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IPM TECHNOLOGY AND ITS INCENTIVES TO RICE FARMERS IN YOGYAKARTA PROVINCE

TEKNOLOGI PHT DAN INSENTIFNYA TERHADAP PETANI PADI DI YOGYAKARTA

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INTISARI

Dampak eksternalitas negatif pada lingkungan dan kesehatan manusia merupakan konsekuensi dari penggunaan pestisida kimia yang berlebihan dan terus-menerus. Hal ini juga telah membawa pengaruh buruk terhadap sektor pertanian mengingat bahwa hanya satu persen penggunaan pestisida kimia yang diserap oleh tanaman, sedangkan sisanya tertinggal di lingkungan sebagai limbah yang beracun. Untuk menghindari masalah serius tersebut pemerintah menghapus subsidi pestisida pada tahun 1989 dan pada saat yang bersamaan dilaksanakan program Pengendalian Hama Terpadu. Untuk mengetahui keunggulan teknologi PHT, evaluasi terhadap program tersebut dilakukan dengan dua cara: (1) mengevaluasi apakah teknologi PHT telah berhasil mengurangi penggunaan pestisida kimia (2) insentif apa yang diberikan oleh teknologi PHT kepada petani dalam menghadapi resiko kehilangan hasil akibat serangan hama dan penyakit tumbuhan.

Penelitian ini menunjukkan bahwa teknologi PHT berhasil mengurangi aplikasi pestisida kimia di Propinsi Yogyakarta tanpa mengorbankan tingkat produksi padi. Juga ditemukan bahwa teknologi PHT memberikan insentif bagi petani dalam bentuk kehilangan hasil yang lebih rendah, serangan hama yang lebih rendah, dan produktivitas yang lebih baik, sehingga para petani bersedia mengadopsi teknologi ini dalam usahatani padi mereka.

Kata kunci: insentif, teknologi PHT, evaluasi

ABSTRACT

Negative externality impacts on environment and human health are the consequences of continuous and heavy use of chemical pesticides. It has also brought about adverse effects towards agricultural production since it was found that only 1% of the inputs was absorbed by the plants, while the rest was left to the environment as poisonous waste. Realizing such serious problems the Indonesian government waived subsidy for chemical pesticides in 1989 and at the same time Integrated Pest Management (IPM) program was introduced. To see the superiority of IPM technology it is important to evaluate the program in two ways: (1) evaluating whether the IPM technology has successfully reduced the use of chemical pesticides, and (2) what incentives the IPM technology provides to the farmers in coping with the risk of crop loss due to the pest damage.

The study found the IPM technology successfully reduced the application of chemical pesticides in Yogyakarta province without sacrificing the level of rice output for the farmers. The study concludes that IPM technology provides incentives to the farmers in the form of lower pest damage, lower crop loss, and better yield so that the farmers are willing to adopt this technology in their rice farming.

Key word: incentife, IPM technology, evaluation

INTRODUCTION

A substantial increase in rice productivity has become a key achievement of the intensification program of agriculture in Indonesia. Agricultural technology characterized by the high use of inputs including chemical pesticides has been promoted in early 1970s. About 725 millions US $ was spent by the government to subsidize agricultural inputs for the farmers, and forty percent out of 725 million dollars were used for chemical pesticides (Conway & Barbier, 1990). One of the distinct behavioral consequences is that the farmers become too heavily dependent on chemical pesticides in protecting their crops (Barbier, 1989).

Negative externality impacts on environment and human health are other consequences of continuous and heavy use of chemical pesticides that have been well proved by many researchers (see for example, Zilberman & Castillo, 1994; Harper & Zilberman, 1992; Crissman *et al.*, 1994; Antle & Capalbo, 1994; Antle & Pingali, 1994; Rola & Pingali, 1993; Bond, 1996; Kishi *et al.*, 1995). Continuous dependency on chemical pesticides has also brought about adverse effects towards agricultural production. First, it was found that only 1% of the inputs was absorbed by the plants, while the rest was left to the environment as poisonous waste (Pimentel, *et al.*, 1993). Second, it is not easy to change the farmers' behavior in using chemical pesticides within a short period of time. The study of Irham (2001a; 2001b) in Yogyakarta indicated that the farmers in the study area still rely on chemical pesticides in protecting their crops.

Realizing the aforementioned problems, the Indonesian government waived subsidy for chemical pesticides in 1989 and at the same time Integrated Pest Management (IPM) program was introduced (Rölling & Fliert, 1994; Ministry of Agriculture, 1996). One of the expected impacts of the IPM program is the reduction of chemical pesticides use (World Bank, 1993; Irham & Mariyono, 2001). Other advantage of implementing the program is that IPM which is regarded as soft and environmentally friendly technology provides other secondary benefits ranging from financial benefits received by the farmers to important environmental benefits for the society (Lazarus & Swanson, 1983). Under the view of sustainable agricultural development and based on a number of successful applications of IPM program, IPM technology becomes one of the components of agricultural development strategy in Indonesia.

Having the superiority of IPM technology as some distinguished institutions claimed (particularly FAO and the World Bank) it is important to evaluate the success of the program in two ways. First is to evaluate whether the IPM technology has successfully reduced the use of chemical pesticides considering the disadvantages of their application in agriculture. Second, what incentives the IPM technology provides to the farmers as the "exchange" of releasing their "old" way in coping with the risk of crop loss due to the pest damage. Lower crop losses, less serious pest damage, and increase in yield are among others that may become incentives for the farmers of not using chemical pesticides in protecting their crops.

In terms of yield incentive in particular, earlier studies have been done by International Rice Research Institute (IRRI) taking the case of the Philippines (Rola & Pingali, 1993) and by SEARCA (1999) for the case of Indonesia. The study showed that the IPM-trained farmers produce higher yields compared to those of non IPM-trained farmers. Beside the statistical weakness of both studies, however, experience shows that it seems to be uneasy to change the attitude of the farmers immediately after their long dependence on chemical pesticides unless there is some incentive to change their habits as mentioned earlier. More studies are still needed to provide more proofs in evaluating the success of the IPM program. The objective of the study are to analyze the role of IPM technology in reducing pest damage, chemical pesticides use and crop loss, and to see the effect of the IPM program on rice yield.

MATERIALS AND METHODS

Secondary and primary data are used in this study. The former type is a cross-section time series data from 1989 – 1999 collected from various related government offices of Yogyakarta province. The latter type is a farm survey data consisting of three consecutive seasons of the year 2000/2001 collected through field survey conducted in Seyegan district, north west of Yogyakarta city. Sixty rice farmers were interviewed during the survey. From the sixty interviewed farmers, thirty of them are IPM-trained farmers while the rest of the samples are Non-IPM trained farmers

The study was conducted in Yogyakarta Province covering four districts namely Bantul, Gunung Kidul, Kulon Progo and Sleman regencies. Those four regencies are areas for the development of IPM program. Farmers Field School (FFS) training on IPM experiment plots for pest monitoring, and application of IPM technology have been disseminated in these areas. Moyudan district was selected as the field survey area. The district constitutes one of the rice production centers in Yogyakarta province where IPM program has been promoted intensively by the regency government of Sleman. The area is located in the north west of the city of Yogyakarta. Farmers Field Schools (FFS) have been set up following the introduction of the IPM program.

Cross-table analysis is a primary tool of the analysis supported by simple statistical test when necessary. A regression method is applied to estimate the level and magnitude of relationship between inputs and yield of rice.

Yield function is developed in estimating the functional relationship. Chemical pesticides input is used as independent variable to know the effect of chemical pesticides on rice yield. To detect the impact of the IPM program on rice yield a dummy IPM is introduced into the model. The following is the estimated model developed in this study.

$$\ln Y = \ln \alpha + \sum \beta_i \ln X_i + d_1 D\text{-}season_1 + d_2 D\text{-}season_2 + d_3 D_{IPM} + \varepsilon_1 \quad (1)$$

where Y is yield of rice (kg/ha); X is rice input for i = 1, 2, ... 8; $D\text{-}season_1$ and $D\text{-}season_2$ are dummy variables for rainy season and first dry season, respectively; D_{IPM} is dummy IPM (1 for IPM-trained farmers, 0 for non IPM-trained farmers). α and β are coefficients of regressions; and ε_1 and ε_2 are error terms.

Recursive demand function is used to see the effect of IPM technology on demand for chemical pesticides. This model is used relied on the assumption that IPM technology is not only able to control the pest but also affect the production process so that the marginal product of chemical pesticides is changed. In this case the use of pesticides (Xp) will be influenced by the level of pest damage (PD), price of pesticides (Pp), price of rice (Ps), and planted area of rice (As). By using this assumption, it is expected that IPM technology (IPM) determine both the level of pest damage (PD) and the level of pesticides use (Xp). Then the following equations are formulated:

$$PD = a_{10} + b_{11} IPM + u_1 \quad ....(2)$$

$$Xp = a_{20} + b_{21}PD + c_{21}IPM + c_{22}Pp + c_{23}Ps + c_{24}As + u_2 \quad ....(3)$$

so that u_1 and u_2 are uncorrelated. By using recursive model the demand function (3) the equation can be directly estimated by using *OLS* (Gujarati, 1995).

RESULTS AND DISCUSSION

The study observed that on the one hand, the farmers in the study area still apply chemical pesticides as an important measure in protecting their crops. On the other hand, however, the success of IPM program in reducing the application of chemical pesticides becomes obvious. As Table 1 shows, IPM-trained farmers apply chemical pesticides (both granular and liquid chemical pesticides) much lower compared with that of non IPM-trained farmers, and statistically significant. It is fair to say that the IPM technology has a positive impact in reducing the application of chemical pesticides in rice farming. Although the two groups apply chemical pesticides for their crop protection, however their idea of using chemical pesticides is different.

To support this tendency, the results of chemical pesticides demand estimation by using recursive demand function is presented (Table 3). According to the model, around 74% of chemical pesticides demand can be explained by all variables included in the model, which is considerably good. Each variable (price of chemical pesticides, level of pest damage, IPM technology, or planted area of rice) significantly influence the demand for chemical pesticides. Under *ceteris paribus* condition, the price of chemical pesticides has a significant effect in reducing the demand for chemical pesticides. Since a ratio of price of chemical pesticides to price of rice is used in the model, this result is theoretically justified. Assuming that the farmers are rational, as marginal product of chemical pesticides decline when the price of chemical pesticides goes up, it will be responded by reducing the amount of chemical pesticides used in rice farming. This condition is met when the marginal product of chemical pesticides equals the new value of the ratio between chemical pesticides price and rice price.

Table 1. Level of pesticides application and use of other chemical inputs

Types of Inputs	Rainy		Dry 1		Dry 2		One Year		Statistical t-value
	IPM-trained farmer	Non IPM-trained farmer	IPM-trained farmer	Non IPM-trained farmer	IPM-trained farmer	Non IPM-trained farmer	IPM-trained farmer	Non IPM-trained farmer	
Granular pesticides (kg/ha)	0.9	5.6	2.2	3.1	1.0	5.3	1.4	4.6	4.42***
Liquid pesticides (L/ha)	187.7	335.7	368.0	526.4	164.6	292.5	240.1	384.9	21.65***
Urea (kg/ha)	180.8	170.0	177.6	170.6	174.9	172.4	177.8	171.0	1.29 ns
TSP (kg/ha)	100.2	111.2	111.3	113.3	109.3	112.2	106.9	112.2	1.13 ns
KCL (kg/ha)	41.0	0.0	41.9	5.5	43.6	0.0	42.2	5.5	5.54***
Seeds (kg/ha)	41.2	43.0	51.0	45.3	48.9	46.7	47.0	45.0	1.30 ns

Source: Farm Survey, 2001 Note: *** = significant at 1% level.

Table 2. Farmers reasons of using pesticides (%)

Types Reason	IPM-trained farmer	Non IPM-trained farmer
Pest damage exist	66.7	40.0
Preventive motive	16.7	50.0
High yield motive	10.0	16.7
Neighbors' influence	6.7	10.0

Source: Farm Survey, 2001

Table 3. Regression results of recursive demand function

Variables	Coefficient	t-value
Ratio of pesticides price to rice price	- 220.43 ***	-3.706
Pest damage (%)	27.130***	3.874
IPM (number of FFS)	-2.599***	-6.161
Rice area (ha)	0.040***	8.513
Intercept	1,754.2 ***	4.519
R^2	0.739	
F-value	23.010***	
D-W	1.922	

Note: *** significant at 1% ** significant at 5% * significant at 10%

Table 3 also indicates that the level of pest damage shows a significant effect on the increase of chemical pesticides demand. This is still consistent with the IPM concept that chemical pesticides will be applied when serious pest damage exists. Dissemination of IPM technology has significantly reduced the amount of chemical pesticides use. It implies that the introduction of IPM has a positive impact on chemical pesticides use reduction in rice farming. This is interesting because IPM Farmer's Field School (FFS) for rice covers majority portion of the area so that FFS for rice has been widely adopted by most of the farmers in this study area. The study found that pest damage experienced by IPM-trained farmers is lower than that of non IPM-trained farmers. Although statistically insignificant, it proves that with a significant difference in terms of chemical pesticides used by the two groups, it is fair to say that higher application of chemical pesticides does not guarantee for lower pest damage (Table 4). The Table proves that the higher rate of chemical pesticides application tends to increase the level of pest damage instead. It seems that the use of chemical pesticides has an adverse effect on pest damage.

Table 5 informs us that although the difference in rice yield between the IPM-trained and non IPM-trained farmers is not statistically significant, the Table also shows that the rice yield of the IPM-trained farmers is still higher compared with those of non IPM-trained farmers. This finding suggests that IPM technology provides a strong effect in reducing the application of chemical pesticides without sacrificing the level of rice output for the farmers. In this regard, it is fair to say that IPM technology provide a yield incentive to the farmers to adopt this technology in the rice farming.

Table 4. Rice yield, pest damage and crop loss

Items	Rainy		Dry 1		Dry 2		One year	
	IPM-trained farmer	Non IPM-trained farmer	IPM-trained farmer	Non IPM-trained farmer	IPM-trained farmer	Non IPM-trained farmer	IPM-trained farmer	Non IPM-trained farmer
Rice yield (kg/ha)	3611	3258	3673	3306	3865	3532	3717	3365
Pest damage (%)	21	29.6	25.6	26.1	20.5	25.5	23.0	27.0
Crop loss (kg/ha)	1848	2276	1749	2228	1469	2002	1688	2169

Source: Farm Survey, 2000.

Table 5. Regression results of yield function

Variables	Estimated results	
	Coefficients	t-value
Intercept	7.6131***	14.732
LnUrea	0.0158	0.212
LnTSP	-0.0046	-0.071
LnKCL	0.0037*	1.507
LnSeed	0.0411	0.599
LnGranpest	-0.0042*	-1.371
LnLiqpest	0.0203	0.925
LnLabor	0.1001**	2.112
LnPestdamage	-0.0683***	-2.429
Dummy IPM	0.0253	0.785
Dummy Season1	0.0154	0.461
Dummy Season2	0.0497*	1.447
R^2	0.1518	
F-value	2.732***	

Note : *** = Significant at 1% ** = Significant at 5% * = Significant at 10%

CONCLUSIONS

The study found that the farmers in the study area still apply chemical pesticides as an important way of the crop protection. The IPM program has successfully reduced the application of chemical pesticides in Yogyakarta province. It can be concluded that the IPM technology has a positive impact in reducing the application of chemical pesticides in rice farming. This finding is supported by the results of chemical pesticides demand estimation using recursive demand function showing that dissemination of IPM technology has significantly reduced the amount of chemical pesticides demand. It implies that the introduction of IPM has reduced the application of chemical pesticides in rice farming.

Although the rice yield between the IPM-trained and non IPM-trained farmers are not statistically different, the rice yield of the former farmers is higher than those of the latter farmers. This finding suggests that IPM technology provides a strong effect in reducing the application of chemical pesticides without sacrificing the level of rice output for the farmers.

It is fair to conclude that IPM technology provides incentives to the farmers in the form of lower pest damage, lower crop loss, and higher yield so that the farmers are willing to adopt this technology in their rice farming.

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