Assessing the Impact of Farmer Field School Participation on IPM Adoption in Uganda

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Abstract

The Integrated Pest Management Collaborative Research Support Program (IPM CRSP) has been implementing IPM farmer field schools (FFS) with small scale farmers in Eastern Uganda since 2001. This study assesses the impact of cowpea-specific IPM FFS on IPM knowledge and the theoretical link between increased knowledge on the adoption of IPM strategies. The assessment was conducted to evaluate the impact of IPM FFS on adoption of IPM strategies. Comparison groups consisting of FFS participants and non participants were used to evaluate the impact of FFS on IPM knowledge and cowpea specific IPM strategies. A summated ratings scale consisting of five attributes was used to measure farmers' knowledge of IPM and another summated scale consisting of five IPM strategies for cowpea was used to measure adoption. The results indicate that participation in FFS leads to more knowledge of IPM and knowledge of IPM is the most important variable in explaining adoption of IPM strategies. These results provide a confirmation of the adoption decision making process and a validation of FFS as an effective mechanism for increasing both knowledge of IPM and the adoption of cowpea specific IPM strategies. Farmers were more likely to adopt component strategies rather than the entire IPM package. The diffusion of IPM knowledge and strategies to farmers who did not participate in the FFS appears to have been limited.

Key words: technology transfer, farmer field schools (FFS), integrated pest management (IPM), adoption, Uganda

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Introduction

Throughout sub-Saharan Africa there is a growing consensus that inadequate systems and methods of technology transfer have limited rapid and broad-based dissemination and adoption of many improved agricultural technologies including integrated pest management (IPM) strategies (Rajotte, Norton, Luther, Barrera, & Heong, 2005; Gutierez, 2003; Maredia & Minde, 2002; Morse & Buhler, 1997). This has led to a search for and experimentation with alternative methods of technology design and dissemination. In the1980s, participatory agricultural research (PAR) emerged as an attempt to enhance technology suitability and transfer by engaging farmers in the research process.

IPM farmer field schools (FFS) emerged out of participatory farmer training activities in Southeast Asia in the late 80s as an approach to reach larger numbers of farmers with essential IPM principles and scientifically derived knowledge and practices (Simpson & Owens, 2002; Feder, Murgai, & Quizon, 2003). The perceived success of IPM FFS, particularly in Indonesia, in training large numbers of farmers and reducing the use of synthetic pesticides, led to the adaptation and application of this approach to other topics and to other areas of the world (Quizon, Feder, & Murgai, 2001; Tripp, Wijeratne, & Piyadasa, 2005).

From 1995-2000, the Integrated Pest Management Collaborative Research Support Program (IPM CRSP) used a PAR approach at on-farm research sites in eastern Uganda to promote IPM and develop IPM strategies for small scale farmers growing cowpea, groundnuts, and sorghum. An evaluation of this project conducted in 2000 concluded that although participating farmers demonstrated a greater knowledge of IPM than non-participants, the number of project beneficiaries was relatively small and IPM knowledge diffusion was limited (Erbaugh, Donnermeyer & Kibwika, 2001). In an attempt to scale-up and reach more farmers, the IPM CRSP combined with the Rockefeller Forum supported Makerere University Grain Legume Project (MUGLP) in 2001, to implement modified farmer field schools with groups of farmers in eastern Uganda.

The primary objective of the FFS was growing a “healthy crop” and the experiential learning approach, a cornerstone of FFS, was adhered to in covering additional topics including pest and disease identification, agro-ecological interactions, and implementing participatory field trials. An additional objective of the IPM CRSP FFS was to communicate and demonstrate cowpea specific IPM strategies that had been developed during the previous six years of participatory agricultural research. Although some argue that the main objective of FFS should be to convey some combination of farmer empowerment, improved farmer decision making and critical thinking skills, others maintain that measuring these outcomes is often difficult and ignores the essential rationale of agricultural development activities to improve small farmer livelihoods through the dissemination of improved farming practices (Bunyatta, Mureithi, Onyango, & Ngesa, 2006; Tripp et al., 2005).

To accomplish these objectives the field school syllabus was modified to focus on the demonstration and dissemination of crop specific IPM strategies. The expected outcomes were to be increased knowledge of IPM, adoption of crop specific IPM strategies, and the diffusion of knowledge and practices via farmer-to-farmer communication. Groups of 20-25 farmers were asked to attend one session every two weeks over the length of an entire growing season or 16 weeks. Each FFS was facilitated by an extension worker who had attended a training-of-trainers workshop (Amujal, 2004).

This study assessed the impact of FFS on IPM knowledge and the theoretical link between increased knowledge on the adoption of IPM strategies. Previous research in the diffusion of agricultural innovations asserts that awareness and knowledge of a new technology is a necessary first step in the adoption, decision-making process (Rogers, 1995). Although a range of IPM FFS assessments have now been conducted there is little agreement as to the framework for these evaluations (van den Berg, 2004; Simpson and Owens, 2002; Quizon et al., 2001). This assessment was conducted to evaluate, modify, and improve the effectiveness of IPM FFS programs in Uganda by the IPM CRSP.

Purpose and Objectives

The main purpose of this study was to assess the impacts of FFS on the adoption of cowpea-specific IPM strategies by farmers in eastern Uganda. The theoretical relationship between enhanced IPM knowledge and adoption is also examined. Traditionally, IPM program effectiveness has been evaluated by assessing the adoption of new technologies and monitoring reductions in pesticide use (Zalom, 1993; Tripp et al., 2005). Participatory approaches and FFS have placed more emphasis on increasing knowledge and awareness of key concepts and creating better farm managers through the development of critical thinking skills. This evaluation is an attempt to provide a framework for merging these two approaches by assessing both increases and adoption of IPM strategies. The specific objectives are to: (a) compare FFS participants and non-participants on knowledge of IPM; and, (b) compare FFS participants and non-participants on the adoption of IPM strategies for cowpea.

Methodology

Evaluation Approach

The assessment of FFS participation on the adoption of IPM strategies corresponds to the model suggested by Bennett and Rockwell in Targeting Outcomes of Programs (TOP) (1995). Their model involves seven stages to guide both program development and program performance assessment. These stages are arranged in ascending order with each stage serving as a step towards achieving higher order program impacts.

This particular assessment focused on stages five (knowledge, attitudes, skills and aspirations) and six (adoption of practices), with the assumption that changes in stage five, as a result of participation in FFS (stages two through four), will lead to changes in stage six. Increased awareness and knowledge are generally considered prerequisites to the adoption of new practices and technologies, including IPM (Rogers, 1995). Since farmer adoption of IPM strategies was an important project goal and FFS objective, this study assesses the effectiveness of FFS in achieving this goal.

Population and Sample

A multi-staged sampling procedure was used to select farmer field school participants and non participants from Kumi and Pallisa districts in eastern Uganda. These two neighboring districts were purposively selected because they are two of the most important cowpea growing districts in Uganda; and share similar agro-ecologies, an ox-plough based farming system and ethnic composition. FFS participants were selected from lists of farmers who had participated in one of six FFS, 3 per district, during the previous year. A systematic random sample of 15 farmers was selected from each FFS list, totaling 45 per district and 90 FFS participants in all.

Control Group

One of the basic principles of impact evaluation design is selection of a control group (Bamberger, Rugh, Church, & Fort, 2004). Non participants were selected to serve as a control group and were defined as those who had not participated in any field school activities**.** There was no assumption that non participants had not received any information about IPM or cowpea IPM strategies. To the contrary, sampling of non participants was purposively conducted in three parishes bordering each FFS to look for any spill-over effects from the field schools. In each of these parishes lists of farmers were obtained from Local Council officials, and five names per parish were randomly selected. The process resulted in the selection of 90 farmers who had not participated in FFS. The final sample consisted of 90 FFS participants and 90 non-participants for a total sample size of 180.

Data Collection and Instrumentation

A draft questionnaire was assembled from previous instruments used to examine socio-economic background characteristics, pest management practices, knowledge of IPM attributes, and FFS assessments. Added to the instrument were specific questions designed to measure adoption of four cowpea specific IPM strategies. The questionnaire was vetted in an intensive two-day session with enumerators. The goals of the training were to have field enumerators contribute to instrument design; insure their understanding of the instrument; and identify sampling frames. Revisions to the instrument included the deletion of several items to reduce the length of the questionnaire. Six extension workers (four female and two male) who had earlier participated in a pre and post test assessment of FFS (Amujal, 2004) were used as enumerators for this study because they were familiar with study objectives and had been previously screened for familiarity with the local language (Iteso), and knowledge of survey methodology and the local farming system. A one-day training workshop for enumerators was held to review the final questionnaire. A pre-test of the instrument was conducted by teams of enumerators with five farmers. All questionnaires were completed through personal interviews conducted by one of the six interviewers. Each enumerator completed 30 questionnaires with either FFS participants or non participants.

Group Comparability

To assess the impacts of FFS on knowledge of IPM and the adoption of IPM strategies, the degree of comparability between FFS participants and non participants was assessed. This was deemed necessary to check for sample selection bias. Using a T-test of mean differences, the two groups are compared on the basis of socioeconomic criteria including sex, age, years of education, household size, farm size, acres in crops and cowpea, and total family income.

IPM Knowledge

Knowledge of an innovation is usually preceded by awareness of a need, and it is need-awareness that precipitates active knowledge seeking behavior in order to address the need. Since IPM is a multi-dimensional concept (Dent, 1995), a summated ratings scale consisting of four attributes, with a score range of 0-11, was devised to measure farmers' knowledge of IPM. Each of these knowledge attributes were considered fundamental to a strong working knowledge of IPM and have been validated in previous IPM studies in Uganda (Erbaugh, et al., 2001; Morse & Buhler, 1997). The coefficient of reliability for the knowledge of IPM scale was .84, indicating an acceptable level of reliability (Nunnally, 1978, p. 245). The first item requested interviewers to evaluate farmers' ability to define these dimensions or attributes of IPM on 0-2 scale, where 0 indicated an inability to define IPM; 1, indicated a partial definition of IPM; and, 2, indicated a more complete definition. Partial and more complete definitions were scored if farmers mentioned one or more of the attributes of IPM including, reducing use of pesticides or using them selectively, using alternative practices besides pesticides to control pests, or protecting beneficial organisms. The second item asked farmers if they were aware of any harmful effects from using pesticides, and was coded 0 if they were unaware; and 1-3 if they were aware of one or more of the potential harmful impacts from using pesticides. A third item asked farmers if they could name any beneficial insects, with a no response coded 0, and naming beneficial insects coded 1-3. The fourth item asked farmers if they knew other practices to control pests and diseases besides using pesticides, with a no (0) response indicating that they were not aware of other means to control pests besides using pesticides and the mentioning of alternative control methods coded 1-3. Alternative control methods mentioned included crop rotation, fallowing, increasing plant populations, roguing diseased plants, hand-removal of pest species, using homemade concoctions, use of locally available bio-rational products, and use of resistant or tolerant varieties.

Factors Associated with Adoption of IPM

The traditional diffusion model has long been employed in the U.S. and sub-Saharan Africa to explain the adoption of farm technologies (Rogers, 1995). However, factors associated with the adoption of IPM practices in developing countries are not well documented. The basic premise of the diffusion model is that adoption behavior is influenced by personal background characteristics, or human capital, such as experience or its surrogate age, and level of education that, in turn, facilitate understanding, access, and exposure to information associated with a particular technology (Pfeffer, 1992; Padel, 2001). Participation in FFS is a direct measure of farmers' access to information. Age and years of education were continuous variables. Education was measured by the number of years of formal education completed. Gender also has been suggested as an important background characteristic that affects access to information and influences adoption (Blumberg, 1992). Sex was a dummy variable with women coded 0, and men coded 1. Others have argued that adoption is better explained by the differential possession of economic assets such as capital and land (Hooks et al., 1983). Total family income was measured as the approximate mean annual farm and off farm incomes separately in Uganda shillings (UGS). Cowpea acreage is the amount of land in cowpea production and was used instead of total farm size because it more accurately reflected each household's resource capacity for putting land into production and the priority of cowpea in the farming system. Adoption of new technologies has long been linked with need (Rogers, 1995), and thus it was assumed that those with greater cowpea acreage would have more need and be more willing to adopt improved cowpea growing methods such as IPM. Distance (kilometers) to sources of inputs such as pesticides can also affect their use. In this case, distance is used as a proxy for capturing the substitutability between IPM strategies and synthetic pesticides. Finally, Lucas and Freedman (1983) note that IPM, in most cases, substitutes knowledge for capital, implying that knowledge of a complex technology such as IPM is critical to adoption.

Adoption of Cowpea Specific IPM Strategies

Through the PAR activities of the IPM CRSP, five IPM strategies were developed for managing the most important pests and diseases of cowpea in eastern Uganda. The first strategy was early planting and was defined by farmers as occurring 7-10 days following the onset of rains. Early planting is important to avoid the build-up of destructive pest populations. The second strategy was correct plant spacing and density. Besides facilitating improved crop management, proper plant density controls the humidity levels between plants which can reduce plant diseases and certain insect pests (Adipala, Obuo, & Osiru, 1997). The recommended plant spacing was 60 cm X 20 cm, which converted to 15-21 plants per square meter. Plant density was measured in each farmer's field by placing a 1m X 1m quadrant in the center of the field and then counting the number of plants. This strategy was recommended to increase plant population and to counter the farmers' traditional practice of broadcast seeding. The third strategy was growing an improved cowpea variety, MU.93, that displayed both insect and disease tolerance and was high yielding.

The fourth strategy was to use synthetic pesticides three times during the crop cycle at budding, flowering, and podding. An earlier baseline study found that farmers in eastern Uganda sprayed their cowpea as much as ten times per season (Erbaugh, Kyamanywa, Epieru, & Mwanje, 1999). The fifth strategy advised farmers to scout their fields on a regular basis for destructive pests and diseases and to spray only when pests were observed in the field as opposed to the traditional farmer practice of spraying regularly following plant emergence.

All five IPM strategies (see Table 1) were coded 0, if farmers had not adopted; coded 1, if they had adopted the specific strategy and combined into two summated adoption scales. Adoption scale "A" used all five IPM strategies, had a score range of 0-5, and a coefficient of reliability of 0.64**.** Scale reliability was lowered by including the three-spray strategy. However, it was decided to retain this strategy in scale "A" because it had been field-tested and recommended. Adoption scale "B" combined four strategies by dropping the three-pesticide-spray strategy. It had a score range of 0-4, and a coefficient of reliability of 0.66.

Table 1
Inter-item Correlations of IPM Strategies

IPM Strategies	Range	Early Planting	Plant Spacing	Improved Variety	Field Scouting	Pesticide Sprays
Early Planting	0-1	-				
Plant Spacing	0-1	.300**	-			
Improved Variety	0-1	.266**	.628**	-		
Field Scouting	0-1	.101	.370**	.297**	-	
Pesticide Sprays	0-1	.169	.212**	.141	.112	-
Scale Total	0-5					
Mean	1.86	.24	.27	.22	.59	.53
Standard Dev.	1.45	.43	.44	.41	..49	.50

** Correlation significant at .01 level; * Correlation significant at .05 level

Data Analysis

A t-test of mean differences was used to assess the impact of FFS on awareness/knowledge of IPM. A summated ratings scale consisting of five attributes of IPM knowledge was used as the dependent variable. To examine the effects of IPM knowledge on adoption of IPM strategies, a Poisson Event Count Model was estimated.

IPM systems (packages) generally consist of several interdependent strategies such as cultural controls, pest monitoring, host plant resistance and biological control agents. Each of these strategies could be adopted individually or in farmer-selected combinations based on their specific means and needs (Bentley and Andrews, 1996). In these cases, the decision to adopt is not binary – 0 for non-adoption and 1 for adoption – but is more likely to lie along a discrete continuum. In the current study the dependent variable takes on values ranging from 0 where no single strategy is adopted, to a value of 5 where all strategies of the IPM system are adopted.

The nature of the dependent variable is an important factor in determining the choice of estimation model, especially in cases where the dependent variable is both non-normal and discrete. A number of studies have ignored the discrete and non-normal nature of IPM adoption variable and considered the dependent variable as continuous and estimated adoption models using Ordinary Least Squares (OLS). Others have assumed that the dependent variable either takes on a value of zero where the farmer adopts none of the strategies, or a value greater than zero where the farmer adopts at least one of the strategies and estimated the model using either the Binomial Probit or Logit models. Selection of these estimation models introduces a number of statistical or estimation errors. For instance, the use of Ordinary Least Squares (OLS) performs best only where the dependent variable is continuous and normally distributed, which is not the case in the present study. Moreover, the Binomial Probit or Logit models could be considered, however, the dependent variable (number of IPM strategies adopted) is not truly binomial as required for estimation of these models.

Event Count Duration Regression Models (ECDR) have been recommended for analyzing adoption of agricultural technological systems (packages) such as IPM strategies (Ramirez and Shultz, 2000). For this study a Poisson Event Count Regression Model was estimated using maximum likelihood approach in which the dependent variable is defined as the total number of possible IPM strategies that could be adopted by farmers. The advantage of this model is that it is able to address the non-normal distribution and the discrete nature of the dependent variable. Independent variables include farmer knowledge of IPM, distance to source of inputs, cowpea acreage, and socioeconomic factors including sex, age and average annual household income.

Findings

Group Comparability

Comparisons of FFS participants and non-participants on key socio-economic variables (see Table 2) indicate significant mean differences between the groups on sex, age, and years of education. Participants were more likely to be female, younger and have completed fewer years of formal education. For the sample population, men averaged 3 more years of education than women. There were no significant mean differences between the two groups on household size, farm size, crop and cowpea acreage, and total family income. The average total income for the sample population in US dollars was $390. Although participants had slightly larger total incomes, the average difference between the two groups was $33.

Table 2

Means, Standard Deviations and Significance Levels of Socio-economic Characteristics for Farmer Field School (FFS) Participants and Non-Participants in Eastern Uganda

Variable Name	FFS Participants N=90	FFS non-Participants N=90	df	T
Sex	.52 (.50)	.71 (.45)	178	2.64**
Age	36.02 (10.52)	39.02 (10.20)	178	1.94 *
Years of Education	5.03 (3.36)	6.87 (3.62)	178	3.52 **
Household size	9.08 (11.51)	8.25 (4.79)	178	-.631
Farm Size	5.67 (3.29)	5.66 (3.08)	178	-.035
Acres in Crops	3.96 (2.42)	3.99 (2.07)	178	.107
Acres in Cowpea	.86 (.69)	.80 (.61)	178	-.683
[1]Total Income (Farm & off-farm)	6.03 (5.64)	5.64 (2.29)	160	-.932

Values in parentheses are standard deviations; [1]Equal Variance not assumed;
* t-test significant at p < 05; ** t-test significant at p<.01

Knowledge of IPM

A T-test of mean differences between FFS participants and non participants was used to assess the impact of FFS participation on a summated ratings scale of IPM knowledge (Table 3). For each IPM knowledge attribute and for the total IPM knowledge scale, a statistically significant difference was found between the two groups. For all items in the scale, mean scores were higher among farmers who had participated in FFS indicating that FFS were effective in improving knowledge of IPM.

Table 3
Means, Standard Deviations and Significance Levels for Items Comprising IPM Knowledge Scale by Farmer Field School (FFS) Participants and non-Participants in Eastern Uganda

Item Description	Range	FFS Participants N=90	FFS non-Participants N=90	df	T
[1]Define IPM	0-2	1.62 (.57)	.19 (.42)	163	-19.13**
[1]ID Beneficial Insects	0-3	1.90 (.97)	.45 (.80)	172	-10.83 **
Negative Effects of Pesticides	0-3	1.77 (.09)	1.19 (.96)	178	-4.09 **
[1]Aware of alternative pest mgt. practices	0-3	2.07 (.94)	1.03 (1.18)	170	-6.46**
IPM Knowledge Scale	0-11	7.35 (2.63)	2.85 (2.61)	178	-11.47**

Scale Adjusted Cronbach's Alpha = .84; Values in parentheses ( ) are standard deviations; [1]Equal Variances not assumed; * t-test significant at p < 05; ** t-test significant at p<.01

Adoption of Cowpea IPM Strategies

Zero-order correlations among all variables in the model along with means and standard deviations are presented in Table 4. Considering that FFS participants were more likely to be female, younger, and have fewer years of education, all relationships between independent variables and dependent variables are in the expected direction except for total income. The correlation for total income suggests that those with higher total incomes were less likely to adopt IPM strategies. Adoption of IPM strategies was most highly correlated with IPM knowledge, followed by years of education, acres in cowpea, and total income. All other correlations were not significant at the $P \leq .05$ level.

The adoption of specific IPM strategies by FFS participants and non participants is shown in Table 5. Although there are significant mean differences between the two groups on the adoption of all IPM strategies, only FFS participants adopted the strategies of plant spacing and using the improved variety. FFS participants were also more likely to be doing field scouting. Although participants were more likely than non participants to have adopted the 3-spray and early planting strategies, almost as many non-participants had adopted the three-spray strategy and very few of either group adopted early planting.

Table 4

Zero-order Correlations between Adoption of IPM Scales and Independent Variables

N = 180	Adoption IPM		Sex	Age	Educ. Level	Total Income	IPM Know.	Cowpea acres
	A	B						
Sex	-.055	-.099	-					
Age	-.057	-.043	.015	-				
Education	-.171*	-.236**	.406**	-.066	-			
Total Income	-.115	-.156*	.057	-.105	.178**	-		
IPM Knowledge	.557**	.553**	.029	-.114	.082	.150*	-	
Cowpea acres	.218**	.198**	.118	.009	.089	.274**	.176**	-
Mean	1.85	1.32	.62	37.5	5.95	5.84	5.11	.83
Std. Dev.	1.44	1.25	.49	10.4	3.60	2.80	3.45	.65

** Correlation significant at .01 level; * Correlation significant at .05 level;
A - Includes 5 IPM strategies: planting date, spacing, field scouting, improved variety, and pesticide application timing.
B - Includes 4 IPM strategies described in "A" but excludes pesticide application timing.

Table 5

Means, Standard Deviations and Significance Levels for cowpea IPM Strategies comprising the Adoption Scales by Farmer Field School (FFS) Participants and non-Participants in Eastern Uganda

Item Description	Range	FFS Participants N=90	FFS non-Participants N=90	df	T
[1]Early Planting	0-1	.31 (.46)	.18 (.38)	178	-2.09**
[1]Plant Spacing	0-1	.53 (.50)	.00 (.00)	178	-10.08 **
[1]Improved Variety	0-1	.43 (.09)	.00 (.00)	178	-8.25 **
[1]Field Scouting	0-1	.82 (.38)	.36 (.48)	178	-6.98**
3-Pesticide Sprays	0-1	.61 (.49)	.45 (.50)	178	-11.47**
[1]Adoption Scale –A	0-5	2.71 (1.41)	1.00 (.86)	178	-9.83**
[1]Adoption Scale - B	0-4	2.10 (1.23)	.54 (.64)	178	-10.66**

Values in parentheses ( ) are standard deviations; [1]Equal Variances not assumed;
* t-test significant at p <. 05; ** t-test significant at p<.01

Poisson regression results for both adoption scales are presented in Table 6. These results indicate that the independent variables included in the model explain a significant proportion of variance for both IPM adoption scales, accounting for nearly 30% in the five strategy scale (scale A), and 34% in the four strategy scale (scale B). Strategy scale B performs better that scale A, presenting larger and more significant coefficients. Farmer's level of IPM knowledge has the largest effect on adoption of IPM strategies for both scales. Possession of IPM knowledge significantly increases (P<0.01) the probability of adopting an IPM strategy by about 23 percentage points for scale A and 31 percentage points for scale B. Cowpea acreage, farmer's level of education, total family income and distance to sources of inputs are also found to significantly affect the adoption of IPM strategies. An increase in cowpea acreage by one acre increases the possibility of adopting an additional IPM strategy by 20 percent for scale A and 30 percent for scale B. This indicates that farmers who rank cowpea high in importance are more likely to adopt IPM strategies. The study also finds that farmers who live farther away from input (synthetic fertilizers and pesticides) sources are more likely to adopt IPM strategies. This finding suggests that farmers with less access to inputs are more likely to substitute such inputs with IPM strategies. For each additional kilometer a farmer lives from the input source, the likelihood of adopting an additional IPM strategy increases by 2 percent. Results for education and gender conflict with the expected positive effect. This is most likely attributable to the composition of the FFS sample being mostly women and with lower education level compared to the non-FFS participants. The notion that poorer farmers are less likely to adopt technologies is not supported by this study. This finding is similar to that found by Octavio and Shultz (2000). Income level exhibits a negative effect on adoption of IPM strategies. For an additional Uganda Shilling that a farmer earns per annum, the possibility of adopting an IPM technology is reduced by about 9 percentage points. Age and sex of the farmer do not significantly affect adoption of IPM strategies.

Table 6
Poisson Model Estimation of the Factors that Influence the Adoption of IPM Strategies (N=180)

	Scale A		Scale B	
Variable	Parameter	S.E.	Parameter	S.E
IPM knowledge	0.232**	0.019	0.305**	0.034
Sex	-0.189	0.109	-0.272	0.156
Education	-0.091**	0.016	-0.123**	0.023
No of cowpeas acres	0.212*	0.062	0.339**	0.087
Total Family income	-0.115**	0.023	-0.174**	0.032
Age	-0.006	0.005	-0.012	0.007
Distance to source of inputs	0.027**	0.008	0.035**	0.010
Constant	-0.146	0.321	-0688	0.537
Pseudo R-square	0.295		0.34	

Figure in parentheses are robust standard errors; Level of significance: ** 1% , * 5%

Conclusions

IPM Farmer Field Schools (FFS) have been deployed around the world since their success in Southeast Asia. However, assessments are needed to evaluate, modify and improve their effectiveness. This assessment indicates that FFS are effective in increasing IPM knowledge, and IPM knowledge is the most important variable in explaining the adoption of IPM strategies. These findings provide a confirmation of the adoption decision making process and also a validation of FFS as an effective mechanism for increasing both knowledge of IPM and the adoption of cowpea specific IPM strategies.

Adoption of cowpea IPM strategies is largely explained by participation in FFS. That farmers with less education were more likely to adopt IPM strategies is related to FFS participants having less education. This would also explain the negative but non-significant findings for sex and age. Both women and younger farmers were more likely to have been FFS participants. Farmers with more total income are less likely to have adopted IPM strategies. This may be related to their having other on or off-farm income generating priorities other than cowpea that reduces their interest, time, and willingness to take on additional risks associated with adoption of new practices. However, farmers with more cowpea acreage are more likely to adopt IPM strategies. These farmers' view cowpea as a priority crop and are thus more interested in adopting improved methods for growing their cowpea.

Independent variables were slightly more successful in explaining the adoption of IPM strategies in scale B than in scale A. In scale B the IPM strategy of 3 pesticide sprays was dropped because it was not highly correlated with the other strategies. In part, this can be explained by the fact that about twenty percent of the FFS participants and non-participants sprayed less than three times because they did not have access to funds necessary to purchase the pesticides or to pay someone else to spray their fields. It appears that the 3-spray strategy represents a slightly different phenomenon than the other IPM strategies in that it requires capital to adopt the strategy. It also indicates that communicating the IPM message of reduced pesticide usage has not been totally accepted by farmers; they still like to use pesticides whenever they can afford them.

The adoption pattern of other IPM strategies indicates other revealing features. Field scouting was widely adopted by FFS participants and some non participants and is an activity many farmers take for granted. Early planting was the least adopted strategy by FFS participants. Adopting this practice is constrained by a lack of available labor and mechanization (animal traction) for land cultivation and planting at the onset of rains, and is a traditional labor bottleneck confronting many small scale farmers in eastern Uganda. Since early planting is a beneficial practice for most crops, the decision as to which crop to plant first is a matter of farmer experience. The adoption of plant spacing and the improved cowpea variety are clearly associated with participation in FFS. The communication of these two strategies to farmers may have been facilitated because these two strategies are divisible and compatible with the existing farming system.

This situation serves as a reminder to policy-makers and practitioners responsible for the design of technology transfer of agricultural innovations that they should not think of adoption in "all or nothing" terms. Farming in any given environment represents a set of specific and inter-related tasks, creating a complexity that cannot be fully anticipated during the development of planned programs for the dissemination of new agricultural innovations. New strategies, like IPM, may be introduced as a total package, but are actually comprised of various components, each entailing a specific set of decisions and actions. Factors like climate, agro-ecology, labor availability, and market access, among others, cause farmers to adjust their strategies as they go about their farm-level decision-making. Hence, what growers learn at a FFS or some other educational setting may not be completely adopted. This is not, however, an indication that the transfer strategy failed. To the contrary, re-invention, that is, the process by which an innovation as a bundle of specific practices is adapted to local conditions and circumstances, is critical to its utilization (Rogers, 1995). A package that allows farmers to partially adopt various components is better because it more accurately reflects the actual context of farm-level decision making.

Another implication of this study for extension programs in all countries is that the strategy of sustained (repeated and over time) field-based extension education is important. Behavioral change, or in this case the adoption of a complex agricultural technology such as IPM, cannot be expected without a sustained educational effort to raise awareness, technological understanding and competence, and lower perceptions of risk (Rogers, 1995). The extension agent who can take a message to the field and provide follow-up visits is more likely to be successful. One-off messages or extension contacts with farmers are not likely to yield adoption results. Repeated contacts by extension agents over a period of time, as suggested in the FFS approach, are more likely to yield desired results.

The diffusion of IPM knowledge and strategies to farmers who did not participate in the FFS appears to be limited. This may be attributed to the relatively short time (seven months) between the end of the FFS and when the assessment took place. Perhaps those who attended the farmer field schools have talked to those who did not about the advantages of using various IPM strategies, and adoption will follow as soon as the next growing season begins. However, it is also possible that non-participants may not follow the lead of participants. Ecological strategies like IPM may need to be used on a sustained basis, that is, for more than one growing season, before benefits emerge. For non-adopters, especially those who did not participate in the field farmer schools, recognizing the benefits of an IPM approach, particularly if those benefits only emerge over time, may impede rapid adoption. This argues for a longer time horizon to be built into the design of impact assessments particularly those that are assessing impacts of informal communication among farmers.

Finally, it appears that the FFS have been able to reach greater numbers of farmers (scaling-out) in a shorter period of time than the PAR approach. FFS activities reached 150 farmers in one year and PAR activities worked with approximately 60 farmers over the course of six years. This is to be expected, considering that the two programs had different goals and levels of programmatic intensity. The goal of PAR activities was to develop and test alternative IPM strategies with a hoped for diffusion of knowledge and practices. The PAR phase of the project used teams of scientists and graduate students to work with farmers over the course of several seasons to develop IPM strategies. As noted in an earlier evaluation, very little farmer-to-farmer diffusion occurred. The main goal of the FFS was to increase farmer knowledge of IPM and to promote adoption and diffusion of IPM strategies developed by PAR activities. The program engaged farmers on a bi-weekly basis to discuss, demonstrate, and test IPM strategies. As was the case for PAR activities, it appears that very little diffusion occurred beyond the FFS groups. This perhaps indicates that farmer-to-farmer diffusion of information is difficult to measure and attribute; requires more time; or, in the case of complex technologies such as IPM is not likely to broadly occur unless the results of technological adoption are dramatic and clearly visible. In the case of this study, the programmatic advantages of FFS in terms of scaling out and adoption appear to be clear, however, the financial sustainability of FFS is unclear and will await future evaluations.

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