Development and linkages of farmer field schools and other platforms for participatory research and learning

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The International Potato Center used the farmer field school (FFS) model in several of its research and development activities on potato and sweetpotato integrated pest, disease and crop management as a platform for participatory research (PR) and/or farmer learning. Four approaches are roughly distinguished based on how the FFS was used, differentiated primarily by the function that participatory research served in the FFS. The PR-FFS approach fully integrated PR and learning activities. The FFS-with-some-PR focused on farmer learning but introduced several adaptive research activities, mainly to allow farmers to be involved in variety selection. The FFS-after-PR approach designed FFS based on participatory research outputs conducted through the farmer researcher team platform, and limited experimentation in FFS to learning and adaptive research. The FFS-with-community-led-research approach builds FFS programs based on off-the-shelf technical information available but mainly aims at establishing active farmer networks that will continue to generate and fine-tune information by themselves. Each of the approaches has its own strengths and weaknesses, which are analyzed in this paper. The major lesson learned is that careful analysis of project objectives, partner expectations, available capacities and resources, and existing platforms to link up with is necessary to determine the appropriateness of employing the FFS model, in general, and one of the four described capacities, in particular.

The concept of the farmer field school (FFS) was born in 1989 when the FAO Inter-Country IPM Program[7] designed this innovative model for farmer training on integrated pest management (IPM) in rice-based cropping systems in Indonesia (Kenmore 1991). This model was different from conventional agricultural extension on IPM conducted thus far, in that it recognized sustainable agricultural development to be people centered, knowledge intensive, and location specific. It attempted to tackle the specific needs for change toward agricultural sustainability

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[7] In full: Inter-country Program for the Development and Application of Integrated Pest Control in Rice in South and South-east Asia, Food and Agriculture Organization of the United Nations. The fourth phase of this program was conducted until 2002 as the Program for Community IPM in Asia (http://www.communityIPM.org).

by applying the principles of nonformal education (van de Fliert 1993). Nonformal education, defined as "the fostering of quality-of-life enhancing learning outside the formal school system" (Dilts 1983), explicitly recognizes human values as a prerequisite for learning. It is based on Paulo Freire's (1972) perspective on education as a problem-solving, con-sciousness-raising strategy for empowerment. As an empowering process, education places importance on how educational processes and relationships affect the learners, not only on the contents (Kindervatter 1979). Therefore, experience-based learning is linked to living problems. It seeks to empower people to actively solve those problems by fostering participa-tion, self-confidence, dialogue, joint decision-making, and self-determination.

Translating these underlying principles to IPM learning, FFS are designed to capacitate farmers by enhancing their agroecological, science-based knowledge and to develop skills needed for informed decision making and problem solving, such as field observation, agroecosystem analysis, experimentation, and farm economic analysis. An IPM FFS lasts for a whole growing season and ideally involves a group of around 25 farmers in weekly, half-day sessions. The trainer's role is to facilitate the experiential learning process, which involves organizing adequate learning activities and providing crucial information where needed. To fulfill this role, trainers need to undergo thorough technical and methodological training themselves, and similar to FFS learning, training of trainers is preferably season-long and experiential.

Successful IPM field schools have often become platforms for follow-up activities, spontaneously organized and funded by the field school graduates; an example is the IPM clubs in Vietnam (Eveleens *et al* 1996). During these follow-up activities, farmer groups study new cultivation problems, organize collective control measures, and set up experiments to further fine-tune technological guidelines for local conditions. FFS groups have initiated other aspects of community development, including rice–fish culture, collective marketing of produce, and advocacy for fair share cropping agreements (van de Fliert and Wiyanto 1996). People-centered extension methodologies enhanced farmers' ability to practice what they had learned, and also taught them how to create and exploit opportunities for further learning. Over time, after FFS groups showed interest and capacity to move from conducting experiments mainly for learning purposes to experiments for adaptive research purposes, research organizations and NGO networks began to consider the FFS as an appropriate platform for participatory research (van de Fliert *et al* 2002).

The International Potato Center[8] (CIP) has used the farmer field school approach for several research and development activities. Farmer field schools were first introduced at CIP in 1995 as a farmer-learning platform for sweetpotato integrated crop management (ICM) in Indonesia, which was later expanded to Vietnam, Philippines, China, Uganda, and Kenya. In 1998, efforts were initiated at CIP headquarters in Peru to adapt the FFS model to include participatory research activities on late blight management, which was expanded to Bolivia, China, Bangladesh, Uganda, and Ethiopia in 1999, and over time included more aspects of

[8] The International Potato Center is a Future Harvest center supported by the Consultative Group on International Agricultural Research (CGIAR). With its headquarters based in Lima, Peru, CIP's research mandate focuses on potato, sweetpotato and, Andean root and tuber crops systems and on natural resources management in high mountain areas.

potato disease and pest management. In Ecuador, collaboration with the FAO Global IPM Facility as of 1999 got CIP involved in community development-oriented activities through potato FFS. FFS models for potato IPM learning also began to be developed in Nepal (1998) and in Indonesia and Vietnam (2001).

FFS activities in various locations were often conducted simultaneously with other conventional and participatory research activities using other platforms, such as the farmer researcher committees (CIALs) in Latin America. The confrontation between platforms led to extensive debates on which was the most effective and how they should be linked (Braun *et al* 2000). After a wide range of field-based experiences with FFS we are better placed to provide more informed conclusions. In this paper we describe our various experiences, and assess what worked and what didn't, and how in practice platforms fitted or didn't fit together. We hope that this assessment will help others in selecting or developing platforms for participatory research and training activities. After outlining the rationale for integrating the FFS model in the research program of an international agricultural research center, we present a detailed description of five approaches to using the FFS in CIP's research program, grouped according to the role of PR in the FFS. This is followed by a comparison of the different uses and an analysis of the linkages and complementarities of the FFS with other research and development platforms. Then, we draw some conclusions and present some lessons learned.

The farmer field school at CIP

Integrating FFS approaches into CIP's research program has been driven by the felt need to link research with development. CIP has a highly decentralized research program with a significant proportion of its scientists posted in regional or country offices. This enables CIP scientists to work more closely with organizations in the national agricultural research and extension system (NARES)[9] and implement activities directly with farmer groups. International agricultural research centers (IARCs) have forever struggled to get their research outputs used by large numbers of farmers. Certain improved varieties ignite a spark and spread like wildfire, but generally these success stories are more the exception than the rule. More complex, knowledge-intensive, and location-specific approaches to production constraints, such as integrated pest and disease management, typically lack the "silver bullet" solutions that easily sell themselves. IARC scientists have dealt with this issue using several strategies:

- *The "this-is-not-my-business" strategy:* Scientists believe that their job is to do high quality, cutting-edge research to move science forward, and after publishing the results in refereed journals their job is done. It is considered the task of the national research and extension system to pick up those results, adapt them to local conditions and applications, and translate them into extension messages. Most of the more basic and strategic research is done with this conviction. At most, collaboration with national research organizations is established and expected to facilitate the link to eventual outreach activities.

[9] Includes government, non-government, and farmer organizations.

- *The "targeting-and-linkages" strategy:* By applying farmer participatory research approaches, scientists anticipate that research agenda and direction will better address farmers' needs, opportunities, and conditions. This is expected to result in research outputs that are relevant and applicable to farmers' conditions and readily taken up by participating farmers. Wider dissemination from the specific participatory research sites to larger farmer communities, however, has proven difficult and requires involvement of some sort of extension mechanism (Connell 2000, van de Fliert *et al* 2000). The link to large-scale extension mechanisms does not automatically exist.

- *The "let's-do-it-ourselves" strategy:* Only in few occasions have (national) researchers been observed to reach substantial numbers of farmers through training, for instance in Cuba where researchers also fulfill extension tasks (Cisneros and Alcazar 2001). Generally, however, to ensure large-scale promotion of research outputs, the do-it-yourself effort of a research organization is limited to developing an effective outreach model and establishing an appropriate implementation mechanism. This implies, first, a translation of the technological content (the research output) into promotional or learning messages and methods for farmers. Second, organizations and a sufficient number of individuals capable of facilitating the dissemination efforts at the desired scale need to be identified, motivated, and adequately trained. Resources for large-scale implementation need to be identified and made available.

When aiming to achieve impact (qualitative improvement of conditions and quantitative coverage) in farmers' fields, complementary application of the three strategies in overlapping and iterative phases and cross-disciplinary collaboration may provide the best results. Good participatory research should improve the relevance of conventional research, but it is not likely to be effective without the latter to back it up. Likewise, suitable options developed with farmers may never reach a broader population if dissemination and implementation beyond research sites is not anticipated. Complementary application of the three research and development strategies would require holistic and collective planning and implementation of a center's overall research program. More commonly, however, we see that participatory research and development activities are localized initiatives of committed individuals (Thiele *et al* 2002).

The farmer field school has been used at CIP as a platform for both the second and third strategy, and in some cases serving both purposes at the same time. Because of its perceived origins in IPM, the FFS platform has primarily been applied at CIP for research or farmer education on integrated pest, diseases or crop management (IPM/IDM/ICM). Currently, initiatives for integrating livestock and marketing issues in field school initiatives are being developed. The FFS seemed the most logical model to adopt and adapt for farmer training on potato and sweetpotato IPM, particularly in countries where strong national FFS programs had been established for farmer training on IPM, such as Indonesia, Vietnam, Philippines, Uganda, and Kenya. Minimum investment is thus needed to establish national cadres of trainers by simply widening the skills of existing FFS facilitators to include the specific requirements of the crop and FFS learning activities adapted to a new cropping system. Moreover, national governments or nongovernmental organizations already applying FFS programs are expected to be more willing to invest in large-scale sweetpotato and potato FFS programs in areas where the crops have major economic importance. This is true particularly for Vietnam and the Philippines, and on a smaller scale also for Indonesia, where researchers could progressively transfer responsibilities for implementation to national extension organizations. However, to introduce FFS in countries with limited experience and capacity in the approach, a considerable investment is required to train trainers.

Where FFS was used as a platform for simultaneous participatory research and farmer learning, the various levels of research and extension objectives needed to be accommodated by one and the same platform. These multipurpose FFS activities were particularly challenging because they were conducted in countries where FFS had not covered much ground yet and with partners who initially had little experience with the approach. Additionally, they focused on disease rather than insect management, which required creative adaptation of the original model. The various uses of the FFS at CIP are discussed in detail in the following four sections, clustered according to similarities in the main objective applied to the use of the field school as a platform and the role of research in the FFS. These four approaches coincide with the grouping of activities by four (groups of) scientists who each held a different conviction on what purposes the FFS should serve as a platform in research and development.

The PR-FFS approach for potato integrated disease management (IDM)

Under tropical highland conditions diseases such as late blight, bacterial wilt and viruses present major constraints to potato production. Late blight, in particular has been one of CIP's most important research priorities. Two main components account for most of the efficiency in controlling late blight: genetic resistance and optimized fungicide use. Farmers' perceptions of the two differ. Resistance is easier to observe and is less dependent on management decisions (and prior knowledge generation), so farmers' perceptions tend to be more uniform. Efficient fungicide use depends on farmers' management decisions at local level (which in turn depends on their knowledge), and the agroecological conditions. Hence farmers' perceptions on the role of fungicide use tend to be much more varied. A special project to work on these issues with farmers in an FFS setting was designed and financed by the International Fund for Agricultural Development (IFAD) in Peru, Bolivia, Uganda, Ethiopia, Bangladesh, and China. These field schools served the purpose of farmer learning on integrated late blight management and participatory evaluation of late blight resistant varieties and clones, and of fungicide management schemes. Because of the emphasis on participatory research, the approach was called PR-FFS. The variety evaluation trials facilitated farmers' access to new potato materials and in some cases, farmers began to have access to materials that had been on the shelf for many years. They also provided researchers with information about the performance of the varieties under these fungicide treatments over a wide range of ecological conditions (Nelson *et al* 2001).

In Peru, there were two types of experiments. The first aimed at identifying and showing to farmers the interaction between genetic resistance of several potato varieties (susceptible, moderately resistant, and resistant) and different fungicide regimes (low, medium, and high frequency of application). The experimental design of this trial was simplified after feedback from farmers indicated that it was too complex for some of them to understand. The second experiment included the evaluation of 10-15 new resistant clones from CIP's breeding program and some other varieties that were managed only with the low fungicide regime. FFS farmers were able to select the best 10 clones that met their expectations out of 50 that were initially introduced in just three cropping seasons. Most of the learning activities on late blight management were based on observing these two experiments, where farmers drew their own conclusions about the role of resistance and what fungicide regime was better for each level of varietal resistance. Farmers considered the level of resistance, weather conditions, and their newly gained knowledge about types of products, doses, and ways of spraying to draw up their conclusions. They learned how to manage resistant varieties or clones with less fungicides, and susceptible varieties with more fungicides in relation to weather conditions.

A significant outcome of this process was that at the same time that farmers selected varieties, they started to multiply the materials that they liked, hence adoption of new clones occurred earlier than if the materials had been passed to the national program for conventional evaluation. Adoption could have begun five years earlier, which would have generated additional benefits for farmers and an increase of at least 20% of internal rate of return when estimating impact (Ortiz *et al* 2002). Other evaluation results indicated that FFS participants tended to use less fungicide than non-participants (Ortiz *et al* 2002), particularly in years with higher disease pressure, which indicated that they tended to optimize fungicide use. Similar results were achieved in Uganda and Ethiopia. During three cropping seasons farmers' knowledge on resistance, types of fungicides, doses, and ways of spraying was enhanced. This, in turn, significantly improved late blight management in their fields.

After several seasons, farmers who participated in PR-FFS on potato late blight management in Peru began to request learning activities on other cultivation constraints. Hence a more comprehensive curriculum was developed jointly with the IPM group at headquarters. Large-scale implementation of potato IPM FFS in Peru has now taken off under an FAO-coordinated project coordinated by FAO. CIP contributed to this process by training field staff and providing published guidelines for potato IPM FFS facilitation.

In Uganda and Ethiopia, PR-FFS were conducted in 1999, 2000, and 2001 with a similar focus as in Peru on potato variety evaluation and fungicide management. Farmers' input in clonal selection was valuable and used as additional criteria for potato variety release. Main field selection criteria established by farmers included tuber yield, resistance to late blight or bacterial wilt, tuber shape, maturity period, seed availability, lack of storage rots, sprouting duration from harvest, palatability, and consumer acceptability. The fungicide management trials involved treatments of various fungicide regimes combined with potato clones/varieties arranged in factorial experiments and with various field sites as replications. Results of these experiments indicated that certain practices such as disease monitoring prior to fungicide applications were quite effective for late blight management compared with other measures.

In addition to the participatory trials, the FFS concentrated on farmer learning related to late blight and bacterial wilt management, such as seed quality and selection, pest diagnosis, use of resistant varieties, fungicide management, decision support systems, safe use of pesticides, and harvest considerations. Farmers requested a series of topics to be covered by the FFS, and hence heavily influenced the direction of the learning process (Olanya *et al* 2000). Several experiments on bacterial wilt management were conducted, such as on disease transmission through infected seed, and a comparison of infected and clean soil on potted plant development. Particularly in Uganda, the seed-plot system as a strategy for small-scale potato seed production systems involving the separation of ware and seed tubers was tested with farmers. In addition to learning in the FFS, farmers visited experimental plots at the local research station. The output of these activities included producing and disseminating information on potato IDM, leading to optimum promotion and use of components of bacterial wilt management in the FFS curriculum, enhancing seed quality, and applying integrated management practices. Eventually, bacterial wilt incidence in FFS farmers' fields decreased and potato yield increased.

The FFS-with-some-PR approach to potato production research and learning

In Bolivia, the PROINPA Foundation, which carry out potato research and breeding activities together with an NGO, ASAR, have promoted FFS in the Cochabamba department of Bolivia. FFS have tested new late blight-resistant varieties and a small number of advanced clones using simple trial designs (two replications and a local control), with one or two fungicide sprays on small study plots (Thiele *et al* 2001). Farmers in the FFS assess late blight incidence, carefully follow the plant growth, measure yields, evaluate tuber shape and color, and cook and taste the harvested tubers. FFS farmers have been multiplying the two preferred varieties from their trials. These varieties combine good resistance with market acceptability. Farmers learn about how these new materials are affected by late blight under differing fungicide treatments on their main learning field where they grow one of the best adapted new varieties using IPM practices. A decision support system is compared with local management. Participatory variety selection (PVS) on their study field and IPM using a resistant variety are complementary in the way they build farmer knowledge about the interaction between varieties, the late blight pathogen, and fungicide use.

Researchers in PROINPA had developed a strategy for fungicide application with multilocational researcher-managed trials over several years. The strategy includes the use of a systemic fungicide before symptoms of late blight appear, alternating with a contact fungicide and shorter intervals between fungicide applications in rainy and damp weather. The strategy proved effective in field trials with very high rates of return. It was incorporated as a central element of IPM for late blight in the FFS (Torrez *et al* 1999). Farmers typically applied fungicide after symptoms appear. A key aspect of the discovery-based learning was to help farmers learn that the disease grows invisibly within the plant. In susceptible varieties this means that the first spray should be made before symptoms appear, whereas in resistant varieties spraying should begin when the first symptoms appear. Farmers also needed to improve their understanding of different fungicide types, dosage rates, and application methods to make effective use of the strategy.

The potato FFS were developed from the beginning as a platform that could test a small set (less than three or four) of the most advanced materials emerging from PROINPA's existing decentralized and participatory breeding processes. Local groups of farmers were involved since the early 1990s in testing quite large sets of breeding materials, with around 30 becoming accepted as the norm (Thiele *et al* 1997). The potential of FFS in linking varietal development with the existing platform for PVS, which included both groups of farmer evaluators and CIALs, was clear from the beginning and the same individuals in PROINPA were involved with both.

It was also clear that the FFS needed to link with seed systems. PROINPA has promoted FFS in higher areas which are more suited to seed production but where late blight is less of a problem and in lower areas which are unsuitable for seed production but where late blight is a major problem. FFS farmers in the two areas have been encouraged to share information about their needs so that higher altitude farmers can produce seed for those in lower altitudes.

FFS were developed as part of CIP's IFAD-funded project. Some of the FFS facilitators returned from their training course believing that the FFS advanced on and replaced existing platforms. As a result, initially FFS were seen as an alternative to farmer research committees (CIALs) which had been established earlier with support from CIAT's IPRA[10] program. This perception subsequently changed. First, over time once several FFS had been conducted it became more obvious that forming a CIAL could be a good follow-up activity to maintain some institutional links. Second, CIALs were becoming more favorably viewed in PROINPA as a mechanism for linking with local municipalities and giving voice to farmers' demands. Third, after many heated discussions, facilitators moved away from the notion of FFS as a hybrid with participatory research, which had been developed in Peru, to see it as more of a training platform with a limited participatory research component.

PROINPA has also begun participatory plant breeding (PPB), with large amounts of genetic material, where farmers themselves make crosses (Gabriel *et al* 2000). At the outset there was confusion about which platform should be used for this. Initially, PPB was fully incorporated within one of the FFS that was under way. Upon reflection, however, it was realized that PPB only gives benefits in the long term since developing variety takes several years. Thus, it was decided that the PPB group would be separated from the FFS. Nevertheless the PPB was developed using discovery based learning methods. Farmers made crosses using different methods to understand and see which worked best. Organizing meetings and developing a curriculum drew heavily on ideas being developed with the FFS. PROINPA is concerned with achieving wider impact; most FFS to date have been within pilot sites. To scale up FFS implementation, PROINPA is negotiating a project proposal with the FAO for training of facilitators and linking FFS implementation to municipalities.

A special theme in FFS activities with some PR in some areas of Bolivia, Ecuador, Uganda, and Ethiopia was postharvest and the linkages with markets and industries. In those places, farmers showed high interest in entering rapidly growing markets for processed potato, which command higher and more stable prices. Typically it is the larger farmers who make use of these new opportunities, which demand higher quality with minimum levels of damage and other criteria such as

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[10]International Center for Tropical Agriculture's Participatory Research with Farmers Program.

size and quantity with the delivery of agreed volumes to meet factory and restaurant deadlines. FFS can use integrated management to deliver a better quality product. And because FFS organizes farmers in groups it could potentially help them compete more effectively because of better quantity and negotiate with agroindustrial groups.

With these ideas in mind PROINPA began working in 2001 with existing FFS in Bolivia, which had been set up to improve integrated management of the potato crop. Special sessions were included in the existing FFS curriculum on calculating profits, marketing, the potato industry, industry and restaurant preferences for potato types, how to produce potatoes for industrial uses, and selection and storage of potatoes for sale (Mamani 2001). FFS farmers were helped to build special silos to prolong the storage period and lengthen the time for selling potatoes to industrial users. Farmers are helping researchers with trials to develop optimum management in the silos. A business meeting was held between the 30 FFS graduates and representatives of the local potato industry. Farmers and industry were divided into separate groups. Farmers answered the question "What varieties do we want to grow and why?" and "How much potato do we produce?" The industry group answered the question "What varieties interest us, and why?" and "How much potatoes do we need?". Each group presented their questions in plenary and so each came to understand the perspectives and needs of the other. Subsequently, farmers' representatives and some of the industrial groups established specific agreements to supply potatoes for processing. As a result of the FFS farmers have learned to meet industrial requirements on size and quality of potatoes. Prior to the training only 20% of farmers could do this properly; afterwards 90 percent were able to do so. As a result of the training and subsequent meetings, FFS farmers are currently supplying a local manufacturer of potato chips. PROINPA is looking at ways to scale up this experience.

In Ecuador, where the FFS are a relatively new initiative, formal linkages to the agrofood industry are being explored. Several organizations, in particular INIAP, CESA, a national NGO, and individual farmers belonging to field schools have interacted directly with the food industry. These established ties provide many opportunities for the future, particularly for producing safer products for both domestic (supermarkets, Frito-Lay) and international markets (Agrofrio) and better prices for farmers.

Postharvest and marketing activities have also been included in the FFS curriculum in Uganda and Ethiopia. This followed a needs assessment and the realization by farmers that knowledge on farm accountability, marketing, and industry trends are essential for financial sustainability. The success of the FFS program in Uganda and Ethiopia has facilitated the expansion of a seed growers association in Uganda and informal farmer-based seed growers in Ethiopia. In Uganda, at least six farmers who graduated from FFS have been admitted into the Uganda National Seed Potato Growers Association (UNSPA) based on their knowledge acquired from FFS and competence in potato seed production. The potato seed growers association have benefited tremendously from the seed trade in the country. The linkage between the seed growers association and the FFS is also based on the fact that potato seed from the association is sold to members of the FFS and neighboring communities thereby developing good agroindustry linkages. Similarly, produce from the field schools and seed plot members are also being targeted for open markets and being purchased by Africare, an NGO, for use in their food security initiative and other marketing intermediaries.

The FFS-after-PR approach for (sweet)potato IPM/ICM

CIP's sweetpotato IPM work in Asia was initiated in 1993 in Indonesia with a strong focus on sweetpotato weevil management. After a participatory assessment of needs and opportunities in 1994/95, the course of the activities was broadened upon farmers' request to integrated crop management (ICM). Farmer researcher teams conducted five seasons of participatory trials on various crop management practices, complemented by researchers who managed specific trials on-station. Farmer researcher teams consisted of two farmers in each of the four research sites, who were selected during the needs and opportunity assessment sessions and intensively involved in further research planning, implementation, and analysis (Van de Fliert *et al* 2002). While the technical content of sweetpotato ICM was being developed, the group of collaborating researchers and farmers began to think about how to scale up dissemination and what additional skill development would benefit sweetpotato farmers. As the predominant IPM training model in Indonesia, the FFS was selected and piloted for the sweetpotato crop. Specific sweetpotato ICM modules were developed with support from CIP's UPWARD Network. In comparison with the rice model that focused on analysis of the balance of pests and natural enemies, the sweetpotato curriculum centered more on ecosystem health and farm management. It specifically taught farmers experimental methodology to encourage them to conduct adaptive research in their own fields. A nationwide trainers' training for government and NGO staff was conducted to support large-scale dissemination of the information. Evaluation studies showed that farmers' participation in research had had a positive impact on the relevance of the training program, significantly contributing to farmers' increased income from sweetpotato (Johnson *et al* 2001).

The sweetpotato ICM FFS model developed for Indonesia seemed applicable to other Asian countries where CIP was working on improving sweetpotato production systems and where field schools had already been widely established: Vietnam, Philippines, China, Uganda, and Kenya. Specific adaptations were made through participatory field studies and plot FFS and adapted manuals were produced in the local languages. In the Philippines, the FFS used production of healthy seed as an entry point, considering the importance of virus diseases in major sweetpotato-growing areas. In Vietnam, the curriculum expanded to post harvest issues, including the use of sweetpotato for animal feed, storage, and marketing. In Uganda and Kenya, sweetpotato production and post harvest was integrated into the cash crops FFS to contribute to a more comprehensive model for farming systems field school.

Establishing cadres of FFS facilitators through training is not enough to ensure large-scale implementation of sweetpotato FFS programs, despite efforts to develop follow-up implementation programs during the training. The major stumbling block has been finding funds for implementation. In Indonesia, after a first round of sweetpotato field schools in six provinces implemented and funded by the National IPM Program, an expected follow-up with local government funds did not materialize as a result of the economic crisis in 1997 (Van de Fliert *et al* 2001). A new initiative is needed to re-ignite interest now that the economic situation is slowly improving. NGO programs, however, have continued to implement activities, but coverage is limited. In the Philippines, local governments in major sweetpotato-growing provinces took a keen interest in expanding pilot activities, and made available funds and personnel (i.e., over $60,000 to date). Similarly, in Vietnam the government has allocated part of its annual FFS budget to sweetpotato FFS training of trainers and implementation. Facilitation of linkage mechanisms with government and NGO programs at an early stage in the FFS development process has been the key to successful follow-up if socio-economic conditions allow.

In potato IPM, work in the Asian region did not start until 1998 when a participatory needs assessment was conducted in Indonesia, and the year after in Vietnam. Potato production constraints in the tropical highlands in Indonesia are plenty, including leafminer fly, bacterial wilt, and late blight; no easy solutions exist. Similar to the sweetpotato IPM work in Asia, participatory research on IPM components was conducted through the farmer researcher team platform. An FFS type platform was chosen only where ready-made technologies for bacterial wilt management needed validation of integrated application under field conditions, and simultaneous learning activities needed to be developed. It was not until three years later that the team felt ready to begin developing an adapted FFS model for potato IPM farmer learning.

The bacterial wilt activities were preceded by many years of conventional research on biological processes and control of bacterial wilt disease in potato production, caused by *Ralstonia solanacearum* resulting in a set of management practices that contributed to preventiing disease outbreak. No one entity would have been able to undertake the activity alone. Participatory needs and opportunity assessment studies had shown that potato farmers in both Indonesia and Vietnam ranked bacterial wilt as one of their major problems. The cause of the problem, however, differed. In Indonesia a crop typically gets infected through seed and soil. In the Red River Delta in Vietnam soils are generally clean of the disease after two seasons of inundated rice, but in addition to using infected seed it was suspected that farmers bring the disease to the field through uncomposted manure. Participatory evaluation of the existing integrated package of management practices to combat bacterial wilt therefore needed to be complemented by research to detect the level of *R. solanacearum* inoculum in farm manure and to assess the efficacy of simple composting methods to eliminate the inoculum.

The methodology chosen to validate and adapt the integrated set of measures, which include various crop management and seed selection practices, was based on the idea that farmers try out and evaluate practices in their own fields only if they have enough knowledge about the reasons why the practices could possibly work. In three different villages in Vietnam and three in Indonesia, 10-15 potato farmers per village became involved throughout the season in a series of six sessions containing both learning and research activities. In Vietnam, a reasearcher led the activities with intensive involvement of some farmer researchers. In Indonesia, teams consisting of a farmer researcher and an NGO staff in two locations, and a researcher and an FFS facilitator in the third village, were in charge after having received prior training. Learning activities were very much FFS-like: hands-on, discovery based, and participatory. Each group managed a learning plot where all the integrated management components were implemented. On an additional plot they conducted experiments of their choice. Throughout the season, farmers' practices in their own fields were recorded to determine whether the learning activities could convince farmers to implement the management components and measure their effects. After harvest, the outputs of the learning and experimental plots were compared with those on farmers' own fields.

Despite the similarities with an FFS setting, albeit with fewer farmers, fewer sessions and focus on bacterial wilt only, we agreed with the participating farmers not to call the activity an FFS yet because we were not sure of the outcome of the experiments and were learning together. Based on the FFS history in Indonesia and Vietnam, farmers' expectations of an FFS is training activity that can advise farmers on what works and what does not. The activities helped to develop both the technical content for a locally acceptable integrated bacterial wilt management approach and learning activities that will be later integrated into a more comprehensive potato IPM FFS curriculum. These curricula are currently under development.

UPWARD-led activities in Nepal (Hidalgo *et al* 2001) and the Philippines (Campilan *et al* 2001) also used FFS essentially as a versatile learning platform, using it as a vehicle for community-based propagation and maintenance of clean planting materials. The use of healthy seed is a central message conveyed to farmers in IPM FFS, but farmers do not always have access to healthy planting material. Since 1998, potato and sweetpotato FFS that focus on production of healthy planting materials have been pilot-tested in Nepal (potatoes) and the Philippines (sweetpotatoes). The goal of these efforts was to use the learning plots to set up farmer experiments on healthy seed production and to propagate planting materials. In Nepal, farmers set aside a portion of the learning plot where seed multiplication was undertaken using pathogen-tested tubers and/or true potato seed (TPS) obtained from the Potato Development Program of the Department of Agriculture (DoA). In the Philippines, farmers set up net houses using locally available materials, where planting materials of sweetpotato are multiplied using tissue-cultured mother plants obtained from the nearby Tarlac College of Agriculture (TCA). The FFS curriculum for seed propagation needed some major adaptations, including (1) adjusting the timing and frequency of sessions to coincide with the critical growth stages and appearance of disease symptoms, (2) conducting a series of FFS (2-3 subsequent seasons) with the same group to encompass the full cycle of seed propagation and on-farm maintenance, and (3) planting potato in learning plots not only for experimentation and observation, but to multiply the seed and distribute these to farmer participants at the end of the season. For sweetpotato seed FFS, adaptations to the curriculum included (1) using "learning net houses" in addition to the experimental and observation plots in the open field, (2) focusing on vine production to multiply planting materials instead of root production as in a typical sweetpotato ICM FFS, and (3) learning methods and tools to help farmers visualize concepts such as vector, pathogen, and hosts.

A major lesson derived from the Nepal experience is that where FFS is widened to seed production, social and institutional arrangements need to be put in place to ensure a more equitable access and sharing of seed produced (Campilan 2002). In subsequent FFS, the facilitators and farmer participants have made sure that this is a key negotiation point during the preparatory meeting for an FFS. Meanwhile in the Philippines, the cost of setting up net houses was a major issue during the FFS. To meet the technical requirements set by the scientists while recognizing the resource limitations of farmers, a low-cost net house design has evolved after experimenting with various local construction materials and simplified designs. It was also realized that an FFS for producing healthy planting materials is a necessary but not sufficient step toward successfully managing sweetpotato diseases. Some planting materials obtained from the FFS net houses became virus infected as early as the first season of planting in the field. A follow-up FFS on ICM has since been developed for farmers, who were earlier trained in planting materials production, to learn practices for maintaining crop health and producing healthy planting materials for subsequent seasons.

The FFS-for-community-led-research approach for potato systems

The CIP–FAO IPM Global IPM Facility collaboration in Ecuador has emphasized multi-institutional and collaborative modalities. Both FFS and CIAL methodologies have been used to enable development practitioners and their organizations to progress to more interactive approaches to community development. More recently, partners have been working with the FFS to develop linkages with the agrifood chain and to influence public policy. Similarly, sweetpotato field schools in Asia and Africa are touching on many of these issues (marketing mechanisms, sweetpotato in the livelihood system, self-financing mechanisms, sustained farmer experimentation), although they were not specifically organized for that purpose, and had been reported as part of the previous approach.

A central theme for Latin America is rapid economic liberalization, which in practical terms has come to mean government restructuring (decentralization) and privatization of resource ownership and management. This process has been commonly referred to as economic and political 'modernization'. Beginning in the 1980s, international development agencies encouraged economic stabilization, privatization, and liberalization throughout Latin America to promote commodity exports and economic globalization. In the early 1990s, the Andean countries responded with new laws with names that included an arrangement of the following constructs: structural adjustment, decentralization, agricultural and forestry modernization, and strengthening municipalities. Bolivia was able to shape this around the concept of 'popular participation', although the original economic mechanisms of decentralization and privatization remained unchanged.

In response, efforts to establish and maintain national IPM programs, for example, must be compatible with the new and emerging institutional framework. The theoretical implications, in terms of knowledge systems and their outcomes and changing roles of key actors, such as governments (municipalities, Ministry of Agriculture), action agencies (NGOs, community based organizations), research institutions (NARIs, universities, CGIAR centers), and increasingly, the private industry, are profound. FFS has helped to shape this re-institutionalization toward community-based structures, but the challenges are many and the work has only begun.

FFS in Ecuador have relied largely on off-the-shelf technologies rather than technology development, further built on the foundation of existing farming practices, and worked with farmers to develop opportunities for the future. One very relevant example is the recent work with *wachu rozado* (in Quichua and Spanish, literally "cut furrow"), a pre-Colombian tillage system where potato is grown under folded grass sod. Initial research on the system has shown that it is both highly productive and resource conserving – a rare combination.

About 20 percent of FFS participants in Northern Ecuador continue to use *wachu rozado* and produce about 21 t/ha, which is the present average in Carchi and about three times the average in other parts of the country. During the design of the FFS, farmers stated that *wachu rozado* required about one-third less fertilizer and pesticide than potato under conventional tillage. Furthermore, farmers said that the system prevented soil erosion, to which soil scientists agreed. Nevertheless, despite much promise, the system is in sharp decline.

Even though FFS have determined that *wachu rozado* requires about one-third less work than doing total tillage by hand, recent access to tractors coupled with total tillage mentality have literally plowed under this promising system. Field schools are working with farmers to improve *wachu rozado* by combining past know-how with modern technologies. For example, FFS have been testing animal traction and tractor implements to fold sod and decrease both mechanized and hand labor requirements (the system only requires one pass with a tractor, rather than three or four as with total tillage). Farmers are also looking at more efficient ways to apply synthetic fertilizers and pesticides, taking advantage of the unique mulching environment. In early plots, FFS have been able to maintain production with 50 percent less external inputs. Scientists from INIAP, the national research service, recently began a project to deepen understanding of the *wachu rozado* system and to build on the empirical results of the FFS.

FFS in Ecuador have also been involved in a research initiative to influence government policy on pesticides. FFS members and their families have participated in a long-term study to understand effects of pesticides on human health, farm productivity, and the environment. Findings in one location have been alarming, with eighty percent of products used belonging to the World Health Organization Hazard Category I agrochemicals. Overuse and careless management of pesticides were found to contribute to adverse effects on human health, including poisoning (171/100,000), dermatitis (48 percent of applicators), pigmentation disorders (25 percent of applicators), and severe neuropsychological effects (peripheral nerve damage, abnormal deep tendon reflexes and coordination). Comparing direct medication costs and recovery, farmers lost the equivalent of six days of work when recovering from a poisoning. Mortality due to pesticides was among the highest reported (21/100,000).

FFS helped to organize a series of community, provincial, and national fora to inform the public of the pesticide situation. This has included a national television program in which an FFS demonstrated its alternatives to decreasing pesticide use. The group is presently working with the FAO and the Pesticide Action Network to eventually eliminate the sale and distribution of highly toxic products.

Rather than operate a single large project, the Ecuadorian initiative brings together funding from multiple sources to build a national program, including various projects focusing on potato systems as well as ongoing project resources of NGO and CBO partners. The project has been progressively maturing, achieving learning and organizational objectives, as it establishes a financial base. Each institution, particularly the NGOs, has invested significant human and material resources. Despite the slow progress, the program is built upon a broad and diverse institutional base. Motivation and organizational commitment appear to be increasing at exponential rates.

Presently, the program is testing a self-financing mechanism based on the model developed by the FAO Global IPM Facility in East Africa. Farmer facilitators are being paid with a portion of the harvest from FFS learning plots. Nevertheless, this approach has caused problems since facilitators and participants tend to be less interested in testing ideas that could potentially harm production. Partners are currently searching for alternatives to participant or community financing of the FFS process.

The four approaches: strengths and weaknesses

The choice for using an FFS approach and the way it was operationalized have mostly been the result of decisions by individual coordinating scientists considering location-specific conditions, local team capacities, and personal convictions. However, we will make an attempt here to compare the approaches and analyze their strengths and weaknesses. Table 1 provides an overview and characterization of the four approaches to FFS use at CIP. In addition to the main purpose that the FFS was expected to serve, the table also shows during what phases in the research and development cycle the FFS was applied and how that was complemented by processes or outputs of other platforms. A full research and development cycle, as applied by most CIP projects reported here, is roughly divided into five phases:

- A needs and opportunity assessment phase.
- A research phase during which technological innovations are developed; this implies basic and applied research the outcomes of which are information and technology components (Innovative technical research phase in Table 1).
- A development phase, during which learning models and mechanisms are developed, based on the FFS principles. This phase implies translation of technical guidelines into learning activities, preparation of modules and a curriculum, and field-testing of protocols (Development of learning model phase in Table 1).
- An extension and implementation phase during which farmers have access to learning opportunities and field test, adapt, and practice what they have learned in their own fields. This phase implies scaling up and out-of-CIP-led efforts (Farmer learning, adaptive research phase in Table 1).
- A monitoring and evaluation phase, both at the level of internal monitoring and evaluation of research and development efforts, and impact assessment of extension and implementation activities.

Table 1 only relates to the second, third, and fourth phases, which are those where FFS has been relevant as a major platform for conducting the activities. The platforms applied during or contributing to these three phases are distinguished between CIP-led platforms (listed on the left and represented by gray boxes), and platforms led by other projects or organizations linked with FFS (listed on the right and represented by black boxes). The shaded boxes across the research and development phases visualize the objectives of the various platforms under the five approaches, and how these platforms are mutually linked within a set of activities.

Table 1. Characterizing different approaches using the farmer field school at CIP.

Approach	Focus of activities – Country*	Main objective of the FFS	Use of platforms by project phase				
				Phase			
				Innovative technical research	Development of learning model	Farmer learning, adaptive research	
1. PR-FFS	Potato IDM – PE, BO, UG, ET, BD, CH	– Applied research on varieties and fungicide management – Development of FFS model – Farmer education					
2. FFS with some PR	Potato production and post harvest – BO, EC	– Development of FFS model – Adaptive research on varieties – Farmer education					
3. FFS after PR	Sweetpotato and potato IPM/ICM – IA, VN, PH, CH, UG, KE	– Farmer education, enhanced with skill and platform development for adaptive research					
4. FFS for community-led research	Potato production and post harvest – EC, BO	– Strengthen development intervention – Strengthen farmer-led, community based innovation					

* IA = Indonesia, VN = Vietnam, PH = Philippines, CH = China, NE = Nepal, UG = Uganda, KE = Kenya, BO = Bolivia, PE = Peru, ET = Ethiopia, BD = Bangladesh, EC = Ecuador, FRT = farmer researcher team

The *PR-FFS approach* served three objectives reflecting the three research and development phases at the same time, while also tapping on outcomes of conventional research activities done elsewhere. Innovative research in the PR-FFS was limited to the development of new information about the interaction between resistance, environment, and disease management, which proved useful for both researchers and farmers. The more straightforward varietal evaluation and fungicide management trials done by farmers rather fulfilled learning and adaptive research purposes. Where over time FFS scaled up and extension programs took over its implementation, gradually a shift has taken place to devote FFS fully to farmer learning and adaptive research. Some initial PR-FFS groups in Peru, however, have specialized in research activities and continue to test control components for late blight. For CIP researchers this provides an interesting opportunity for collectively conducting trials with farmers on new late blight management components, such as simple decision support systems combining resistance and fungicide use.

The *FFS-with-some-PR approach* mainly provided farmers with opportunities for adaptive research on varieties and learning. Learning content drew heavily on outcomes of research done elsewhere, and on links with CIALs. While farmers learned a lot about late blight and its management on the learning field, they did not adapt the strategy proposed by the research institution based on local conditions or improve on it in any meaningful way. Where FFS had a strong focus on post harvest issues, they mainly served to educate farmers and better link them to markets and industries. This involved some farmer research, for example on storage management. Links with CIALs have provided a complementary set of platforms for farmers to collectively work on improving their potato enterprise.

Although experimentation in these FFS did occur, in practice no significant participatory research had taken place. Why did this happen? The strategy is a complex composite technology regarded by researchers who developed it as “finished” rather than a “prototype”. On the IPM learning parcel farmers applied the whole strategy against local practice. There was no need to vary the strategy across the parcel or over time to understand the way in which any of its components affected the overall strategy. Furthermore the strategy had been developed in multiple locations over several cropping seasons. Significant farmer testing of the strategy would also require multiple locations and research over several seasons with different seasonal incidence of late blight. No significant PR took place because the single season single community FFS was too localized a platform to make it possible. Farmers had as much on their plate as they could manage to improve their understanding of late blight and the use of fungicides. Expecting them to engage in meaningful PR under these circumstances did not seem reasonable. For more complex technology and difficult-to-understand problems, PR requires prior training in the technology itself and research methodology. In participatory variety selection, the major variable across treatments, the varieties themselves, is much easier to understand. This explains the success of the FFS in PR with participatory variety selection and its limited progress with integrated management of late blight.

The *FFS-after-PR approach* is part of projects with a clearly phased structure, with the technical content developed separately from, prior to, and facilitated through a different platform than FFS development. The farmer researcher teams in Indonesia undertook quick and focused research, which was needed because not many off-the shelf technologies were available to tackle the constraints in sweetpotato and potato production under prevailing conditions. Other countries could benefit from the outcomes. Farmer researchers have been heavily involved in FFS development as well, and hence strongly contributed to connecting technology development and FFS development phases. For large-scale implementation of FFS, the project established the mechanism and provided backstopping, monitoring, and evaluation to pilot cycles, after which the project was phased over to extension organizations.

A strong point of this approach is that the route that was taken through partly overlapping phases from needs assessment to phasing over to extension organization has been clear to the whole team all the way. As a result, everyone's role was clear during the various phases. Additionally, the participatory research process has been of high quality and genuinely participatory, because farmers are trained on experimental methodologies, assisted throughout the research process and heavily involved in agenda setting, planning, implementation, and analysis. PR in the FFS is limited to adaptive research activities and seldom contributes to producing an innovation. A weakness of the approach is that as soon as activities are phased over to extension organizations, one no longer control has over intensity, direction, and quality of follow-up activities. The quality of experimental methodology taught to farmers has not always been good, leading to limited farmer experimentation in their own fields afterwards. To maintain quality and improve farmer experimentation, longer-term guidance of trainers and FFS farmers would be needed.

The *FFS-with-community-led-research approach* mainly addresses farmer capacity building, with an initial, clear focus on a cropping system but serving other goals, too. When aiming at sustainable agricultural development this should be the final goal for each intervention. However, who should lead such an initiative? An IARC in the lead has the advantage of direct linkages with research activities and access to the latest research outputs. On the other hand, IARCs are not yet structured and geared toward implementing large development programs.

Conclusions

The previous sections have elaborated on how the FFS has been used in CIP-led research and development activities, and how these FFS were linked to other platforms. Four different approaches to the use of FFS were distinguished. Whereas all approaches have provided opportunities for farmers to learn, in an experiential way, about production and post harvest issues in potato and sweetpotato systems, they mainly differed in application and nature of participatory research in the field school. In addition to the experiential learning experiments contributing to farmer knowledge generation but not to the generation of new, public knowledge, in most FFS covered under the four approaches, farmers have become engaged in adaptive research activities. These experiments served to field-test and fine-tune information or technologies made available to farmers through the FFS. In some cases, the FFS has provided a platform for research of a more applied, innovative nature. This is true when researchers have been substantially involved in the research. Intensive researcher involvement, however, tends to limit scaling up. Another differentiating characteristic of the four approaches is found in the extent to which linkages between FFS and other platforms for farmer research, such as CIALs and farmer researcher teams, were established and capitalized upon.

Each of the approaches has its merits and weaknesses and there is no single best approach. The choice of a platform for a certain activity should be done based on clearly stated objectives and analysis of the context to support that platform. To avoid raising false expectations, these objectives and expectations should be specified and agreed upon with the participating farmers. Farmers should be clear about whether they are involved in an activity serving learning or research purposes, or both. The applicability of the research output for farmer practice needs to be clearly discussed with participating farmers, particularly for those activities mainly serving research objectives so as not to raise false expectations.

The various field experiences, and the opportunity to write this paper and do a more analytic comparison, provided several valuable insights. A major lesson we learned is that doing participatory research and organizing farmer-learning activities is a chicken and egg situation. Good PR requires prior learning, whereas designing good learning activities requires prior PR to have a solid technical base. This dilemma was tackled in the FFS-after-PR approach through the phased project implementation and linkages with other PR platforms, whereas FFS primarily served a farmer training purpose. In the PR-FFS and FFS-with-some-PR approaches, the dilemma expressed itself in scale, in that FFS events with more PR were conducted on a smaller scale and at increasing scale PR began to be limited to adaptive research activities. The FFS-with-community-led-research approach mainly drew from existing, conventional research outcomes and encouraged farmers to further conduct adaptive research. When designing a project activity, it is critical to think about how learning activities and PR are brought together under the specific circumstances of the project area. Based on CIP's experiences, this could be within a single joint platform, across two platforms, which exist simultaneously, or through two platforms which are developed one after the other. There may be other possible options. Whatever strategy is chosen, it would be beneficial to look carefully at what other platforms already exist and think about linkage activities and mechanisms. It is also necessary to assess the implications of using a certain platform for both individual participating farmers and researchers and the organizations the various partners represent, with regard to capacity, commitments, and expected outputs. More empirically based work on what works, what doesn't, and why or why not, on platforms for farmer participatory research and learning, objectives to fulfill, and linkages to encourage, is needed and would provide an interesting area of research.

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