

# **Evaluating Farmers' Knowledge and Awareness of Integrated Pest Management (IPM): Assessment of the IPM Collaborative Research Support Project in Uganda**

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## **Abstract**

The IPM CRSP (Integrated Pest Management Collaborative Research Support Program) has been applying a farmer participatory IPM strategy at on-farm research sites in Eastern Uganda since 1995. Comparison groups composed of project participants and non-participants were used to evaluate the impact of project activities on IPM knowledge and awareness change among two hundred small scale farmers. The evaluation instrument used a summated ratings scale consisting of four attributes to measure farmers' knowledge of IPM, and crop specific indices to measure pest management. The results demonstrate that more active participation increases knowledge of IPM pest management knowledge, providing preliminary support for the project's participatory research and extension approach. However, project beneficiaries were relatively few and were slightly more socioeconomically advantaged. Recommendations for increasing the number of farmer participants and improving the evaluation process are made.

## **Introduction**

Farmer participation and integrated pest management (IPM) are important trends in agricultural research and extension in sub-Saharan Africa. Over two decades, attempts to develop and disseminate IPM in developing countries have met with limited success (Yudelma et al., 1998; Kiss & Meerman, 1991). Increasing farmer participation in the development and implementation of IPM programs has emerged as a strategy for increasing the application of IPM, particularly among small-scale farmers (Dent, 1995).

IPM was first developed in response to environmental concerns about the abuse or overuse of chemical pesticides associated with intensive-input agricultural systems in developed countries. The traditional approach was to develop pest and disease control alternatives to reduce or eliminate the use of chemical pesticides. The role of extension was to transfer and disseminate these technologies

and practices directly to farmers (Morse & Buhler, 1997).

More recently, alternative approaches have evolved for small-scale farming systems in developing countries. These approaches seek to combine indigenous farmer knowledge with scientific knowledge of cropping systems and pests to develop site appropriate IPM systems. Variouslly labeled as ecological or sustainable IPM (Mangan & Mangan, 1998; Schwab, 1995), these approaches are often described as being knowledge intensive (Morse & Buhler, 1997). Since they require enhanced knowledge and understanding of biological factors and ecological interactions for their successful implementation by small farmers (Dent, 1995), ecological IPM programs are increasingly linked to participatory research and extension approaches (Norton et al., 1999).

The IPM CRSP (Collaborative Research Support Program) has been using a farmer participatory IPM strategy at on-farm research sites in Eastern

Uganda since 1995. Farmer participation at each stage of the research process provided the nexus for an emerging synthesis of both ecological and traditional approaches. Following five years of implementation it was decided to launch an evaluation to assess project impacts. Although participating farmers had consistently supported the project, an evaluation to assess project impacts was considered important to assess program effectiveness and suggest program modifications.

### **Purpose**

The main purpose of this study was to evaluate the impact of project (IPM CRSP) activities on IPM knowledge and awareness change among small-scale farmers in Eastern Uganda. Evaluating the impact of traditional IPM programs generally has relied upon assessing adoption of new technologies and monitoring reductions in pesticide use in developed countries (Zalom, 1993). An ecological approach to IPM, however, places more emphasis on increasing knowledge and awareness of key concepts as a precursor to the adaptation and application of this knowledge by project beneficiaries. As a result, there is a need to develop and adapt methods and instruments to evaluate knowledge intensive IPM programs, particularly those implemented with small scale farmers in developing countries.

### **Methodology**

**Evaluation Approach:** The assessment of project impacts used in this study followed the hierarchical target/outcome structure suggested in the Targeting Outcomes of Programs (TOP) model of Bennett and Rockwell (1995). Their model involves seven stages to guide both program development and assess program performance. This evaluation is conducted at the third stage, or KASA. The TOP model assumes that changes in knowledge, attitudes, skills and aspirations (KASA) lead to changes in practices, that in turn, create the desired change. Increased knowledge and awareness are generally considered prerequisites to the adoption of new practices and technologies, including IPM (Rogers, 1995).

**Population and Sample:** A multi-stage sampling procedure was used to select eight villages in two districts in Eastern Uganda. In each district, 4 sub-counties were selected, with two of these being sub-counties where the IPM CRSP had active programs and two others where the CRSP had not previously been active. The selection of sub-counties where the IPM CRSP had not been active was based on geographic proximity and agro-ecological similarity to those where the IPM CRSP had been active. Villages in each sub-county were then purposively selected: two were selected near NGOs that had worked with the IPM CRSP. In sub-counties where the IPM CRSP had not been active, villages were selected near an identified, active farmer NGO. Lists of farmers for each village were obtained from local council officials at the village level. A systematic random sample of 25 farmers was selected from each village, totaling 100 interviews in each district, and 200 interviews in all.

**Data Collection and Instrumentation:** The evaluation instrument was developed through the iterative process of farmer participation with scientists and extension agents. Farmer knowledge and knowledge gaps of on-farm ecological relationships, priority pests and diseases, and pest management practices, suggested questions for assessing knowledge and awareness change. This included a series of questions that required farmers to identify pests and diseases from enlarged photos and specific questions about pest and disease management practices.

Enumerators were selected based on their familiarity with local languages, survey methodology and past experience with IPM CRSP activities. A one-day enumerator training workshop was held prior to pre-testing the instrument by teams of enumerators in their respective districts. All questionnaires were completed by personal interviews. Female enumerators, two for each district, were instructed to interview female farmers knowledgeable of the farm operation when possible. Enumerators, both male and female, were instructed to follow the systematic selection process described above.

**Comparison Group Identification:** An important objective of the sampling procedure was to have comparison groups composed of both project participants and non-participants. Participation was established by asking respondents if they had participated in two or more IPM CRSP activities. Participation in the IPM CRSP is a trichotomous variable with (0) indicating no participation (N=142), (1) indicating participation in 1 or 2 activities (N=34), and (2) indicating participation in three or more activities (N=24). For some analyses, the participation variable was made dichotomous, yielding non-participants (N=142), and participants (N=58).

**Group Comparability:** To attribute outcomes to project activities, it was necessary to assess the degree of comparability of the two groups. Using a T-test of mean differences, the two groups were compared on the basis of socio-economic criteria including sex, age, years of education, farm income, and acres in crops. Sex was a dummy variable with women coded (0) and men (1). Age and years of education are continuous variables. Education was measured by the number of years of formal education completed. Farm income was operationalized by asking farmers to approximate their annual farm income in Ugandan shillings (UGS), using seven categories ranging from less than 50,000 to more than 500,000 Ugandan shillings, coded 0-6 (1000 UGS = \$1 USA). Crop acreage was the amount of land in production at the time of the interview. Crop acreage was used instead of total farm size because it more accurately reflected each household's resource capacity for putting land into production.

**IPM Knowledge:** The project did not begin with a rigid predetermined definition of IPM, because local and contextual pest management experience was not known. Since IPM is a multi-dimensional concept (Dent, 1995), it was decided to let important dimensions emerge from participatory activities. Early activities established that most farmers preferred to use, and many were frequently using, chemical pesticides; many farmers were unaware of alternatives to pesticides for managing pests; farmers were unaware of many crop diseases and small insects; and were generally unaware of beneficial insects. In recognition of farmers' preference for using pesticides it was decided to

retain and promote "IPM" as a brand name for pest management alternatives that would supplant or moderate chemical pesticide usage. Each of these knowledge attributes or dimensions was considered fundamental to a strong working knowledge of IPM. Through program activities, the IPM CRSP attempted to increase the knowledge and awareness of these dimensions.

A dichotomous measure of a multi-dimensional concept was considered inappropriate; thus a summated ratings scale consisting of these four attributes was devised to measure farmers' knowledge of IPM. The coefficient of reliability for the knowledge of IPM scale was .72, indicating an acceptable level of reliability (Nunnally, 1978:245). The first item requested interviewers to evaluate farmers' ability to define these dimensions or attributes of IPM on a 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 potential harmful impacts from using pesticides. A third item asked farmers if they could name any beneficial insects, with a no response coded 0, naming one insect coded 1, and naming more than 1 insect coded 2. 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 or locally available bio-rational products, and using resistant or tolerant varieties.

**Knowledge of Crop Specific Pests, Diseases and Management Alternatives:** Farmers determined priority crops, pests, and diseases during the initial participatory assessment (PA). In Iganga District, the priority crops selected by farmers were maize, beans, and groundnuts; for Kumi District the priority crops were sorghum, groundnuts and cowpea. Following the PA, IPM CRSP activities focused on developing knowledge and awareness of priority pests and diseases, and, pest management alternatives. To assess knowledge accrual impact from IPM CRSP activities, a set of test questions were developed for each crop. Since pest and disease identification was an early activity of the IPM CRSP, some questions pertained to enlarged photos of specific pests, diseases, or plant damage. Other questions asked for specific responses about resistant varieties, post-harvest storage techniques, disease vectors, or control practices. Responses to these questions were coded either 0 for not-known, or 1 if the farmer knew the answer or identify the pest or disease. These responses were then combined to form an index of pest management knowledge for each crop.

**Data Analysis:** To test the effects of various levels of participation in IPM CRSP activities on knowledge of IPM, one-way analysis of variance was used. The simple hypothesis that guided this analysis was that increased participation in IPM CRSP activities would be associated with more knowledge of IPM. The impact of project participation on knowledge of crop specific pests, diseases and knowledge items was assessed using a t-test for equality of means. The hypothesis here was that there would be significant differences of crop specific knowledge between those who had and those who had not participated in the project.

## Findings

**Group Comparability:** Comparisons of non-participants and participants on key socio-economic variables provide some indication that programmatic activities may be reaching older, larger and wealthier farmers (see Table 1), although mean differences were not dramatically large even for those that were

Table 1

### Summary of T-Test Analysis: Means, Standard Deviations and Significance Level

Variable Name	Non-participants (N = 142)	Participants (N = 58)	Degrees of Freedom	T
Age	38.78 (12.53)	43.33 (11.58)	198	-2.38*
Sex	.507 (.501)	.414 (.496)	198	-1.196
Years of Education	6.65 (3.34)	7.27 (3.07)	198	-1.23
Farm Income	2.75 (1.64)	3.84 (1.69)	198	-4.23**
Acres in Crops	5.05 (4.28)	7.20 (6.00)	198	-2.84**

Values in parentheses ( ) are standard deviations.

\* t-test significant at  $p < .05$

\*\* t-test significant at  $p < .01$

statistically significant. The reader should keep in mind that none of the farmers were well off economically. In US dollars, average farm income was \$275, and rarely exceeded \$500. Even given the lower cost of living in Uganda, none of the small scale farmers participating in this project were wealthy.

Additional T-tests of mean differences were conducted on the 100 participants (n=58) and non participants (n=42) from sub-counties where the IPM CRSP had active programs. The results were somewhat the same. Compared to non participants, participants were farmers with more acres in crops and more farm income. Within these IPM CRSP targeted sub-counties, participants were also more likely to be female and had higher levels of education. However, the difference in age was no longer statistically significant.

**Knowledge of IPM:** Table 2 presents the mean IPM Knowledge scores by the three different levels of IPM participation. The majority of respondents (71%) have not participated in IPM CRSP activities. This is not surprising considering that half the villages in the sample were deliberately selected because they had not participated in IPM CRSP activities. The hypothesis tested is that participation in IPM CRSP activities had a positive impact on knowledge of IPM. An analysis of variance

(ANOVA) presented in Table 2 shows that overall, those who participated in more IPM activities have greater knowledge of IPM than those who have not participated.

**Knowledge of Crop Specific Pests, Diseases and Management Alternatives:** Since priority crops differed by district, the sample size for each crop was 100, except for cowpea in Kumi District, and beans and groundnuts in Iganga District, where not all farmers were growing these crops.

A t-test was used to compare means between participants and non participants on a summated ratings scale of crop specific pest management knowledge (Table 3). For each crop specific knowledge scale, a statistically significant difference was found. In every case, mean scores were higher among farmers who had participated in the IPM CRSP.

## Discussion

A measure of evaluation effectiveness is the information gained by those trying to improve programs. The results of this study indicate that more active farmer participation increased knowledge of IPM. This provides some preliminary support for the participatory research and extension approach being used by the project.

Table 2

### Summary of One-Way Analysis of Variance of IPM Knowledge by Level of Project Participation

IPM CRSP Participation	N	Mean	Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
0 - none	142(71)	1.61	Between Groups	563.304	2	281.652	97.443	.000
1 - some	34(17)	3.76	Within Groups	5669.416	197	2.890		
2 - active	24(12)	6.58	Total	1132.720	199			
Total	200	2.58						

Values in parentheses ( ) are column percentages.

F ratio for one-way analysis of variance significant at 0.5 level.

Table 3

Mean Scores on Crop Specific Pest Management Knowledge by Level of Participation  
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Crop	Range	Group	N	Mean	t	Sig.
Maize N=100	0 - 5	No participation	66	1.18	-6.74	.000
		Participation	34	3		
Beans* (N=98)	0 - 4	No participation	64	0.406	-6.56	.000
		Participation	34	2.03		
Sorghum (N=100)	0 - 6	No participation	76	3.26	-3.44	.001
		Participation	224	4.17		
Cowpea (N=97)	0 - 6	No participation	74	3.24	-4.88	.000
		Participation	23	4.7		
Gnuts (Iganga) (N=77)	0 - 5	No participation	49	1.61	-3.59	.001
		Participation	28	2.53		
Gnuts (Kumi) (N=100)	0 - 5	No participation	76	2.42	-5.44	.000
		Participation	24	4.04		

\*Levene Test for Equality of Variances: F = 75.87; Sig:.000; Thus t-test for equality of Means, equal variances not assumed.

However, the analysis provided evidence that the number of project beneficiaries was small, and even among this group of small scale, relatively poor farmers, beneficiaries were still the more socio-economically advantaged. Altogether, only 58 (29%) of the farmers sampled had participated in project activities, despite nearly 5 years of project activities and purposively sampling villages located near research sites. Ironically, an important reason why more farmers have not participated may be the emphasis placed on using a participatory approach. Activities such as participatory assessments, farmer field monitoring, on-farm trials and field evaluations were generally limited to small groups of farmers so that program quality could be maintained and to remain within project budgetary parameters. Others have noted that participatory programs are more demanding than conventional on-station, on-farm approaches and, as a result, have encountered similar difficulties in trying to expand participation ( Douglah & Sicilima, 1997; Roling & van de Fliert, 1994).

The project made concerted attempts to ensure equal access to project activities, even going to the extent of working with NGOs with exclusive female membership and conducting farmer open days. This helps explain why female participation was higher in IPM CRSP active subcounties. Efforts to be more inclusive of poorer farmers may have been confounded by the noted phenomenon that attendees at training programs are often the more aggressively innovative farmers, that is, those with better education, larger acreage, and higher farm income (Haug, 1999; Dent, 1995; Rogers, 1995). Participatory agricultural research (PAR) programs may not be a remedy for reaching the most marginalized in society and the conduct of agricultural research, even PAR, may self-select for those with the capacity to innovate and accept risks. Addressing the needs of the poorest of the poor, although a desirable objective will always be difficult particularly when the majority of farmers in a targeted community are small and resource poor.

## Implications

To reach a broader audience with a more compact format, a discovery and experiential learning-based IPM training module has been developed for extension agents to use with groups of farmers over the course of a single growing season next year. Additionally, in keeping with the participatory precept that knowledge is contextual, a new evaluation instrument has been constructed for use in the field with farmers during the growing season. Future assessments of this project will examine the impact of IPM knowledge and awareness change on adoption of pest management technologies.

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