Participatory approaches for IPM research and development in smallholder estate crops: why, when and how?[1]

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Abstract

Smallholder estate crops integrated pest management (IPM) is characterised by the need for adaptive implementation of effective pest control options by knowledgeable and skilled individual farmers, in the context of collective decision making and action for sustainable management of the larger ecosystem and manoeuvring of market opportunities. The development of such an PM system is evidently favoured by the application of participatory approaches in research and development, in order to positively influence the appropriateness of information and processes developed. A framework for planning, implementation and evaluation of participatory projects is presented, illustrating the advantages of a phased strategy and the need for careful determination of the type of platform to facilitate for the collaboration, depending on objectives of the various activities, capacities of partners, and the socio-cultural context. Consultation of whole farming communities is essential in participatory needs and opportunity assessment efforts, and many methods to facilitate this process have been published. Farmer researcher teams are appropriate where activities serve mainly a basic and applied research purpose, and risk is involved that should not be shared with the larger community. Farmer field schools and farmer research committees have served as platforms for more adaptive research, where new information and innovations need to be fine-tuned to local conditions or compared with farmers' current practices. Participatory demonstration trials or field days to researcher-managed trials are appropriate when farmers are involved on a consultative basis to provide evaluation criteria for and validate technologies developed by researchers. The essence of participation in research and development is that objectives, agenda, methods, level of ownership and roles at all stages are mutually agreed on by all partners in the process.

Introduction

The application of participatory approaches in agricultural research and development initiatives is increasingly becoming the norm. Several advocates of participatory approaches have published widely since the late 1980s (e.g., Chambers *et al*., 1989; Jiggins and De Zeeuw, 1992), but only recently have more and more mainstream institutions begun to realise that new technology alone is not enough to achieve impact in farmers' fields, particularly those in resource-poor and risk-prone areas (e.g. Ashby *et al.*, 1995; Sperling *et al.*, 1993 Thiele *et al.*, 2001). Recognition is even growing 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. Case studies have measured a tangible influence on project impact of farmer participation at crucial stages in the cycle of project planning, implementation and evaluation (Johnson *et al.*, 2000). Particularly in systems where social, environmental and economic sustainability goals are equally important,

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actor-oriented, integrative and participatory approaches leading to platform building for resource use negotiation and collective decision-making at the larger ecosystem level are invaluable to achieve meaningful improvement of people's livelihood (Röling and Jiggins, 1998; Cramb, 2000)

Effective integrated pest and crop management (IPM/ICM) strategies in smallholder estate crops systems are supposedly characterised by several of the above-mentioned sustainability goals, as we are dealing with complex systems where collective interests are often in conflict with individual interests. Additionally, IPM requires the availability of information and a basket of options to farmers, to flexibly apply based on informed decision making. Therefore, the application of participatory approaches in research and development efforts that provide such information and adaptable options, as well as opportunities for farmers to enhance their knowledge and skills in a meaningful way could have tremendous added value. This paper explores some reasons why participatory approaches are particularly attractive for smallholder estate crops integrated pest management research and development, and outline when and how farmer participation can be initiated and facilitated.

Why apply participatory approaches to smallholder estate crops IPM research and development?

Smallholder estate crops production systems, dealing with crops such as cotton, coffee, tea, cacao, pepper and cashew, are characterised by several conditions that distinguish them from seasonal food crops. The following issues require special attention when dealing with these systems:

- *Estate crops have a perennial cropping cycle*. This requires long-term investment in soil fertility and ecosystem health by the farmers. For smallholders the agro-ecosystem stretches across the boundaries of individual fields, which implies that individual farmers will have to be considerate of their neighbours. Whatever practices they choose to apply, the effects on neighbouring fields may be either harmful or beneficial, as are the practice of the neighbours to their field. Collective decision making and action of groups of neighbouring farmers with regard to, for instance, soil conservation and pesticide use, may result in more effective and sustainable ecosystem management.
- *The produce has high quality requirements*. Most of the produce of estate crops systems goes to the market where consumers have quality demands. These could deal with, for instance, taste, (lack of) pesticide residues, and aesthetics of the products. Farmers should be aware of, and respond to, these demands in order to provide a product that is appreciated and, hence, could be sold at a better price. Information exchange channels between the various stakeholders, including farmers, traders and consumers, would help farmers to set their production criteria. Additionally, technology options to produce product of required quality should be available.
- *Estate crops are mainly cash crops*. The market determines the success or failure of the estate crops production system, since prices often fluctuate tremendously. Collective action of farmers to influence the market mechanisms, and where possible policies, would provide helpful conditions for achieving economic sustainability of estate crops enterprises. This could be realised by, for instance, establishing cooperatives and information exchange channels.

These conditions provide special challenges to research and development initiatives in smallholder estate crops systems. These challenges can be more easily tackled when the various stakeholder groups are involved at crucial stages of the research and development cycle, which calls for the application of genuinely participatory processes.

When is farmer participation desirable?

When a research and development effort is aimed at achieving impact in farmers' fields, it faces the implication that not only a focus on biophysical research to develop solid IPM components can be fostered, but also serious attention is required on development, extension and implementation objectives. Achievement of impact on farmers' livelihoods for an approach such as IPM is a very ambitious goal requiring both qualitative change relating to farmer capacities, practices, collective action and support systems, and significant quantitative change regarding numbers of people reached and increased income generated. Careful and participatory planning and implementation at each project stage to achieve: (1) appropriate need and opportunity definition and priority setting, (2) successful generation of applicable information and innovations, and (3) appropriate development and use of dissemination mechanisms and their effective implementation, can contribute to the realisation of the intended impact. A framework recognising sequential steps through and linkages between the research, development, extension and implementation realms is presented here to provide a way to navigate participatory planning, implementation and evaluation of projects (Van de Fliert and Braun, 2002). It is based on the assumption that farmers' involvement as decision makers at all appropriate stages of the process is central to the application of participatory approaches. 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 technology, 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 framework

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. These objectives have to be considered and anticipated during all phases of the process.

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. 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 internalise (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.

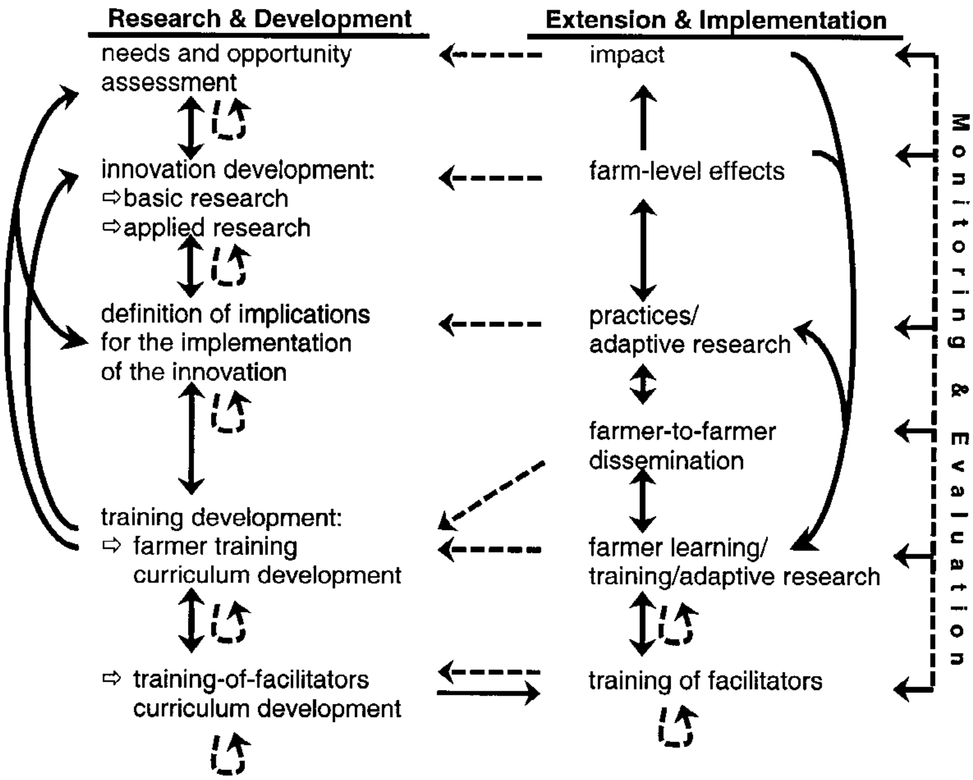

Figure 1: Framework for integrative, farmer participatory research aimed at impact

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 (Haverkort, *et al.*, 1991; Lilja and Ashby, 1999), as is often the case in conventional research. Regardless of the fact whether the initiative derives from the farming community or from outsiders, it implies that outsiders 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. It should also be determined who is interested and capable of doing what at the various activity levels. Whereas basic research is still primarily considered the domain of technical scientists and farmers may have limited involvement here, they can play an important role in the applied research phase. The degree of involvement of the various actors will depend on the nature of the problem, the research process, 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 agro-ecological, 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).

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 research and development leg. 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. 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 fulfil and important role to pre-test activities and provide feedback for improvement.

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. 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 government or non-government organisations, 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. The involvement of accomplished trainers is critical to the success in the field (Van de Fliert *et al.*, 1995).

In the case of IPM training, 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. In projects requiring considerable problem-solving, decision-making and platform-building capacity, such as smallholder estate crops IPM, farmers need more process-oriented learning opportunities and support.

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.

After training has taken place, the major actors in the implementation realm are, of course, the farmers who decide to implement, adapt or reject the information and innovations gained. 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, analyse, evaluate and, finally, solve many of their own problems without having to depend upon external advice.

Feedback mechanisms 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. Moreover, economic analysis alone is insufficient for impact assessment, 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 a research and development project through appropriate targeting.

In order to be able to justify the research and development investment, the monitoring and evaluation system should be designed to consider the individual outputs in relation to the objectives set for each research and development 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 research and development 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 research and development. Monitoring and evaluation of clearly defined indicators should generate valuable feedback to the scientists for further research and development, if needed. This information can then be used effectively to adjust the research and development 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).

How can farmers be involved as research and development partners?

Determining who should participate in participatory initiatives and how this could be done is crucial to successful collaboration and appropriate outcomes of a research and development initiative. Many papers and manuals have been published during the past decade presenting approaches, methods and tools for stakeholder analysis, participatory needs and opportunity assessment, technology development, and monitoring and evaluation (e.g. PRGA, 2002; Chambers, 1992; Pretty *et al.*, 1995, Guijt, 1998). It is beyond the scope of this paper to provide an overview of methods that can be applied in participatory initiatives, and therefore the sections below will be limited to some general principles and the description of some platforms that can be established for effective collaboration between farming communities and research and development agents.

Generally, participatory research and development activities imply shared ownership and collaboration amongst a team of partners, including farmers, technical and social scientists, extensionists and development workers, and other relevant stakeholders. Roles and responsibilities will depend on individual interests and capacities (or the ability to develop a certain capacity). Farmers are by and large good at providing a 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 under real-life conditions. Typically, the technical scientists share new, specific 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 fulfil a role to facilitate communication with rural communities and scale up pilot activities. Certain individuals, however, may have the capacity to handle technical as well as social research and/or communication aspects in a project.

Participatory research and development efforts involving researchers, farmers and representatives from other stakeholder groups, should begin with detailed problem analysis, which may be complimented by the identification of opportunities. The objective is to gain a broad understanding of the agro-ecological 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, 1992). Problem and opportunity identification can be conceptualised 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. 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 prioritised 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.

Once the research agenda is agreed, knowledge generation and innovation development follows through basic and/or applied research activities. Farmers' roles may vary from "analysts and evaluators" (Fano *et al.*, 1996, Snapp, 1999) who validate technologies developed by research, to "farmer researchers" who determine and test treatments in their own fields (Van de Fliert *et al.*, 2002; Gündel, 1998; Ashby *et al*., 1995). Where farmers' role is expected to be limited to evaluators of technology, the appropriate platform for facilitation of the process may be provided by sessions in training events that include demonstration trials, or field days where farmers visit researcher-managed trials at crucial moments in the crop cycle. However, more intensive farmer involvement in, and ownership over, the process should be accommodated through specially designed platforms that are adapted to the project needs and the socio-cultural context. CIALs, or farmer researcher committees, are an example of a platform widely applied in Latin America (Ashby *et al*., 1995). The farmer field school (FFS), a model originally developed for rice IPM training in Indonesia (Van de Fliert, 1993) but currently applied all over the world for a wide range of purposes, has accommodated participatory technology development efforts alongside training activities in crops where the technical training contact still had gaps. A third example of a platform for participatory research is formed by farmer researcher teams, which have operated in collaborative activities of the International Potato Centre (CIP) with potato and sweetpotato farmers in Indonesia. The farmer researcher teams and farmer field schools will be elaborated on more extensively below. For participatory monitoring and evaluation, the only general rule presented here is that the same actors as in the previous stages, representing all stakeholder groups, should be involved in setting of evaluation criteria, if possible in design and implementation, and in the analysis of evaluation outcomes.

Farmer researcher teams

Farmer researcher teams are established in project sites in an effort to provide more ownership to farmers over the research and development process by involving them as colleagues throughout the project cycle. They consist of two farmers per project site – normally of the same village – who are invited or select themselves to become intensively involved in the research process as farmer researchers. The number of farmers per community is purposefully limited to two per site because the research activities are of a basic and applied nature, implying uncertainty about research output, hence a possible risk to crop production output. We do not want to share research risk with too many farmers, and neither do we want to raise false expectations in farming communities. To accept research risk and understand that crop failure can also be an important research output, the farmers involved (just like the researchers and development workers) should be broad minded and inquisitive. By experience it is often only a few farmers in a community who are able, interested, and can afford the time and risk to get involved intensively in research. Furthermore, training and intensive guidance is required to upgrade research skills and support farmer fieldwork. Teams of two farmers per site rather than individual farmers has, however, proven to result in more creative processes because farmer researchers have someone who is working under similar conditions to talk to and develop ideas with on a day-to-day basis. Some farmer researchers from the same site conduct trials as a team, while others have individual trials but assist each other at crucial moments in planning, planting and harvesting.

The mechanism applied to establish, strengthen and operationalise these farmer researcher teams is made up of the following components:

- (Self-)selection of farmer researchers during preliminary needs identification community meetings. Criteria for selection in the (sweet)potato projects include being a (sweet)potato farmer, having an interest in research, and being available to conduct research activities and attend seasonal review and planning workshops.
- Initial project planning workshop and training. Project objectives and outline are reviewed and reformulated, and research activities for the first season are planned and designed. Principles of research methodology are discussed and guidelines for conducting research under farm conditions are agreed upon.
- Routine visits to farmer researchers by a facilitator (a staff member of a partner organisation that could be a local NGO or a research institute) as a discussion partner to solve problems or take crop management decisions and collect data.
- End-of-season review and planning workshop with a rotating venue amongst research sites. Research data are analysed, conclusions and research output formulated, and detailed plans for the next season are made. These workshops also serve to socialise research output and processes to the study site communities.
- End-of-project national seminar in which project methodology and outputs are presented to stakeholder representatives at a national level (policy makers, staff from relevant research institutes and extension organisations, NGO networks).

Prior training on participatory approaches in order to facilitate these processes adequately may be required for partner researchers. Farmer researcher teams have been involved in research ranging from needs and opportunity assessment studies on farmer cultivation practices, to basic and applied research activities (e.g., population dynamics trials of key pests and their natural enemies, variety, fertilization and pest management component trials) and even piloting and evaluation of farmer field school learning activities. Trials can be totally farmer-designed and farmer-conducted, but also researcher-designed and collectively conducted, or any other structure in between those two extremes, as long as all parties agree on the process.

Farmer field school as a platform for participatory research

Whilst the FFS mainly serves training purposes through experiential learning, over time its use has been diversified as a reaction to occurring needs. A wide range of organisations, including research institutions and NGO networks, has applied the FFS approach to cropping systems more complex than that of the rice-based cropping system for which the FFS was initially designed. The FFS has, in many instances, evolved into a platform serving advanced learning and adaptive research. The traditional FFS model accommodates several experiments, although these experiments are pre-designed and their outcome guaranteed in order to fulfil a learning purpose. The more farmers learn the more they develop a curiosity for doing experiments providing them new knowledge or allowing them to test options. The FFS then provides a safe environment for them to learn about experimental methodology and practice experimentation without running the risk of losing their crop. This does not mean that farmers have to be able to use randomised split-plot designs and advanced statistics to interpret their data. Enhanced understanding of the factors that influence the outcome of their experiments and some basic "rules of the game" of experimentation, however, has proven to greatly improve farmers' capacity to generate useful information for location-specific decision making. By learning to test and tailor generic guidelines, farmers can put knowledge gained into better, more applicable practices (Van den Berg and Lestari, 2001). In other instances, FFS programmes have been used to provide an opportunity for researchers to collect data over a wide range of ecological conditions, for instance for participatory variety selection (Nelson et al, 2001). In such cases it is very important that the objective of the trial and the applicability of the research output for farmer practice is clearly discussed with participating farmers, so as not to raise false expectations.

In a crop like sweetpotato where high variability exists in cultivation conditions, practices and opportunities, location-specific implementation of IPM practices is a necessity. This implies that farmers should be able to test and adapt ideas and broad guidelines under the specific conditions of their farms, requiring them to have the skills to do so in a dependable manner. The sweetpotato IPM FFS curriculum contains a series of activities to enhance farmers' experimental capacities in order to anticipate more adaptive research oriented follow up to initial field schools (Van de Fliert and Braun, 1999). The series of sessions on experimental methodology begins with: an inventory of farmer habits and methods in doing experiments on their own farms, an analysis of the reliability of the results obtained, and discussions on how to improve these methods. The concepts of focused problem definition, control treatment, and replication are introduced and farmers are guided through the process of designing, implementing and analysing their own experiments on the FFS plot. While building skills, these FFS experiments simultaneously serve an adaptive research purpose. Several of the original sweetpotato ICM FFS in Indonesia resulted in follow up and self-supported collective experimentation by farmer groups during post-FFS seasons, as well as initiatives by individual farmers to more systematically test information in their own fields (Van de Fliert et al, 2001).

Conclusions

It has been argued that the application of participatory approaches for smallholder estate crops IPM research and development is expected to positively influence the appropriateness of information and processes developed. To materialise effective implementation of participatory approaches in projects with a commitment to achieving impact in farmers' fields, the first step should be to identify distinct phases and related objectives during project design. Secondly, a decision must be made regarding the most appropriate platform for each phase to achieve the various objectives and fully allow for participation of all stakeholder groups. The phasing of projects and anticipating the application of a different platform for farmer and researcher involvement in each phase, is crucial for implementing strong research, development and extension activities, and consequently achieving qualitative and quantitative impact in farmers' fields. Needs and opportunity assessment studies are required to consult farmers on the direction and agenda an activity. Basic and applied participatory research can enhance the technical content, its applicability to farmer management systems, and the quality of learning approaches. Larger scale farmer education programmes are needed to help make the information and technologies available to a large audience. Community-led follow-up IPM activities allow for location specific adaptation, internalisation and further local innovation. The various platforms for farmer research, learning and organisation can be both complementary and evolving from one into the other as objectives and ownership over the process shift over time. Only a solid, participatory planning, implementation and evaluation process that takes into consideration the whole cycle from problem to impact as defined by farmers' criteria, will increase the likeliness that research and development outputs are put into practice and that collectivity in a community is established. This should eventually lead to improved crop and farm management and, as a result, to sustainable improvement of the livelihoods of smallholders.

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