16. Beyond higher yields: The impact of sweetpotato integrated crop management and farmer field schools in Indonesia

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Abstract

A pilot program of sweetpotato (*Ipomoea batatas* (L.) Lam) integrated crop management (ICM)-farmer field schools (FFSs) was implemented in six communities in Indonesia, using protocols developed jointly by a team of farmers, researchers, and development workers. Monitoring and evaluation studies showed that participation in the FFS enhanced farmers' crop management knowledge and skills. Several of theirs changed cultivation costs and/or increased yields. Farmers` participation in research was shown to have contributed to the relevancy, appropriateness, and impact of the sweetpotato ICM-FFS protocols.

Introduction

During 1994-97, CIP, with support from UPWARD (The Users' Perspectives for Agricultural Research and development is a CIP-affiliated network of Asian researchers conducting participatory R&D projects in root crop systems) and in collaboration with public and private sector groups, implemented a project to develop a protocol for a sweetpotato ICM-FFS in Indonesia. Collaborators were Mitra Tani, a local non-government organization (NGO); the National Research Institute for Legume and Tuber Crops; and Duta wacana Christian University (Table 1). Project activities were implemented in major sweetpotato growing areas in East and Central Java, where sweetpotato is grown as an important cash crop through out the year, monthly in rotation with rice. The project strategy relied on participatory approaches and methods at all stages: needs assessment and project design, ICM development and farmer learning protocols applying the FFS approach, pilot-scale implementation of the sweetpotato ICM-FFS, and monitoring and evaluation. (For details of project strategy, activities, and outputs, see van-de-Fliert et al., 1996; van-de-Fliert and Braun, 1997; Braun and van-de-Fliert, 1997; Asmunati et al., 1999; van-de-Fliert, 1999.)

To institutionalize the sweetpotato ICM-FFS model that was developed and to allow for large-scale farmer learning and implementation, staff from the National IPM Program (NIPMP) and 30 local NGOs underwent FFS facilitators' training: NIPMP staff in June 1997, NGOs staff in April 1998, follow-up programs were implemented and funded by these local extension organizations, and a second research project was initiated to evaluate their activities over a 2-yr period (1998-99) (Table 1). The work was carried out by Mitra Tani, with methodological and financial support from CIP and UPWARD. Rigorous process and impact evaluation were considered critical elements of a through documentation of the sweetpotato ICM research, development, and dissemination experience.

Sweetpotato ICM is knowledge-intensive and site-specific. Its goal is to achieve sustainable, collective agro-ecosystem management by well-informed and skilled farmers (van-de-Fliert and Braun, 1999). The FFS learning process provides farmers` new knowledge and skills through discovery and experimentation (van-de-Fliert, 1993). Therefore, the monitoring and evaluation study not only measured economic impact of ICM, but analyzed the FFS implementation and dissemination process. In addition, it assessed impact in relation to changed farmer capacity and cultivation practices, and farm-level effects using additional indicators for human, social, and environmental capital.

In 2000, the sweetpotato ICM-FFS project was selected as one of three cases to be included in a study on the costs and impacts of participatory research and gender analysis conducted and funded by the Consultative Group on International Agricultural Research (CGIAR) system wide program on Participatory Research and Gender Analysis for technology development and institutional innovation (PRGA). The objective of the PRGA study was to assess the implications of incorporating different types of user participation into research on farmers' natural resource management, with specific attention on women and the poor. Four categories of impacts are evaluated: 1) adoption and impact of the technologies developed, 2) strengthening of human and social capital among participating individuals and communities, 3) establishment of feedback links to formal research, and 4) costs of doing research.

CIP/UPWARD and PRGA impact evaluations of the ICM-FFS activities are complementary. While both studies looked at the impact of FFS implementation on sweetpotato farmers' knowledge and production practices, the PRGA study additionally focused on the role of user participation in the development of the ICM-FFS. Taken together, their results should provide insight into how user participation influenced the orientation and activities of the research project, and how those changed in turn affected the final impacts of the project technologies.

Methods

The CIP/UPWARD monitoring and evaluation study applied an analytic framework developed with all stakeholders during a workshop at the beginning of the project. Indicators for impact evaluation had been determined with the stakeholders earlier during the ICM research project. The framework considered the various program implementation levels for monitoring and evaluation: 1) training of facilitators, 2) FFS implementation, 3) horizontal dissemination within the community, 4) ICM implementation by trained farmers, 5) farm level effects, and 6) implications for research and development institutions. For each evaluation level, information sources, variables, and indicators were determined, and data collection methods designed as follows.

Pre-FFS:

- Observation and internal evaluation during facilitator training.
- Individual qualitative baseline interviews with FFS participants (who later become ICM farmers).

During FFS:

- Process observation and recording during FFS sessions.
- Pre-tests/post-tests on ICM farmers' knowledge.

Post-FFS:

- Evaluation meetings with participants and facilitators.
- Individual interviews with facilitators, village official, and traders.
- Two-step individual interviews with ICM farmers (FFS graduates) and randomly selected non-ICM farmers.
- Season-long record keeping of post-FFS sweetpotato cultivation by ICM farmers.

- Observations in ICM and non-ICM farmers' field.
- Annual evaluation and planning workshop with all stakeholders.

Farmers were intensively involved in methods design, data collection and analysis, and presentation during a final seminar with research and extension policymakers.

The PRGA study was designed to investigate the benefits and costs of including users in research, particularly on how impacts vary depending on the nature of participation. The conceptual framework is based on a typology of participation, which defines types of participation in relation to who makes decisions about research process priorities and activities (Lilja and Ashby, 1999). For each of the stages of the research process (design, testing, and dissemination) hypotheses were developed relating type of participation to each of the four categories of expected impacts of different types of participation (Johnson and Lilja, 2001). These hypotheses helped guide the design of the empirical methods in each of the three cases. The hypotheses for the ICM-FFS study, which used predominantly collaborative participation, are shown in Table 2.

Both qualitative and quantitative data and analyses were used to examine the hypotheses regarding participation and impact. The study relied greatly on available reports and economic data from the project. Available implementation and production data were analyzed to assess economic impacts. PRGA and CIP staff collected additional data on human and social capital impacts of participation during a field trip in August 2000 by conducting semi-structured interviews with participants and key informants in the project communities. Additional interviews with scientists, policymakers, and extension and development workers were conducted to assess the extent to which there was feedback from the project to the stakeholder groups. Finally, through the analysis of the available data sets and interviews with project staff, the PRGA study team assessed the overall impact of user participation on project goals, activities, outputs, and costs.

Results

Due to limitations of space and the fact that the PRGA analysis is still in process, only a limited number of key results are included here. The first set of results pertains to measurable impacts of the ICM-FFS on farmers' knowledge, skills, production practices, and social relations in the FFS villages. This analysis is followed by a discussion of the role of farmer participation in the design and development of the ICM-FFS, and its implications for impact.

Impact of ICM-FFS on farmer knowledge, skills, production practices, and social relations

FFS implementation and process evaluation

The impact assessment were conducted in the six communities where NIPMP conducted pilot-scale sweetpotato ICM-FFS in 1997/98. Four of the districts were the same as where the earlier ICM research project had been conducted, i.e., Mojokerto and Magetan in East Java province and Karanganyar and Magelang in Central Java. (In East Java, the FFSs were implemented in the same hamlets, although with different farmers than those involved in FFS development). The two additional districts were Sleman in Yogyakarta province, and Kuningan in West Java province. Because the sweetpotato FFSs were organized for rice IPM-

FFS alumni groups, the actual villages selected in Magelang and Sleman were not really major sweetpotato growing communities. Selection of ICM farmers was based on the NIPMP criteria for FFS implementation, and basically involved the rice IPM-FFS alumni.

An overview of sweetpotato ICM-FFS implementation in the six NIPMP sites is given in Table 3. All FFSs conducted at least 17 sessions. Although an initial 25-28 participants were selected in each FFS, the average attendance per session ranged from 16-19 participants, which is comparable to IPM-FFS implementation in other crop (Eveleens et al., 1996). Although only 27% of FFS participants were women, they were substantially represented in three communities: Magelang (49%), Sleman (56%), and Kuningan (60%). The variation in women's participation reflects the regional variation of women's involvement in sweetpotato cultivation. In addition to curriculum activities, all FFS groups designed and conducted their own experiments to test and refine the ICM guidelines and to practice experimental methods. The experiments dealt with either fertilization or varietal evaluation.

Both training- of-facilitators and FFS models increased knowledge among trainees and demonstrated potential impact of ICM in sweetpotato cultivation. Knowledge increase of FFS participants ranged from 28% to 254% per group (Table 3). Increase yield (Figure 1) and more effective or efficient use of external inputs were demonstrated on collective learning plots in most of the sweetpotato ICM-FFSs. The farmers generally credited the FFS process with adding to their knowledge and skills. Knowledge areas singled out included pest and diseases, natural enemies, seed health, soil health, and plant nutrient management. Skills areas included routine field observations, experimentation, fertilization, seedbed preparation, pest management (none or reduced pesticide use), and vine lifting.

Effects at farmer level (human capital)

To assess the impact of the FFS on participants' knowledge and skills, post-FFS comparisons were made between farmers who had attended the ICM-FFS (ICM farmers) and those who had not (non-ICM farmers). Regarding production-related knowledge and practices, results show that ICM farmers are more likely to understand the concept of natural enemies and do a more thorough job on field observation than no-ICM farmers (Table 4). Enhanced knowledge and skills resulted in several changes in farmers' sweetpotato cultivation practices. More ICM than non-ICM farmers practiced seed selection and good water management. Fertilization practices changed in that more ICM farmers applied more balanced fertilization. ICM farmers were significantly more likely to use potassium (K) fertilizer than non-ICM farmers ($P < 0.05$), and they applied higher average rates. More ICM than non-ICM farmers used organic fertilizer, albeit at lower application rates. Several seasons later, however, farmer researchers reported the use of organic manure as one of the major benefits of ICM. Over time still more farmers are beginning to use it and understand its benefits. Surprisingly, pesticide application frequency was not influenced by ICM training. Thirty percent of ICM farmers applied 1 or 2 applications of pesticides on the sweetpotato crop during the post-FFS season, which is exactly the same as before training, and slightly more than among non-ICM farmers (21%), who, however, give only 1 or 2 applications as well. One reason may be the already low levels of pesticide use in these areas. More ICM than non-ICM farmers, however, began to implement field sanitation to manage sweetpotato weevil.

However, yield assessment skills of ICM farmers did not visibly improve (Table 4). Nevertheless, attention to marketing in the ICM-FFS seemed to have helped ICM farmers in all except one district to negotiate for a somewhat better price (Figure 1), although the data are only significant for Mojokerto ($P = 0.063$). In Magetan, ICM farmers effectively received a lower per kg price than non-ICM farmers ($P = 0.056$), because they were unable to negotiate a higher per area unit price with the traders, even though they obtained higher yields.

Another important indicator of human capital is the ability of farmers to experiment in their own field. We found no difference in experimentation between ICM and non-ICM farmers. However, that may be due to a bias in the data. Nearly all the non-ICM farmers who reported experimenting were from Mojokerto, where the farmers` researchers who worked on the development of the ICM-FFS curriculum during 1994-1995 had a particularly strong influence, resulting in an unrepresentative global average for non-ICM farmers. In Karanganyar and Kuningan, the FFS groups continued with collective rather than individual experimentation on ICM components in the sweetpotato crop after the FFS season. Observations of the study team confirm that ICM farmers do have better skills and more interest in experimentation.

Effects at the farm level (financial capital)

Changes in knowledge, skills, and practices appear to have translated into a 24% higher average net income for ICM farmers compared with non-ICM farmers. ICM farmers obtained slightly higher (5%) sweetpotato yields than non-ICM farmers. That was not, however, significant over the whole data set (Table 4). By district, yield differed significantly (by 1 test) in Magetan and Sleman ($P < 0.05$) and Mojokerto ($P < 0.10$). On average cultivation costs of ICM farmers were 15% less ($P < 0.05$) than those of non-ICM farmers. But on a district basis the difference was significant only in Karanganyar ($P < 0.05$) and Magetan ($P < 0.10$) (Figure 1). ICM farmers tended to spend slightly, but not significantly, more on inorganic fertilizer inputs, which was mainly a result of their higher use of the more expensive fertilizers such as K. The cost of land rental and use of hired labor was the same for both groups.

Slightly higher yields and market prices were responsible for ICM farmers receiving a 10% higher gross income from sweetpotato than non-ICM farmers (Figure 1). But the difference was significant only in Kuningan ($P < 0.10$). Due in part to their lower cultivation costs, ICM farmers did achieve a significantly greater net income/ha than non-ICM farmers ($P < 0.05$), particularly those in Mojokerto ($P < 0.10$) and Karanganyar ($P < 0.05$).

The ICM-FFS teaches a broad range of technologies and practices relating not only to crop production but also to farm management and marketing. One way to assess the combined impact of the new knowledge, skills, and practices is to look at how ICM-FFS attendance affects the overall profitability of sweetpotato production.

The dependent variable in the profit function is net income/ha from sweetpotato production. Independent variables that are expected to influence profitability include expenditure on fertilizer (mean value = US $43/ha) and hired labor (mean value = US $100/ha), and dummy variables for land tenure status (26% farmed rented land), for whether the farmer attended ICM-FFS (60% attended), and for water management practices used (59% used routine rather than sporadic irrigation). Community dummy variables were also included to control for the influenced of local conditions. A Cobb Douglas functional form was assumed.

The results of the analysis show that participation in ICM-FFS is significantly and positively associated with net income from sweetpotato production (Table 5). (One explanation for the fact that participation in ICM-FFS is positively and significantly associated with net income from sweetpotato production could be that the ICM-FFS participants were already better farmers than nonparticipating farmers. To rule out possibility, baseline production data collected before the development of the ICM technologies and practices were analyzed, and did not show that farmers who would subsequently participate in ICM-FFS had higher yields or net incomes than those who did not. In fact, the opposite was true, suggesting that the results presented in this paper may underestimate the economic benefit of the ICM-FFS.)

Participants in ICM-FFS have higher net incomes than non-participants, after controlling for other factors such as land tenure and water availability. The community dummy variables are significant for Kuningan and Karanganyar, the communities with very favorable ecological conditions for sweetpotato production, and where the response to the ICM-FFS was most enthusiastic. Neither fertilizer expenditure nor hired labor costs were significantly associated with profitability of sweetpotato production. As mentioned earlier, ICM farmers use more costly K-fertilizer but less N-fertilizer than non-ICM farmers (Table 4). In an earlier version of the analysis, gender was included as a dummy variable, however, it was not significant and therefore results are not presented here.

Effect at the community level (social capital)

The collective activities of FFSs are carried out in a group and are intended to strengthen the capacity of farmers to work together, to share information, and to learn from each other (Van de Fliert, 1993). To assess impacts of the ICM-FFS on these social capital variables, data were collected on farmers' practices regarding sharing information about the FFS and about agriculture in general, and about their participation in group activities with other FFS members. The majority of ICM farmers (68%) reported disseminating sweetpotato ICM information to other farmers or neighbors. There was, however, wide variation between the communities. In five of the six communities, over 90% of participants talked about the FFs with others, but in Magetan only 41% did so. Magetan, it should be noted, was where the research had taken place. Most of the villagers were aware of at least the general issues of the sweetpotato ICM-FFS.

On average, each participant talked with 3 people. Nearly all the information exchanges on sweetpotato ICM occurred in the field (53%) or in home/group meetings (42%). In Karanganyar and Sleman, dissemination also occurred beyond the village where the ICM-FFS was conducted. Men and women differed significantly in whom they talked to about FFS. Men talked much more with neighbors and almost exclusively with other men. Women talked much more with relatives and similarly almost exclusively with other women. ICM information transmitted to other nonparticipating farmers mainly dealt with variety and healthy seed selection (62%), plant nutrient management (54%), sweetpotato pest and diseases (35%), soil preparation and health (10%), and yield assessment (10%). Spontaneous diffusion of information between farmers, however, cannot be considered an impact of the project. Interviews with farmers and other key informants suggest that the communities have a long history of sharing agricultural information. The high levels of spontaneous dissemination are related to high existing levels of social capital in the communities. In several communities, FFS groups have continued to engage in collective experimentation, something they did not do before participating in the sweetpotato ICM-FFS.

The contribution of farmer participatory research to the impact of the ICM-FFS

As mentioned earlier, the research process that led to the development of the ICM technologies and practices and the ICM-FFS curriculum were developed in a participatory mode. Farmer input was obtained from needs assessment data and from an intensive process of collaborative research with eight farmers in four communities over a period of 3 years. Both farmers and researchers conducted experiment, and regular workshop were held to present findings, analyze results, and plan future work.

The importance of farmers' contributions to the research process was made clear early when it was discovered that farmers did not believe that pests were the main constraint to sweetpotato production. The original CIP/UPWARD project had called for the development of an integrated pest management (IPM) FFS curriculum. Farmer input resulted in a shift from IPM to ICM. Within the ICM framework, topics the farmer identified as important and on which they carried out experiments included plant nutrient management, varietal selection, and cultural practices such as planting methods, vine lifting, and intercropping. In four of these five areas, the farmers' experiment generated results for practices and guidelines that were included in the final curriculum. The experience working with farmers also contributed to the ICM-FFS focus on health, and its emphasis on teaching principles and experimental methods.

These impact results show that the major areas in which the FFS enhanced farmers knowledge, productivity, and profitability were in plant nutrient management, water management, varietal and planting material selection, and overall better observation skills. An FFS focused entirely on pest management would likely have had much less impacts. Fertilizer and seed selection were by far the two topics most commonly mentioned by ICM-FFS participants when they talked to other farmers. That suggests that they are the elements that will be most widely disseminated informally. The results regarding individual and group experimentation indicate that an ongoing process of productivity improvement may have been set in motion by the ICM-FFS process.

Conclusions

Sweetpotato ICM-FFS has contributed to increased knowledge and skills among farmers who participated. These human capital increases have resulted in concrete changes in production and marketing practices that contributed to higher yields and higher income from sweetpotato production. These results were essentially achieved by improving the efficiency of existing practices rather than by introducing totally new technologies. Farmers participation in the research process, particularly in the identification of possible areas for improving efficiency, appears to have contributed to both the relevance and the impacts of the ICM-FFS.

Whereas most of the impacts shown in this study are significant statistically, they may seem to be less so in practical terms. The magnitude of the differences of individual parameters between ICM and non-ICM farmers are often relatively small, but taken as a whole they indicate the initiation of change in farmers' crop management behavior. As mentioned earlier the data may underestimate the true differences between ICM and non-ICM farmers, mainly as a result of the inability to control for spillover effects from participants to non-participants. Given that ICM is complex and that increased knowledge does not immediately result in changed practices, it is likely that over time the benefits from ICM-FFS may grow. Subsequent field visits as part of the PRGA study gave that impression. A final factor that could have affected the magnitude of the observed impacts is the Asian financial crisis that hit Indonesia in 1997. The profitability of sweeetpotato was drastically reduced, hence the reduced incentives for farmers to invest in it.

Nonetheless, the question of whether the benefits justify the costs of ICM-FFS is valid. This issue will be examined in greater detail in the forthcoming PRGA study. Participatory development of the sweetpotato ICM-FFS took several years and was intensive due to the amount of component research required to fill the gap of technological guidelines for the crop. In addition, a broader and more widely applicable FFS model was developed and documented. That facilitated similar CIP projects in other countries in and beyond the region. To assess cost effectiveness of the project, it would have to be compared with a conventional CIP research project with similar scope aimed at both productivity enhancement and natural resource management, rather than with a conventional extension-oriented FFS.

The six pilot field schools were conducted in the selected districts to trigger interest from local authorities so that they might allocate funds for larger-scale implementation. But the economic crisis that hit Indonesia in 1997 onwards, and simultaneous failures in some major rice bowls in Indonesia during 1998, caused all agricultural development to be allocated to rice production. Expansion of sweetpotato FFS implementation within the government extension system has not yet been achieved. The newly established Directorate of Root Crops Production has committed itself to organizing a nation wide sweetpotato ICM-FFS program whenever the economic situation allows. It is hoped that the results of this study will contribute to the implementation of the program. Additionally, NGO programs have continued to apply ICM-FFS approached in sweetpotato and other crops, and these efforts will be evaluated during 2001-2002.

References

Asmunati, R., Wiyanto, and E. van de Fliert. 1999. Integrating sweetpotato ICM and FFS approaches in government and NGO initiatives in Indonesia, In: Users' Perspectives for Agricultural Research and Development (UPWARD), Learning to manage livelihoods: New perspectives in root crop R&D.UPWARD, Los Banos, Laguna, Philippines. P. 129-139.

Braun, A.R. and E. van de Fliert. 1997. The farmer field school approach to IPM and ICM in Indonesia: User participation. In: UPWARD. Local R & D: Institutionalizing innovations in rootcrop agriculture. (Users' Perspectives for Agricultural Research and Development (UPWARD), Los Banos, Laguna, Philippines. P. 44-46.

Eveleens, K.G., R. Chisholm, E. van de Fliert, M. Kato, P.T. Nhat, and P. Schmidt. 1996. Mid-term review of phase III report. FAO Inter-country program for the Development and Application of integrated Pest Control in Rice in South and Southeast Asia, Makati, Metro Manila, Philippines.

Johnson N. and N. Lilja. 2001. Characterizing and measuring the effects of incorporating stakeholder participation in natural resource management research: Analysis of research benefits and costs in three case studies. Participatory Research and Gender Analysis (PRGA) Working Document. PRGA/Centro Internacional de Agricultural Tropical (CIAT), Cali, Colombia.

Lilja, N. and J.A. Ashby. 1999. Types of participatory research based on locus of decision-making. Participatory Research and Gender Analysis Working Document (PRGA) No. 6. PRGA/CIAT, Cali, Colombia.

Van de Fliert, E. 1993. Integrated pest management: Farmer field schools generate sustainable practices. A case study in Central Java evaluating IPM training. Wageningen, Netherlands. 304 p.

Van de Fliert, Elske. 1999. Integrative, farmer-participatory methodology for poverty-sensitive research: Sweetpotato and potato integrated crop management in Southeast Asia. Paper presented at the Centro Internacional de Agricultural Tropical International Workshop Assessing the impact of agricultural research on poverty alleviation held 14-16 September 1999, San Jose, Costa Rica, 14 p. Available at:
http://www.ciat.cgiar.org/poverty/bar_papers.htm.

Van de Fliert, E. and A.R. Braun. 1997. One step back, two step forward: Sweetpotato ICM development in Indonesia, in: UPWARD. Local R&D: Institutionalizing innovations in rootcrop agriculture. UPWARD, Los Banos, Laguna, Philippines. P. 153-167.

Van de Fliert, E. and A.R. Braun. 1999. Farmer field school for integrated crop management of sweetpotato: Field guides and technical manual. International Potato center, Bogor, Indonesia.286 p.

Van de Fliert, E., R. Asmunati, Wijanto, Y. Widodo, and A.R. Braun. 1996. From basic approach to tailored curriculum: Participatory development of a farmer field school model for sweetpotato. In: UPWARD. Into action research: Partnerships in Asian rootcrop research and development. UPWARD, Los Banos, Laguna, Philippines. P. 59-74.

Table 1. Overview of the CIP/UPWARD-supported sweetpotato ICM-FFS development and evaluation projects in Indonesia, 1994-1999

Research phase	Needs assessment And baseline	Technology (ICM) development	FFS development and Institutionalization	PM&E of SP ICM FFS implementation
Project I : Sweetpotato ICM and ICM-FFS development				
1994/95 wet season	PRA, RK, FO			
1995 dry season	RK, FO	8	Pilot FFS in SP	
1995/96 wet season	RK, FO	17(3)	Write modules	
1996 dry season		14(6)	Pilot SP ICM FFS	
1996/97 wet season		12(2)	Revise Modules	
1997 dry season		6	ToT NIPMP	
Project II : PM & E				
1997/98 wet season				Process M & E
1998 dry season			ToT NGOs	Process and impact
1998/99 wet season				Impact evaluation
1999 dry season				Analysis

ICM-FFS = integrated crop management-farmer field school.
PRA = participatory rural appraisal methods, RK = season-long record keeping, FO = field observations.
Number of farmer-managed trials; number of researcher-managed trial in parentheses.
NIPMP = National Integrated Pest Management Program, Indonesia.
PM&E = participatory monitoring and evaluation.

Table 2. **Hypotheses for the ICM-FFS study**

Stage	Type of participation	Hypothesis
Design	Consultative	Farmers participation results in an increase in the proportion of the targeted beneficiary group that could be reached by the project because the priority topic chosen for research is more relevant to the needs and priorities of targeted farmers (H1)
Testing	Collaborative	Farmer participation at the testing stage results in an increase in the number of potential adopters within the target group since the specific technology or technologies selected for recommendation are more appropriate, given farmers` criteria and constraints (H2)
Dissemination	Collaborative	There is an increase in the probability that potential adopters for whom the technology or technologies are appropriate will be aware of them and be willing and able to adopt them and to recommend them to others (H3)

Table 3. Overview of implementation and process evaluation of six NIPMP-conducted sweetpotato ICM farmer field school, 1997- 1998

District Variable	Mojokerto East Java	Magetan East Java	Karanganyar Central Java	Magelang Central Java	Sleman Yogyakarta	Kuningan West Java
Major sweetpotato growing area	Yes	Yes	Yes	No	No	Yes
FFS implementation	Jan-Jun98	Aug-Dec 97	Sep97-Feb98	Sep-Dec97	Aug-Nov97	Nov97-Apr98
Season	(wet/dry)	(dry/wet)	(wet)	(dry/wet)	(dry/wet)	(wet)
Meetings (no.)	17	17	17	18	17	17
Participants (range)	10-25	11-27	14-27	11-27	11-27	13-28
Meetings (avg. no.)	16	18	19	18	16	17
Women participation (% of trainees)	0 %	0 %	7 %	40 %	56 %	60%
Experiments conducted	Fertilization (application rate; organic)	Varieties; N Application rates	Fertilization (potassium, N-K rates)	Varieties	Varieties	Organic fertilizer
Avg. knowledge Increase between pre- and post-test	56 % (13)	28 % (20)	48 % (24)	126 % (25)	40 % (10)	254 % (19)

In addition to standard FFS trials.

Pre-and post-test consisted of 10-15 questions each. Scores correspond with the number of correctly answered questions. Percentage knowledge increase is calculated by ((score post-test – score pre-test) / score pre-test)* 100 %. The figures in the table represent the average knowledge increase of all participants per FFS who did both pre-and pest-test (number of respondents give in parentheses).

Table 4. Differences in knowledge and skills, practices, and inputs and outputs of sweetpotato cultivation during a post-FFS season by ICM-FFS participation

Variable	ICM (N = 73)	Non-ICM (N = 50)
Knowledge and skills		
Understand the concept natural enemy (%)	86	52
Practice routine/thorough field observation (%)	75/47	75/29
Conduct experiments (%)	18	16
Can assess yield within reasonable range (%)	48	53
Cultural practices		
Practice seed selection (%)	45	37
Practice good water management (%)	68	58
Use N-fertilizer (%/kg N/ha)	96/223	92/242
Use P-fertilizer (%/kg N/ha)	68/78	60/58
Use K-fertilizer (%/kg N/ha)	28/20	13/7
Use organic fertilizer (% t/ha)	35/1.3	29/1.6
Pesticides applications (avg. no./season)	0.4	0.3
Practice field sanitation after experiencing weevil attack (%)	49	30
Inputs and Outputs		
Value of hired labor (US$/ha)	107	112
Value of inorganic fertilizer use (US$/ha)	29	27
Value of total cultivation cost (US$/ha)	201	237
Yield (t/ha)	20.5	19.5
Price received (US$/t)	32	30
Net income (US$/ha)	391	316

Exchange rate of Rp. 8,500/US$ 1.00.
Significant at $P < 0.05$.
In addition to cultural practices, the FFS also included yield estimation of the crop in the field. Sweetpotato farmers in Java often sell their standing crop, so the ability to accurately assess yields is an advantage when negotiating a selling price.
During the needs assessment, farmers had identified their weak bargaining power as a major constraint to achieving a good income from sweetpotato.
Magelang is excluded from the analysis because there are no non-ICM cases in this community

Table 5. Results of estimation of sweetpotato profit function coefficients; dependent variable is long of net income per hectare (N = 81, adjusted R = 0.05)

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

Magelang is excluded from the analysis because there are no non-ICM cases in this community and Sleman is excluded because it is not an important sweetpotato growing area.

Figure 1. Sweetpotato storage root yield, market price, gross and net income, and cultivation costs: performance comparisons between FFS plots, farmers trained in ICM, and non-participating in Magelang, East Java