* (n = 49)	73.5	18.4
Mucuna (n = 42)	66.7	26.2

a. MB = mother-baby trials.

There are no significant differences between female- and male-headed households on the technologies of which they had knowledge. However, the sources of the knowledge show differences. Female-headed households only learned from the MB trials or friends/relatives, while male-headed households report learning from a wide variety of sources, including extension agents. Similar differences appear between men and women in general. Women were more likely than men to have learned of the technologies from the MB trials, and in three of the five technologies (excluding incorporation of residues and the intercrop groundnut-pigeon pea) the differences between men and women were statistically significant ($P = 0.07$). These results suggest that the trials are an effective way of getting agricultural information to women, who may have less access to it than men have.

Those who reported knowing about the technologies were also asked whether they had ever used them. One third of the respondents said that they had incorporated legume residues. About 10% reported having used the legume intercrops, and only 2% reported having used mucuna. Most, but not all, were in the project villages. Half of those who reported having incorporated legume residues were women. Of those who reported having used the maize-pigeon pea intercrop about 33% were women, and 20% of those who used the groundnut-pigeon pea intercrop were women. Although the numbers remain very small, and we do not know how much they planted to the technologies, this does suggest that in addition to the cases of adoption some farmers are also testing the technologies.

Visits to the trials

Almost everyone in the project villages reported knowing about the MB trials, while level of knowledge varies in the control villages (Table II-22) In terms of visits to the trials by farmers who were not trial managers, there are distinct patterns between the communities that are statistically significant (Table II-23). Only in Mbingwa village, where the main project attention was focused, were farmers likely to visit both types of trials. In both the Mbingwa control and in Santhe, visits to the baby trials were common, and visits to the mother trials were relatively rare. This suggests that farmers see the trials as substitutes rather than complements. In two of the four communities, farmers appear to view them as substitutes rather than complements. It also suggests that as a mechanism for diffusing information, the MB model may have a greater potential to reach people than a centralized demonstration plot.

Table II-22. Percentage of respondents in each control village with knowledge of the trials.

Communities	Know of trials	Visit mother trial	Visit baby trial
Mbingwa	100	77	40
Control 1	72	17	72
Santhe	92	0	60
Control 2	13	0	0

Table II-23. Number of non-baby-trial managers who visited trials, by community and type of trial.

Communities	Visits to trials[a]				
	Baby only	Mother only	Both	Neither	Total
Mbingwa	1	1	9	2	13
Mbingwa control	15	0	3	7	25
Santhe	9	0	0	4	13
Santhe control	0	0	0	15	15

a. X_2 test for significance <0.001.

Human and Social Capital Impacts

Working together with researchers is assumed to improve the human capital of participants. If work is done in groups or if information sharing is encouraged, then social capital, defined as the ability of farmers to work together and share information, may be increased as well. In the conceptual framework of the impact study, it was assumed that human and social capital impact could only be achieved with empowering (collaborative or collegial) participation. In this project we had only functional (consultative) participation. Therefore, the null hypothesis is that there is no impact on human or social capital, and the alternative is that there is. To specify the alternative hypothesis more carefully, we can use the hypothesis for the impact of human and social capital of collaborative participation at the testing stage—*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 recommendations with other stakeholders who may have different opinions (H6).*

Human and social capital impacts were assessed via individual interviews with 16 randomly selected baby-trial participants, 11 in Mbingwa and five in Santhe; six were women and 10 were men. Participants were both from the CIMMYT trials (two men/ three women) and from the ICRISAT trials (six men and three women in best-bet trials, three men and one woman in the manure trials, the woman in the latter was also in the former). In addition to the baby-trial managers, two of five so-called "experimenting farmers" were interviewed. Experimenting farmers are those who wanted to host baby trials, but wanted to make adjustments to the trial methodology. They could not participate officially if they did not follow the protocol; however, field staff provided them with seed and technical assistance so that they could conduct their own experiments with the new technologies. In general, researchers neither monitored nor analyzed the results of these experiments, however.

Interviews were semi-structured. Changes in participants' knowledge and capacity to experiment were evaluated based on questions about their reasons for participating; their knowledge and understanding of the trials, the technologies and the results; their interaction with the enumerator/research assistant; their experimentation practices; and their perceived benefits. Changes in ability to work together and in negotiation capacity were assessed through questions about the interactions of baby-trial managers with other farmers, with the enumerator/research assistant, and with extension agents, and about their perceived benefits.

Knowledge and Experimentation Practices

The two most common reasons given for participation were to learn about soil fertility and to test the technology themselves. These reasons are consistent with building human capital rather than obtaining direct short-term benefits such as seed. All the motives mentioned for participating are essentially related to personal benefits. No one mentioned community level benefits or participating for the good of the community. Focus group discussions organized by ICRISAT scientists several months after the PRGA fieldwork confirm these observations on reasons for participation.

When asked about the specific trials, all baby-trial farmers interviewed were able to describe the plot layout and their activities. When asked why there had to be many baby trials, all said it was so that many people could have a chance to participate. No one mentioned the importance of replication of the trial by different farmers in different fields and seasons.

Respondents were asked several questions about their interaction with the enumerator. When asked about what trial results they received from him, none of the women was able to answer. The men all said that they were given the trial results; however, only one said that he got results from all trials. The rest talked about comparing their own trials from one year to the next, but never about comparing their trial results to those of others. Although this is consistent with their apparent lack of understanding of, or interest in, the replication aspect of the baby trials, all baby-trial managers felt they were able to compare their own results with those of others. They all offered reasons for different outcomes observed across plots, usually based on inherent qualities of the field and/or the farmer. We do not know whether these perceptions were consistent with the data from the trials, but it does appear that the farmers did not gain an increased appreciation for technical aspects of experimentation such as replications as a result of participation. A reason for this may relate to the way that the data were collected and presented. Focus group discussions revealed that many farmers had trouble with the data collected being converted to standard metric measurements such as kilos or tons per hectare. These are not local measures and farmers had difficulty interpreting them. They also claimed to have difficulty extrapolating results from the small trial plot to a typical field (Rusike 2001).

When asked whether they would continue to keep track of the kind of detailed input and output information that the enumerator collected, none said that they would change their record-keeping practices as a result of participation in the trial. Seven said they already kept all data in their heads, one said for up to 3 years. A few said they only keep yield information, not information about inputs. The fact that the enumerator did most of the data collection could account for farmers' relative lack of interest in the data. It may have resulted in better quality data, especially given the high levels of illiteracy among farmers. However, collecting and analyzing data could also have been a learning experience for farmers, and was used as such in subsequent trials in a follow-up project (Freeman 2000, Heinrich et al 2001, Rusike et al 2001).

Nonetheless, farmers in Chisepo report that they enjoyed their interactions with the enumerators and other project staff. When asked about what kinds of information they exchanged with the enumerator/research assistant, most said production information and plot history. However, four (including one woman) said that they also gave their opinions and 10 (including four women) said they were able to ask questions about specific agricultural issues and problems. Women may have found these visits especially useful because none of them reported having worked with a researcher or extension agent before. Only two men said they had never worked with extension agents before. It is important to note here that interaction of participants with enumerators varied across sites, and Chisepo was likely one of the best-served communities in this regard. Focus group discussions in other communities revealed dissatisfaction with the usefulness and timeliness of enumerator visits.

When asked whether they engaged in experimentation before participating in the trials, one woman mentioned having tried out something new when she came into possession of some soya seed, but no one reported any systematic experiments with clear objectives or comparisons. Six men said they had been involved in other trials, two for research and four in demonstration trials. When asked about post-trial experimentation, another woman said that she did a test during the trial of plots with and without manure. None of the others said they would continue doing systematic tests or comparisons.

The focus group discussions led by ICRISAT scientists reached slightly different conclusions, namely that baby trials could empower farmers. This was especially the case regarding farmer experimentation in Dedza where the standard protocol was significantly modified. In Dedza, enumerator presence was weak while at the same time an NGO, Concern Universal, supported extensive farmer-training activities parallel to the MB trials. During interviews, most farmers reported that they had not conducted experiments before they hosted ICRISAT trials. A few farmers, however, explained that they had conducted simple experiments in the past involving comparisons such as growing tobacco and maize in rotation with groundnuts to assess soil fertility benefits of groundnuts on different crops and returns to different crop rotations. But the farmers who reported carrying out experiments on their own before initiation of ICRISAT trials explained that they conducted them without marking out specific plots and distinct arrangements in the fields to control for variability. Nevertheless, these farmers felt that they were carrying out research because they were trying to differentiate between different returns. Farmers felt that the research design introduced by ICRISAT is a better method because they planted the crops in measured plots. This made it easier to estimate yield per unit area and compare differences in returns compared to estimation by eye, which they used to do when conducting trials on their own.

When asked if they were establishing trials on their own after hosting ICRISAT trials, farmers reported that they were maintaining the experiment plots because they wanted to continue learning the effects of different crop mixes on soil fertility to see if they could obtain similar benefits. This explains why farmers were establishing experiments to determine how a variety of crops would respond to incorporation of mucuna residues (mucuna was only available in ICRISAT baby trials in Dedza); and comparing methods of making compost manure and the effect of compost compared to legumes such as pigeon pea. Some farmers were trying out treatments that they had liked on different fields with different soil types. Farmers who were conducting farmer-led, farmer-managed trials in the new villages in which ICRISAT has not worked directly reported establishing trials on larger plot sizes than the eight ridges by 7.5 m standard baby-trial design. These ranged from10 ridges by 10 m to 20 ridges by 15 m, depending on the amount of resources. Farmers explained that larger plots sizes enabled them to better estimate the returns of alternative treatments and how to fit these within their farming systems. Farmers also indicated that they were conducting experiments that reflect their own interests. They were testing the effect of maize and legume intercrops and rotations on a wide range of crops including maize, Irish potatoes, and garden peas. This usually followed the conducting of participatory rural appraisals (PRAs) and training for transformation by Concern Universal, facilitated visits to the research station, and MB trials in neighboring villages. Concern Universal then provided seed while allowing the farmers to try their own combinations. These results suggest that the way the MB trial is implemented, rather than the trial structure itself, conditions empowerment impacts. There may be tradeoffs between generating large amounts of comparable data for researcher needs and conducting capacity building for local farmers and communities.

Overall, the PRGA fieldwork in Chisepo did not find much evidence that human capital and experimenting capacity among baby-trial managers has been systematically increased as a result of the trial. A possible explanation is that the relative rigidity of the trial methodology and the major role played by the enumerator did not encourage farmers to become actively involved in analyzing either the trial design or the results. The fact that real opportunity for participation was limited in the trials is confirmed by the existence of the so-called experimenting farmers. They mentioned that still others in the community are experimenting on their own, and are using baby trial technologies and modifying them. These farmers were not interested in participating in the trails, however. This result underscores the importance of different types of participation for different purposes. The MB trial was used for technology validation, which required comparable results. It may be unrealistic to expect to strengthen experimentation skills in this context. It may also indicate something about the type of farmers involved. This validation trial was best suited for “representative” farmers, whereas the truly “experimenting” farmers may have an important role at the technology design stage.

Ability to Work Together, Share Information, and Negotiate

Even though many baby-trial farmers had never participated in formal activities with research or extension staff, 10 of the participants said that they went to extension agents when they had question about agriculture. Most said they received satisfying responses. Of the six who did not go to extension staff and instead asked friends, four were women.

Evidence on information sharing and the extent to which the MB trials contributed to improving this practice is mixed. People say they share information at appropriate times and places. However, project staff reported that in the first year of the baby trial project, farmers were refusing to give information to others and had to be told that part of the job of trial manager was to answer questions from other farmers. It appears that this message was taken to heart because all but one of the baby-trial managers said that many people stopped by their fields, especially from other villages, to ask questions. The one man who received no visits said his land was far from the road. One person said that people from other communities visited the baby trials even more than people from the trial communities themselves because local people either knew, or went to, the mother trial.

All participants reported having regular meetings with other baby-trial managers. All meetings took place in their fields and they compared results and helped newcomers. Six participants (five men and one woman) said that they had been in groups (production/input, finance, political) with other baby-trial managers in the past. Ten participants (including two women) from one village said that they would be in a Promotion of Soil Conservation and Rural Production (PROSCARP) project promoting vetiver grass and cassava with the baby-trial managers. The village head said that having the groups for the MB trials helped attract the PROSCARP project. No one reported any spontaneous continuation or expansion of the project-related activities with any other baby-trial managers after the trials.

With the possible exception of information sharing, there is little evidence that participation in the MB trial enhanced the capacity of farmers to work together in Chisepo or empowered them to initiate new activities designed to find solutions to common agricultural or other problems. Farmers worked well together as part of the project and some specifically said that they enjoyed doing so. However, when the project ends, so will their activities. Outcomes may be different in other communities such as Dedza where the trials were implemented differently and more emphasis was placed on farmer training.

Feedback to Formal Research Impacts

Analysis and Discussion

Researchers are also expected to benefit from their interaction with farmers in a participatory research process. The benefits to researchers consist of a better understanding of farmers' priorities, knowledge, capacity, preferences, and constraints. In the case of consultative participation at the testing stage, the hypothesis is *(H13) Researchers learn farmer criteria for evaluating technologies.*

Analysis of the trial data and farmer preference information has shown some differences in farmer versus researcher ranking, and has provided some possible reason for why these differences might occur. This information has influenced project staff. Given that the results are recently obtained and in some cases preliminary, they have not been widely disseminated as yet. However, a review of project documents revealed that several articles are either accepted by or in review at refereed journals based on data from the baby trials, suggesting that forthcoming results will continue to be made available to other researchers (Kanyama-Phiri et al 2001, Snapp et al 2001). In addition, the methodology itself was published regionally, and was adopted both by CIMMYT soil fertility scientists and by maize breeders at CIMMYT who now use it extensively in maize trials (CIMMYT 2000). The methodology was also presented at the PRGA International Seminar in Nairobi in November 2000. Perhaps because it does not radically differ from conventional on-farm trial methodologies, the MB trial appears to be meeting with acceptance from researchers.

The more methodological aspects of the work and the gender focus formed the basis of a subsequent project funded by DFID called "Will women farmers invest in improving their soil fertility management? Participatory experimentation in a risky environment." This project, which expands the work to Zimbabwe, also brings in many other national and international organizations to study participatory research methods and soil fertility technologies. Although this project is not solely responsible for stimulating interest in participatory research in southern Africa, it is focusing methodological attention and catalyzing comparative analysis of several on-going projects (Freeman 2000)

The extent to which the MB trial project influenced national policy in Malawi is not clear. Rate of job turnover is high among national researchers, and many of the researchers and policy makers from national institutions who participated in the project design have since left the country. At the local level, staff from the initiative who also work in the Chisepo area were aware of the project, and had taken some of its technologies to test in their own villages. Although the technologies were of interest, the methodology was not adopted. Staff said that they took the technologies and made a "mother trial", but it was essentially a demonstration plot. This suggests that they view the baby trials as a tool for research rather than extension, an opinion echoed by ICRISAT's NGO partner at the Dedza site. Although this assessment is accurate, the data from the adoption survey suggest that the baby trials can also be useful in raising awareness about technologies, perhaps even more so than a central demonstration plot.

Cost of Research Impacts

The general hypothesis with regard to research costs is *(H20) Moving from conventional to consultative or collaborative forms of participation generally increases formal research organizations' costs at the particular stage where it is incorporated; however, it may reduce cost at subsequent stages.*

A related hypothesis is *(H22) Participation without compensation increases farmers' costs unless it relies exclusively on those farmers (often a small and unrepresentative group) who already experiment on their own with new technologies and practices.*

To assess the impact of using the MB trial on the magnitude and structure of cost impacts, a table was made of each activity, the costs, and the relevant counterfactual in a non-participatory project (Table II-24). The purpose of this exercise was not to arrive at a dollar value of the difference in cost, but rather to get a better understanding of the tradeoffs associated with incorporating user participation at different stages of the research process.

Table II-24. Differences between traditional on-farm and mother-baby (MB) trial methodologies, with implications for research costs (adapted from Snapp 2000b).

Activity	Traditional on-farm	Malawi MB farmer participatory research (FPR) method
Technology and site selection	**Method:** Researcher selects sites, with input from project staff.	**Method:** Workshop with senior level officials in research and extension to negotiate objectives, technologies, and sites.
	Cost: Researcher time, perhaps some travel to visit sites.	**Cost:** Workshop preparation and implementation; time costs of participants. In Malawi, cost was US$3000 for about 50 people for 4 days).
	Pros: Takes less time, and relates better to past project and trial experience.	**Pros:** Includes more stakeholders and provides some "peer review" because site and technology choices must be negotiated. Sites chosen specifically to be representative of different agroecosystems and socioeconomic factors taken into account such as market access, thus extrapolation and scaling up facilitated. Include adoptability criteria from researcher viewpoint.
	Cons: Less opportunity for feedback from other stakeholders outside the project. Objectives are usually to maximize biological outputs not farmers' goals.	**Cons:** Takes more time, and may result in selections that are less well linked to historical experience of the project.
Site characterization	**Method:** None, because presumably site selection was based on knowledge of area.	**Method:** Preliminary participatory rural analysis (PRA) and reconnaissance work to better understand farmer opinions, attitudes, and practices.
	Costs: n/a	**Costs:** Researcher time, travel expenses, and survey implementation and analysis costs.
	Pros: Less costly.	**Pros:** Participatory work requires a good understanding of the social and ecological environment in order to address issues of extrapolation.
	Cons: If site selection was not based on appropriate criteria, the results may be misleading and/or misinterpreted.	**Cons:** Costly, and results may be superficial, especially if researchers are not well trained in PRA techniques.
Training in FPR methods	**Method**: None	**Method:** Training of enumerators and local extension staff on FPR techniques including how to ask open-ended questions, sensitivity to differences in gender, power, etc. Role-playing and use of visuals to communicate more effectively with farmers.
	Cost: None.	**Cost:** Planning and implementation of workshop. In the case of Malawi, workshop expenses alone (without researcher or participant time) were US$6000 for two workshops, one north and one south, which were attended by 40-60 people.

Continued.

Table II-24. Differences between traditional on-farm and mother-baby (MB) trial methodologies, with implications for research costs (adapted from Snapp 2000b).

Activity	Traditional on-farm	Malawi MB farmer participatory research (FPR) method
Training in FPR methods	**Pros:** Less costly, if interaction with farmers is limited.	**Pros:** Can yield valuable indigenous knowledge.
	Cons: Poor interaction with farmers could affect trial performance and/or interpretation of results.	**Cons:** Effective interaction with farmers requires specialized skills that many field staff do not possess.
Selection of participating farmers	**Method:** Typically researchers (or technicians) work through the local extension offices that help them identify appropriate farmers. A meeting is held between researchers and farmers to explain the project and arrive at conditions for use of farmers' fields.	**Method:** The project contacted the extension planning area (EPA), and the EPA selected the specific villages. A community meeting was held in each village to explain the project and identify participants. Selection of participants was based on recommendations of village officials and on volunteers.
	Costs: Researcher/technician time and travel, and some compensation to extension agent for time.	**Costs:** Researcher and technician time, per diems for extension staff and other officials from the region, snacks.
	Pros: Less costly.	**Pros:** Works through existing extension system, but at the same time deals directly with farmers and attempts to ensure their buy-in and support. Selection of farmers by village meeting held with researchers and extension staff, negotiated with village to include poorer households and female-headed households, as well as better-resourced households.
	Cons: Without farmer understanding and buy-in, it may be difficult to manage the trials well. Also, this method of participant selection may exclude marginalized groups who could be targets of the technology development program.	**Cons:** Selecting participants based on volunteers and recommendations may exclude marginalized groups who could be targets of the technology development program. Working with the poor or others who did not participate voluntarily may increase costs, or reduce effectiveness of results if the participants are not the most interested and suited to the job.
Design protocols for experiment	**Method**: A single protocol is designed and made available to technician and perhaps also to extension agent. Protocol generally not changed over time.	**Method**: Multiple protocols are designed for different baby trials, and are made available and accessible to all participating farmers. Researchers agree on uniform, relatively simple protocol for site characterization, field operation time schedule, plant emergence, weed monitoring, and yield/biomass evaluation. Farmer evaluation built in as part of field manual. Protocol changed over time to include farmers' comments (e.g., weeds).
	Cost: Researcher time in design.	**Cost:** Researcher time to design trials, and costs to copy and distribute manuals and evaluation books to all trial managers.

Continued.

Table II-24. Differences between traditional on-farm and mother-baby (MB) trial methodologies, with implications for research costs (adapted from Snapp 2000b).

Activity	Traditional on-farm	Malawi MB farmer participatory research (FPR) method
Design protocols for experiment	**Pros:** Less costly, and experiment design can be more sophisticated.	**Pros:** Farmers understand the design and can therefore better manage the trials. They can also evaluate the trial and results appropriately; negative and positive traits.
	Cons: Farmer may not understand the trial design, which could affect trial management and/or farmers' perceptions of the results.	**Cons:** Trial designs must be simple enough to be understood and managed by farmers, whereas the mother trial allows researchers to test a wider range of technologies and complicated monitoring to be conducted, such as nitrogen dynamics.
Establishment and maintenance of trials	**Method:** Technician visits farmers' fields and supervises hired laborers in establishment of trials. Paid laborers carry out management, and technician makes visits to monitor and make observations. The frequency of visits by researcher and/or technician will vary according to the trial design and personal preferences.	**Method:** A meeting was held to explain the trials to farmers. Technician and sometimes researchers accompanied farmers in critical phases of establishment and maintenance.
	Costs to researchers: Travel expenses of technician, inputs to trial (e.g., seed, fertilizer, time of casual labor, and rent for land). Harvest kept by researcher and may be sold.	**Costs to research:** Time of full-time enumerators in two of three sites, travel expenses of technician and researchers (six visits per month – two per site x three sites), inputs to trial (e.g., seed and fertilizer, and casual labor for mother trial). Farmer keeps baby trial harvest.
	Cost to farmers: None.	**Costs to farmer:** Labor in baby trials and opportunity cost of field. In the case of Malawi, the plots were small to minimize labor input. Additional costs were in field preparation, weeding, harvesting intercrop, and data collection/meeting attendance. The marginal cost of the trial vs. a pure maize stand is less than 2 days of work.
	Pros: Professional and consistent management of trials should enhance quality of results and of data collected.	**Pros:** Trials carried out under farmers' conditions give better idea of how technology would perform in reality. Close supervision of trials by farmers may improve the quality of results.
	Cons: If researchers and technicians are not attentive, trial management could be very poor. Incentives for choosing location and for visiting trials may be unduly affected by institutional policy (e.g., per diems).	**Cons:** If management varies across farmers it could make results difficult to analyze and interpret. This is also a positive: a means to capture how a technology performs across a range of different farmer-management levels (use adaptability analysis of REML ANOVA to statistically evaluate performance under different environments, biophysical structure, and farmer management).

Continued.

Table II-24. Differences between traditional on-farm and mother-baby (MB) trial methodologies, with implications for research costs (adapted from Snapp 2000b).

Activity	Traditional on-farm	Malawi MB farmer participatory research (FPR) method
Field days/ visitors	**Method:** Variable number of field days held per site.	**Method:** Researchers and technicians held several field days per year, visiting mother trial and some baby trials. Farmers made presentations about the progress of their own trials. In addition, many outsiders visited.
	Costs: Costs will vary depending on type and amount held, and on who attends.	**Costs:** Snacks, per diem, transport costs for technicians and researchers (some could be combined with monitoring visits)
	Pros: Farmers can ask questions and give opinions.	**Pros:** Opportunity for non-participants to learn about the progress of the trial, from both researchers and farmer participants themselves. Researchers get feedback from farmers.
	Cons: Interaction is usually one-way, from researcher to farmer. Also, information and notes beyond number of attendees are not usually kept so the value of the exchanges between participants is lost for research purposes.	**Cons:** Costly for researcher, and time consuming for farmers, especially unplanned visits not associated with field days.
Technology evaluation/data entry and analysis	**Method:** Data entry specialists enter data and researchers do analysis for their own purposes.	**Method:** Data entry specialists enter data and researchers do analysis for their own purposes and to report to other stakeholders, including farmers.
	Costs: Researcher time in coding and analysis, data entry time in entering.	**Costs:** Researcher time in coding and analysis, data entry time in entering.
	Pros: Data collection and analysis may be more conventional and therefore less time consuming.	**Pros:** Analysis will include farmer perceptions as well as technical measures of the trial outcomes. A wide range of farmer management is captured, and performance under varying conditions. Could identify technologies that are difficult for farmers to implement, or technologies that they do not want to implement as they are.
	Cons: Type of data collected may be excessively technical (e.g., weekly biomass measures) and costly. Insufficient sites may be included, so technologies are not tested under a range of environments, stresses, and realistic farm management conditions.	**Cons:** Given the amount and type of data collected and their complexity (e.g., farmer preferences and rankings), researchers may need to spend more time in analysis, and more time and money seeking additional expertise to do the analysis. Data variability can be high.

Continued.

Table II-24. Differences between traditional on-farm and mother-baby (MB) trial methodologies, with implications for research costs (adapted from Snapp 2000b).

Activity	Traditional on-farm	Malawi MB farmer participatory research (FPR) method
Workshop to present results	**Method:** None.	**Method:** Two workshops per year for 3 years. Presentation of results to farmers?
	Costs: n/a	**Costs:** Cost of workshop planning and implementation. In the case of Malawi, this was US$3000 per workshop x two workshops x 3 years = US$18,000.
	Pros: Less costly.	**Pros:** Keeps researchers informed and provides opportunity for regular feedback to them during the process.
	Cons: Researchers get less feedback and farmers and local extension agents may never know the results of the analysis.	**Cons:** Costly.
Survey of farmer experimentation and adoption	**Method:** None	**Method:** Survey of farmer perceptions of technologies and adoption in target areas, as well as non-target areas as control sites.
	Costs: n/a	**Costs:** Cost of conducting and analyzing survey. In the case of Malawi, about US$500 per two-part survey conducted at three sites with 240 farmers.
	Pros: Less costly.	**Pros:** Keeps researchers informed of technology adoption and farmer priorities.
	Cons: Researchers get less feedback to shape future priorities through evaluating farmer adaptation of technologies, adoption, and experimentation.	**Cons:** Costly if data are not analyzed thoroughly, as is often the case with activities at the end of projects.

The main cost increases associated with the baby trials were training for staff on participatory methods, maintaining enumerators in the field sites to support baby-trial managers, and training for research on analysis of farmer preference data and other data generated by the baby trials. Training costs were about US$6000 to hold workshops for all staff in Malawi. In assessing the training costs, note that because most researchers and field workers do not currently have skills in participatory research methods and analysis, these training costs must be absorbed by the first projects to involve farmer participation. Once these skills become more common, the marginal cost to a project of using participatory research, especially in a methodology such as the MB trials, will be relatively small.

Some of the additional research costs were offset because farmers provided land and labor for the trials. On the average, they contributed between 50 and 70 hours of work on the trial. However, marginal costs associated with the trial as opposed to just planting maize were only about 8 hours, suggesting that the costs to farmers were not high, and were likely offset by the fact that farmers received seed and in some cases small amounts of fertilizer, and they kept the harvest. Baby trials were deliberately designed to be small in order to limit the land and labor requirements. In fact, many baby-trial farmers complained that trials were too small. Such a complaint is not valid with regard to the research goals of the project, but certainly suggests that farmers found their participation economically beneficial and would not have minded putting in more land and labor to get more output. In fact, farmer comments indicate that they may have found the results more beneficial if they had been done on scales resembling a typical field. Given that these farmers may not have been the most inclined towards experimentation, these results suggest that the MB methodology does not impose significant financial burdens on participants.

The extent to which farmer experimentation and modification can and should be incorporated into the MB trial methodology depends on the specific goals of the project, for example testing technologies, validating technologies, or empowering farmers. It appears that solid support from the enumerator is important in all cases to guarantee the quality of the results. Although beyond the scope of this study, an interesting question to address would be how many baby trials and what type of baby-trial farmers are most appropriate given the particular research goals?

Summary and Conclusions

The MB trial methodology for participatory technology validation allows researchers to obtain the quality agronomic data that they need to assess technology performance, and at the same time provides important qualitative and preference information from farmers about the overall adoption potential of a technology. Scientists at ICRISAT developed the methodology and implemented it in 1997-2000 to test soil fertility technologies in Malawi and Zimbabwe. Trial results and assessments of farmer preferences showed that while agronomic results were basically as expected, farmers did not coincide with researchers about which technology was most preferred, based on farmer-defined criteria. Farmers preferred a technology that was lower yielding, but that was perceived to be less risky. Further, farmers identified some new characteristics, such as the ability to suppress weeds, which researchers had not previously considered. Men and women differed, although not significantly, on the criteria they used to evaluate the technologies. These findings can be useful to researchers in subsequent technology development and dissemination work.

Results of an adoption study carried out in project and control villages show little spontaneous adoption of the technology packages offered to date. However, evidence shows that farmers are testing the technologies, and a high level of partial adoption in terms of incorporating crop residue that was part of the technology package tested at the MB trials. The MB methodology is associated with widespread dissemination of the knowledge of the technologies. Many people reported visiting the baby trials rather than the mother trials, which suggests that this methodology may be more effective than a traditional test or demonstration plot in disseminating information about new technologies.

It was hypothesized that farmer management of baby trials could strengthen farmers' own ability to experiment and to share results with others. Although this type of impact is notoriously difficult to evaluate, on the basis of the data collected by the PRGA it does not appear that baby-trial farmers made significant changes in their experimentation practices as a result of the project. An explanation of the result could be that the insistence on following a protocol limited farmers' ability to experiment within the context of the project, hence limiting the participation of the real "innovators" among the general farmer population. This is consistent with ICRISAT's own findings in Dedza. In practice, the field assistants supported some experimenting farmers in Chisepo who wanted to test the technologies using different trial designs; however, it was done on an ad hoc basis. Systematic incorporation of this activity into the MB trial could enhance the methodology's ability to stimulate experimentation, as well as empower farmers and improve relationships between farmers and researchers.

Researchers on the other hand do appear to have benefited significantly from their interaction with farmers during the project. In addition to what ICRISAT and CIMMYT soil scientists learned about farmer preferences in Malawi, dissemination of the trial method and results via publications has been substantial. A follow-up project was recently initiated to expand the testing of the technologies and to undertake a systematic comparison of different methods for incorporating user participation. The fact that this project involves many institutions and researchers is evidence of widespread interest in both the technologies and the contribution of farmer participation to technology design and dissemination.

Finally, although cost increases were associated with the MB methodology, many of them were due to time costs associated with training staff and with maintaining field staff to support the trials. Some of these costs are because staff capacity in the use of participatory methodologies is currently limited. Once these methods become more common, the marginal costs of using a methodology such as the MB trials will likely be low. The MB methodology does not appear to place a large financial burden on participating farmers.

CHAPTER 4:

ASSESSING THE IMPACTS AND COSTS OF USER PARTICIPATION IN THE DIFFUSION OF SOIL CONSERVATION PRACTICES IN CENTRAL AMERICA: THE ACORDE-WORLD NEIGHBORS (WN) INTEGRATED DEVELOPMENT PROJECT IN HONDURAS[6]

Nancy Johnson and Nina Lilja

Introduction

From 1981-1991, WN and ACORDE, together with the Ministry of Natural Resources of the Government of Honduras, promoted improved soil conservation practices such as contour barriers, drainage ditches, and use of organic fertilizers in south central Honduras. To combat the lack of success typically achieved by projects promoting soil and water conservation practices, the project took a novel participatory approach to technology diffusion. Instead of simply demonstrating the benefits of the practices, the project attempted to build farmer and community capacity to understand agroecological principles, to discover for themselves how and why soil conservation practices work, and to experiment with and adapt the technologies and practices to fit their specific conditions.

The project took a broad approach to improving economic, social, and ecological conditions via agriculture, and was one of the first to promote human capacity development and the formation of village leaders as agents of change (Bunch 1982, Sherwood and Larrea 2001). To the extent possible, project activities were carried out in the context of community groups, and local farmers were trained to take over extension jobs and scale up the work. The project's combination of 80% practical training and 20% theory meant that much of the work was carried out in farmers' fields through experiments, visits from project technicians, and exchange visits among farmers. The project staff made a significant commitment to the community during project implementation. Extension workers, in this case Guatemalan farmers who had worked with a previous WN project, lived in the area for the duration of the project.

The International Institute for Environment and Development (IIED) named the ACORDE-WN project in Guinope (1981-1989) as one of the eight most successful development projects in the world (Bunch 1988), and as one of the best examples of the adoption of soil and water conservation practices. Significant adoption was observed in the study areas during the course of the project. According to WN reports, at the time the project

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[6] The authors are grateful for the contributions of Roland Bunch, Gabino Lopez, John Hellin, and Steve Sherwood. Research assistance from José Fernando Escolán Rodezno is also gratefully acknowledged.

ended, over 1000 farmers had adopted technologies that increased basic grains' yield sevenfold. Nearly 1400 farmers had tripled their yields of basic grains as a result of adopting soil conservation practices. Subsequent follow-up studies indicate that adoption and adaptation continue (Hellin and Larrea 1998, Bunch and Lopez 1999). In addition, increases in farmer capacity (Larrea 1997), experimentation, and the exchange of information among farmers (Bunch and Lopez 1999) were also documented.

Because of its success, the ACORDE-WN work in Guinope and other parts of Central America has received much attention from researchers and development practitioners. It has been the subject of numerous studies documenting adoption and impact (Bunch 1990, Smith 1994, Pretty 1995, Selener et al 1997, Hellin and Larrea 1998, Bunch and Lopez 1999). The association of farmer participation with such positive results has been particularly interesting. For this reason, the PRGA selected the ACORDE-WN work in Guinope for inclusion in this study despite its being primarily a development rather than a research project. Its focus on building farmer capacity and stimulating experimentation was a major influence on the field of farmer participatory research.

This study goes beyond documenting impact to look at how farmer participation contributed to that impact. Besides production and environmental impacts, this study also looks at human and social capital impacts in the communities. The influence that the project and farmer participation had on other R&D agencies and the costs and cost-effectiveness of this methodology versus other methods are also assessed. The analysis is based largely on existing data; however, some primary data were collected during a 3-week visit to Honduras in February 2001. Data collection included interviews with project staff and others familiar with the project. A household survey was also carried out in three communities in the municipality of Guinope.

Conceptual Framework for Assessing the Impact of Participation

Types of Participation

The conceptual framework for the PRGA study is outlined in the earlier methodology section. According to this common framework for analysis, cases are categorized according to the typology, and then the relevant hypotheses regarding each of the four impacts are examined.

Given that the project was fundamentally one of development, it does not lend itself easily to categorization using the typology. Like the CIP case, its activities were iterative. The project entered communities with technologies and an extension strategy; however, upon arrival the technologies became the basis for a process of testing and adaptation to modify them for local adoption and diffusion. Training and skill building became part of the primary mechanism for diffusion because farmers needed to build human capacity to be able to undertake the necessary experimentation and adaptation. Over time, local farmers were trained to be professional extension workers; however, the training built on their own experiences as farmers and stressed the importance of relating to other farmers as equals (Hellin 1999). The final goal was to build a self-sustaining process of experimentation, information sharing, and adaptation or diffusion of technologies that would lead to sustainable increases in productivity. For the purposes of this study, we focus on the project's testing activities and on its development of human and social capital as a diffusion strategy. Within the project, these activities were carried out collaboratively with farmers, but spontaneous testing and diffusion also occurred (Table II-25).

Table II-25. Types of participation used in the World Neighbors Guinope project[a].

	Contractual	Functional	Empowering		Farmer experimentation
		Consultative	Collaborative	Collegial	
Design	XX				
Testing			XX		XX
Diffusion			XX		XX

a. Columns represent the shift in decision-making authority from researchers to farmers. The first column (contractual experimentation) is a non-participatory approach. The last column (farmer experimentation) was collegial, with farmers increasing participation over time.

Gender and Poverty in the WN Project

The main component of this project, the soil conservation work, did not include women. This decision was made as a result of some preliminary analysis that showed that women do not play significant roles in agriculture. This analysis focused only on women's actual work in the field, not on management, where women may play a larger role. Although women were not involved directly, interviews with them suggest that they do know about the practices, and in some cases even implemented them.

After several years working mainly on agriculture with men, the project added a component for women. This focused on health/sanitation, home gardens, and food preparation. Home garden work included the introduction of vegetables to diversify and improve diets. Much less has been written about this aspect of the project, and it appears that it had less of an impact, partly because it started later and promoted less attractive technologies with fewer resources. The methodology was similar, for example working with groups to strengthen local organizational capacity, but had less of an explicit focus on experimentation or capacity building. The impact assessment work that follows will look at impact on both men and women; however, given that there were essentially two different projects, not much can be gained by directly comparing impacts. Rather, we try to assess the benefits that women perceived from the soil conservation activities of the and the costs of not having targeted women in the project.

In terms of poverty, the Guinope project worked only with farmers. In some communities this could lead to the exclusion of the poorest, landless residents; however, in Guinope nearly all had access to land so the focus on farmers did not exclude the poor (Roland Bunch, personal communication, 2001). Among those with access to land in Guinope, the project targeted the smallest-scale and poorest farmers, whose land was most suitable for the types of conservation technologies being promoted. These were in fact the farmers who participated. A researcher at a local university commented that this project and others like it may have had the effect of stigmatizing soil conservation practices by making them seem appropriate only for the poorest (Myra Falk, personal communication, 2001). Less poor farmers would be reluctant to adopt them and thereby associate themselves with the poor. Although this comment is worrisome with regard to possibilities for scaling up, it clearly shows that the project hit its mark in terms of its target population.

Technology Impacts

This section examines the role of farmers' participation on the technologies generated by the project, their adoption, and on the distribution of their impacts. User participation in the testing stage is hypothesized *to increase adoption because the technology or technologies ultimately identified will be more appropriate for farmers (H2).* Participation at the diffusion stage would result in an *increase in the probability that farmers for whom the technologies are relevant and appropriate will be aware of them and be willing and able to adopt them and to recommend them to others (H3).* In the other case studies, these two impacts would be assessed separately. However, in this project, the testing and diffusion strategies were essentially the same because they focus on providing information as a complementary input to permit experimentation and adaptation. The remainder of this section documents adoption and impact on project communities, on women, and on non-project communities, and links those impacts to user participation.

Evidence of Adoption of Soil Conservation Practices

According to Sherwood and Larrea (2001), 1500 farmers adopted soil conservation practices as a result of the project, about 34% of the total number of farmers in the municipality (Hellin and Larrea 1998). Benefits are primarily realized through increased crop yields. By 1988, nearly 1000 farmers had achieved yields of over seven times their traditional levels, and nearly 1400 had at least tripled yields (Bunch 1988). Although these numbers reflect agronomic rather than economic gains, and in some cases refer only to what farmers achieved on their test plots, they nonetheless demonstrate that significant number of farmers were working with the technologies and achieving good results.

Project impact varied by community. The project worked in 41 communities in three municipalities. These communities are roughly equivalent to *aldeas* (villages). For the purposes of this analysis we often use population and other data at the village level with the understanding that they do not exactly match the scale at which the project worked.

According to project staff, of the 10 villages in Guinope where the project worked, the impact of their agricultural and NRM activities was high in five, medium in three, and low in two. The project only had activities for women in six villages, where impact was high in three, medium in two, and low in one.

Different technologies also had different adoption rates (Table II-26). The project's main initial technologies were contour barriers, drainage ditches, and organic manure. Over time they expanded into other technologies, such as insect pest control and vegetable production. According to data collected by Bunch and Lopez as part of a 1994 impact study, in Pacayas, where the project impact was felt to be high, about one third of all farmers adopted contour barriers while nearly all had stopped burning and begun using organic fertilizers. In Mansaragua and Lavanderos, where impact was felt to be medium, fewer than 15% of households adopted barrier or drainage ditches. Levels of organic fertilizer use were high in these communities, however. Bunch and Lopez (1995) note that the levels of adoption are high in the project communities, but do not appear to have spread spontaneously to other areas.

Data collected from 55 randomly selected households in three communities as part of this study show even higher levels of adoption, consistent with fact that the census may over estimate farm households. As in the Bunch and Lopez study, the selection of communities was stratified by level of impact. The communities were Pacayas (high impact), Lavanderos (medium impact), and Silisgualagua (low impact). In Pacayas, 100% of farmers in the sample had adopted soil conservation practices, 64% during the project and 36% after the project ended (Table II-27). In Lavanderos, 62% adopted one or more of the technologies, half during the project and half after it ended. In Silisgualagua, where the project deemed impact to be low, about 50% of farmers reported having adopted soil conservation practices, all but one during the project's life. Overall, live barriers were the most common practice people reported adopting. Organic fertilizer use has declined dramatically because of an increase in price, and currently is used only in Pacayas. Statistical analysis confirms significant differences between the three communities in terms of their adoption levels and patterns (chi-square significant $P = 0.056$).

Table II-26. Number of farmers adopting technologies in three communities in Guinope in 1981, 1989, and 1994.

Technology	Number of farmers adopting								
	Pacayas			Mansaragua			Lavanderos		
	1981	1989	1994	1981	1989	1994	1981	1989	1994
Contour grass barriers	0	13	13	0	5	5	0	14	10
Contour or drainage ditches	0	19	19	0	8	8	0	17	6
Green manures	0	0	2						
Crop rotation	12	18	33	0		50	0	21	27
No burning of fields	0	20	33	0	24	32	2	22	55
Organic fertilizers (*gallinaza*)	2	20	33	2	50	100	0	18	75
No. of households in community in 1994[a]		36			125			128	

SOURCE: Bunch and Lopez 1995, p 7.

a. Numbers are from 1994 agricultural census; they may overstate the actual number of farm households.

Table II-27. Number of farmers who had adopted soil conservation practices[a] in three communities in Guinope.

	Pacayas (n = 11)	Lavanderos (n = 24)	Silisgualagua (n = 18)	Total (n = 52)
Did not adopt	0	9	9	18
Adopted during World Neighbors (WN) project	7	7	8	22
Adopted after WN project	4	7	1	12

a. Practices include live barriers, drainage ditches, incorporation of residues, organic fertilizer, and/or no burning.

Past studies have not focused on the inter-community differences that may explain the differential adoption rates. In the data collected for this study, some attempt is made to differentiate the communities and relate these differences to adoption. Lavanderos, the largest of the three communities, is closest to the town of Guinope. Silisgualagua is the furthest from Guinope, but has good road access. In terms of overall quality of life, as defined by quality of housing, accessibility, and economic level, Silisgualagua is the best off, followed by Pacayas and Lavanderos (Escolán 2001). Table II-28 presents some additional characteristics of the three communities.

Table II-28. Selected characteristics of the communities of Pacayas, Lavanderos, and Silisgualagua, Honduras.

Characteristics	Pacayas (n = 11)	Lavanderos (n = 24)	Silisgualagua (n = 18)
Number of households[a]	20	85	55
Those with own land (%)	100	89	89
Average area owned (ha)	2.5	2.4	2.2
Average area cultivated (ha)	3.3	6.2	1.8
Those with irrigation (%)	82	25	17
Those growing basic grains only (%)	18	66	44
Those cultivating flat land (%)	36	25	6
Those cultivating "good" land (%)	27	38	56
Those earning outside of agriculture (%)	36	52	61

a. Approximate number of houses that are occupied full time.

Cultivated area does not differ significantly across the communities, but land owned differs greatly. In Lavanderos, and especially Silisgualagua, many farmers have large areas of forestland. In the past, resin collection was a major economic activity in Silisgualagua, but the forest department, Corporación Hondureña de Desarrollo Forestal (COHDEFOR), now strictly limits this activity. Families in Lavanderos and Silisgualagua are still more likely than those in Pacayas to earn income outside of agriculture.

Perhaps a more important factor differentiating the communities and influencing adoption of project technologies is access to irrigated land. In Pacayas, 82% have access to irrigated land, while in Silisgualagua only 18% have access. Having irrigation is highly correlated to being able to grow horticultural crops rather than just basic grains. The ability to grow high-value crops would clearly affect a farmer's incentive to invest in soil conservation practices. Farmers in Pacayas are more likely to have flat land than in the other communities; they are also the most likely to adopt. Farmers in Silisgualagua are more likely to cultivate steep slopes, yet they are the least likely to adopt, which suggests that other factors such as access to irrigation appear to be the major determinants.

Impact on Women

Because of our interest in women's participation and impact on women, data were also collected from women about their knowledge of, participation in, and benefits from the WN activities. Interviews were conducted with the female household head in the same randomly selected households where data were collected on agriculture and soil conservation. In terms of stratification based on impact levels in this case, rather than have one community from each impact level, the sample included one community that was high for both men and women (Pacayas), one where it was medium for both (Lavanderos), and one where it was ranked low in terms of the impact of the agricultural aspects of the project, but high for women (Silisgualagua). The gender divergence in the last community made this an interesting one to examine.

Participation and adoption rates are lower in the case of women's projects, ranging from about half in Pacayas and Silisgualagua to a third in Lavanderos (Table II-29). These levels are consistent with the project's subjective ranking of the communities, but the differences are not statistically significant. Staff say that during the time of the project, participation and enthusiasm were high and the activities of the women's groups had an impact on the communities (Leoncio Valladares, personal communication, 2001). However, women have not continued practicing or innovating in the way the men have, either individually or in groups. A former staff member said that the low impact was because there was really less science and less capacity building, so that when the support of the project ended, there was no solid base upon which to continue (Irene de Valladares, personal communication, 2001).

Table II-29. Women's participation (%) in World Neighbors activities in three communities in Honduras.

Form of participation	Pacayas (n = 10)	Lavanderos (n = 27)	Silisgualagua (n = 20)
Knew of project	100	81	90
Knew of soil conservation activities	56	41	65
Participated in project	50	26	45
Participated in soil conservation	10	7	21
Adopted some project technology	50	33	50
Adopted soil conservation practices	10	11	10

Most women say that they continue to use the hygiene and food preparation information that they learned, although few reported experimenting or innovating with what they learned. They no longer make the jellies and jams for sale. Home gardens, which were the focus of the agricultural activities with women, are not common except in Pacayas where 40% of women have them. Only a quarter of women in Silisgualaguas have home gardens, and no one in Lavanderos reports having one.

Women's knowledge of, and participation in, the soil conservation activities was less than for the project in general (Table II-29). In each community, a few women claimed to have participated and adopted. These were usually daughters in families where the father was involved, or where women did some agricultural work. Women's limited participation in agriculture clearly limits their direct involvement in and benefit from this aspect of the project. Some have subsequently argued that if agriculture is defined more broadly to include not only working in the fields, but also making management decisions, and storing and preparing food, then women would be much more involved (Sherwood and Larrea 2001). This may be true with regard to food preparation, but in the PRGA survey few women were able to say even how much land their husbands had, which does not suggest much participation in farm management decisions.

Regarding who benefited more from the ACORDE-WN activities, most women said that men and women benefited equally. In Pacayas, 75% of women thought so, while 25% thought than men benefited more. In Lavanderos, 88% of women thought that benefits were equal, while 6% felt men benefited more, and 6% felt women benefited more. In Silisgualagua, 60% of women felt that benefits were equal, with the remaining 40% split equally between greater benefits for men and for women. An explanation for this finding is that women feel they have benefited indirectly from the project activities with the men.

Overall Trends and Project Impact

Although most men and women feel that the situation has improved both economically and in terms of overall quality of life in their communities over the past 15 years, women are less enthusiastic than men in all cases (Table II-30). The data also show that people are more positive about overall quality of life changes than about economic changes, reflecting that rural development is not synonymous with economic development, and that improvement has occurred in both.

Table II-30. Men's and women's perceptions (%) of economic and overall quality of life tendencies over the past 15 years in three communities in Honduras.

	Pacayas		Lavanderos		Silisgualagua	
	Men	Women	Men	Women	Men	Women
Economic:						
Better	80	75	83	72	72	65
Worse	0	0	13	24	17	29
Same	20	25	4	4	11	6
Quality of life:						
Better	90	88	88	75	100	95
Worse	0	0	0	0	0	5
Same	10	12	12	25	0	0

In every community, women were more likely to mention improvements in agriculture as a reason for better economic conditions than were men. In Pacayas, nearly all men and women credited vegetable production and the ACORDE-WN project with bringing economic improvements. In the other communities, women were twice as likely as men to mention agriculture specifically as having contributed to economic development. The men in these communities were more likely to mention outside projects and their influence on the way people work. This could reflect the fact that men were participants in project activities and therefore had more appreciation of the processes rather than just the final products.

Results are similar in terms of men's and women's perceptions of changes in the overall quality of life. Both men and women in Pacayas again cite improvements in agriculture in general and vegetable production in particular. In Lavanderos, over half the men credited the help of outside organizations and projects, in collaboration with local people, for improving the overall quality of life in the community. Only one quarter of the women credit the organizations, while one third mention agricultural improvements. None of the men in Lavanderos mentioned agriculture in regard to quality of life. In Silisgualagua, 50% of the women credit outside organizations, and just 11% credit agriculture. Again, no men mentioned agriculture. Sixty percent of the men mentioned organizations as having contributed; however, most referred specifically to recent health and sanitation projects. These data suggest that in Pacayas the ACORDE-WN project made a direct and lasting economic impact on the community, so significant that it affected the overall quality of life. In the other communities, the economic impacts were not as dramatic, and the project is one of several factors contributing to a broader process of overall development.

Impact outside Guinope

Although impact has clearly been high and lasting in the Guinope municipality, little impact can be observed outside the original project domain (Bunch and Lopez 1999). The project is known among local researchers as a case of isolated success (Juan Carlos Rosas, personal communication, 2001). This study did not collect data in other areas, but the differences in land management inside and outside the project communities could be seen from the road.

Role of Farmer Participation in Achieving Impact

For the purposes of the study, simply documenting adoption and impact is not sufficient. We must show that they are linked to incorporating farmer participatory methods in the project. The low adoption rates generally observed with soil conservation practices suffice to show that this project did obtain higher rates than other projects. It did not use any incentives or subsidies, eliminating that as a reason for its success. In fact, the non-use of incentives in Guinope could well be a reason why the project has better adoption, and certainly better sustained adoption.

The project was one of agricultural improvement, for which soil conservation has to be a necessary ingredient. The staff recognized that agricultural production rather than soil conservation is the priority for small-scale farmers. Therefore they promoted a combination of technologies (e.g., live barriers, chicken manure, vegetable production, and pest control) that would reduce soil erosion, but also have production benefits in the short run (Bunch 1998, Hellin 1999). Although the project had essentially selected the technologies and approach before the start, staff began with community consultations to assess specific needs and to discuss whether and how what the project offered was relevant to local needs and priorities. This approach was an important element in gaining community interest and confidence. Two of the four reasons that farmer innovators gave for becoming involved in the project were related to the participatory approach (Sherwood and Larrea 2001, p 12):

(1) Demonstrated commitment of extension workers to the community.
(2) Activities were pertinent to the priority concerns.
(3) Ideas promoted by the program were simple and have results.
(4) Extension workers and the project mostly learned to listen to farmers' suggestions.

The project was flexible in its initial approach to working with farmers. For example, the original plan was for farmers to work together in groups to conduct experiments with the new technologies. However, farmers resisted this plan in favor of individual plots. If the extension workers had insisted, participation might have been lower. In all communities, attendance at the weekly "theory" meetings was low the first year, so during this time extension workers were authorized to rent plots of land along the main road and use them to demonstrate the benefits of the technologies. The following year, participation tripled as people had the opportunity to see how the technologies worked.

The combination of demonstration and hands-on experimentation is considered an important factor in the project's success. Many extension projects stop at getting farmers interested in the technologies via these kinds of demonstration plots. If the technologies are widely applicable and need no adaptation, then this may be sufficient. However, most agricultural technologies do not usually fit this description, they often must be adjusted to community- and even plot-level conditions. If farmers are not capable of making the adaptations, then technologies that are potentially beneficial will not be adopted.

An example of adaptation was the contour ditches promoted by the project. Because sloped land is usually not expected to have drainage problems, water logging was not taken into consideration in designing the canals. In practice, some sloped land does have drainage problems so the design of the canals had to be adjusted, giving them a 0.5% to 1% slope.

A widely documented case of farmer adaptation is the case of live barriers, a technology that was unique in Honduras to the ACORDE-WN project (Sherwood and Larrea 2001). The project initially promoted live barriers of Napier and King grasses because they were the most effective for controlling erosion. Over time, however, farmers began to realize that these grasses could be invasive, that their root systems competed with agricultural crops, and that they produced more fodder than most farmers were able to utilize (Hellin and Larrea 1998). Hellin and Larrea document 19 species being used in live barriers in Guinope in 1995; and document a trend in establishing barriers over time moving away from the initial two grasses towards other species (Figure II-3). This occurred while the project was underway and continued after it finished. Fieldwork in 2001 also found a wide variety of plants in the barriers, especially in Lavanderos. The ability of farmers to adapt the technologies rather than abandon them appears to be critical to their continued and growing usefulness.

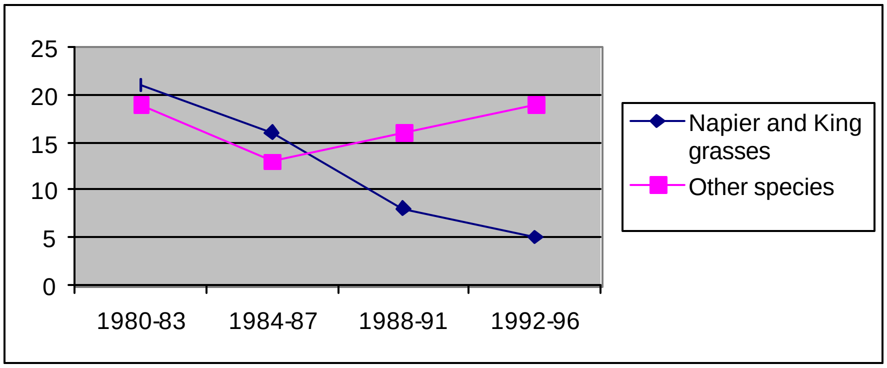

Figure II-3. Number and type of live barriers established by 63 farmers in Guinope, Honduras (adapted from Hellin and Larrea 1998, p 36).

Human and Social Capital Impacts

It is hypothesized that participation in the research process can build human and social capital among beneficiaries. Collaborative participation in technology testing can *enhance participants' own testing and evaluation skills and improve their ability and confidence to interact with researchers and extension workers (H6)*. If activities stress collective work and information sharing, then impact on social organization as well as individual capacity could occur. Collaborative participation in the diffusion stages is hypothesized to help *farmers/communities learn what is involved in mass diffusion of technology, particularly the complexity of adoption decisions and the importance of complementary inputs such as seeds, credit, or information (H8).* Again, separating these two activities is difficult in the case of this project. However, in general the testing benefits would be available to all farmers, while the diffusion impacts would be more likely to be observed among the farmer-leaders, farmers who received training and went on to become extension workers with the project. These two groups will be assessed separately in this analysis.

Before presenting the results, it is important to describe who the farmer participants were and how they were selected because this process has implications for both the results and our ability to extrapolate from them. Guinope and its neighboring municipalities were selected by ACORDE and WN because of the many poor farmers cultivating degraded lands. The ecological and social conditions were also considered to be representative of a larger agroecosystem.

Within Guinope, the project had activities in every community. Everyone was invited to attend meetings and participate in project activities, and participation was on the basis of self-selection. No incentives were given to encourage participation. Although participation levels were generally high, it is widely acknowledged that those farmers who were most interested, capable, and dedicated were the ones who most profited from the project. These were the ones who went on to become extension workers in their own right. They were not by any means the richest farmers nor the most educated, but they had some special quality about them. Sherwood and Larrea (2001) state that the farmers selected as promoters showed more "interest, ability, and 'volunteer spirit' than others" (p 13). Others familiar with the project and the region also say that the same able farmers who received training in WN went on to participate in other programs and to some extent monopolize the benefits (Juan Carlos Rosas , personal communication, 2001, Leoncio Valladares, personal communication, 2001;). This is to be expected in participatory research, and it does not invalidate impact or impact assessment. In fact, the existence of some well-trained and motivated farmers could enhance the impact of other programs, especially less participatory programs, by making sure that the technologies are widely disseminated on a farmer-to-farmer basis. However, it is important to recognize that these few farmers had some special and largely unobservable characteristics that made them receptive to the opportunities that the project offered. Therefore, we cannot generalize from their experiences to estimate how all farmers might benefit from similar training and experience.

Impact on Farmer-Leaders

Larrea (1997) and Sherwood and Larrea (2001) have extensively documented the experience of the farmer-leaders of the Guinope project. What follows is based on their research, unless otherwise cited. In Latin America and the Caribbean, the project was an early user of local people as agents of change; over time, more than 50 local farmer-leaders were made by the project. The process of formation was variable, but it generally followed the steps presented in Table II-31. The first 3 years emphasize training farmers in increasingly complex agroecological principles, from soils to IPM. The last 3 years focus more on developing leadership and management capacity. Following the termination of the program in 1989, 32 farmer-leaders went on to work with other development projects in Honduras (Bunch 1988).

Table II-31. Stages of farmer involvement in the Coordinating Association of Resources for Development (ACORDE) - World Neighbors (WN) project in Guinope.

Status	Essential learning	Year
Project leader	Administration of projects	6
Promoter (paid)	Planning methodology	5
Promoter (volunteer)	Organization leadership	4
Promoter (volunteer)	Systems integrated pest management	3
Experimenter	Horticulture, irrigation	2
Farmer	Soil	1

SOURCE: Hellin and Larrea 1998.

Sherwood and Larrea (2001) identified 10 farmer-leaders, whom they call innovators, for in-depth interviews to better understand what motivated them to become leaders and how it had changes their lives. These leaders were usually from poor families and broken homes, and were religious and committed to their families and communities. Some were already leaders in the community when the project began, and others were just ordinary people who experienced considerable personal development as a result of the project (Leoncio Valladares, personal communication, 2001). Although they were not among the richest in the communities when they began participating in the project, they all had established stable homes and their family welfare was considered to be high. The 10 innovators were significantly different from the general population of adopters in certain ways. They were younger, with an average age of 42 years versus 47 for adopters. They also had more education, smaller families, and less time in the community – all likely to be a consequence of their youth. Innovators cultivate less land, but more plots, than do adopters, and are more likely to have off-farm income.

When the ACORDE-WN project ended, a few of the 10 farmer-leaders went to work in other parts of Honduras. Two eventually worked in other parts of Central America before returning to Guinope. At the time of the Sherwood and Larrea work, all 10 were again living in Guinope. All were farmers, experimenters, and consultants to development organizations. They continued to establish and lead projects in the communities, for example six organized a watershed group (named GUIA). One former leader was opening his own farmer-training center.

The leaders were often sought by organizations both inside and outside the community. They also assumed traditional leadership roles in their communities. Many complained that they had little time left for their families, and a few even became ill from the stress of so much responsibility. Their contributions were widely recognized within their communities, occasionally stimulating jealousy.

Impact on Farmers and Communities in General

The 10 leaders represent those who were most willing and able to take advantage of the opportunities offered by the program. Such farmers were 50 of the approximately 1500 adopters. To better understand levels of innovation among the general population of adopters, Hellin and Larrea (1998, p 6) randomly selected a sample of 63 adopting farmers and developed indices of adoption and adaptation based on live barrier technology. They found that among adopters, about 20% were what they called low adopters, meaning that they used few technologies in small areas; 40% were medium adopters; and the remaining 40% were high adopters. In terms of innovation, the pattern was the opposite, with 41% showing little innovation and only 18% showing high levels of innovation. This suggests that not all who benefited from the technology benefited from the project's capacity building aspects.

The PRGA survey also attempted to assess ongoing innovation, experimentation, and information sharing among all farmers. The results differ significantly by community (Table II-32). New technologies and practices were reported in both basic grains and new crops, and include spacing, varieties, and rotations. The ideas came from agricultural development projects, from other farmers, or from the farmer himself. The relatively low level of innovation in Pacayas, where project impact was high and where high-value agriculture predominates, is surprising. Past impact studies have found a high level of innovation in this community (Bunch and Lopez 1995, 1999). The one innovation reported there was the addition of coffee to reduce erosion and protect water supply above an irrigated field. Perhaps finding such success with the vegetable production gives them less willingness or incentive to change.

Table II-32. Innovation and experimentation among farmers (%) in three communities in Guinope.

Community	Adopted new technology in last 5 years[a]	Experiment	Experiment alone	Share results with others
Pacayas (n = 11)	9	36	50	100
Lavanderos (n = 24)	46	50	58	83
Silisgualagua (n = 16)	31	44	38	88
Total (n = 51)	33	45	50	88

a. Chi-square significant at $P = 0.10$.

Experimentation includes both spontaneous experimentation and experimentation in connection with an organization such as the Escuela Agrícola Panamericana (EAP)-Zamorano or the local agricultural research committee (CIAL). Experiments were most varied in Pacayas, where farmers reported working with green manures, insect control, and varieties. In Lavanderos, nearly all experiments were with new plants or varieties; however, a wide variety of materials were tested, including beans, potatoes, sugar cane, chilies, and plantain. In Silisgualagua, nearly all reported experimenting with bean varieties as part of a CIAL experiment. Most farmers report that they share the results of their experiments with others. This is an improvement over what occurred in the early years of the project, when farmers did not share and often lied when asked by others how they achieved good results (Roland Bunch, personal communication, 2000).

People learned to experiment from a variety of sources, including organizations, neighbors, and their own experience and initiative. Just over 20% reported having learned to experiment from ACORDE-WN—a large proportion considering that the project was 15 years ago and many current farmers were not old enough to have participated. However, they may have learned from parents. Seventeen percent said they learned from neighbors and 13% learned from CIALs. A quarter of the sample said they learned to experiment on their own, but they were all from Lavanderos, where they accounted for half the sample. Another 25% said they learned from other sources, for example EAP-Zamorano.

The fact that farmers share information among themselves is also supported by data on where they get agricultural information. Access to formal extension agents—by which people mean staff of any agricultural research or development project—differs significantly across the communities (chi-square significant at $P = 0.02$). Extension is essentially only available in Pacayas, where 45% of farmers reported having received at least one visit from extension in the past year. In Lavanderos none received visits, and in Silisgualagua only 11% did.

Thus, farmers get information from a variety of sources, including extension, mass media, or other people. Sources differed significantly by community ($P = 0.008$). Just over a third of farmers relied only on other farmers for information. Sixty percent received information from a variety of sources including other farmers, ranging from 90% in Pacayas to about 50% in the other two communities. In Lavanderos and Silisgualagua, the "other" category was high, while it did not exist in Pacayas, which is known for high levels of information sharing. The community has worked out a system whereby anyone who goes to town checks prices for all crops currently grown in the community and reports the information to everyone. The importance of high-value crops and of selling crops makes accurate market information critical for this community.

Overall Levels and Changes in Social Capital

In 1995, EAP-Zamorano assessed all 27 communities in the Yeguare watershed, which includes Guinope, to prioritize its work in the region. Each community was ranked using 13 criteria such as accessibility to university, university interest in the zone, capacity of the local people, and community organizational capacity. According to the results, the eight ACORDE-WN communities were significantly less accessible than other communities in the watershed, yet they had higher levels of both human capacity and organization/institutional capacity. In the case of human capacity, the difference is statistically significant ($P = 0.005$) (EAP 1995). These results are consistent with high levels of human and social capital impacts on these communities. They are also consistent with the lack of diffusion of such impacts to neighboring communities even after 20 years.

As part of the PRGA survey, respondents were asked about their membership in community organizations. Men belong to a significantly larger number of community groups in Pacayas (1.1) and Silisgualagua (1.3) than they do in Lavanderos (0.6). Women are much less likely to participate in community groups than are men. Women participate in an average of five groups. As was the case with men, women in Silisgualagua participate in many more groups (0.9) than women from Pacayas or Lavanderos (0.3) (significant at $P = 0.05$). Using group membership as a measure of social capital, Silisgualagua would be considered to have the high levels of social capital and Lavanderos the lowest.

As part of the PRGA survey, men and women were also asked to assess changes in community social capital, as measured by community activities and by solidarity, and identify key influences in the changes. In all communities, men generally feel that more community activities are now available than 15 years ago when the ACORDE-WN project ended (Table II-33).

Table II-33. Opinions (%) on changes in social capital in three communities in Guinope.

	Pacayas		Lavanderos		Silisgualagua	
	Men	Women	Men	Women	Men	Women
Community activity:						
Worse	9	0	8	0	6	0
Same	9	11	13	30	12	18
Better	82	89	79	70	82	82
Unity/ solidarity[a]:						
Worse	9	0	25	4	0	18
Same	64	25	38	58	22	35
Better	27	75	38	38	78	47

a. Chi square significant at $P = 0.01$.

Variation is significant both within and among the three communities in how they perceive that community solidarity has changed over the past 15 years. In Pacayas, of those who feel that things are better, two-thirds credit organizations and projects such as ACORDE-WN with motivating people and bringing them together. In Lavanderos, of those who thought that things were better, 77% of both men and women credit outside projects. Of those in Silisgualagua who feel that solidarity has increased, most men and women credit outside projects.

Two general observations can be made on the basis of this analysis of perceptions of change. The first is that economic and social benefits of projects may not be correlated. Men in Pacayas probably benefited the most economically from the project, yet felt the least amount of improvement in solidarity, and were least likely to credit projects with stimulating community activity. Silisgualagua, on the other hand, arguably benefited the least economically, but felt that solidarity increased and that the project had an impact in motivating people to work together. This underscores the importance of assessing impact on the basis of a broad range of criteria.

Second, perceptions of changes in community solidarity varied greatly within and between communities, most likely because people's impression of what solidarity means is so subjective. This suggests that if a project seeks to have impact in this area, as many projects currently do, attention to stakeholder differentiation at all stages of the R&D process will be critical to achieving and demonstrating success.

Feedback to Formal Research Impacts

Analysis and Discussion

It is hypothesized that incorporating users into the innovation process improves the flow of information between different stakeholders, for example researchers, extension agents, and farmers. This improved information flow should result in better technologies and other innovations, whose economic benefits in the short run will be realized via the greater adoption and impact of the technologies. However, it is important also to document improved linkages, information flows, and associated changes in policy and practices because these can yield benefits in the longer term.

Regarding the project's technology testing activities, it is hypothesized that as a result of user participation, *researchers/extension agents improve their understanding of farmer criteria—including any new, shared criteria that are developed in the process of the interaction (H14).* Regarding the diffusion activities, it is expected that through collaborative participation *researchers/extension workers would learn about farmer-to-farmer diffusion practices and about what kinds of information and skills both farmers and extension workers need to support this spontaneous diffusion (H17).* Impacts were documented through interviews with project staff, researchers, and other development practitioners, and through existing literature.

The work of Hellin (1999) and Hellin and Larrea (1998) is one of the few examples of research attention to documenting farmer criteria for technology evaluation in the ACORDE-WN project. Individual extension workers probably learned a great deal about farmers' experiment methods. However, given that the main focus of the project was diffusion, these may not have been systematically recorded and analyzed. According to project staff, researchers in the natural sciences have not shown interest in particular farmer discoveries or adaptations.

A lesson learned by project staff that relates to technology testing is that there is a need for participatory technology development with women (Roland Bunch, personal communication, 2000). Existing technologies for home gardens or other agriculture- or NRM-related activities for women are simply not appropriate. An option for involving women further in agricultural and NRM activities might be in the area of animal husbandry. Although only a small percentage of women had gardens, 90% reported raising animals. It is not enough to pressure women into participating in programs, or even worse, bribe them through incentives to take part. Programs that want to benefit women must also develop technologies that can benefit women. Better rates of adoption by women, as well as sustainability of the technology, are best achieved by finding the technology that women want.

The impact of this project on the thinking and practice in diffusion has been significant. Largely because of its impact on the ground, the methodology and its application in Guinope and other project sites has had a great deal of conceptual and practical influence on the fields of people-centered agricultural and rural development (Bunch 1982, Pretty

1995, Krishna et al 1997, Scarborough et al 1997). In particular, the project's emphasis on capacity building and experimentation, coupled with the evidence of ongoing, post-project innovation, has influenced the fields of participatory technology design and development (Bunch and Lopez 1999). This is supported both by the publications and citations, and by the impressive list of visitors to the project from all over the world, whose names are kept in a guest book maintained by one of the project's most innovative farmers.

Project documents report that at least five other development programs were modeled after this one in Honduras alone by the time the project ended. Programs based on local leaders and farmer-to-farmer diffusion are widespread in Central America and other areas (Programa Campesino a Campesino [PCAC], etc). Less evidence exists of influence on national institutions as opposed to NGOs or international organizations, however. In 1980, project staff were asked to train 150 extension agents in the methodology; a few years later the effort was cancelled, largely because of resistance on the part of extension agents. In 1990, attracted by the success achieved in Guinope, the Minister of Agriculture again requested training; a month later he left his post and his successor did not pursue the request. More recently, the main government extension service (Programa Nacional de Desarrollo Sostenible [PRONADERS]) is incorporating the Guinope process into its work. The Honduran government is presently adopting the Guinope methodology as national policy.

Impact on research at the national level has been limited; however, this is again because the Dirección de Investigación de Ciencias y Tecnología Agrícola (DICTA) has little research capacity. Several researchers at EAP-Zamorano who are familiar with the project and the area said that the ACORDE-WN work is well known, but more as a case of localized agronomic successes than for its methodology. Both project staff and local people say that recent projects working in the zone (EAP-Zamorano, Centro Asesoria para el Desarrollo de Recursos Humanos en Honduras [CADERH], Land Use and Productivity Enhancement project [LUPE]) have not used the same methods. Nonetheless, several theses at EAP-Zamorano, for example Larrea (1997) and Izquierdo (1994), have looked at issues of human and social capital development and community participation in Guinope, and have documented benefits of the ACORDE-WN project. Interest in the project is more from the perspective of social science and community development rather than technology development.

Costs of Research Impacts

It is hypothesized that including PR methods should make projects more cost effective. Participation may also change the cost structure, raising costs in some areas while lowering them in others.

The ACORDE-WN project cost about US$400,000 over 8 years. Most of these costs—three quarters in the last year—were for salaries. This is consistent with the fact that time and human resources were the major inputs; the project was clearly more costly than a typical extension project if assessed in terms of the number of communities or farmers visited. In terms of cost effectiveness, however, this project was probably much higher than traditional extension because of the large number of adopters compared to other soil and water conservation projects. World Neighbors sets its goal as US$300 per family that triples basic grain yields. In this project, the costs were about US$325.

Although we do not have information on how many hectares are under conservation practices in Guinope, we can estimate using survey and census data. According to the PRGA survey, the average farmer had 0.7 hectares under conservation practices. About 5500 residents live in Guinope. To be conservative, if we assume that 50% are farmers, this implies a total area of 1925 hectares under soil conservation practices in 2001. This estimate gives a project cost per hectare of US$208—low compared to other projects in the area.

The CIAT database of soil and water conservation projects in Central America (Dvorak 1996) contains two projects in Honduras during the same period that give cost and impact data. One project promoted the same technologies as ACORDE-WN in three departments (Copan, Lempira, and Ocotepeque) between 1980-88. They spent US$20 million, and obtained 3118 hectares planted to soil conservation practices, which implies a cost per hectare of US$6414 (Kaimowitz, cited in Dvorak 1996). Another project worked with soil conservation and forestry technologies in the municipality of Omoa, department of Cortes, between 1976-82. It spent US$700,000 and obtained 361 hectares with soil conservation and 467 hectares with plantation forests. Assuming that funds were divided between the two activities on the same ratio, this implies a cost per hectare of US$845 at the end of the project. However, a follow up visit to Omoa in 1990 showed that 40% of the works had been abandoned, which would raise the cost to over US$2000 per hectare. In both of these projects, subsidies and incentives such as credit, subsidized input, and payment for labor were used.

Summary and Conclusions

There is no doubt that the ACORDE-WN project had an impressive level of impact on poor farmers in Guinope. Levels of adoption of soil conservation practices were high during the project, and continued use and innovation can still be observed today, 20 years after the project began. The project success appears to be due to the participatory methods used to attract farmer attention, demonstrate benefits of the technology, build human capital to experiment and innovate, and strengthen capacity to share information. Little diffusion was observed beyond the project communities, which suggests that scaling up cannot be left solely to spontaneous diffusion.

Impacts were high among poor farmers, who were the primary participants. Much less impact was observed among women, few of whom participated in the agricultural or soil conservation activities. The project did offer other activities for women, but they were clearly secondary and the results were not as impressive. The reason for women's low participation in the soil conservation activities is that women did not participate in agriculture in Guinope.

The principle lessons with regard to women's participation are that in this case, women's low involvement in agriculture means that their lack of involvement in the project probably did not have a negative impact on the effectiveness of the project's agricultural and NRM activities. Having a direct impact on women will require working in different areas, and investigating their particular wants. Participatory research and technology development will be necessary because existing knowledge and technologies appear to be insufficient. The project's experience with women shows that, unless the technologies being promoted are relevant and beneficial, their adoption will not be sustainable.

Men and women felt that their communities had improved over the past 15 years both economically and in terms of overall quality of life. Many credit agriculture and projects such as ACORDE-WN for contributing to the gains. Women were more likely to credit agriculture specifically and men were more likely to mention how projects increased capacity and changed work practices and habits. This is consistent with women being more indirect beneficiaries of the projects.

In terms of capacity building, the project is linked to increased levels of experimentation, innovation, and information sharing among farmers. A few farmers actually became promoters and extension workers as a result of the training they received in ACORDE-WN, and went on to earn salaries from development projects in Honduras and abroad.

The communities in which the project worked have higher levels of human and social capital than their neighbors. Both men and women in all communities feel that community level activities have increased, and they generally credit projects that encourage people to work together. However, working together does not necessarily lead to higher levels of community solidarity. There are important differences both within and among communities in terms of how people perceive solidarity to have changed over the past 15 years. The data suggest that solidarity is not necessarily related to either prevalence of community activities or economic development. Those who felt that solidarity increased often cited outside projects as having contributed, which demonstrates that projects can have impact here. However, these empirical findings suggest that having impact on something as complex as community solidarity, especially on target stakeholder groups, will require careful attention to stakeholder differentiation.

The experience in Guinope has been widely documented and has had a significant impact on NGOs and on international R&D organizations, particularly in the areas of participatory methods. The impact on Honduran institutions appears to be more limited. Several attempts have been made to incorporate lessons and practices from the ACORDE WN project into government research and extension activities, however none has been fully implemented.

Finally, the commitment that the project made to the communities in which they worked implied higher costs than conventional extension programs incur in which a single agent is responsible for a larger territory. In terms of cost effectiveness, however, this project was more successful because unlike most projects promoting soil and water conservation practices, it achieved high adoption rates. Based on limited data available from other projects promoting the same technologies in Honduras, ACORDE-WN had a much lower cost per hectare under conservation practices than the others had. A reason for the cost effectiveness of the project is that local village extension workers are much less expensive than professional outsiders. Also, their own highly productive fields are the best source of credibility for convincing others.

CHAPTER 5:

THE IMPACTS AND COSTS OF USER PARTICIPATION IN NRM RESEARCH: A COMPARATIVE ANALYSIS OF THREE CASES

Nancy Johnson, Nina Lilja, and Jacqueline Ashby

In this section, all empirical impacts observed in the three case studies are discussed separately, by stage of research process (see table II-34 for summary).

Types of Participation in the Three Cases

Among the three cases, a variety of both participatory and non-participatory approaches were used (Table II-1). Consultative and collaborative participation were predominant, and there were no cases of collegial participation. All projects used participatory methods in the testing stage. Only CIP used participatory approaches at every stage of the research process; and only CIP used multiple types of participatory research at the same stage of the research process. Whatever their dissemination approach, all projects experienced spontaneous dissemination (farmer experimentation at the dissemination stage); however, this is not participatory in the sense that it does not involve organized communication with formal researchers.

Given the types of participation in the cases, the main hypotheses that we can test relate to consultative participation versus conventional research methods at the design and testing stages, and collaborative participation at the dissemination stage. The remainder of this paper is organized around the three stages of the research process-design, testing and diffusion.. For each stage, relevant hypotheses for all four impacts are assessed. A summary of the comparative analysis is presented in table II-34. The concluding section assesses the usefulness of the typology of participation and the conceptual framework developed for this analysis.

User Participation in Project Design

The CIP project was the only one that involved user participation in project design where key problems and potential solutions are identified. In both ICRISAT and ACORDE-WN, project staff made these decisions, drawing on past experiences and in consultation with other R&D professionals.

Technology Impacts

The hypothesis regarding participation at the design stage is not type-specific, which means that impact would be expected to increase as participation of farmers increased. It was hypothesized that participation at the design stage would lead to an increase in the proportion of the targeted beneficiary group that could potentially be reached by the project because the priority topic chosen for research would be more relevant to the needs and priorities of targeted farmers (H1). The findings in these case studies support this hypothesis with regard to impacts on the size of the potential beneficiary group.

In the case of CIP, user input in the design stage led to significant changes in the focus and activities of the project, most importantly the shift from IPM to ICM. Analysis of both production data and opinions of FFS and non-FFS participants show that ICM aspects of the work were indeed most relevant to farmers, and contributed to the benefits that farmers obtained.

Where farmers did not participate at the design stage, topics initially selected for research were less relevant to users' immediate needs. In the ICRISAT case, evidence supports the researchers' conclusion that soil fertility was the problem; however, the technologies chosen for testing (the legume intercrops and rotations) were found not consistent with users' preferences and constraints. Researchers selected the technologies based on their agronomic performance, although they knew that they had not been accepted in the past. Lack of adoption was in part the motivation for seeking farmer input via the MB trial methodology. Useful information for research was obtained as a result of the project; however, adoption remains low.

The WN project was similar to the ICRISAT case in that it worked with existing technologies whose adoption had been low. However, in ACORDE-WN's case, the project's flexible implementation and intensive focus on farmer capacity building and adaptation overcame some initial inconsistencies between user needs and project technologies. The conclusion from these three studies is that if adoption is the goal in the short run, then involving users in the early stages can help identify technologies that are relevant and appropriate. If users are not involved at the beginning, it may mean that farmers either spend more time later in adapting technologies or they simply do not adopt them.

Impacts with regard to women are mixed; however, there is no support for the assumption that not including gender explicitly hindered a project's ability to achieve its stated NRM objective. Diagnostic gender analysis was carried out in the CIP case, and it was found that women generally played a small and secondary role in sweet potato production. Therefore they were not targeted in subsequent project activities. Some women did ultimately participate in the SP ICM FFS as implemented by the NIPMP, and the results of the impact assessment do not show gender differences in the economic benefits of participation.

The ICRISAT case did not conduct gender diagnostic analysis; however, it was assumed that cultural aspects of agriculture (e.g., men's vs. women's crops) would make this project relevant to women. Women played a part in the project activities, and appeared to have benefited economically to the same extent that men did.

In the WN case, no formal diagnostic gender analysis was done. However, again project staff knew that women were not involved in agricultural production and therefore did not include them in NRM project activities. In this case, we did not find examples of women benefiting directly from the technologies or practices promoted by ACORDE-WN. Including women in the design stage of the NRM component of this project would likely have resulted in a very different project, perhaps not focusing on soil conservation or even crop agriculture. Not including women does not appear to have diminished the impacts with regard to the project-stated soil conservation objectives.

Although these studies support the hypothesis that farmer participation at the design stage increases the size of the potential beneficiary group, no support was found for the implicit assumption that the magnitude of benefits increases as participation moves from functional to empowering. The CIP did a consultative assessment of constraints and opportunities in sweet potato production. They also did data collection and interpretation, and pilot field schools to test the methodology for sweet potato collaboratively. Given the iterative nature of the project, the usefulness of consultative work done just at the beginning is difficult to compare with the ongoing collaborative activities. However, clearly some of the lessons from participation, such as the importance of non-pest issues or the opportunity for improving efficiency of nutrient management, emerged in both consultative and collaborative analysis. In fact, the consultative analysis may even have identified more constraints. Farmer-researchers were initially reluctant to believe some of the researchers' conclusions from needs' assessment, such as the importance of economic analysis or the possibility that current nitrogen fertilizer use was excessive. Over time, and as a result of experimentation activities, they were convinced. Collaborative participation was important in refining the issues and in developing and testing technologies, but regarding their contribution to identifying problems and priorities, collaborative participation at the design stage did not appear to be better than consultative, and may even have been less effective.

Human and Social Capital Impacts

It was assumed that human and social capital impacts would only occur with empowering participation, which we define here as collaborative or collegial. Using collaborative participation at the design stage was expected to improve participants' 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. Here we can assess whether these impacts occurred in the collaborative aspects of the CIP case. Because no women participated in the collaborative research activities, gender-differentiation of benefits cannot be assessed. We can look at whether any impacts were observed among the participants in the consultative aspects, and test the assumption that no impacts occur with functional participation.

Because the principal participants in the CIP collaborative activities at the design stage—the farmer-researchers—were also the participants in collaborative activities at subsequent stages, separating the two effects is difficult. A way of doing so is to look at progress over time. Project staff observed that farmer-researchers were initially hesitant to advance opinions, and that the content of their input was often simplistic. As their experience with experimentation and sharing information grew, they became much more confident and more capable of managing complex concepts, activities, and interactions. This suggests that their involvement in design-stage activities alone was not sufficient to increase their capacity. However, combining design and testing stages led to significant impacts. This finding does not support the hypothesis that collaborative participation at the design stage has human and social capital benefits.

Regarding impact on the participants in the consultative activities, the individuals who participated in these activities were not an explicit focus of the data collection. Some were involved because they later participated in the FFS, but as a group the farmers who collected field data or who answered questions in the consultative needs' assessments exercises were not systematically evaluated. We can state that in all our interactions with farmers, the farmer-researchers were significantly different from others in terms of their ability to express themselves, to answer and ask questions, and to explain complex issues. They were also more likely to experiment, and to be sought out by others for advice. Further, the village leaders and other key informants specifically mentioned changes in the human capacity of farmer-researchers, but said nothing about these impacts with regard to other farmers. These observations are consistent with the assumption that there are no human and social capital impacts with functional participation at the design stage.

Feedback to Formal Research Impacts

Similar to the human and social capital benefits among participants, we would also expect to find benefits to the knowledge and capacity of researchers as a result of their interactions with farmers. With consultative participation, researchers would be expected to learn about farmers' existing problems and their priorities for solutions. In collaborative participation, researchers and farmers interact so that although researchers still ultimately learn about farmers' priorities and constraints, these may have evolved as a result of the interactions with researchers. Further, in collaborative participation, researchers incorporate farmers' perspectives in their work because authority for identifying final priorities, problems, and solutions is shared. Impact can be observed among researchers at the project, program, or institutional levels.

The results from the CIP case support the general hypothesis that user participation increases researchers' knowledge of user priorities and constraints. The project contributed to changes in CIP research priority decisions regarding sweet potato weevil in Asia, the importance of scab, and the the need to screen germplasm for important commercial characteristics like starch content. The ICM concept is also widely used within the center.

Support for the hypothesis that the nature of feedback impacts differs by type of participation is less strong. As reported earlier, the initial information generated from consultative and collaborative participation at the design stage was very similar. As mentioned above, researchers drew some conclusions from their consultative work that did not emerge initially in the collaborative work. Over time, as the collaborative interaction between researchers and farmers continued, new priority topics and problems emerged, partly as a result of new knowledge and perspectives gained through interaction, confirming that collaboration can influence farmers' priorities and criteria.

Cost of Research Impacts

It was hypothesized that costs increase as participation moves from conventional to consultative or collaborative participation, although they may be reduced later. Participation is also hypothesized to increase farmers' costs. In general the results of these three cases support these hypotheses; however, the magnitudes of the differences may not be as large as is often assumed. For example, ICRISAT invested in participatory activities with researchers from different institutions to identify problems and select technologies. It may have been possible to include farmers with little additional cost, and their input could have resulted in changes in technologies and/or implementation strategies. In the CIP case, the financial costs of the consultative and collaborative work were not so different. The consultative was shorter in duration with more high-cost researcher time. There is no evidence that conducting diagnostic gender analysis increased costs. CIP's collaborative design-stage work lasted longer—2 to 3 years, but this also included many of the testing stage activities—and involved more farmer and field assistant time. The CIP case suggests that even at the collaborative stage some research costs, such as managing data collection, can be passed on to farmers, which raises their costs, but lowers total project costs even when farmers are compensated. This impact was previously hypothesized to occur only in collegial participation.

User Participation at the Testing Stage

At the testing stage, where solutions are tested and evaluated and recommendations made, all three projects used some form of user participation. The ICRISAT project used consultative, and the CIP and ACORDE-WN projects used collaborative.

Technology Impacts

The size of the potential pool of potential adopters is determined at the design stage through the selection of the problem to be addressed and the type of solutions to be considered. At the testing stage, user involvement is hypothesized to contribute to increased adoption by helping ensure that the technology or technologies ultimately selected for dissemination are appropriate for the largest number of people either in general or in specific beneficiary groups. The cases provide some support for this hypothesis.

The ICRISAT case, where participation was consultative, provides on suggestive, preliminary evidence about possible future impacts. Where farmers carried out trials according to researcher-designed protocols, farmers' perceptions and rankings of the technologies differed from those of researchers. This information could be useful for future technology development or for designing dissemination strategies. Because women participated in the trials, preferences could be disaggregated by gender. Some differences were found, but were not statistically significant. Because testing was consultative, we cannot know whether farmers had any ideas about how the technologies might be adapted to make them more appropriate for their purposes, nor whether gender differences would have mattered here.

Where testing-stage participation was collaborative, farmer input led to changes in the technologies themselves, which were linked to higher levels of adoption. Farmer-researchers in the CIP project made a significant contribution to testing, evaluation, and adaptation. They selected which technologies to test, designed and implemented trials, and evaluated results. In many cases, such as fertilizer use, they may have obtained the same results and interpreted them in the same way as researchers would have done. In others, such as cultural practices or the testing of the FFS methodology, they provided insights that researchers would not have had.

In the case of the ACORDE-WN project, the technologies selected by the project were presented to farmers as a basis on which to begin a self-sustaining process of innovation. High levels of adoption and especially adaptation, both during and after the project, support the hypothesis that farmer involvement in testing and modification is key to achieving high levels of adoption with NRM technologies such as soil conservation practices.

Human and Social Capital Impacts

Since human and social capital impacts were assumed to occur only with empowering participation the relevant hypothesis to test related to the collaborative participation used in the CIP and ACORDE-WN cases. The hypothesis was that farmers/communities would 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 recommendations with other stakeholders who may have different opinions (H6). The null hypothesis of no impact would be expected for the ICRISAT project. The experience of the three cases is consistent with the hypothesis.

In the cases of CIP and ACORDE-WN, where farmers and researchers carried out experiments collaboratively over a period of several years, human capital benefits to the farmers were significant. As mentioned above, they increased their knowledge and understanding of agroecology and of experiment methods. In the case of the CIP farmer-researchers and the ACORDE-WN farmer-leaders, they also increased their self-confidence and ability to interact with outsiders such as researchers and extension agents. The farmer-researchers and farmer-leaders continue to experiment, and to be sources of information in their communities. No such impacts were found among participants in the ICRISAT case, whose interaction with researchers was significantly less intense. The baby-trial farmers enjoyed participation and benefited directly from the opportunity to work with the field assistant and ask him questions. However, we found no evidence of substantive changes in their understanding of soil fertility management issues or experiment methods. It is important to note that these results reflect the impacts of the MB trail method as observed in Chisepo. ICRISAT's subsequent impact assessment work found that when implemented in a more collaborative manner, the MB method did generate human and social capital impacts.

Although human capital benefits were visible and significant, social capital benefits were less so. In the CIP case, many benefits were widely socialized in the sense that the farmer-researchers shared what they learned with their neighbors. However, this seemed to be due more to already existing habits of and networks for information sharing rather than to new patterns of behavior stimulated by the project. In the ICRISAT case, information sharing increased in the context of the project because participants were specifically instructed to share what they were doing with neighbors—something they were not always doing spontaneously. We found little evidence that this would continue after the project ends. No other group activities were formed in connection with the project activities. In both cases, the lack of externalities or other aspects of the resources and technologies that might require collective action surely contributed to the lack of social capital impacts.

The ACORDE-WN project had impact on social capital variables such as information sharing and community activities. The technologies promoted in this project were also essentially at plot level and therefore did not require collective action for effective implementation. However, the project devoted a lot of time to building individual and group capacity in addition to promoting soil conservation technologies. Despite these efforts, in terms of overall community solidarity, evidence on impacts was mixed, reflecting that these types of impacts are complex and difficult to assess, and that stakeholder differentiation is highly important.

Feedback to Formal Research Impacts

Consultative participation at the testing stage is expected to increase researcher knowledge about farmers' criteria for evaluating technologies. With collaborative participation, the potential benefits go beyond researchers learning about farmers' criteria to include the establishment of new shared criteria and the incorporation of the criteria into their research activities.

Researchers and extension agents in all cases benefited from their interactions with farmers. In the ICRISAT project, researchers not only learned of new criteria—such as the ability of technologies to suppress weed growth—but also learned that farmers give less value to other criteria, such as yield potential, than researchers do. Some evidence showed that women and men may have different criteria, and further project work will focus exclusively on women. Researchers from other institutions have adopted the particular participatory methodology used, the MB trial method, for getting basic farmer input from many farmers.

The CIP approach was much smaller scale, working more intensively with fewer farmers. As mentioned in the previous sections, farmers learned a lot from researchers and were clearly influenced by researcher knowledge and methods. The benefits to researchers from the testing stage activities of this project were not so much related to specific criteria or aspects of technologies, but rather to more conceptual issues concerning the different purposes for which experiments are conducted. Within the project, there were experiments carried out by farmer-researchers to assess new technologies, and experiments with the FFS for learning and demonstration purposes. The project had not initially recognized these as different, with different implications for how they should be presented to participants, what skills were needed from both participants and researchers for implementation, and how the results should be interpreted. The project is influencing CIP's research program at a broader level. An NGO involved in the project has also made radical program changes and now incorporates elements of research in all its activities. Impact on the NARS involved was limited.

In the ACORDE-WN project, intensive interactions occurred between farmers and extension agents concerning how to test, evaluate, and adapt technologies. Because this was an extension-oriented project and the purpose of experimentation was to facilitate adaptation and adoption, systematic data on the experiments and their results were not recorded, analyzed, or published. This limited the extent to which others learned from specific technical findings of the trials. However, a great deal of research and extension attention has been attracted to the methodological aspects of the project, especially at international R&D organizations, mainly because of its high adoption rates. In what attention there has been to farmer adaptation, such as in the case of live barriers, the purpose has been to call attention to the participatory methodology, not the adaptations themselves.

Costs of Research Impacts

It is hypothesized that moving from conventional to consultative or collaborative forms of participation increases research costs, at least in the short term. Long-run cost effectiveness should, however, increase. Farmers' costs also increase unless the project works only with the subset of farmers who already engage in experimentation.

In the case of the ICRISAT MB trials, the main costs associated with supporting the baby trials were enumerator salaries, training for project staff in participatory methods, and research time learning and conducting analysis of the type of data generated by the trial method. In the latter two categories, these are one-time costs associated with the PR methods being new in the Center. Future PR projects using the same staff will not have to bear these costs to the same extent. Therefore, the main recurring cost is enumerator time.

How this cost compared to non-participatory projects depends on the nature of those trials. In some cases, on-station trials or carefully managed trials where field assistants regularly visit test plots could be more costly than MB trials (especially on a per trial basis). On the other hand, less intensive methods, such as one we were told of where researchers sent trial kits by bus to extension agents to plant, monitor, and send back results, would clearly be less costly to the research program. Controlling for quality, the actual implementation costs of the MB trials likely were not significantly higher than a non-participatory method.

Farmers were not compensated except for the seed they received from the trial; yet many farmers, both male and female, wanted to be involved initially and stayed involved in subsequent years. This suggests that the trials were not a financial burden for the participants, although some of this may be because the field assistant helped with much of the work. The field assistant said it was easier to work with women because they were more likely to follow the protocol.

In the CIP case, the regular and intensive interaction among researchers and farmer-researchers via workshops added to costs. However, the costs of the actual testing done by the farmer-researchers were not especially high. The farmers were compensated for their time, but they were paid relatively little compared to a researcher or a research assistant. In the early years of the project, farmers were less skilled, but as their experience and capacity grew—largely because of the intensive interaction with researchers—the quality of their experiments improved. As was the case with ICRISAT, use of PR methods is costly at first because new skills must be learned. Once these skills are in place, then the costs decline and quality improves.

The ACORDE-WN project dedicated many more human resources to the communities where they worked, but worked with farmer-extension workers rather than researchers or professional extension agents. This probably lowered costs and increased impact. However, comparing this project methodology to conventional research trials is difficult because trial data were not kept or analyzed.

User Participation at the Diffusion Stage

The CIP and ACORDE-WN projects used collaborative participation in the diffusion stage, which involves identifying target beneficiaries and designing an extension strategy and/or methodology involving complementary inputs. The ICRISAT project did not have an explicit design component for participatory dissemination. What has been done to date, including production of an extension brochure, is conventional.

Technology Impacts

It was hypothesized that by incorporating users in the design of the dissemination activities, adoption would increase by making sure that those for whom the problem and technology were relevant and appropriate had adequate information, skills, and other inputs necessary to adopt. The experiences of the CIP and ACORDE-WN projects support this hypothesis. In the CIP case, for example, the flexibility of the FFS methodology and the focus on experimentation and skill building made it possible for NGOs to implement it for crops other than sweet potato. In the ACORDE-WN project, the willingness of staff to adjust both technologies and project activities to suit farmer preferences increased farmer interest and participation.

In both the CIP and the ACORDE-WN cases, the key complementary inputs were knowledge and skills. Evidence from the study of spontaneous diffusion in the ICRISAT case suggests that seed availability may be a constraint there. However, little attention was given in that project to farmer knowledge and capacity for adaptation.

None of the projects designed gender-differentiated strategies for diffusion of their NRM technologies. Evidence from studies of spontaneous diffusion in the ICRISAT and CIP cases suggest that women and men receive and diffuse information through different sources. This suggests that if a main part of a project's diffusion strategy is by farmer-to-farmer dissemination, attention to gender may be important in achieving impact.

Human and Social Capital Impacts

Incorporating users into the design of diffusion strategy is expected to increase their understanding of what is involved in mass diffusion of technologies, including the complexity of decision making and the importance of complementary inputs. ***The results of the cases with regard to this impact are mixed.*** In the case of WN, the farmers who were selected to work as promoters and later extension workers learned a great deal about the diffusion of technologies, with many going on to work as extension agents, consultants, and even founders of agricultural service centers. In the CIP case, an attempt to train farmer-researchers to become FFS trainers was not successful. The farmers felt uncomfortable with the process, and much preferred their roles as researchers and resource people. The reason for the different outcomes may be that the CIP farmer-researchers were selected for one purpose (research) and then trained for another (training/facilitation). In the ACORDE-WN case, the farmers were part of a lengthy selection process that included both experimentation and extension activities.

Feedback to Formal Research Impacts

The hypothesis for feedback to research from collaborative participation was that researchers learn about farmer-to-farmer diffusion practices and about what kinds of information and skills both farmers and extension workers need to support spontaneous diffusion (H17**).** Both the CIP and ACORDE-WN case experiences support this hypothesis, with each project making changed to its proposed dissemination strategy based on farmer input.

The impacts regarding the knowledge and skills needed for successful systematic dissemination were much stronger than the ones relating to farmer-to-farmer dissemination. This is especially evident in the ACORDE-WN case, where diffusion beyond the project communities has been limited even 15 years after the project ended. As mentioned earlier, the main "complementary input" needed is information and skills, which it may not be possible to leave to "market forces" in the same way as inputs such as credit or seed production.

Cost of Research Impacts

Costs were hypothesized to increase as participation increased, and this was the case in the projects at least in the short run. However, cost effectiveness appears to have increased because of participation. In the CIP case, running trial FFSs to get farmer feedback and train farmer-researchers was costly, but farmer input led the project to abandon plans to develop its own implementation capacity and work through others, thus reducing project costs and likely enhancing cost effectiveness. It also contributed to the important lesson about farmer-researchers' unsuitability for training/facilitation.

In the ACORDE-WN case, training farmer-extension agents incurred some costs, although much of the early learning was done as part of regular project activities. These farmer-extension agents came to replace outside project staff, which reduced costs and enhanced impacts. Comparisons of cost effectiveness figures show that the project was much more cost effective than other projects promoting similar technologies. In both cases, it must be pointed out that the farmers involved in the design of diffusion strategies had also been involved in other earlier testing stage activities of the projects. This experience clearly increased their effectiveness to contribute in the diffusion stage activities.

Table II-34. Summary of the main impacts of user participation by stage and type

Stage	**Main impacts**[a]			
	Technology and its adoption	**Human and social capital**	**Feedback to research**	**Costs of research**
Design	Highly important if goal was adoption and/or if subsequent farmer adaptation was unlikely.	Low, even in empowering participation.	Important impacts within and beyond the projects. Limited impact on NARS.	Cost increase compared to conventional, but empowering was not more costly than functional.
	Empowering participation not necessarily better than conventional. Lack of gender analysis was not a problem for achieving project initial NRM goals, but none of the projects specifically targeted women as beneficiaries of NRM work.		Empowering participation not necessarily better than conventional.	Diagnostic gender analysis did not increase costs of consultative participation.

Continued.

Table II-34. Summary of the main impacts of participation by stage and type (preliminary results).

Stage	Main impacts[a]			
	Technology and its adoption	**Human and social capital**	**Feedback to research**	**Costs of research**
Testing	Important observed or potential impacts in all cases.	Very high human capital impacts in collaborative, low impact in consultative.	Impacts observed within and beyond the projects.	Recurring costs of participatory trials not significantly different from conventional on-farm trials. Costs increased with collaborative aspects such as workshops, rather than with actual trial costs.
	Collaborative is better than consultative in terms of achieving impact.	Lower impact of testing activities on social capital, although may be due to nature of resource or technology.	Significant impacts observed.	Additional costs regarding training and data analysis. However, these are one-time costs that occurred because PR methods are new.
	No strong support for importance of gender differentiation.	Not including women as participants in collaborative testing deprived them of human capital benefits.	Collaborative not necessarily better than consultative	Including women in consultative testing did not increase costs.
Diffusion	Impacts observed from farmer input to the methodology.	High impacts observed on a subset of non-representative participants.	High impact regarding recognition of importance of skills and knowledge as key complementary inputs issues, less on farmer-to-farmer dissemination.	Short-run costs increased slightly, but overall cost effectiveness also increased.
	Gender differentiation may be important.			

a. NARS = National Agricultural Research Systems; NRM = natural resource management, and PR = participatory research.

CHAPTER 6:

THE IMPACTS AND COSTS OF USER PARTICIPATION IN NRM RESEARCH: SUMMARY AND CONCLUSIONS

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In 1996, the PRGA Program developed a proposal assessing the impact of user participation in natural resource management research. In that proposal, six main questions about impact of user participation were posed. This section attempts to answer these main questions using the information from the three cases studies presented here in the preceding chapters.

Question 1. Did Participation and Gender Differentiation Change Project Objectives or Priorities with Respect to Technology Development and Transfer for NRM?

In all three projects, user participation changed project objectives and priorities. Regarding changes in technology development, the CIP project changed its focus from IPM to ICM as a result of user input gained from individual and group interviews and detailed production data. The change involved broadening the scope of the field school curriculum from pest management alone to include varietal selection, seed and plant health, nutrient management, and economics and marketing.

In the ICRISAT case, the project objective and activities were already well defined by the time the baby trials were implemented so the scope for farmer influence here was limited. Nonetheless, farmers' assessment and ranking of the four legume-based soil fertility technologies tested in the MB trials were different from those of researchers. Farmers also contributed to the development of new technologies for testing (e.g., combining small quantities of organic and inorganic fertilizers) and identified potentially important aspects of technologies (e.g., weed suppression) that researchers subsequently included in the trial protocol. No dissemination has been done so far. However, the information provided by farmers should be useful in selecting technologies for future testing and would be expected to affect the technologies ultimately recommended for widespread dissemination.

Both the CIP and WN cases dealt with technology transfer. In the CIP project, farmers helped design the FFS curriculum. Farmer input came in the form of participation in, and evaluation of, pilot field schools by participants. The main contributions from farmers were: (1) focus on plant and soil health, (2) focus on experimenting skills, (3) more emphasis on interpersonal dynamics within the field school, and (4) the recommendation that field schools be implemented by the existing FFS agency rather than by the project itself in order to enhance their creditability and appeal to farmers.

The WN case was essentially a dissemination project that used farmer experimentation as a mechanism for diffusion and adaptation of existing technologies. The basic technologies and project philosophy did not change over the course of the project, but adaptations were made to the technologies themselves and to the way that they were promoted. Adaptations to the technologies included changing the recommended slope of some contour ditches and the composition of plants in the contour barriers. Changes in the way technologies were disseminated included moving from group to individual experiment plots and, in some cases, establishing researcher-managed demonstration plots first so that farmers could see the technologies before becoming involved in trials of their own.

All projects assessed the importance of gender in their activities. World Neighbors determined that women did not play a major role in agriculture and soil conservation activities. As a result, they implemented a separate program of activities focused on nutrition and agroenterprise. The addition of the women's activities represents a shift in project activities. However, the main soil conservation activities were unchanged by the results of gender analysis.

In the CIP case, when needs' assessment data were disaggregated by sex, women were found to be not active in sweet potato production. Therefore, they were not specifically targeted in the project's research activities. As a result of the analysis, no special efforts were made to include women in subsequent work.

In the ICRISAT case, it was assumed that women would be important stakeholders in legume-based soil fertility technologies because of their important role in agriculture and the fact that legumes are considered women's crops. Even so, few women were baby-trial farmers in the first year, mainly because the village head selected participants. In the second year, special effort was made to include women. Although the trial objectives, design, and protocol did not change as a result of women's participation, men and women did differ in terms of their evaluation of individual technologies.

Question 2. What Difference Did Participation Make to the Cost or Impact of the Research?

Within the projects, the changes in scope, objectives, and activities were associated with increased relevancy and appropriateness of technology. Impacts on costs were mixed.

The CIP's shift from IPM to ICM resulted in the development of a broad set of crop management technologies. The technologies were disseminated via FFSs in six communities during 1997-98, and impact assessment was conducted in 1998-99. The ICM attendance had significant positive impacts on farmer knowledge and on income from sweet potato production (van de Fliert et al 2001). Increases in net income are due to a combination of improved technologies and management practices developed during the project and disseminated via the FFS. Although many of these practices are difficult to measure, we have data on fertilizer use. The ICM farmers used more KCl and TSP than did non-ICM farmers. These nutrient management practices are consistent with recommendations that emerged from the participatory diagnosis and testing process.

To better understand what farmers found useful to themselves and others, farmers who attended the ICM FFS were asked about what information from the field school they had shared with other farmers. Their responses indicate that the ICM rather than IPM components were the most important. Seed health was the most common topic mentioned (about 26%), followed by nutrient management (23%). Pest- and disease-related topics were mentioned by almost 15% of ICM attendees. Only about 6% of attendees (and no women) reported mentioning pest- and disease-related aspects as most important. This suggests that had the project focused only on pest and disease issues, it would have been less relevant to farmers' needs.

In the needs' assessment phase of CIP's project, activities most closely associated with the participatory approach were 7 months of researcher time in project design, methodology development, data collection, and analysis. Farmers and field staff collected three seasons of production data at a cost of US$15,000. A workshop was also held with project staff and the eight farmers who would take part in the testing, at a cost of about US$700. Between 1995 and 1997, farmer-researchers carried out a series of trials costing about US$1250 per year. Farmers usually address two to three topics per season. The research-led trial on which farmers implemented cost US$500, but the manufacturer donated some of the inputs. In addition, six workshops were held to present and evaluate results and plan future trials. Each workshop cost about US$800. Finally, a short workshop costing about US$80 was held at which the project staff and farmer-researchers formulated the outline for the curriculum of the FFS. Of these costs, the only ones that would not have been incurred in a non-participatory project are the workshops. Researcher time, data collection, and costs for on-farm trials would represent a cost to any project. Because farmers, rather than project staff, did much of the fieldwork, the costs were reduced even with compensation. The project was completed on time, which means that the participation did not cause it to go on longer than planned.

In the ICRISAT case, it is too early to say how farmers' input will ultimately affect the selection of technologies for dissemination. However, the agronomic and preference data have been analyzed, and the results are being used in the design of subsequent stages of the project. Researchers initially ranked groundnut-pigeon pea and maize-*Tephrosia* intercrops as the best for farmers because of their high grain yields. Baby-trial farmers, however, ranked maize-pigeon pea intercrop as the best because of the grain-legume mix and the lower labor requirements. Economic analysis of baby trial data (Rusike 2001) later confirmed farmers' preferences. According to the baby-trial farmers, the pigeon pea-groundnut rotation was attractive, but only for commercial farmers who had enough land for rotations.

The bulk of the costs associated with the MB trial method was related to building capacity of researchers and field staff in participatory methods. The projects spent about US$6000 on training workshops. Cost increases were also associated with analyzing data collected from farmers, mainly because this required statistical techniques not traditionally used for agronomic data. Like the training costs, these are essentially start-up costs incurred because staff were not familiar with participatory methods. The only ongoing costs would be the field time of the researchers and the maintenance of the field assistant in the community. Comparing the amount of time spent on the MB trials with conventional on-farm trials in the region is difficult because there is no "typical" experience. Some researchers never visit their field sites at all, while others maintain a frequent presence there. The ICRISAT staff find that the better supported baby trials produced more reliable data than those that received fewer or less timely visits from field staff, which suggests that costs savings here may not be cost effective.

Some of the additional research costs were offset because farmers provided land and labor for the trials. On the average, they spent between 50 and 70 hours of work on the trial. However, marginal costs associated with the trial as opposed to just planting maize were only about 8 hours. This suggests that the costs to farmers were not high, and were likely compensated by the fact that they received seed and in some cases small amounts of fertilizer, and they kept the harvest.

The investment that WN made in building farmer capacity and adapting technologies to local circumstances appears to have paid off in terms of adoption. According to Sherwood and Larrea (2001), 1500 farmers adopted soil conservation practices as a result of the project, about 34% of the total number of farmers in the municipality (Hellin and Larrea 1998). Benefits are primarily realized through increased crop yields. By 1998, nearly 1000 farmers had achieved yields of over seven times their traditional levels, and nearly 1400 had at least tripled yields. Although these numbers reflect agronomic rather than economic gains, and in some cases refer only to what farmers achieved on their test plots, they nonetheless demonstrate that a significant number of farmers were working with the technologies and achieving good results. Data collected in 2001 as part of the PRGA study found that 44% of farmers had adopted conservation practices as a result of the project (Table II-27)

The ACORDE-WN project cost about US$400,000 over 8 years. World Neighbors sets its goal as US$300 per family that triples basic grain yields. In this project, the costs were about US$325. Most of the costs—75% in the last year—were for salaries. The project was clearly more costly than a typical extension project if assessed in terms of the number of communities or farmers visited. However, in terms of cost effectiveness this project was likely much higher than traditional extension because of the many adopters compared to other soil and water conservation projects. The estimated cost per hectare under conservation practices in World Neighbors was US$208. Other similar projects in the region had costs of US$6414 and US$2000 per hectare (Kaimowitz, cited in Dvorak 1996).

Question 3. Did Participation and Gender Differentiation or New Organizational Strategies Affect the Number of Beneficiaries, the Type of Beneficiaries Adopting New Technology, or the Speed at Which They Adopted?

In the three case studies, we were unable to analyze the impact of participation or gender on the speed of adoption, mainly because no appropriate counterfactual was available. However, the fact that WN achieved significant sustained adoption with a technology that had had little previous success could be interpreted as an increase in the speed of adoption. Similarly, the fact that user participation led CIP to change its dissemination strategy to one that was more likely accepted by farmers could potentially increase the rate of adoption of the sweetpotato ICM FFS technology.

Regarding the type of beneficiaries, the projects mostly targeted poor farmers, and this did not change during the projects. The farmer evaluation data from ICRISAT trials suggest that farmer participation may help target the final technologies towards the poorest by flagging technologies such as the groundnut-pigeon pea intercrop that may only be viable for larger, better off farmers.

Although we have no direct evidence on the impact of participation on number of beneficiaries, several of the cases provide examples that are consistent with such impacts. The ICRISAT case also provides some evidence on the impact of participation on the number of potential beneficiaries. Farmers, especially those who were not participants in the trials, were more likely to visit the baby trials than the mother trial (Tables II-22, II-23). This suggests that the inclusion of baby trials increased the number of farmers who were exposed to the technologies compared with a conventional on-farm trial. This impact is likely to have been particularly big for women. Women only learned of new technologies from the MB trials or through friends, while men had access to other sources of information such as the extension service. For three of the five technologies, women were significantly more likely than men to have learned about the technology from the MB trial, which suggests that the method is particularly effective at getting information to women.

In the CIP case, the expansion from IPM to ICM should increase the number of people that the technology reaches by increasing the range of problems for which the technology is relevant. Further, the fact that the ICM FFS curriculum focused on general capacity building made it adaptable for implementation with other crops besides sweet potato. Evidence shows that some of the NGOs who received training-for-trainers went on to do ICM FFS for crops as diverse as onions, chili peppers, cashews, and ginger.

Question 4. Was Local Experimentation with New Practices Strengthened?

Some evidence was found in all cases that participation strengthened local experimentation. In the WN case, farmer capacity to experiment with and adapt technologies is credited with being the key to its success. According to farmers surveyed in 2001, 45% of farmers experiment. Of these, 21% said they learned to experiment from ACORDE-WN, a large proportion when considering that the project occurred 15 years ago and many current farmers were not old enough to have participated.

In the CIP case, we found evidence of enhanced experimenting capacity among the eight farmers who worked intensively with researchers to develop and test the technologies included in the ICM FFS. Both the farmers themselves and key informants in their communities said that these men had changed as a result of their participation, and were now viewed as innovators and expert farmers. Project documents also refer to how their skills and capacity increased over the course of the project. Data from the FFSs themselves do not support the claim that attendance stimulates experimentation because there is no significant difference in incidence of experimentation between attendees and non-attendees. However, in some cases, certain FFSs in certain communities have carried on group experimentation, which suggests that other factors beyond just attendance at the FFS also affect this.

Evidence of enhanced farmer experimentation in the ICRISAT case is mixed. In Chiespo, site for this study's fieldwork, farmers who managed baby trials were able to describe the trial protocols and the data that were collected and analyzed, but few were able to articulate concepts such as controls or replications. None said they would continue doing systematic experiments after the trials were finished. An explanation is that farmers had relatively little input into the design of the trial or analysis of the results. They were not encouraged to make adaptation nor were their analytical skills strengthened by the project. Subsequent impact assessment by ICRISAT staff found that in other communities, where implementation of the Mother-Baby methodology was more flexible and where farmers received "training for transformation" parallel to the MB trial activities, impact on local experimentation appears to have been stronger (Heinrich et al 2001, Rusike et al 2001). This suggests a possible tradeoff between data for researcher needs and capacity building for baby-trial farmers.

Question 5. Did Capacity Building Improve Local Skills, Problem-Solving Ability, and Ability to Initiate and Sustain Participation without External Facilitators?

This question goes beyond the previous question's focus on experimentation to inspect broader indicators of individual and collective empowerment.

The WN case was where we found most evidence of increased individual and social capacity. As part of the project's methodology, a select group of farmers was trained to become farmer-promoters. About 50 such farmers were trained, many of whom went on to work with other agricultural and development project in Honduras and abroad. Some have returned to the region and continue to work with both local and external organizations in agricultural and NRM issues.

To examine impacts at the level of the broader community level, we used data from a 1995 assessment by EAP-Zamarono of all 27 communities in the Yeguare watershed, which includes Guinope where WN worked. Each community was ranked using 13 criteria such as accessibility, university interest in the zone, capacity of the local people, and community organizational capacity. According to the results, the eight ACORDE-WN communities in the watershed were significantly less accessible than other communities in the watershed, yet they had higher levels of both human capacity and organization/institutional capacity. In the case of human capacity, the difference is statistically significant ($P = 0.005$) (EAP 1995). During fieldwork for this study conducted in 2001, many farmers credited the ACORDE-WN project with increasing community activities and solidarity, though responses differed by gender and by community.

In the CIP case, it was clear from talking to the farmer-researchers that they, like the farmer-innovators in the WN case, had benefited significantly from their participation in the research project. They formed strong bonds with researchers and with the other farmers, and continued to maintain them after the project ended. Their roles in their communities also changed, relative to other farmers and to officials such as extension agents. The farmer-researchers are sharing the benefits of their increased knowledge and skills with the rest of the community. However, it would be incorrect to interpret this as an impact on community information sharing, Rather, it appears to be a consequence of existing modes of social interaction. In the ICRISAT and ACORDE-WN cases, for example, participating farmers did not initially share information about the trials with other farmers and had to be instructed to do so as part of the conditions of participation.

From the CIP farmer-researchers we learned of examples of how their increased knowledge and capacity had increased the ability of the community to negotiate with outsiders such as traders or the extension service.

All cases had examples of improved individual and social capital. In CIP and ICRISAT, it is too early to say whether these changes, especially to social capital, will persist and lead to significant change.

Question 6. Was There Feedback to NARS or IARC Research that Changed Their Research Priorities or Practices beyond the Scope of the Specific Project?

In all cases, user participation led to feedback that changed the priorities and practices of research institutions.

In the case of CIP, the shift from IPM to ICM that occurred within the project can also be observed in other CIP potato and sweet potato work in Asia, Latin America, and Africa. The results of the project contributed to a reduction in emphasis on sweetpotato weevil research in Asia, and was one of several influences that led sweetpotato breeders to focus on scab disease and on the importance of starch content. A CIP researcher involved in the project who had not had significant experience doing participatory research went on to lead a project on participatory research in another IARC. Another was recently named leader of a CIP newly formed working group on participatory methods. The Indonesian NGO involved in the project has adopted more participatory approaches to problem identification and now incorporates farmer experimentation in all its activities. No evidence was found of substantive changes in the NARS.

The participatory testing model developed and used in the ICRISAT case has been widely disseminated (Snapp 1999b) and adopted by researchers from other IARCs (CIMMYT 2000). In addition, a multi-institutional project involving IARCs, NGOs, and NARS to assess women's participation in soil fertility work was developed as a follow up to the initial activities (DFID project). Unfortunately, extensive turnover of staff in national institutions limited the extent to which feedback occurred there.

The success of the WN project has been widely publicized, and has had a great deal of influence in the fields of community and rural development. Most of the impact has been methodological, especially concerning participatory methods and farmer-to-farmer dissemination. Little feedback was observed on scientists involved in agronomic aspects of developing soil conservation technologies.

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LIST OF ACRONYMS AND ABBREVIATIONS USED

ACORDE	Coordinating Association of Resources for Development
ANOVA	analysis of variance
CADERH	Centro Asesoria para el Desarrollo de Recursos Humanos en Honduras
CGIAR	Consultative Group on International Agricultural Research
CIAL	Comité de Investigación Agrícola Local (*Local Agricultural Research Committee*)
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo (*International Maize and Wheat Improvement Center*), Mexico
CIP	Centro Internacional de la Papa (*International Potato Center*), Peru
COHDEFOR	Corporación Hondureña de Desarrollo Forestal (*Honduran Corporation for Forestry Development*)
DFID	Department for International Development, UK
DICTA	Dirección de Investigación de Ciencias y Tecnología Agrícola, Honduras
EAP	Escuela Agrícola Panamericana, Honduras
EPA	extension planning area
FADO	Flemish Organization for Assistance in Development
FAO	Food and Agriculture Organization of the United Nations, Italy
FFS	farmer field school
FHH	female-headed household
FO	field observations
FPR	farmer participatory research
IARC	International Agricultural Research Center
ICM	integrated crop management
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, India
IDEAA	Development and Equity in African Agriculture
IIED	International Institute for Environment and Development, UK
IIRR	International Institute for Rural Reconstruction, Ecuador
IPM	Integrated Pest Management, Andean regional subproject
IPM	integrated pest management
ISNAR	International Service for National Agricultural Research, Neths
LUPE	Land Use and Productivity Enhancement project, Honduras
MAI	Ministry of Agriculture and Irrigation, Malawi
MARIF	Malang Research Institute for Food Crops, now RILET, Indonesia
MB	mother-baby trial of ICRISAT
MHH	male-headed household
NARS	National Agricultural Research System
NEPED	Nagaland Environmental Protection and Economic Development project
NGO	nongovernmental organization
NIPMP	National IPM Program
NRM	natural resource management
OFCOR	On-Farm (Client-Oriented) Research
PCAC	Programa Campesino a Campesino
PM&E	participatory monitoring and evaluation

PR	participatory research
PRA	participatory rural appraisal
PRGA	Systemwide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation of the CGIAR
PRONADERS	Programa Nacional de Desarrollo Sostenible, Honduras
PROSCARP	Promotion of Soil Conservation and Rural Production project of Natural Resources Institute in Malawi
R&D	research and development
RILET	Research Institute for Legumes and Tuber Crops, East Java, Indonesia
RK	season-long record keeping
SP	sweet potato
ToT	training-of-trainers
UPWARD	Users' Perspectives with Agricultural Research and Development, Manila, Philippines
WN	World Neighbors

FUTURE HARVEST

Future Harvest is a non-profit organization that builds awareness and support for food and environmental research for a world with less poverty, a healthier human family, well-nourished children, and a better environment. Future Harvest supports research, promotes partnerships, and sponsors projects that bring the results of research to rural communities, farmers, and families in Africa, Latin America, and Asia. It is an initiative of the 16 food and environmental research centers that are primarily funded through the Consultative Group on International Agricultural Research.

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CGIAR

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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In recent years the CGIAR has embarked on a series of Systemwide Programs, each of which channels the energies of international centers and national agencies (including research institutes, non-government organizations, universities, and the private sector) into a global research endeavor on a particular theme that is central to sustainable agriculture, fisheries, and forestry.

PRGA

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).

PRGA Program activities are funded by Canada's International Development Research Centre (IDRC), the Ford Foundation, the Rockefeller Foundation, and the governments of Germany, Italy, the Netherlands, New Zealand, Norway, and Switzerland.

CIAT

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® INTERNATIONAL MAIZE AND WHEAT IMPROVEMENT CENTER

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

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

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 Baños, The Philippines.

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