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"Solidarity in a competing world — fair use of resources"

How much Do Farmers Care about Pesticide Externalities?

A Choice Experiment among Thai Vegetable Farmers

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Abstract

Agricultural pesticides are widely used to control pests globally in market-oriented farming systems especially in vegetable production. High and incorrect use has led to high external costs to ecosystems and human health. This paper aims to explore farmers' choice preference for alternative pest management methods, ranging from environmentally harmful to benign. External costs of pesticides were reviewed and alternative pest management practices were studied for selected vegetables in Thailand. Farmers' preference for certain pest management methods and outcomes were investigated using a choice experiment. About 300 vegetable farmers were sampled in three sub-urban provinces of Bangkok, including Ratchaburi province, Nakorn Pathom province and Pathum Thani province. Attributes of pest management methods and outcomes included farm ecosystems, human health, eco-labeling, market opportunities, training in integrated pest management, and the additional farm cost. A mixed logit model was employed to investigate the effect of each attribute on the respondents' preferences for the pest management practices and outcomes and to estimate farmers' marginal willingness to pay for each attribute. Levels of pesticide use in vegetable production were found to be high as farmers tried to protect their investment from a wide range of pests and diseases. Alternative methods were not widely available and used in an ad-hoc manner to complement pesticides rather than substitute them. To make vegetable farming in Thailand more environmentally friendly, alternative pest management practices need to be disseminated in combination with intensive farm-level training.

Keywords: Agricultural pesticides, Integrated Pest Management, Choice Model, Sustainable agriculture.

Introduction

High and incorrect use of chemical pesticides has led to high external costs to ecosystems and human health worldwide. The external costs of pesticide use in Thailand were estimated to be about USD 18.7-27.1 /ha in 2010 (Praneetvatakul et al., 2013). The negative externalities of pesticide use could be reduced by using economic incentives combined with supportive measures to change on-farm practices through awareness-raising about the adverse effects of pesticides and introducing farmers to non-chemical alternatives to manage their pest problems. Nevertheless, it would first be important to know how farmers themselves consider pesticide externalities.

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In the field of agri-environmental policy, choice experiments have been applied widely such as estimating willingness to pay for pesticides by apple and pear growers (Gallardo and Wang, 2009), investigating the factors affecting Spanish farmers' willingness to participate in a hypothetical programme (Espinosa-Goded et al., 2010), assessing farmers' willingness to participate in voluntary conservation schemes (Christensen et al., 2011), and a recent study on greening area by Schulz, Breustedt and Lohmann (2014).

Objective

The main objective of the study is to explore and value farmers' preference for alternative pest management options.

Methods and data

Discrete choice experiments are a common tool to assess people's preferences or decisions in hypothetical situations, e.g. before a new product is launched or a new technology is made available. We asked vegetable farmers to choose their most preferred alternative from a set of choices with characterized called attributes. Choice models are based on random utility theory (Luce and Tukey 1964, Quandt 1968, and Theil 1970 as cited by Schulz, Breustedt and Latacz-Lohmann (2014). The econometric methods for their estimation were developed by McFadden (1974) and Louviere and Woodworth (1983) cited by Schulz, Breustedt and Latacz-Lohmann (2014) to analyze choice experiments data.

Our choice model was developed in four steps. First, attributes and levels were determined by experts through focus group meetings held in Bangkok and in the study areas (Table 1). Second, we calculated the number of option using a Full Factorial as $2^2 \times 3^2 \times 4 = 144$ and then reduced this to 48 options using a Fractional Factorial Design to avoid confusing the farmers with too many options. Third, each choice card was built from two selected options. we got 24 choice sets. Last, six patterns were produced for interviews i.e. each farmer answered four choice sets.

We conducted a farm household survey in three provinces near Bangkok, i.e. Pathumthani, Nakorn Pathom and Ratchaburi, where vegetable farming is concentrated. Data for 303 farmers were collected in 2016.

Table 1 Attributes and levels of environmentally friendly pest management options

Attributes	Number of levels	Details
1) Impacts on Ecological Environment and Certification for Environmentally Friendly Pest Management Practices.	3	1) Few natural enemies (Status Quo) 2) Good Ecosystems (high natural enemies and good environment) 3) Good Ecosystems with Eco Certification
2) Long-term Human Health Impact (farmers and family members)	2	1) High cancer risk (Status Quo) 2) Good Health (low cancer risk)
3) Market Opportunity for Environmentally Friendly Pest Management Products	3	1) Local market (Status Quo) 2) Supermarket (Store) 3) Export
4) Knowledge and Training in Integrated Pest Management (IPM)	2	1) No IPM training (Status Quo) 2) IPM training
5) Additional Costs of Production (USD/ha/Crop)	4	1) 0 (Status Quo) 2) 313 3) 625 4) 1250

We used a mixed logit model to analyze the data and applied a simulated maximum likelihood estimator to obtain the indirect utility (Vi) using the following equation:

$V_i = \beta_0 Existing + \beta_1 Ecosystem + \beta_2 Ecolabel + \beta_3 Health + \beta_4 Store + \beta_5 Export + \beta_6 IPM + \delta\ Price$

Where;

Vi	Indirect utility of farmers
β0	Coefficient of existing options (status quo)
βi	Coefficient of attributes
δ	Coefficient of price
Existing	Existing pest management
Ecosystem	High natural enemies and good environment without eco-certificate
Ecolabel	High natural enemies and good environment but with eco-certificate
Health	Good health (low risk to cancer due to chemical pesticide use)
Store	Supermarket
Export	Export market
IPM	Integrated Pest Management Training
Price	Additional production costs (USD/ha/Crop)

The marginal willingness to pay (MWTP) for attribute i can be calculated as:

$$MWTP_k = -\frac{\beta_k}{\delta}$$

Results

Significant attributes were ecosystems, Eco Veggie Certification, Health, Integrated Pest Management Training and Price. Store and Export were not significant (Table 2). Farmers valued health as the most important aspect in pest management choices (3,154 USD), followed by Ecosystems (2,197 USD), IPM training (1,274 USD), and Eco Veggie Certification (223 USD) (Figure 1).

Table 2 Mixed logit model of environmentally friendly pest management options

Attributes	Vegetable Farmers	
	Coefficient	Z
Ecosystems	1.660***	7.07
Eco Veggie Cert.	1.828***	7.52
Health	2.383***	8.20
Store	-0.262	-1.36
Export	-0.210	-0.83
IPM	0.963***	4.72
Existing	1.544***	4.33
Price	-0.0007556**	-2.44
Log likelihood	-908.78234	
LR ch2 (8)	349.18	
Prob>chi2	0.0000	

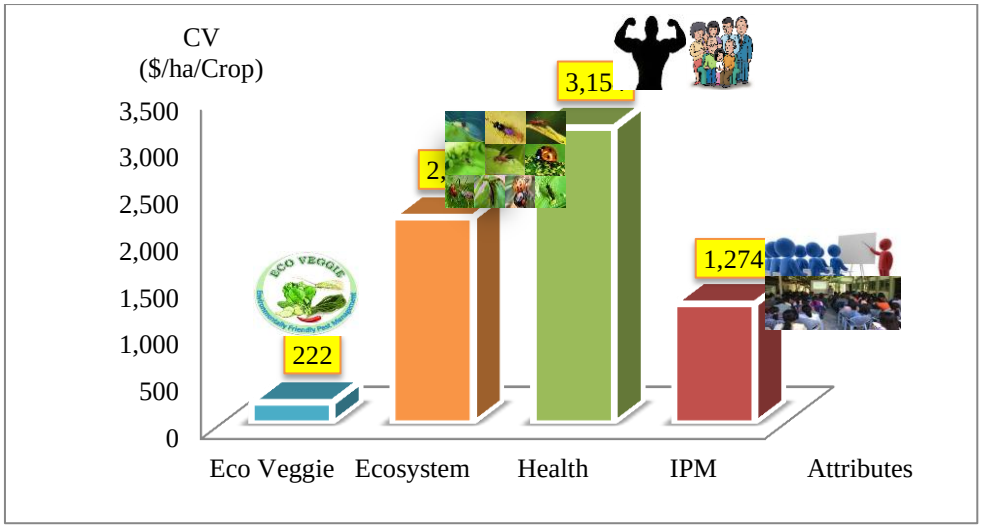

Figure 1: Compensating variation for each attribute, 2016.

Conclusions and Recommendation

The results show that farmers care about pesticide externalities as they were highly willing to pay to protect their health when given alternative pest management options. Healthy ecosystems were considered as the second most important attribute which farmers were willing to pay for to control agricultural pests. Integrated Pest Management (IPM) training was very important to enhance farmers' knowledge to address with pesticide externalities. Last, certification of environmentally friendly pest management appears important as alternative option. To make vegetable farming in Thailand more environmentally friendly, alternative pest management practices need to be disseminated in combination with intensive farm-level training.

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