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What is the Role of Farmers' Training on Cotton Production in Pakistan, China, and India?

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Introduction

From 2000 to 2004, (FFS) program on Integrated Pest Management (IPM) was supported by the Food and Agricultural Organization of the United Nations (FAO) under the "FAO-EU IPM Program for Cotton in Asia". The main activity of the program was to train selected farmers in the major cotton producing countries in Asia in Farmer Field Schools (FFS). FFS is an intensive season long experiential where farmers are being taught in actual field situations. The trainees are expected to make better decisions after improving their knowledge and skills. The expected benefits of the program are a reduction of the overuse of chemical pesticides and on the long term to replace existing pest control strategies with a more sustainable and environmentally more benign cotton production system.

Impact assessment studies were carried out on the individual country level (Walter-Echols and Ooi 2005). Different methodologies have been used in these studies. Hence results are difficult to compare. In addition, based on these results it is not possible to judge the overall efficiency of the investment in FFS on the program level. This study takes an econometric approach to analyze farm level data from China, India and Pakistan. The objective of this study is to assess and compare the impact of FFS training on pesticide use and cotton productivity and to identify country-specific factors that may cause differences in the training effects.

Farm level panel data were collected during the year 2000 to 2003. Baseline surveys were conducted before the start of training (in China and India this was in the year 2000 and in Pakistan in 2001). Follow up survey with the same farmers were carried out in the year after the trainings were conducted. The sample size is 535 respondents in China, 83 in India and 190 farmers in Pakistan.

Theory and Model

The classic 'difference in difference' (DD) treatment model has been applied in this paper. The method allows estimating the effect interventions (treatment) to a set of multiple subpopulations and outcomes are measured for each group comparing before and after intervention (Athey et al. 2002).

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The effect of the training is measured using a logarithmic growth model. The model was first applied in the field of pest management (Feder et al. 2004). Growth in performance of cotton production like productivity or pesticide use can be explained by a number of influencing factors including FFS training and other socio-economic characteristics of the farmers. The model differentiates between three groups of farmers: (a) FFS participants (b) Non participants but living in the same village and (c) control group, i.e. non-participants farmers who live in a different village than the first two groups. For farmer i in village j and time period t, the model can be given by:

$$\Delta\left(\ln Y_{ijt}\right) = \alpha + \beta D_{Nijt} + \mu D_{Gijt} + \gamma \Delta X_{ijt} + \delta \Delta Z_{ijt} + \Delta \varepsilon_{ijt}$$

Where Y denotes the cotton production performance indicators such as yield and pesticides usage. D_N and D_G denote the dummy variable for Non-FFS and FFS farmers respectively. Δ denotes the differencing operator between times of two surveys between pre-training and post-training. X and Z are the vectors of household and village characteristics that also affect performance. γ and δ are the corresponding vectors of parameters. ε is the residual that represents all time-varying components of the error. Growth in performance (α) is identical among all three groups of farmers prior to the training. After the training FFS farmers are assumed to shift to higher performance growth (μ).Because of an expected diffusion effect, Non-FFS farmers are assumed to switch to a higher growth in performance (β) whereby: μ > β > α. Hence the impacts on FFS performance of FFS and Non-FFS can be measured by (μ - α) and (β - α), respectively.

Results

Table 1-3 present the impact of FFS on insecticide cost, total Environmental Impact Quotient (EIQ)[ii] score, and cotton yield respectively, comparing the three countries. According to the results of the insecticide cost analysis, FFS group had a significantly lower growth rate compared to control farmers. Denoting the negative signs of coefficients of FFS group, the result indicates that FFS farmers decreased insecticide costs over time for all three countries. For India, the results of insecticide cost analysis give appearance to both direct and diffusion effects of FFS through significant negative signs of coefficients of Non-FFS group. Moreover, the significant coefficient of control group displays a positive sign, which obviously point out that they increasingly spent insecticide costs over time with out FFS. Contrarily, no diffusion effects of FFS are found in Pakistan and China indicated by no significant difference between Non-FFS and control group. Non-significance of control group shows that with out FFS training the insecticide costs were not changed during the study time.

As for the EIQ score, the significant negative value of coefficient for FFS farmers shows that the growth rate of FFS group was lower than that of control group for both countries. Results also illustrate that FFS farmers decreased their use of highly toxic pesticides compared to the control group. In other words, while there is an increase in the use of dangerous pesticides this increase is lower for FFS farmers. While the non-significant coefficients for Non-FFS show that there were no diffusion effects from FFS. Again for India, control group had the significant coefficient, which showed that they increasingly use high toxicity of pesticides.

[ii] The values can be used to compare different pesticides and pest management programs to finally evaluate a pesticide or program, which is likely to have lower environmental impact. The formula for determining the EIQ value is the average of individual pesticides of the farm worker, consumer, and ecological components (Kovach, C. Petzoldt et al. 1992). Low EIQ score indicates low environmental impact.

The results of FFS effects on cotton yield among three countries are demonstrated in Table 3. For China and Pakistan the FFS group had the significantly highest growth rate in cotton yield. As seen from the positive signs of coefficients of FFS group in regressions, the result shows that FFS farmers enhanced their yield compared to control group. For China, the extra growth rate of Non-FFS and the growth rate of control group were not as high as that of FFS group. Therefore, the result is consistent with the hypothesis that FFS and Non-FFS would perform better than the control group. In contrast to China and Pakistan, in India result show that yields of both groups in FFS village were declining over time due to other factors that could not be included in the model due to lack of data.

Table 1: Comparison of effect of FFS on insecticide costs ($/ha) among three countries

Countries / Variables	Pakistan			China			India		
	Coeff.	Robust Std. Err.	t-value	Coeff.	Robust Std. Err.	t-value	Coeff.	Robust Std. Err.	t-value
FFS group (μ)	-1.647	0.471	-3.50^{***}	-0.962	0.109	-8.81^{***}	-2.400	0.985	-2.44^{**}
Non-FFS group (β)	-0.489	0.469	-1.04^{ns}	-0.043	0.239	-0.18^{ns}	-1.767	0.969	-1.82^{*}
Control group (α)	-0.090	0.099	-0.91^{ns}	-0.078	0.054	-1.44^{ns}	0.840	0.964	0.87^{ns}
R^2		0.0452			0.0478			0.1807	
F-statistics		6.51^{***}			39.11^{***}			5.81^{***}	
N		190			535			83	
Hypothesis test: (p-values)									
$\mu < \alpha$		0.001			0.000			0.017	
$\mu < \beta$		0.076			0.000			0.007	
$\beta < \alpha$		0.298			0.856			0.072	

Note: *** Significant at 1%, ** significant at 5%, * significant at 10%, ^{ns} non-significant difference

Table 2: Comparison of effect of FFS on total EIQ (scores) among three countries

Countries / Variables	Pakistan			India		
	coefficient	Robust Std. Err.	t-value	coefficient	Robust Std. Err.	t-value
FFS group (μ)	-2.274	0.534	-4.26^{***}	-2.503	1.000	-2.50^{***}
Non-FFS group (β)	-0.922	0.517	-1.79^{*}	-1.036	1.141	-0.91^{ns}
Control group (α)	0.328	0.156	2.10^{**}	1.253	0.981	1.28^{ns}
R^2		0.0649			0.1204	
F-statistics		10.06***			5.64^{***}	
N		190			83	
Hypothesis test: (p-values)						
$\mu < \alpha$		0.000			0.014	
$\mu < \beta$		0.058			0.019	
$\beta < \alpha$		0.076			0.366	

Note: *** Significant at 1%, ** significant at 5%, * significant at 10%, ^{ns} non-significant difference

Due to lack of information concerning scientific name of pesticides, the EIQ score of China can not be calculated.

Table 3: Comparison of effect of FFS on cotton yield (kg/ha) among three countries

Countries / Variables	Pakistan			China			India		
	Coeff.	Std. Err.	t-value	Coeff.	Std. Err.	t-value	Coeff.	Robust Std. Err.	t-value
FFS group (μ)	0.210	0.087	2.41^{**}	0.117	0.021	5.71^{***}	-0.360	0.176	-2.04^{**}
Non-FFS group (β)	-0.019	0.093	-0.21^{ns}	0.040	0.020	1.96^{**}	-0.368	0.177	-2.08^{**}
Control group (α)	-0.567	0.067	-8.44^{***}	0.099	0.014	6.86^{***}	0.492	0.163	3.03^{***}
R^2		0.0477			0.0594			0.0915	
F-statistics		4.68^{***}			16.79^{***}			2.30^{ns}	
N		190			535			83	
Hypothesis test: (p-values)									
μ > α		0.017			0.000			0.044	
μ > β		0.007			0.000			0.934	
β > α		0.837			0.051			0.041	

Note: *** Significant at 1%, ** significant at 5%, * significant at 10%, ^{ns} non-significant difference

Conclusions and Outlook

FFS training in cotton production can generate benefits even under very different and natural and socio-economics production conditions, as these exist in the three countries included in the analysis. Generally the program significantly reduces the insecticide use in three countries including to the benefit from decreasing environmental impact. On the other hand, the productivity effects are higher in countries with lower yields such as for example in Pakistan.
Similar to previous studies (Rola et al. 2002) we found little evidence for knowledge diffusion effects. However the results indicate that investment in farmer education could well pay off if trained farmers retain their knowledge learned during the training and do not go back to their old practices. An initial analysis based on the results of previous country studies yielded a rate of return of 16 % (Praneetvatakul et al. 2005). Such cost benefit analysis can be redone using the data generated by this study.

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