Deutscher Tropentag - Bonn, 9-11 October 2001
Conference on International Agricultural Research for Development

Farmers' Training and the Adoption of Upland Agricultural Technologies in the Black River (Song Da) Watershed, Northeast of Vietnam.

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Abstract

This study aims to understand adoption of maize-related technologies by local farm households in the Northwest region of Vietnam. The study covers both sustainable and yield-enhancing technologies. One of the major objectives is to test the effects of training on adoption rate and farm yield. Data for the study was collected from 70 households by a social forestry development project as part of the project's impact monitoring activity. As for econometric tools, the probit and ordinary least squared (OLS) methods are employed to analyze the data set. Three models are used: a training model, an adoption model, and a yield model.

The findings from the study show that farmers with and without training as well as adopters and non-adopters of new technologies are insignificantly different. Training has positive correlation with the adoption of new technologies but shows insignificant effects on yield. Farmers in the study area do not adopt new technologies as a package. Adoption of improved maize unambiguously increases the yield. The adoption of hedge row and fertilizer technologies, however, shows insignificant effects. The findings imply a policy issue of the relationship between training and adoption of new technologies and between yield enhancing and sustainable technologies.

Introduction

This paper aims to study the adoption of maize-related technologies and its effects on the yield in the Northwest upland area of Vietnam with emphasis on the effects of farmers’ training. Three technologies are selected for the study: hedgerows on the upland as a sustainable technology, and a fertilizer technology and an improved seed technology as two yield enhancing technologies.

Previous literature about adoption model shows that though new technologies are often promoted as a package, farmers often adopt them in a sequence rather than adopting them as a package (Feder, Just and Zilberman 1982; Leathers and Smale 1991; Smale, Just and Leathers 1994). The decision to adopt the new technologies is often based on both financial and non-financial factors related to new technologies. Studies also show that education/ training is quite important to the adoption of new technologies, particularly with regard to sustainable technologies (Lin 1991; Salamon and Farnsworth 1997). Studies about sustainable technologies suggest that the use of both agricultural and non-agricultural means is required to promote adoption of sustainable technologies (Rosegrant and Livernash 1996; Pehu 1999).

Data and Methods

Data

The data set contains 70 observations from a household survey conducted by a technical cooperation project named the Social Forestry Development Project (SFDP) Song Da in 15 villages, 6 H'mong and 9 Thai villages, in two districts: Tua Chua of Lai Chau province with a homogenous group of H'mong people in the data set, and Yen Chau of Son La province with homogenous group of Thai people, Northwest region of Vietnam. The data collection is among the project's impact monitoring activities.

The hypotheses

The working hypotheses are to test 1) the effects of farmers' training on farm yield and the adoption of the selected technologies, 2) the effects of adoption of new technologies on the farm yields, and 3) the effects of technical assistance (extension).

Some of the initial expectations from this study are that training is positively related to the adoption of new technologies and the increase of yield; and the adoption of seed-fertilizer technologies is positively related to the yield while the adoption of sustainable technology may have negative effect on the average yield at least in the short time frame covered in this study. If a loss in yield occurs with the adoption of sustainable technologies, which is normally due to the reduction of land for main crop, it is expected that the loss can be regarded as the willingness to pay for the future value of the improved soil fertility and the conservation of soil quality. It is noted that full effects of sustainable technologies can only be measured over time; hedgerows in the long run may reduce the need for fertilizer.

The models

Three theoretical models are set up for the hypothesis testing. The models are training model, which aims to analyze and differentiate the characteristics of the trainees and non-trainees; the adoption model, which is used to characterize and distinguish adopters from the non-adopters; and the yield model, which is to evaluate the effects of the selected technologies. The training and adoption models are estimated with the probit model while the yield model is regressed with ordinary least squares (OLS) method.

The Estimation Results and Discussion

The estimation results show that there are no significant differences in the socio-economic characteristics of farmers with training compared to those without training (see Table 1). Likewise, there are not significant differences in the socio-economic characteristics between adopters and non-adopters of these technologies (see Table 2). While training in general shows significant effects on the adoption of new technologies, it does not have any significant additional direct effects on the farm yield. Study results also show that farmers do not adopt the studied technologies as a package. Since the current data set lacks the farmer's adoption history, future studies that take into account the time series data may verify this conclusion.

In the adoption model, a data separation problem was encountered in the estimation of the improved maize technology because the number of non-adopters is too few to estimate the model. The data separation problem can be avoided by improving the data quantity and, possibly, the data quality.

Generally, the estimation results show interesting findings. Within a community, the socio-economic characteristics of farmers who receive training are not significantly different from those who do not receive training. Similarly, households that adopt the yield improving and sustainable technologies are not significantly different from non adopters in terms of their socio-economic characteristics. In addition, the empirical analysis with the current data set shows that farmers in the studied area do not adopt the studied technologies as a package. The probability that a household has adopted any single technology is not conditional on whether other technologies have been adopted. A farmer who has adopted improved maize is not more likely to adopt hedgerows than a farmer not using improved maize. However, it is to be noted that since the data set does not include the time a farmer started with each technology, this study only looks at the current situation of adoption and misses the adoption history of each household. Further study needs to take into account the time that a farmer started with a new technology.

Table 1: Estimation Results of Training Model

Variable	Estimate	Marginal effect	Standard error	Pr>Chi sq
Improved maize: Farmers with training=45, without training=25				
Intercept	1.3855^{**}		0.5592	1.32%
MAIZELAND	-2.64E-05	-9.43E-06	4.71E-05	57.43%
POSITION	0.0643	0.0229	0.5580	90.83%
DISTRICT	-1.2577^{***}	-0.4485	0.3689	0.07%
RICH	0.5155	0.1838	0.5079	31.01%
POOR	-0.5822	-0.2076	0.4979	24.23%
Log likelihood:	-36.1315			
Fertilizer use: Farmers with training =32, without training=38				
Intercept	0.2164		0.4621	63.95%
MAIZELAND	-2.3E-05	-9.28E-06	3.90E-05	54.82%
POSITION	0.3924	0.1555	0.4906	42.37%
DISTRICT	-0.5174^{*}	-0.2051	0.3133	9.86%
RICH	0.4366	0.1730	0.4425	32.38%
POOR	-0.2687	-0.1065	0.4528	55.29%
Log likelihood:	-44.9703			
Hedgerows: Farmers with training =44, without training=26				
Intercept	0.6099		0.4834	20.70%
MAIZELAND	3.7E-05	4.57E-06	4.24E-05	38.17%
POSITION	-0.5354	-0.0471	0.5285	31.11%
DISTRICT	-1.0702^{***}	-0.1403	0.3469	0.20%
RICH	0.4014	0.0630	0.4804	40.35%
POOR	0.1411	-0.1392	0.4692	76.36%
Log likelihood:	-39.4304			

*, **, ***: estimate is significant at 10%, 5% or 1% significance level, respectively.

For explanation of variable, see Annex: Description of Variables.

With respect to the adoption of new technologies, training is, as expected, significantly and positively related to the adoption of studied technologies. This finding highlights the importance of training to farmers, particularly the upland farmers living in such remote areas as the studied villages. On the other hand, the fact that training shows up to

Table 2: Estimation Results of Adoption Model

Variable	Estimate	Marginal effects	Standard error	Pr>Chi sq
Improved maize^{+}: Adopters=63, Non-adopters=7				
Intercept	5.9593		514,418	100.00%
$TRAIN_{im}$	1.9013^{**}	1.21E-08	0.8981	3.43%
$PRAC_{f}$	0.7672	4.88E-09	0.6847	26.25%
$PRAC_{h}$	0.0109	6.96E-09	0.6387	98.63%
MAIZELAND	1.39E-03	8.85E-14	9.55E-05	88.42%
POSITION	-0.2658	-1.69E-09	593,685	100.00%
DISTRICT	0.8194	5.22E-09	0.8159	31.52%
RICH	1.0355	6.60E-09	540,802	100.00%
POOR	-6.8737	-4.38E-08	514,418	100.00%
Log likelihood	-11.3963			

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Table 2: Estimation Results of Adoption Model (cont.)

Variable	Estimate	Marginal effects	Standard error	Pr>Chi sq
Fertilizer use: Adopters=47, Non-adopters=23				
Intercept	-1.4988*		0.8989	9.54%
$TRAIN_f$	0.7299*	0.2402	0.3919	6.25%
$PRAC_{im}$	0.6802	0.2239	0.6045	26.05%
$PRAC_h$	-0.1213	-0.0399	0.3752	74.64%
MAIZELAND	1.03E-04*	3.38E-05	0.0001	6.06%
POSITION	0.5134	0.1690	0.7570	49.76%
DISTRICT	0.8097**	0.2665	0.3812	3.37%
RICH	0.0710	0.0234	0.5240	89.22%
POOR	-0.1073	-0.0353	0.5289	83.93%
Log likelihood	-33.7879			
Hedgerows: Adopters=36, Non-adopters=34				
Intercept	-0.5592		0.8434	50.73%
$TRAIN_h$	1.3505***	0.5388	0.3868	0.05%
$PRAC_{im}$	0.0546	0.0218	0.6344	93.14%
$PRAC_f$	-0.1402	-0.0559	0.4004	72.63%
MAIZELAND	3.46E-06	1.38E-06	0.0000	93.56%
POSITION	-0.7184	-0.2866	0.5281	17.37%
DISTRICT	-0.0686	-0.0273	0.3713	85.35%
RICH	0.0891	0.0355	0.4823	85.34%
POOR	-0.4063	-0.1621	0.5213	43.57%
Log likelihood	-37.8529			

+: There are slight differences in estimation results by SAS and by Limdep for this activity due to data separation problem. Estimation results shown in this table are from Limdep.

*, **, ***: estimate is significant at 10%, 5% or 1% significance level, respectively.

have no direct effects on yield poses the question of follow-up activities, which is to make sure that the trained farmers do according to what they learn from the courses. In additions, farmers in Tua Chua show up to have more training but adopt no more, even less in fertilizer technology, than do farmers in Yen Chau. This brings in the question of suitability of the training topics and the selection of trainees, if there ever is a selection of participants for training courses.

As shown in Table 3, adoption of new technologies has non negative effects on a farmer's yield, even with sustainable technology where the land for main crops is taken away. In general, adopters of all the selected technologies unambiguously have better yield than the non-adopter. This gain in yield is attributed to the adoption of improved varieties, which helps increase the yield about 80% on average. However, the fact that there is no complementarity among the selected technologies both in the adoption of new technologies and in the increase of yield may imply that the use of fertilizer-seed technologies to compensate for the loss in the adoption hedgerows is not sufficiently good enough to promote hedgerow technology. If the hedgerow technology is to be further promoted in the area, other diffusion methods may be required. This finding is in line with results from empirical studies which suggest the use of both agricultural and non-agricultural effort in the promotion of sustainable technologies.

Table 3: Estimation Results and Model Statistics of the Yield Model

Variable	Estimate	T-statistics	Variable	Estimate	T-statistics
Intercept	11.2647***	10.3996	$PRAC_{im}$	0.5886**	2.2003
LGMAIZELAND	-0.4759***	-3.7864	$PRAC_f$	0.1305	0.5305
POSITION	0.3864*	1.7613	$PRAC_h$	-0.3256	-0.8913
RICH	0.1504	0.7422	PR_ALL	0.1856	0.6134
POOR	-0.5757***	-2.7362	PT_{im}	-0.0174	-0.0889
DISTRICT	0.9349***	6.0203	PT_f	-0.3059	-1.5171
			PT_h	0.1198	0.3679

Model's statistics and goodness-of-fit	
No of households	70
R^2	0.6148
Adj-R^2	0.5337
Std. deviation	0.5443
F-statistics	7.5818

*, **, ***: estimate is significant at 10%, 5% or 1% significance level, respectively.

However, it is again noted that complementarity among the studied technologies may exist over a longer period of time but cannot be analyzed with the available data.

Most of the household socio-economic characteristics have no effects on the training and adoption decision but are statistically significant to the yield. Land size is significantly important to yield. Estimation shows that small farmers have higher yield than do larger farmers, which is explained by the fact that farmers maximize their profit based on their scarcest resource. On the other hand, poor farmers have lower yield than medium and rich farmers but rich farmers do not have better yield than do medium farmers. This implies that the level of intensification may slow down as the farmer becomes richer and achieves a certain level of yield or the response of yield to the incremental investment slows down as the level of investment goes up at a certain level. Farmers with position in the village also show up to have higher yield than do other farmers. This fact can be explained by the possible higher education and better access to resources by farmers with position in the village management. This explanation is in line with findings from previous studies in adoption model.

Conclusions and Recommendations

Based on the findings, the following conclusions and recommendations are made:

1. The estimation results show that in with the current data set, farmers have not adopted the studied technologies as a package. This finding is consistent with previous empirical studies about sequential adoption model.
2. Training is important to the adoption of new technologies. People who get trained are more likely to adopt the technologies than people who do not. In the area where the educational level of the farmers is low, the organization of training in the adoption of new technologies is very important.
3. Follow-up of training activities is important. In the context of the SFDP Song Da, this activity needs to be strengthened since it is closely linked to the effectiveness of training activities. For the less educated farmers and/or for the adoption of sustainable technologies, whose existence values are not clear, following-up of training activities becomes even more important
4. Though adoption of hedgerow technology evidently reduces the land available for main crop, the study results show that no significant reduction of yield is experienced. Since it is believed that this technology helps increase soil fertility and protect the soil from erosion, it is concluded that adoption of hedgerow technology may be promoted in larger scale. However, since there is no complimentarity among studied technologies, different method may be needed for the promotion of hedgerows in the area.
5. Adoption of new technologies, particularly the improved seed varieties, helps increase the farm yield. Since poor farmers do not participate adequately in training and are not significantly among the adopters of new technologies, supports should be more targeted to help them increase the farm yield.
6. Future studies may need to take into account factors like the time when a household started with each technology, the education level of the family head, and the area of land under each technology. Since it is assumed that education is strongly related to the adoption of new technologies and the increase of yield, inclusion of education variable in the future study may help test this hypothesis. In addition, the scale by which a farmer decides to adopt a technology is also assumed to be significant to the change in the crop yield. It is therefore expected that by including this data in future study, it will help test this hypothesis and verify the results from the study in this study.

Acknowledgements

The author is grateful to the SFDP Song Da project for making the data available for this study. Special thanks to Dr. Langworthy, Dr. Aradhyula and Dr. Frisvold from the Department of Agricultural and Resource Economics at the University of Arizona for their valuable comments and guidance during the study. Thanks to Dr. Sikor from Department of Agricultural Economics and Social Sciences at Humboldt University Berlin for his encouragement and comments on the paper.

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Annex: Description of Variables

Variable	Description	Type
MAIZELAND	Land size in m for maize crop of the household	Continuous
LGMAIZELAND	Log of land area for maize	
POSITION	Position of the household head in the village	1=Y[+], 0=N[+]
RICH	The household is rich	1=Y, 0=O[+]
POOR	The household is poor	1=Y, 0=O
DISTRICT	The location of the district where the household lives. This variable takes into account the differences between the two studied districts in terms of cultural, ethnicity and geography.	1=Yen Chau, 0=Tua Chua
$PRAC_i$	The household currently practices/ adopts improved maize (im), fertilizer use (f) and hedgerows (h) technologies.	1=Y, 0=O
PR_ALL	The household currently practices all the studied technologies: improved maize, hedgerows and fertilizer use.	1=Y, 0=O
PTi	Household receives training and adopts improved maize (im), fertilizer use (f) and hedgerows (h) technologies.	1=Y, 0=O

[+]: Y=Yes, N=No, O=Otherwise