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Conceptualizing Integrative, Farmer Participatory Research for Sustainable Agriculture: From Opportunities to Impact

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Conceptualizing Integrative, Farmer Participatory Research for Sustainable Agriculture: From Opportunities to Impact[1]

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Summary

This paper offers a conceptual model for integrative, participatory research projects that aim to improve the sustainability of agriculture and natural resource management. The purpose of the model is to provide a systematic framework for farmer participatory research that can guide the design of projects, their analysis and the documentation of results. In the model, explicit boundaries are drawn between research and development, development and extension and between extension and implementation. The objectives, activities and actors associated with each of these realms are described; and the role and principles of monitoring and evaluation are clarified. Examples are provided from three case studies of participatory projects with a retrospective analysis and critique based upon the framework.

Introduction

Farmer participatory research has received increased attention and recognition since the "Farmer First" (Chambers *et al*., 1989) and Participatory Technology Development (Jiggins and De Zeeuw, 1992) concepts were first introduced in the late 1980s. Acceptance of the important role that farmers can play, if given a chance, in agricultural research, development and extension has grown considerably. More and more mainstream institutions have realized that new technology alone is not enough to achieve impact in farmers' fields, particularly those in resource-poor and risk-prone areas. This change in perception is widespread and is being internalized by the centers of the Consultative Group on International Agricultural Research (CGIAR) through a Systemwide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation (PRGA, 1997). The CGIAR has altered its mission, from a primary focus on productivity, to include concerns about the environment and poverty, reflecting a growing understanding that securing food, eradicating poverty and protecting natural resources are inseparable goals (PRGA, 2000). Many other organizations are also developing ways to involve farmers in processes for generating economically and environmentally sound technologies, and managing natural resources more sustainably, and more equitably. Awareness of farmers' critical roles as resource managers is increasing. At the same time recognition is mounting that ecologically sound agriculture and natural resource management means going beyond consulting with farmers, to sharing decision making and responsibility for the outcomes resulting from management choices and decisions.

Determining who should participate in sustainability initiatives is seen as an increasingly important concern, and greater sensitivity to stakeholder issues has led to important insights. For example, it is now more widely recognized that rural women are a growing proportion of the very poor, a trend that has been called the "feminization of poverty" (Kaaria and Ashby, 2000). Women are especially vulnerable to the downward spiral of poverty because of their often limited access to natural resources and other assets, and because of the degraded condition of these resources.

Given this evolving understanding of sustainability challenges, research for sustainable development must focus on preserving or increasing the capacity of the systems being managed to produce desired benefits in the future. Actor-oriented, integrative and participatory approaches (Cramb, 2000) are increasingly seen as a way to address the multiple and often conflicting social, environmental and economic sustainability goals of different interest groups.

In older agricultural research and development approaches, such as on-farm and farming systems research, farmers were often considered as research subjects or passive components of the system under investigation. In contrast, farmers' involvement as decision makers at all appropriate stages of the process is central to farmer participatory research. Particular emphasis is placed on their participation in the early stages of needs and opportunity assessment, setting of research and development objectives, and establishment of indicators. Benefits of such an approach include early definition of the criteria that farmers use to assess

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technology (PRGA, 1997), and the development of adaptable technological options that meet user needs and preferences, rather than standard technologies or packages. Hence, the likelihood of location-specific adaptation and implementation of these options becomes much greater, as has been shown in many studies (e.g., Haverkort, *et al.*, 1991; Bentley, 1994; Sperling *et al.*, 1993, Ashby *et al.*, 2000, Ceccarelli *et al.*, 2000).

The early involvement of farmers in the research and development (R&D) process usually leads to the formulation of a systems diagram often framed as tree of problems and opportunities, with many ramifications, rather than a single clear-cut issue. This difference in perception between farmer-users and scientists stems from farmers' more integrated, holistic view of farm and resource management as opposed to that of the discipline-oriented scientists, who are taught to break problems up into manageable parts. The participatory approach often leads to the need to address complex interrelated issues that require attention to numerous related elements. Consequently, this requires an integrative, pandisciplinary[1] and cross-sectorial perspective from teams, which may include discipline-oriented specialists. Stakeholder (e.g. farmer) involvement in the R&D phases will also contribute to the identification of appropriate extension mechanisms and methods to share innovative approaches with larger numbers of farmers. The contemporary focus on sustainable agriculture and natural resource management does not imply large-scale transfer of finished technologies, as has been the mode for a long time. Rather, it involves location-specific, informed practice, consensual decision making, and adaptive management. This requires collective farmer learning about technological and other innovations, and flexible options that can be adapted; enhancement of capacities for opportunity identification, problem solving, and decision making; platform building for resource use negotiation; and collective decision-making at the larger ecosystem level (Röling and Jiggins, 1998, Braun *et al.*, 2000).

Despite the growing recognition of the potential of integrative, farmer participatory research, many institutions and individual researchers still choose to apply approaches dominated by narrow technical and economic perspectives, neglecting complementary social and more macro perspectives (Röling, 1997). This may be for the valid reason that basic disciplinary research is needed, as well, or for the less valid reason that researchers have not been trained to deal with, or do not feel comfortable with, holistic and social dimensions. Despite positive prognoses about the future of participatory research given, for instance, by a number of scientists in the CGIAR system (e.g., Ashby *et al*., 1995), such work is threatened in many CGIAR centers given the current funding and policy climate (Fujisaka, 1994; Thiele *et al.*, in press). Additionally, the scientific value of participatory research is often questioned, especially from the standpoint of precision, research detachment, control, and replicability[2]. A further quality concern is to what degree participatory research generates theories that have predictive capacity.

These criticisms seem to miss the point, and it appears more appropriate to ask what kinds of approaches are required in order to tackle the challenges[3] at hand. Cooperrider and Srivastva (1987) suggest that action research approaches [such as farmer participatory research] should be judged on their capacity for generating fresh alternatives for social action, rather than solely on the predictive capacity of their theories. They appeal for a redefinition of the scientific aims of action research that will dynamically reunite theory and practice. In their view, the aim of research is not the detached discovery and verification of laws, allowing for prediction and control, but rather its capacity to challenge guiding assumptions and to raise fundamental questions regarding contemporary social life.

Carvalho and White (1997) examined the issue of scientific value, and the unification of theory and practice in the context of approaches for poverty alleviation. They concluded that the measurement of poverty could be addressed more effectively through integration of participatory and conventional approaches. They suggested that integration adds value by improving our understanding of what poverty is, and by offering opportunities for confirming refuting and enriching operational definitions or theories of poverty. In this view, the quality of understanding of what poverty is directly affects capacity to promulgate poverty alleviation policy.

Judging the effectiveness of any particular research approach depends on comparing the objectives and expected impact with actual outcomes. In participatory research, this process is particularly challenging because it can be difficult to define objectives and expected impact with sufficient precision, and it may be difficult to isolate the causal pathways involved in a particular outcome (Cramb, 2000). Many participatory research activities are of a pilot nature, and impact is often insufficiently documented beyond the pilot area. The literature abounds with inconsistent, confusing jargon, which may be related to the lack of methodological training for practitioners. The boundaries between research and development, development and extension, and extension and implementation are often vague or absent. Identification of research and development phases and the definition of objectives for each of them are often neglected. Greater consensus on the purpose and principles of farmer participatory research approaches, and a better understanding of methods and the characteristics of each of the process phases can help make participatory research more relevant and efficient, and can contribute to redefining the criteria for judging its scientific merit.

This paper provides a conceptual framework for integrative, farmer participatory research and development in the context of sustainable agriculture and natural resource management. It addresses the consistent use of participatory approaches in a full cycle from planning to action and change, necessary to achieve qualitative and quantitative impacts. The cycle begins with a portrayal of how the stakeholders understand the system – showing linkages, and pointing to problems, needs, opportunities and finally to priorities. Based on this it moves on to the search for solutions, which may involve the development of technical options, organizational innovations, and dissemination strategies. The learning process that unfolds leads to enhanced capacities, changed behavior, and ultimately to different kinds of impact (technical, economic, human resource capacity, social, environmental). These processes are iterative and require solid monitoring and evaluation mechanisms at all stages.

This paper is complemented by insights from three case studies, which were analyzed using the model as a framework[4]. The cases, presented in boxes, assess how successfully each project discerned the different phases in the research and development process, and analyze how confusion about the phases may affect project evolution and outcomes. Finally, the paper gives suggestions on how the model can be applied in the design or analysis of projects.

Cycling from priority-setting to impact

The model for integrative, farmer participatory research for sustainable agriculture aiming at impact described here, was developed as a framework for project design and evaluation in the context of the CIP[5]- and UPWARD[6]-supported "Sweetpotato integrated crop management (ICM) and ICM field school development" project in Indonesia[7]. Given that the project was designed according to the model, and that the model was adapted as the project advanced, a high degree of congruence between model and project can be expected. Two other UPWARD projects, i.e. a bacterial wilt project in Nepal and a potato IPM project in the Philippines, provided material for the other two case studies presented in this paper. The design of the Nepal and Philippines projects was not based upon the model, and the corresponding case studies therefore represent a retrospective application of the model to these experiences.

It is emphasized here that the model is not intended to be prescriptive, nor should it be considered something fixed and final. The diversity of approaches that have emerged in farmer participatory research is one of its strengths. Through the model we aim to demystify some concepts and terminology often used erroneously or inconsistently, and to provide a systematic map to aid the navigation of integrative, farmer participatory research.

The framework

Farmer participatory research projects aim at achieving tangible impact by encouraging farmer involvement at all appropriate stages. It is not always clear what is meant by impact; therefore the concept should be clearly defined from the start. This paper defines impact as *achievements directly related to overall goals*; e.g. the improvement of sustainable livelihoods of rural families in a certain region. Achievement of impact is a very ambitious goal requiring both qualitative change (e.g., farmer capacities, practices, collective action, support systems) and quantitative change (e.g., a considerable number of people reached and income generated). Careful planning at each project stage to achieve (1) appropriate problem and opportunity definition and setting of priorities, (2) successful generation of applicable information or innovations, and (3) appropriate development and use of dissemination mechanisms and their effective implementation, can contribute to the achievement of this kind of impact. Such research and development activities demand a team of collaborators including farmers, technical and social scientists, extensionists and development workers, and other relevant stakeholders. The farmers provide the holistic perspective, share what works and what needs to be improved in the current system, set the evaluation criteria for innovations in accordance with their objectives, and test possible innovations. Typically, the technical scientists share new information that may provide options for improvement, and methodologies for testing the technical options. The social scientists help to identify the constraints and opportunities in the support system, seek ways to reduce the constraints and enhance the opportunities, and translate innovations into farmer learning objectives. The extensionists and development workers can fulfill a role to facilitate communication with rural communities and scale up pilot activities. Certain researchers, however, may have the capacity to handle technical as well as social and/or communication aspects in a project.

Figure 1 presents a possible route from needs and opportunity assessment to impact in the context of sustainable agricultural development. The framework emphasizes iterative phasing or cycling of activities and a division of major responsibilities among different actors in the process, by distinguishing three main activity realms, i.e.:

- Research and development
- Extension and implementation
- Monitoring and evaluation

These are strongly interconnected and activities in the individual realms will partly overlap in time and space. Additionally, the process is not limited to a linear set of sequential activities, but allows back and forth movement between the realms. A predisposition of this model is that joint learning opportunities involving all the actors are needed to achieve the objectives of enhanced capacity in systems analysis, decision-making capacity, and platform building[8]. These objectives have to be considered and anticipated during all phases of the process.

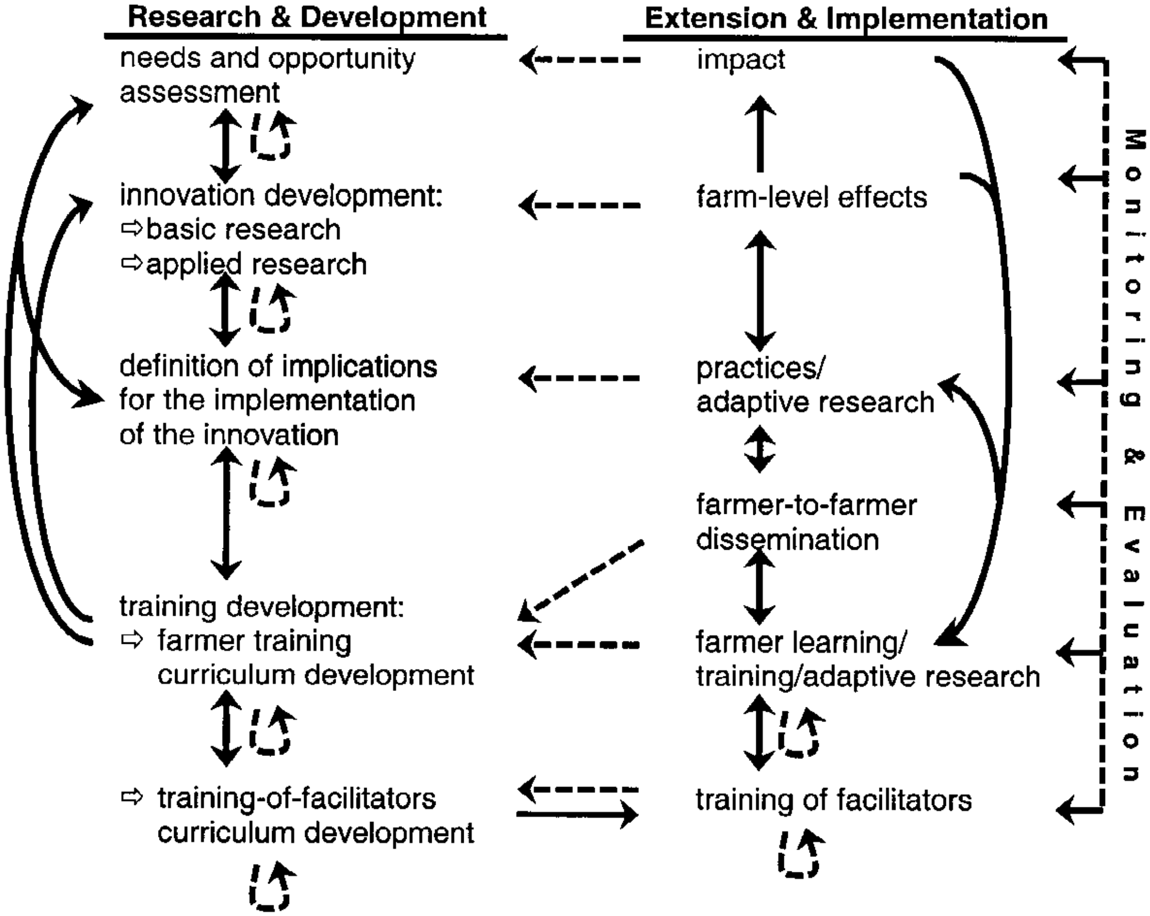

Figure 1: Framework for integrative, farmer participatory research aimed at impact

In conventional research and transfer of technology systems, research is seen as the exclusive domain of scientists, extension as the delivery of messages by the staff of a formal extension service, and implementation as the straightforward adoption of the recommended technologies by the farmers. In farmer participatory approaches, however, the research and development realm (the left leg in the figure) consists of co-creative processes to identify needs and opportunities, generate new information and innovations, consolidate them with existing farming practice, and then translate them into learning objectives and activities for enhanced farmer performance. These processes are likely to be highly iterative and synergistic. The right leg of the framework (extension and implementation) contains the phases during which efforts are made—either in a formal or a non-formal setting—to share innovations with larger groups of farmers, who then test, evaluate and internalize (or reject) them in their farming practices, finally leading to impact. The monitoring and evaluation realm, in addition to providing a reflective mechanism for each stage of the cycle, overlaps and links the components of the other two realms by observing and measuring what happens during learning and implementation, and relating and/or feeding back this information to the research and development realm for further adjustment or impact assessment. A summary of objectives, activities and actors for each realm is presented in the sections below.

The research and development realm

The major mission of agricultural research institutes has traditionally been to increase food production and to minimize the effects of production-reducing factors. The scientists' task therefore focused on the development of new technologies and troubleshooting problems that arose in the systems developed. Research was often divided into basic and applied modes. These are complementary, both being indispensable in the process of conventional and participatory development of innovations. In participatory research, the topic under investigation is not determined solely by researchers (Biggs, 1989; Pretty, 1994; Mikkelsen, 1995; Ashby, 1996; Probst, 2000; Lilja and Ashby, 1999), as is often the case in conventional research. Whether the development initiative derives from the farming community or from outsiders (researchers, development workers), scientists together with the community should clearly identify problems, needs and opportunities to set the agenda for further activities. Ongoing identification of changing needs and emerging opportunities is required throughout the process to adjust the activities accordingly.

Participatory research and development efforts involving researchers and representatives from other stakeholder groups usually begin with detailed problem analysis, which may be complimented by the identification of opportunities. The objective is to gain a broad understanding of the agroecological and socio-economic context. Many methodologies have been developed over the past decades to assist researchers and farmers in participatory problem identification, of which Participatory Rural Appraisal (PRA) has become the best known and most widely applied (Chambers, 1994)[9]. Problem and opportunity identification can be conceptualized as a form of systems analysis and should lead to the (participatory) formulation of overall project goals and specific research and development objectives. When users are actively involved in systems analysis and setting of objectives, it is likely that identified needs refer to a variety of issues to be addressed, crossing multiple scientific disciplines (Box 1). When research capacities are limited with regard to either funding or expertise, priorities should be carefully set with the participation of all stakeholders, taking into account the interrelatedness of the various problems. The output of the systems analysis phase is a prioritized research and development agenda. The identification and evaluation of already existing, potential solutions to be tested and consolidated with innovations, is an important component of this phase.

The sweetpotato ICM development project in Indonesia was a collaborative effort among sweetpotato farmers from East and Central Java, a local NGO (Mitra Tani), an international agricultural research center (CIP-ESEAP Region), the Research Institute for Legumes and Tuber Crops, and Duta Wacana Christian University. Although initially designed as an integrated pest management (IPM) project, results of the needs identification study re-oriented the project towards ICM at an early stage in order to address farmers' major concerns. The project assessed a range of aspects including:

- The impact of cultivation practices, pests and diseases on production
- Farmer knowledge of crop health, pests and natural enemies
- Current crop and pest management practices
- The marketing system
- Farmer decision-making capability with respect to crop and pest management and marketing

In a mid-elevation area (1200-1500 m) of the southern Philippines, vegetable and potato cultivation generates the highest net income per ha, about 8-10 times that of maize. Potato cultivation threatens sustainable use of natural resources because of erosion from up-down ploughing, downstream water pollution from pesticides, and deforestation by farmers seeking bacterial wilt free areas. During village-level workshops, researchers, extension workers, farmers and local leaders discussed possible solutions. A potato IPM project was designed to address these issues. As an attractive alternative to potato cultivation, the project offered the farmers seeds of high-value vegetables.

Box 1. Participatory formulation of project goals

Once the research agenda is agreed, innovation development follows. This phase is likely to include both a basic and an applied research component. Farmers' involvement in innovation development is particularly desirable at the level of applied research (Box 2). Their role may vary from "analysts and evaluators" (Fano *et al.*, 1996, Snapp, 1999) who validate technologies developed, to "researchers" who determine and test treatments in their own fields (Ashby *et al*., 1995; Van de Fliert and Braun, 1997; Gündel, 1998). Whereas basic research is primarily considered the domain of technical scientists, technical and social scientists and farmers are all expected to play a role as actors in the applied research phase. The degree of involvement of each will depend on the nature of the problem and of the possible solutions to the problem. Continuous feedback among the actors doing basic and applied research, as well as reflection on the findings of the problem identification phase, is desirable to ensure the consistency of components developed.

"Development", in the Research and Development context, is defined here as the translation and validation of innovation development outputs in relation to the agroecological, socio-economic and cultural conditions in the target areas. Development should not stop after technical research, which is often considered the final step at the boundary of research mandates. Innovation development should be followed up by deliberate attention to the task of training development. Experience has shown that the linear, top-down linkages between research and extension, as practiced in conventional transfer of technology extension models, often failed because of inappropriate technology and/or inadequate "packaging" of the extension messages (Röling, 1988; Hagmann and Chuma, 1998).

Within the framework for integrative, farmer participatory research, the first phase of the potato bacterial wilt project in Nepal fell mainly in the R&D realms. Problem identification was based on a rapid rural appraisal conducted by a multi-disciplinary team including a plant pathologist, entomologist, agronomist, extension worker and socio-economist. Farmers functioned as interviewees and informants. Once priorities became clear, possible control methods were investigated by team members doing MSc research. After the IDM methodology had been designed, implementation was discussed with farmers, resulting in a project plan and formation of a Cropping Systems Improvement Committee. The R&D process was iterative within the development, extension and implementation realms, feeding back to the researchers so they could adapt their methodology before attempting it in other villages.

In the Philippines, the "Community-Based Pest Management for Sustainable Vegetable Production" project involved the Northern Mindanao Agricultural Integrated Research Center, the Municipal Agricultural Office and UPWARD as part of the Sustainable Agriculture and Natural Resources Management Program (SANREM), funded by USAID. Sixty-three farmers (six groups and four individuals) experimented with alternative seed sources (true potato seed and quality seed tubers); and four groups in different villages participated in establishing IPM pilot sites as a basis for developing a sound technology and training curriculum.

Box 2. Pilot experimentation sites involving farmer groups

Moreover, consistency is needed between the nature of the innovation and that of the extension approach and methods applied to convey the innovation to farmers (Röling and Van de Fliert, 1998). Therefore, to ensure consistency, we should look not only at the innovations *per se*, but also define the capacities that practitioners need to implement them, as well as the requirements for the support system (input supply, markets, etc.). This leads to an analysis and definitions of what a change in agricultural practice by the developed innovations implies for the farmers. What knowledge, attitudes and skills will they need? This is central to the development phase and needs attention before efforts are focused on the development of a training curriculum or other protocols for farmer learning. The importance of this phase is clear in the contrast between "simple" technological innovations (e.g., the introduction of an improved variety) and complex, sustainable agricultural approaches such as integrated pest, nutrient, crop or natural resources management. Adoption of a new variety can be evaluated by quantifying the area planted to it. In contrast, for integrated pest management (IPM) and other complex practices, the overall expected output of "improved problem solving, opportunity identification, decision making capacity and platform building" has to be translated into an extended set of clearly defined operational indicators in order to design appropriate training activities enhancing such knowledge, skills and organization. Traditional linear, content-oriented approaches—often pre-packaged in the form of diffusion materials—have not proven effective for the more complex processes inherent to the development of a sustainable agricultural system (Matteson *et al.*, 1994). The characteristics of such an approach are knowledge intensive with both a macro and micro perspective, tend to be location specific, and require analytic problem-solving and decision-making skills in order to be sustainable. Consequently, there is a need to explore the concomitant communication methods required for a successful outcome. Additionally, the process of defining the implications for implementation of the innovations may provide new insights for problem identification and/or raise issues that need to be fed back to the phases of adaptive or basic research.

The framework in Figure 1 shows *training development* as the next component of the R&D leg; hence still the responsibility of scientists. Preferably, this responsibility is shared by technical and social or extension scientists, and of course farmers and extension and development workers, where appropriate. Training development implies the design of activities, modules and media for farmer learning, based on the definition of the implications for the implementation of the innovations. Field-testing of these activities is part of the development process (Box 3). Once the curriculum for farmer training is designed, we begin thinking of a curriculum for training of facilitators, preferably applying the same methods as those to be used in farmer training. Training activity development requires skills different from training activity facilitation, however somewhere in the process skilled facilitators can fulfill and important role to pretest activities and provide feedback for improvement.

In Indonesia, Sweetpotato ICM technology was developed through:

- Analysis of farmers' practices as documented during needs identification
- Experiments conducted by farmer researchers
- Experiments at the CIP field station
- Literature review

The technology was revised after testing in a pilot ICM farmer field school (FFS). The ICM FFS curriculum was based on pilot FFS activities:

- Testing the rice IPM FFS model (Van de Fliert, 1993) as a basis for sweetpotato ICM FFS
- Designing a tentative sweetpotato ICM FFS curriculum and a training-of-facilitators curriculum based on FFS evaluation
- Conducting, evaluating and revising the FFS and training-of-facilitator curricula, documented in a manual for FFS facilitators

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Box 3. Curriculum development for sweetpotato ICM

The extension and implementation realm

Extension—understood here as a function of disseminating an innovation to a wider audience—is not normally considered part of the mandate of research institutions (Fano *et al.*, 1996); therefore suitable mechanisms and partners have to be found to facilitate dissemination (Box 4). To ensure that these partners can do their job well, scientists can play an important role as they have both technical and methodological skills. Extension workers of GOs or NGOs, on the other hand, have a comparative advantage as communicators at the village level. They must, however, have obtained appropriate training themselves in a training-of-facilitators program before they can be expected to run a training curriculum (Box 5). The involvement of accomplished trainers is critical to the success in the field (Van de Fliert *et al.*, 1995).

In many developing countries, extension services lack the human resource capacity—in terms of both quantity and quality of staff—to reach a critical mass of their target audience effectively (e.g., Röling, 1988). Much of the information reaching farmers is disseminated by other farmers, either directly by conveying experiences or indirectly by showing them an example of practices implemented in the field and the resulting effects. Recent experiences with IPM training in several Asian countries have shown the positive impact of involving farmers as trainers, and of enhancing farmer networks in order to support farmer-to-farmer dissemination deliberately (Eveleens *et al.*, 1996; Braun, 1997). Farmer facilitators must be selected with care and given additional training on facilitation methods. At the same time, a training program needs to address farmer interaction/network requirements at the planning stage (Box 6).

Transitions from the R&D to the extension phase are not usually smooth given the traditionally weak linkages between these realms. In the case of a community approach to potato bacterial wilt management in Nepal, a multi-disciplinary team from the Lumle Agricultural Research Center (LARC) promoted a multi-pronged Integrated Disease Management (IDM) approach that included:

- Widespread awareness of the seriousness of bacterial wilt
- Elimination of infected planting material
- A three-year ban on growing potatoes
- Crop rotation with non-host crops
- Disease-free seed
- Roguing of self-sown potatoes
- Farmer education on IDM

Pilot-scale activities were initiated in two villages. After three years, the project was extended to two more villages. Positive results in two villages showed that the community approach was effective for managing bacterial wilt. Failure in the other two villages was due to unwillingness of some farmers to respect the ban.

Analysis based on the integrative, participatory research framework suggests that the first phase reflected an iterative R&D process within the development, extension and implementation realms, feeding back to the researchers to adapt their methodology before transferring it to other villages. The second phase should have been conceptualized as a scaling-up activity within the extension and implementation realms. Expansion was strongly hampered by the continued involvement of the researchers, who failed to transfer responsibility to existing extension mechanisms. The project had not anticipated impact on a larger scale at the work-plan preparation stage, where researchers would gradually hand over tasks to the extension system and the farmers.

Box 4. Transition from R&D to extension in the potato IDM project in Nepal

In the second phase of the Philippines potato IPM project, the national IPM program "Kasalikasan" joined the project, offering a nine-day training-of-trainers event, followed by an FFS (twenty weekly sessions) for farmer groups. Facilitators felt insecure because the training of trainers had been too brief to adapt the technology and curriculum to local conditions and different crop requirements, i.e. from cabbage to potato, since potato crop management technologies for mid-elevation areas were not available. Additionally, considering the actual problems farmers were facing with regard to the overall production and marketing system, the technology and training curriculum should have taken the entire cropping and post-harvest cycle into account. Given their limited experience with the IPM FFS, the trainers fell back into an instructive rather than a facilitative teaching mode.

The trainees had difficulties in internalizing not only the major FFS concepts but also those related to potato IPM. Experiments conducted in the FFS testing multiple treatments made it difficult to reach clear conclusions or to enhance farmers’ experimentation skills. Given logistic constraints, the trainers were unable to provide full-scale technical and methodological backstopping. Their support was limited to technical presentations during the FFS sessions.

Box 5. Training-of-trainers in the Philippines potato IPM project

Trainees from six major sweetpotato-growing districts in four provinces of Indonesia made work plans for ICM FFS implementation with funds from the National IPM Program and the local government. It was originally intended to scale up from a small core group of farmer master trainers (most had been farmer researchers in an earlier stage of the project). This proved untenable, their potential as field school facilitators having been overestimated. Although they felt confident as researchers, they felt much less so as trainers for lack of experience with the FFS training approach. A new plan for scaling up involved the national IPM program (farmer) trainers.

One possible mechanism in this process was under-utilized, i.e., farmer-to-farmer dissemination. This option could have been anticipated by (a) clearly defining the expected output relating to awareness raising on sweetpotato ICM within the farming communities where sweetpotato ICM field schools are conducted, and (b) more specifically developing activities in the field school model addressing farmer-to-farmer dissemination.

Box 6. Farmers as trainers

In projects requiring considerable problem-solving, decision-making and platform-building capacity (e.g. IPM, ICM, NRM), farmers need more process-oriented learning opportunities and support. A literature review of self-reliant and self-managed projects (Brekelbaum, 1990; 1994) identified various essential skills for farmers, including:

- Critical thinking
- Diagnosing and solving problems
- Formulating and prioritizing objectives
- Developing and implementing action plans
- Communicating effectively
- Systematizing information and analyzing results critically
- Identifying indicators for quantitative and qualitative monitoring and evaluation
- Developing external linkages, both horizontal and vertical
- Showing solidarity

In the case of IPM and ICM, farmers need to understand the complex interactions between host plant/pest, plant health/tolerance, population dynamics, soil health and other ecological principles. In addition, training events should provide opportunities to farmers to do adaptive research to test and refine technology guidelines under prevailing conditions, and simultaneously to develop experimental skills in order to continue adaptive research in their own fields. This type of knowledge and skills development not only requires interaction over a period of time, but also facilitators who are themselves capable of handling these processes. The training of facilitators would therefore need to contain the same processes as the learning activities for farmers, to ensure that the facilitators have experienced the process of enhancing their knowledge and skills.

The major actors in the implementation realm are, of course, the farmers who decide to implement, adapt or reject an innovation. Enhanced knowledge and skills—obtained in training events, through contact with fellow farmers or any other form of learning—are expected to lead to a change in farmers' management practices. At this stage, scientists have no direct role in farmers' implementation, continued learning and adaptive research processes, and have to rely on feedback through monitoring and evaluation efforts as to how farmers respond to the innovation. At most, in pilot sites, scientists can work together with farmers to adjust guidelines according to specific conditions. Many theories have been developed to explain the process of adoption of innovations (Rogers, 1995); but in sustainable agriculture, *adaptation* to farm-specific conditions is considered a more valuable output than the straightforward adoption of a new technology or methodology. The ability to adapt guidelines is evidence of farmers' enhanced capacity to experiment, analyze, evaluate and, finally, solve many of their own problems without having to depend upon external advice.

Feedback mechanisms, however, are critical in this realm because farmers often receive contradictory messages from other sources (e.g., promotional campaigns by commercial companies that sell inputs) that could lead to confusion. Questions arising during implementation need to be addressed by trainers whose role is also to support the adjustment process and help bridge communications between farmers and researchers.
When changes occur in farmers' capacities and practices, effects at the farm level can be expected, for instance, yield increase, reduction of expenditures, and more ecologically balanced pest and natural enemy population ratios in the field. Such changes occurring on a larger scale are expected to result in a broader impact, such as improvement of rural people's livelihoods and a healthier environment. Effects and impact achieved, when beneficial to farm families, are expected to trigger further dissemination and learning within the farming community.

The monitoring and evaluation realm

Systematic monitoring and evaluation of projects assures the capacity to make adjustments before it is too late, learn from experiences and justify the research investment. Monitoring refers to a systematic and continuous assessment of progress and changes caused by the implementation of an activity (Guijt, 1998). Monitoring (represented by the dotted U-turn arrows in Figure 1) of research activities provides feedback on whether the research process is on track and needs adjustment, whereas monitoring of extension activities provides additional information on the appropriateness of the research outcomes and to explain the results of impact evaluation studies. Guijt (1998) distinguishes evaluation (the dotted straight arrow in Figure 1) as the identification of the broader positive and negative outcomes of an activity or process to reach a conclusion about its overall value and achievement of objectives. In many research institutions, process monitoring is limited to the compilation of annual progress reports, and project evaluation is the responsibility of economists. As a result, evaluations often focus on cost-benefit analyses of novel technologies. For integrative, participatory research projects dealing with sustainable agriculture, internal monitoring at all steps is vital to maintain consistency of activities within the interdisciplinary context, while for evaluation economic analysis alone is insufficient because it will not reflect project objectives that are human resource oriented. In participatory projects, monitoring and evaluation should be planned and implemented in conjunction with all partners, particularly the farmers, to encourage further internal learning and assess project progress and output based on indicators defined collectively. Participatory monitoring and evaluation begins when project objectives and activities are defined by developing assessment indicators and methods for keeping track of progress and measuring success or failure. Such a monitoring and evaluation process can strongly enhance the effectiveness of an R&D project through appropriate targeting.

In order to be able to justify the R&D investment, the monitoring and evaluation system should be designed to consider the individual outputs in relation to the objectives set for each R&D phase. The expected outputs of the activities and elements in the extension and implementation realm should relate directly to the objectives of the activities in the R&D realm at the same horizontal level (see horizontal links in Figure 1). Is the impact of the activities consistent with the overall goal? Are the farm-level effects in accordance with the nature of the innovation (for instance, reduction of pesticide load on the farm ecosystem as a result of IPM practices)? Have farmers' capacities and practices after training reached the levels required for implementation of the innovation? Do dissemination mechanisms result in effective farmer-to-farmer communication? Are the processes of farmer education and training-of-trainers compatible with the curriculum design? The indicators for monitoring and evaluation should also derive from these outputs. This implies that to obtain impact, scientists should seek mechanisms for incorporating extension and implementation requirements when setting objectives for R&D. Monitoring and evaluation of clearly defined indicators should generate valuable feedback to the scientists for further R&D, if needed. This information can then be used effectively to adjust the R&D activities further, if needed, or serve as an example to other projects.

This is a huge task; and when budgets are restrictive, evaluation efforts tend to be limited to the elements that donors require; i.e., mostly the data traditionally collected by economists, such as yield and economic returns. In the case of sustainable agriculture, however, evaluation indicators should relate consistently to the project objectives, which, if defined well, will focus on people and their environment as much as, or even more than, on technologies and economics (Van de Fliert, 1998) (Box 7).

The Indonesia sweetpotato ICM project deliberately phased over the technology (ICM) and training (FFS) models developed to the existing extension mechanisms—i.e., through training-of-trainers and backstopping of farmer training—in an attempt to anticipate larger scale impact.

Indicators of the integrative nature of the project:

- Change of project scope from IPM to ICM
- Multidisciplinary collaborators including eight farmers
- Specialized input for specific research activities for which no expertise existed on project team

Indicators of the participatory nature of the project:

- Farmer researchers' intensive participation at all stages except proposal writing
- Level of community involvement (farmers, traders, consumers) at problem identification stage and pretesting of models

Consequently, research addressed farmers' needs and contributed highly to validation of guidelines and methods developed. ICM guidelines were therefore readily accepted by farmers attending FFS, as well as by the government institutions in charge of root crops. Nevertheless, the farmer researchers raised the issue of how their research activities would directly benefit their fellow farmers, which had not apparently been the case. The discussion showed clearly that perceptions about "impact" differed. Impact, as defined in the model, cannot be expected only from participatory technology development activities and should therefore be avoided as research still carries risk. On the other hand, benefits of research should—to the extent possible—be tangible to motivate farmer interest in participating. At the same time, monitoring and evaluation activities should identify factors leading not only to success but also to failure, including indicators dealing with the human factors.

Box 7. The impact of farmer participation in all project stages

Application of the model

The diversity of ecological zones and farming systems requires a flexible approach to research and development. Additionally, the complexity and interrelatedness of cultivation problems in small farm systems, within the context of existing support systems that may or may not function properly, is poorly served by strictly disciplinary research approaches. An example is the increasing occurrence of aphids and other insects on rustic crops like sweetpotato in Indonesia. Injudicious insecticide use triggering resurgence has partly contributed to this situation, but the main cause is higher-than-necessary levels of nitrogen fertilizer applied by the farmers every season. Over-fertilization leads to faster population growth of aphids. Although storage root yield may be reduced as a consequence of excessive nitrogen application, some farmers believe they can get a higher price if the crop looks green and lush when a trader comes to the field to negotiate purchase of the standing crop (Van de Fliert, 1996). Pest, fertilization and marketing issues are interwoven so it would be of no use to develop and disseminate aphid control strategies without touching upon the other issues and making sure that farmers understand their interrelatedness.

Another example of the need for a change of course in R&D is the evolution that IPM underwent during the past decade, particularly in rice-based cropping systems in Asia. IPM's first principle of "grow a healthy crop" implies attention to a wide array of cultivation practices contributing to the prevention of pest attack in an ecologically sustainable way (Van de Fliert, 1998). In IPM development for sweetpotato in Indonesia, where pest pressure is only low to moderate in most seasons, farmers demanded greater emphasis on cultivation practices other than pest control strategies, and on marketing strategies, resulting in a change in project focus to ICM. This also occurred in sweetpotato IPM programs in Vietnam and Uganda (Braun and Van de Fliert, 1997). ICM in Indonesia goes as far as developing training activities to enhance the marketing skills of farmers who perceive this to be their major problem. The relationship between cultivation problems and market diversification becomes clear here: better crop management contributes to more efficient production, enhancing the prospects for using the crop as a raw material where farmers can get added value through processing and thereby improve their livelihood (Braun *et al.*, 1995).

When facing situations as complex as this, scientists with narrow disciplinary training may choose to combine forces with colleagues from other disciplines and with farmers having the necessary holistic perspectives. Integrative and participatory, co-creative approaches to R&D recognize the human factor as the core element to attain synergistic outputs and impact. The importance of determining and then reconciling the different perspectives of each of the stakeholder groups cannot be overly stressed. When the different realms and disciplines are brought together, communication often breaks down. Although it takes time and energy to achieve this, it is critical to project success (Box 8).

The model presented here is offered as a tool to facilitate the simultaneous phasing of such R&D activities. The nature and severity of the issue will determine the depth of integration and participation needed to reach the desired impact effectively and efficiently. This can be decided only on a case-by-case basis, by factoring in possible solutions, information needs, lessons from previous experiences, and the level of expertise and funds available. When certain steps cannot be taken due to limited resources (e.g. funds, mandates, connections, adequately trained people), alternatives should be sought to guarantee the desired impact, or objectives should be adjusted in line with a more realistic expected impact.

In the potato IPM FFS project in the Philippines, the training-of-trainers FFS was intended as an arena to develop appropriate technology guidelines and concomitant extension exercises. Both trainers and trainees interpreted the project more as an effort to promote potato-vegetable cultivation without taking into account technological limitations. Farmers were active in the FFS experiments, but given the complex nature of the high-value vegetable-potato production system, their participation was difficult at several stages, especially those of planning and problem identification. The structure did not permit sufficient farmer participation in either technology or training development. Moreover, project actors had different perceptions of the realm they were working in, resulting in confusion among research, development and extension objectives.

This divergence of perceptions was further aggravated by non-participatory nature of the problem identification process. For lack of carefully defined and prioritized problems, FFS trainers recurred to materials from the cabbage IPM FFS approach. They were less open to developing new extension methods and viewed technology dissemination as more important than technology development. Consequently, the project suffered for lack of clear consensus as to the objectives and systematic planning and implementation of activities in anticipation of farm-level effects and impact. As a result of the problems encountered during the training-of-trainers-FFS cycle, there was inadequate adjustment to local conditions.

Box 8. The importance of a shared perspective in complex multi-disciplinary projects

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Notes

[1] A pandisciplinary perspective implies a union or fusion of knowledge. An alternative term introduced by Wilson (1998) is consilience.
[2] Given these criticisms, many participatory research practitioners are concerned with science quality issues, and are actively engaged in inventorying and assessing methodologies (Johnson et al., 2001; PRGA, 2000), and searching for ways to increase rigor and reliability (Loader and Amartya, 1999; Defoer *et al*., 1998; Carvalho and White, 1997; Ceccarelli *et al*., 2000). At the same time, others researchers have focused more on epistemological concerns as they have abandoned mechanistic research designs intended to establish universal causal linkages between variables. Prominent social scientists such as Cooperrider and Srivastva (1987) have shifted away from the logical positivist framework to what has been termed the “sociorationalist” philosophy of science. Similar changes are occurring in the natural sciences as the paradigm shift from the Cartesian to an ecological worldview gains ground (Capra, 1997). In both cases, theory and practice are increasingly seen as part of synthetic whole. Likewise, the process of knowing (research) is understood to be inseparable from the phenomena under study, an idea that is totally at odds with the Cartesian concept of scientific objectivity and impartiality. Sociorationalist philosophy views science as one means of helping humanity create itself, recognizing that scientific theories have the capacity to affect and be affected by cultural practices.
[3]The challenges are well summarized by Capra (1997): as a result of human activities the earth’s forests are receding, while its deserts are expanding. Topsoil is diminishing and the ozone layer is being depleted. Concentrations of heat-trapping gases in the atmosphere are rising while the numbers of plant and animal species are shrinking. Human conflict is increasing as the human population continues to expand, and the gap between rich and poor widens. Finding ways to reverse these processes is clearly the most pressing and important

task that humankind has ever faced, and a critical question is how best to harness, integrate and add value to current approaches, and to go beyond them if necessary.

[4] The full document (see Van de Fliert *et al*., 1998) may be obtained from the authors.

[5] Centro Internacional de la Papa, or International Potato Center, which is one of the CGIAR centers.

[6] User's Perspective With Agricultural Research and Development, which is a CIP-affiliated network of Asian researchers doing participatory R&D in rootcrop systems.

[7] More detailed information about project methodologies and achievements can be found in UPWARD publications (UPWARD, 1996; 1997) and in Pradhanang and Elphinstone (1997).

[8] Platform-building is addressed by approaches such as farmer research committees (Ashby *et al*., 1995; Ashby *et al*., 2000), farmer-led action research facilities (Ooi, 1998), mother-baby trials (Snapp, 1999), participatory extension (Hagmann and Chuma, 1998), and others (e.g. Braun and Hocde, 2000; Stroud, 2000; Gündel, 1998), These approaches are not elaborated here.

[9] Appreciative inquiry is an alternative approach, which replaces the problem-oriented methods with processes that build on community achievements, existing strengths and local skills (Cooperrider *et al*., 1999; Elliot, 1999).

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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