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Impact of Farmer Field School Training on Acquisition of Integrated Pest Management Knowledge by Farmers

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Abstract

The FAO-EU-ADB funded National Integrated Pest Management Programme (Nat-IPM) for Cotton in Pakistan during 2001-2004 and introduced new extension training methodology called Farmer Field School (FFS). Basic principle of FFS training was to enable farmers to be self sufficient, using Integrated Pest Management (IPM) practices that are agro-ecosystem friendly. To assess the impact of this new FFS training model in connection to agro-ecological sound IPM practices with special reference to cotton, study was conducted in four districts of Sindh province of Pakistan. The sample size comprised of 432 farmers in total, selecting 108 farmers from each district. The results of this study indicated that FFS was a favorable process in increasing farmers' IPM knowledge regarding use of pesticides, nutrient management and their decision making process with regard to the agro-ecological sound farming. It appears that effects of training exist, if not increased even after the five years after the termination of the programme.

Keywords: *Integrated pest management, farmer field school, extension, agro-ecosystem.*

Introduction

Pakistan is the world's 4th biggest cotton producing country after China, India, and USA. The world cotton production is projected at 24.8 million tons, during 2010-11 as against 22.01 million tons recorded in 2009-10, estimating an increase of 12.6 percent (GoP, 2011).

Despite being one of the largest cotton growing countries, cotton yield in Pakistan is low as compared to other countries. The low yields result from unfavourable weather conditions, pests attack and limited awareness of pest management options for improved cropping. The Farmer Field School (FFS) is a training model developed primarily by Food and Agriculture Organization (FAO) in which farmers gain the decision making power regarding use of agro-chemicals at their field. The FFS approach is unique extension season long training conducted on their fields. This extension approach is action-learning oriented where farmers are allowed to observe, analyze and make alternative decision about their crop (Kingsley, 1999).

The basic principle of FFS training was to enable farmers to become self sufficient, using Integrated Pest Management (IPM) practices. To tackle these issues farmers require to have improved disease and pest recognition, to understand methods of monitoring and control options and be able to correctly apply chemistry or IPM techniques. The farmers who participate in FFS become part of wide scale IPM programmes, ranging from local to national research; they analyze production issues and develop solutions for them at the country level (FAO, 2000). This collective research with farmers involve establishing local

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needs, information about local conditions, eco-system characteristics, and weather (Linh, 2001). Various studies regarding IPM-FFS programmes agree that FFS strengthens farmers' eco-logical knowledge (Thiele *et al.,* 2001; Rola *et al.,* 2002; Feder *et al.,* 2004; Reddy and Suryamani, 2005 and Tripp *et al.,* 2005). Improved farmer knowledge and understanding of the crop eco-system ultimately increases their production and profit (Godtland *et al.,* 2004 and Khan and Muhammad., 2005).

It was assumed that FFS training improved farmers' IPM knowledge and helped in farmer-to-farmer diffusion during IPM programme in 2001-2004. This study intended to collect information on acquisition of IPM knowledge by farmers regarding pesticide use, nutrient management and their confidence on decision making process.

Methodology

Four districts viz., Hyderabad, Tando Allahyar, Matiari and Mirpurkhas were selected as the study area, where FFSs were established during 2001 to 2004 for cotton through Nat-IPM Programme. A descriptive research study was carried out. In descriptive survey research, the researcher selects a group of respondents, collects information and then analyzes the information to answer the research questions (McMillan, 2008).

The target populations of this study was categorized in three groups; i.e. trained group (IPM-FFS participants), exposed group (non-IPM-FFS participants but from villages exposed to IPM-FFS training), and control group (farmers who were neither involved in IPM-FFS nor living in IPM-FFS village). A list of the original IPM-FFS trained farmers (trained group) were obtained from National IPM-FFS programme coordinator, Director General, Agricultural Extension Wing, Hyderabad, Sindh. The sample was selected from each group on the basis of tables (Fitz-Gibbon & Morris, 1987). The total 144 sample size of farmers (trained group) included in the research study were evenly distributed by district (36 from each district). Similarly, the sample of 144 farmers for the exposed group were randomly selected from village where IPM-FFS training had occurred and 144 farmers (control group) were randomly selected from the villages having at least 20 Kilometers away from IPM-FFS trained villages but where sufficient cotton growing farmers were available. Within each of the farmers groups further matching characteristics such as age, education, and landholding were established. The total sample size of farmers' category hence comprises 432.

The questionnaire was developed in consultation with the IPM-FFS experts and following review of available literature. The concepts or ideas were predominantly measured through different statements on a continuum ranging from negative to positive. Survey was conducted for this study during the period March to September 2009. Despite several efforts, a total response rate of 93.75% was obtained. More than 60% response rate is sufficient for comparison between two or more than two groups and for the validation of the research results (Wunsch, 1986). IBM-SPSS version 19 was used for data analysis. Frequency, mean, percentage, and standard deviation were calculated. For the comparison among groups ANOVA was performed and Duncan Multiple Range Test (DMRT) was applied to rank the means.

Findings and Discussion

Demographic Information

The demographic characteristics of the sampled farmers are presented in Table 1 that shows most of the farmers (28.1%) were young and falling into the age grouped of 21-30 years. The educational level of farmers was not good; majority of them (27.4%) educated only up to primary level. Most of them (27.4%) were owners of land in between the range of 11 to 20 acres. Large number of (36.3%) farmers had farming experience in the range of 11 to 20 years followed by less than 10 years of experience (29.6%). Majority of the farmers (25.9%) had their farm yearly income more than 100,000/- (pak rupees) followed by farm income in the range of 41,000 to 60,000 (23.0%) farmers.

Table 1 Demographic information of farmers

Characteristics	Category	Trained		Exposed		Control	
		No.	%	No.	%	No.	%
Age (years)	Less than 20	25	18.5	33	24.4	36	26.7
	21 to 30	38	28.1	31	23.0	36	26.7
	31 to 40	30	22.2	32	23.7	34	25.2
	41 to 50	23	17.0	26	19.3	18	13.3
	51 & above	19	14.1	13	9.6	11	8.1
Educational Level	Illiterate	26	19.3	33	24.4	35	25.9
	Primary	37	27.4	32	23.7	31	23.0
	Middle	24	17.8	22	16.3	21	15.6
	Matriculate	11	8.1	16	11.9	13	9.6
	Intermediate	13	9.6	13	9.6	17	12.6
	Graduate	15	11.1	12	8.9	14	10.4
	Post Graduate	9	6.7	7	5.2	4	3.0
Status	Land Lord	26	19.3	16	11.9	19	14.1
	Tenant	65	48.1	76	56.3	71	52.6
	Lease Holder	10	7.4	12	8.9	16	11.9
	Owner-Cultivator	34	25.2	31	23.0	29	21.5
Farm Size (acres)	Less than 10	27	20.0	31	23.0	28	20.7
	11 to 20	37	27.4	32	23.7	29	21.5
	21 to 30	30	22.2	28	20.7	33	24.4
	31 to 40	21	15.6	29	21.5	22	16.3
	41 & above	20	14.8	15	11.1	23	17.0
Farming Experience (years)	Less than 10	40	29.6	47	34.8	37	27.4
	11 to 20	49	36.3	54	40.0	44	32.6
	21 to 30	23	17.0	20	14.8	32	23.7
	31 to 40	15	11.1	10	7.4	11	8.1
	41 & above	8	5.9	4	3.0	11	8.1
Farm Yearly Income (rupees)	Up to 20,000	7	5.2	12	8.9	10	7.4
	21,000 to 40,000	27	20.0	33	24.4	34	25.2
	41,000 to 60,000	31	23.0	27	20.0	19	14.1
	61,000 to 80,000	15	11.1	23	17.0	22	16.3
	81,000 to 100,000	20	14.8	15	11.1	19	14.1
	100,000 and above	35	25.9	25	18.5	31	23.0

Farmers' Perception about Use of Pesticides

The effectiveness of IPM-FFS training were studied by knowing the perceptions of the respondent farmers on a set of 13 statements related to awareness about the pesticide use in cotton. The five points Likert scale (e.g. 1=Strongly disagree, 2=Disagree, 3=Undecided, 4=Agree, 5=Strongly agree) was used to assess the perception of the farmers, and according to farmers' responses through Likert scale, the results were formed and presented in Table 2. The data show that the perceptions of the respondent farmers were significantly ($P<0.01$) varied for almost all the statement regarding awareness about pesticide application on cotton.

Table 2 Category-wise farmers' perception of indiscriminate/safe use of pesticides

	Awareness About Pesticides	Trained Farmers		Exposed Farmers		Control Farmers		F Value	Sig.
		M	SD	M	SD	M	SD		
1	Pesticides applications are necessary to protect the cotton crop.	2.72_a	1.22	3.16_b	1.24	3.47_c	1.04	14.142	0.001**
2	Pesticides kill only harmful insects and not effects on beneficial.	2.27_a	0.91	2.65_b	1.20	2.94_c	1.26	11.642	0.001**
3	It's true that the pesticide induces resistance to pest population.	3.76_b	0.93	3.40_a	1.02	3.21_a	1.04	10.716	0.001**
4	Repeatedly application of pesticides increases the pest population.	3.85_c	0.84	3.61_b	0.99	3.21_a	1.07	15.060	0.001**
5	Indiscriminate use of pesticides leads new pest problems in cotton.	3.86_c	0.81	3.47_b	0.94	3.11_a	1.08	20.794	0.001**
6	Expensive pesticides help farmers to control pests and diseases.	2.28_a	0.95	2.62_b	1.09	3.02_c	1.20	15.543	0.001**
7	The mixing of two or more pesticides will increase its effectiveness.	2.38_a	1.05	2.63_a	1.13	2.94_b	1.15	8.619	0.001**
8	It is good to use a little more pesticide than recommended dose.	2.23_a	0.91	2.42_a	1.00	2.89_b	1.18	14.299	0.001**
9	Pesticide applications contaminate the air, water, soil, and food.	3.76_b	0.89	3.50_a	1.02	3.33_a	1.07	6.521	0.002**
10	No matter, if animals run around the fields while spraying pesticides.	2.37_a	0.99	2.61_a	1.01	2.88_b	1.12	8.073	0.001**
11	It is not safe to clean spray equipment in tanks or stream of water.	3.79_b	0.77	3.64_b	0.80	3.30_a	1.04	10.493	0.001**
12	One can sick from pesticide spraying, if not take protective measures.	4.06_b	0.83	3.90_{ab}	0.90	3.72_a	1.00	4.672	0.010*
13	It is correct that pesticide is sold in the market means it is safe.	2.13_a	0.88	2.37_a	1.10	2.80_b	1.25	12.948	0.001**

1 = Strongly Disagree 2 = Disagree 3 = Undecided 4 = Agree 5 = Strongly Agree
* = Significant at 0.05 level of significance, ** = Significant at 0.01 level of significance
Values in a column with different superscripts are significantly different ($P < 0.05$), as assessed by ANOVA and Duncan's Multiple Range Test (DMRT).

The respondents were asked to disclose on 'pesticides applications are necessary to protect the cotton crop' the responses of trained, exposed and control farmers were significantly different and Likert scale showed that exposed farmers and control farmers 'agreed' the statement while trained farmers showed 'undecided' attitude. The respondents when invited to perceive on the statement 'pesticides kill only harmful insects and not effects on beneficial' all the respondent categories either disagreed or kept calm over this statement but differences were significant. The perceptions of trained, exposed and control farmers on statement regarding resistance of insect pests to pesticides differed significantly and trained and exposed farmers 'agreed' and control farmers were 'undecided' with the statement. Similarly, perceptions of trained, exposed and control farmers on the statement that 'repeatedly application of pesticides increases the pest population' were significantly different where trained and exposed farmers 'agreed' the statement and control farmers showed 'undecided' attitude. While asked the farmers for commenting on the statement that 'indiscriminate use of pesticides leads new pest problems' the trained and exposed farmers straight-way 'agreed' the statement but control farmers remained 'undecided' over the statement; however, responses between trained, exposed and control farmers differed significantly. All the respondent categories remained 'undecided' over the statement that expensive pesticides effectively control insect pests; but showing highly significant difference in farmers' response.

The respondent farmers did not show positive response (undecided) over the statement that 'mixing of pesticides increases their effectiveness' and showed significant differences in responses of trained, exposed and control farmers. The trained, exposed and control farmers were not positive (undecided) for the 'use of higher pesticide doses than recommended' and variation in responses of respondents were significant. Further questioning on 'air, water, soil and food contamination due to pesticide application' 'agreed' by trained farmers but exposed and control farmers were 'undecided' over the statement; and differences were significant while negative response of respondents (undecided) was offered by trained, exposed as well as control farmers and variation among respondent categories was significant. Similarly, cleaning of spray equipment in tank or water stream is unsafe' was 'agreed' by trained and exposed farmers, but control farmers were 'undecided' over the statement; and differences among respondents were significant. It was 'disagreed' by the trained farmers and 'agreed' by the exposed and control farmers that one can sick from pesticide spraying if protective measures are not observed, and variation among respondents was significant while trained, exposed and control farmers did not agree (undecided) with the statement that 'it is correct that pesticide is sold in the market means it is safe, no matter how it is used' and differences are significant. Tripp *et al.* (2005) conducted a survey about the FFS and the IPM practices in the Southern Sri Lanka and found that the farmers initially applied some IPM practices that reduced insecticides by 81% but later on they gave up further practices and did not share that information to the other farmers. He has called for further assessment of the IPM-FFS training programmes and held insufficient assessment as a part of the problem. The IPM practices have covered just 1 to 5 % of the entire farmers. The complete research displays the impact and efficiency of communication elements as

well (Godtland *et al.*, 2004; and Van den Berg and Jiggins, 2007).

Farmers' Perception of Nutrients Management

The perceptions of the respondent farmers on a set of 10 statements related to awareness about the nutrient management in cotton were invited. The five points Likert scale (e.g. 1=Strongly disagree, 2=Disagree, 3=Undecided, 4=Agree, 5=Strongly agree) was employed to assess the perception of the farmers and the data are presented in Table 3. The data indicate that the perceptions of the trained, exposed and control farmers differed significantly ($P<0.01$) in relation to nutrient management in cotton.

According to the respondents 'fertilizers are necessarily required for growing cotton' trained, exposed and control farmers equally 'agreed' this statement and the differences in perception of between these farmer categories were non-significant and Likert scale means show that trained and exposed farmers 'agreed' the statement and control farmers were 'undecided' over the statement that 'all required nutrients exist in soil, but their availability varies soil to soil' but significantly different between respondent categories. The trained farmers also 'agreed' the statement that 'excess of nitrogen increases insect pest population' but exposed and control farmers were 'undecided' over the statement; variation among farmer categories were significant. The perceptions of trained, exposed and control farmers on 'nitrogen obtaining from soil organic matter' was non-significant, however, trained farmers 'agreed' with the statement and exposed and control farmers did not. Balanced nutrient application improves yield and quality of crop was 'agreed' by all the respondents and difference amongst them were non-significant. The trained, exposed and control farmers non-significantly 'agreed' over the statement that 'balanced nutrient application maintains soil fertility on sustainable basis'; while 'timely application of balanced fertilizers ensures maximum yields' 'agreed' by all the respondent farmers. Similarly, respondents were also 'agreed' that 'farmyard manure contains a large quantity of plant nutrients', having amongst them non-significant differences in perception. All the respondents 'agreed' that 'farmyard manure improves efficiency of applied fertilizers' showing significant differences among them. All the farmer categories 'agreed' that 'farmyard manure increases soil water holding capacity and makes soil more porous' but differences between respondent categories were significant. The results of present study are also in line with those reported by Bajwa *et al.* (2010) who found that extension field workers provided information to the farmers regarding fertilizer requirement and effectiveness. The extent of provision and effectiveness of information ranged between 2.75 to 3.18 and 2.77 to 3.53 respectively and there was consistency in responses.

Farmers' Confidence on Pest Management Decision Making Method

The respondent farmers were asked to disclose about their confidence level regarding pest management decision making method/source. Various decision making methods as applied by the farmers were identified and responses were recorded on the basis of five points Likert scale (1=Extremely confident, 2=Unconfident, 3=Neutral or Unsure, 4=Somewhat confident, 5=Extremely confident) and the results are presented in Table 4. The data show that for pest management decision making, the trained farmers were 'somewhat confident' for Cotton Eco-System Analysis (CESA), while exposed and control farmers

were 'neutral/unsure' for this method/source but the differences in respondent categories were significant. When asked for Economic Threshold Level (ETL) as the pest management method/source, response of trained, exposed and control farmers was significant, but trained and exposed farmers were 'neutral/unsure' but control farmers were 'somewhat confident'.

Table 3 Category-wise farmers' perception of nutrient management

	Awareness About Nutrient Management	Trained Farmers		Exposed Farmers		Control Farmers		F. Value	Sig.
		M	SD	M	SD	M	SD		
1	Fertilizers are necessary required for growing cotton.	3.93_{a}	1.04	3.84_{a}	1.00	3.84_{a}	0.96	0.383	0.682
2	All required nutrients exist in soil, but the percentage varies.	3.65_{b}	0.94	3.49_{b}	1.09	3.17_{a}	1.20	6.874	0.001**
3	Excess of nitrogen application helps to promote the insect pest.	3.69_{b}	1.14	3.28_{a}	1.04	3.20_{a}	0.90	8.622	0.001**
4	Nitrogen element can be obtained from soil organic matter.	3.60_{b}	0.96	3.36_{a}	0.98	$3.39_{a b}$	0.91	2.629	0.073
5	Balanced nutrient application ensures improvement in yield.	4.04_{b}	0.82	3.82_{a}	0.85	3.91_{ab}	0.70	2.475	0.085
6	Balanced nutrient application maintains soil fertility.	3.97_{a}	0.78	3.79_{a}	0.95	3.94_{a}	0.74	1.930	0.146
7	Balanced use of fertilizer ensure optimum yield.	4.21_{b}	0.81	4.00_{a}	0.78	4.03_{ab}	0.77	2.934	0.054
8	Farm Yard Manure contains a large quantity of plant nutrients.	4.05_{a}	0.82	3.94_{a}	0.87	3.87_{a}	0.88	1.474	0.230
9	Farm Yard Manure also improves efficiency of applied fertilizers.	4.16_{a}	0.86	3.73_{a}	0.81	3.63_{b}	0.99	13.584	0.001**
10	Farm Yard Manure increases soil water holding capacity.	3.93_{b}	0.84	3.68_{ab}	1.13	3.53_{a}	1.09	5.153	0.006**

1 = Strongly Disagree **2** = Disagree **3** = Undecided **4** = Agree **5** = Strongly Agree

* = Significant at 0.05 level of significance, ****** = Significant at 0.01 level of significance

Values in a column with different superscripts are significantly different ($P < 0.05$), as assessed by ANOVA and Duncan's Multiple Range Test (DMRT).

The response on pest management decision by 'discussion with other farmers' was different significantly and the respondents of all the categories were 'somewhat confident'; while variation among farmer categories was non-significant and trained or control farmers were 'somewhat confident' on decision by discussion with other family members and exposed farmers were 'neutral/unsure. All the respondents were 'unconfident' over pest management decision following neighbor practices, and variation among farmers was significant, while trained farmers were 'unconfident' over 'pest management decision on calendar basis, and exposed or control farmers were 'neutral/unsure' while pest management decision by extension worker were commented positively 'somewhat confident' by all the farmer categories. The trained farmer perceived 'no confidence' on dealers' recommendation but exposed control farmers remained 'neutral/unsure'. However, pest management decision through farm manager/landlord was slightly favored by all the farm categories 'neutral/unsure' while all the farmer categories were also 'neutral/unsure' for pest management

decision on NGO/FO advice. The pest management decision following media (TV, Radio, Newspaper) was positively favored 'somewhat confident' by all the farmer categories. In a study previously conducted by Wandji *et al.* (2007) reported that the farmers trained through IPM-FFS training methods are well trained to identify the cotton insect pests and diseases, while untrained farmers are entirely unaware of these problems. Moreover, the trained farmers use correct method of controlling the insect pests and diseases; while the untrained farmers rely on the decisions of pesticide dealers, seed companies and neighboring farmers.

Table 4 Category-wise farmers' confidence level of pest management decision making method/source

	Decision Making Methods/Sources	Trained Farmers		Exposed Farmers		Control Farmers		F. Value	Sig.
		M	SD	M	SD	M	SD		
1	Cotton Eco-System Analysis (CESA)	3.87_{c}	0.86	3.10_{b}	0.83	2.81_{a}	0.53	70.033	0.001**
2	Economic Threshold Level (ETL)	3.19_{a}	1.06	3.30_{a}	0.99	3.70_{b}	1.23	7.840	0.001**
3	Discussion with other farmers	3.91_{b}	1.01	3.51_{a}	1.11	3.50_{a}	1.10	6.269	0.002**
4	Consultations with family members	3.68_{b}	0.97	3.39_{a}	1.19	3.62_{ab}	1.09	2.637	0.073
5	Follow neighbor practices	2.61_{a}	0.96	3.07_{b}	1.17	3.48_{c}	1.09	21.665	0.001**
6	Making decisions on calendar basis	2.36_{a}	1.09	2.70_{b}	1.14	3.58_{c}	1.14	41.758	0.001**
7	Recommendation by EFW/F	3.90_{b}	0.86	3.92_{b}	0.99	3.67_{a}	1.04	2.869	0.058
8	Recommendation by dealers/traders	2.36_{a}	1.21	2.64_{b}	1.06	3.17_{c}	1.16	17.496	0.001**
9	Instruction by farm manager/land lord	3.03_{a}	1.02	3.33_{b}	1.06	3.34_{b}	1.31	3.263	0.039*
10	Follow NGOs or FOs advice	2.90_{a}	0.89	2.92_{a}	0.83	2.71_{a}	1.00	2.152	0.118
11	Media (TV, Radio, Newspaper)	3.90_{b}	0.78	3.60_{a}	1.02	3.64_{a}	0.98	4.159	0.016*

1 = Extremely Unconfident **2** = Unconfident **3** = Neutral or Unsure **4** = Somewhat Confident **5** = Extremely Confident

* = Significant at 0.05 level of significance, ****** = Significant at 0.01 level of significance

Values in a column with different superscripts are significantly different ($P < 0.05$), as assessed by ANOVA and Duncan's Multiple Range Test (DMRT).

Conclusion

Knowledge and information about agricultural technologies plays important role to empower the farmers. In developing country like Pakistan, disseminating knowledge and information to farmers effectively and timely is critical challenge for agriculture extension. Various approaches have been experienced by extension to diffuse agricultural knowledge and information to uplift farmer confidence. The IPM-FFS training programme is also extension methodology to diffuse

knowledge and information among farmers regarding agro-ecological sound farming. The results of this study indicated that FFS training was a favorable process in increasing farmers' IPM knowledge and information about use of pesticides, nutrient management in cotton and their decision making process with regard to the agro-ecological sound farming. It appears that effects of FFS training exist, if not increased even after five years of the termination of the IPM programme. However, the diffusion of knowledge and information to non-FFS participants appears to have been limited that shows FFS participants transferred little knowledge to other farmers. FFS training based IPM programmes provide inter-personal trust that is essential for working mutually and evolving innovations so it was suggested that the farmers can be good source of transferring knowledge and information, regarding this the reorientation of FFS participants is important.

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