

## Estimating Compliance Behavior in the Pesticides Regulation among Paddy Farmer

Norashikin Baharom<sup>1</sup>, Jamal Ali<sup>1</sup>, Fazli Shah Abd Aziz<sup>2</sup>

<sup>1</sup>School of Economics, Finance and Banking, College of Business, Universiti Utara Malaysia, Sintok, Kedah, Malaysia

<sup>2</sup>School Business Management, College of Business, Universiti Utara Malaysia, Sintok, Kedah, Malaysia

**\*Corresponding Author:** Norashikin Baharom, School of Economics, Finance and Banking, College of Business, Universiti Utara Malaysia, Sintok, Kedah, Malaysia

**Abstract:** The increase in population size and the pattern of food intake has led the requirement to increase food production at the same time. Rice is absolutely among the food that most of the world population eat. Farmers are constantly trying to increase production of rice in line with its ever-increasing demand and increased production will lead to an increase in farmers' income. Apart from fertilizers, other inputs often used by farmers are pesticides that can control insects and diseases. However, most of the applied pesticide get dispersed in the environment and affects the health of unprotected paddy farmers and sprayer workers. Exposure to pesticides is one of the most important risks among paddy farmers. Lack of information and proper training on pesticide use often reported playing a major role in occupational accidental among paddy farmers. The previous study found that some farmers use the banned pesticides and carry out improper occupational security standard for handling process of pesticide. This study trying to find factors that can influence the compliance behavior of pesticides regulation by paddy farmers in Northern Peninsular of Malaysia. The Theory of Planned Behavior (TPB) model has been selected to measure farmer compliance behavior on the pesticides regulation such as the types of consumed pesticides and procedure applying the pesticides. Results of the descriptive analysis show that socio-economic factors such as age, experience, level of education, farm size, farm status, training and relationship with agencies can influences compliance behavior. While, the estimated Logit Model indicates that factors such as intention, attitude, subjective norm and perceived behavioral control can also influence compliance behavior. The study has highlighted the need for proper training for paddy farmers on the handling of pesticides and undertaking awareness on dangers of pesticides to paddy farmers and young generations. The findings of this paper suggest that government and non-government agencies can play the important role to educate people about pesticide handling procedure need to be educated to farmers for more understanding of the pesticides regulations.

**Keywords:** Compliance, Pesticides, Malaysia

### 1. INTRODUCTION

Identifying factors that allow regulations to be followed by a target group is important to enable the objectives of the introduced rules to be accomplished[1]. The term of compliance reflects the ability of the target group to act according to the order of the set of regulations. Authorities who enforce such regulations will ensure that the targeted groups comply with the regulations, [2].In the agricultural sector, regulations are designed to achieve certain goals. In fact, the rule made it possible to develop the agricultural sector and become sustainable [3]. The United States Environmental Protection Organization classified that, the agricultural regulation as a set of rules that consist of several regulations related to agricultural infrastructure, seeds, water supply, fertilizers, and pesticides consumption [4]. In addition, there is regulations issue arise related to agricultural financing, labor, marketing of agricultural products, agricultural insurance, agricultural rights, conditions and arrangements for land tenants, agricultural processing rules and rural industries[5].

In reality, agricultural regulation has an impact on agricultural production, sustainability, animal welfare and safety of food products [6]. However, the agricultural sector is currently experiencing various issues of compliance related to the types of pesticide regulation [7]. The most significant issue is about the risks of pesticide consumed in the agricultural sector including the risk to human and animal health, and negative effects on the environment. The risk occurred when the chemical is not

used properly [8]. The existence of risk has resulted in several regulations being made to mitigate the risk of using the pesticide. The regulations include the types of pesticides that can be used according to classes of pesticide, the applying pesticide procedure, and types of pesticide consumed do not have a negative impact on the environment and the public [9]. Although various strategies have been performed and enforced to ensure that farmers are in compliance with the pesticide procedures, it is found that the compliance rate still does not reach the desired level [10]. The situation was shown by studies in Thailand which found that 98 types of banned pesticides were used by farmers in Thailand [11]. Furthermore, the same study reported that 73 percent of Penang's farmers use banned Class1b pesticides [12]. In addition, other study also found that banned pesticide such as endosulfan was widely used in the Indian agricultural sector [13].

The use of pesticides has created serious concerns and is often debated among medical practitioners and environmentalists [14] [15] [16]. In Malaysia, agencies handle with pesticide issues are Department of Agriculture, Health Departments, and environmental related agencies. There are some farmers still using prohibited pesticides and apply pesticide not in accordance with the permitted specifications by the Malaysian Pesticide Board. Researchers reported that farmers are still using banned pesticides since they believe this method traditionally produced a positive impact on crop production rates [11]. Based on the situation, this study attempted to identify the compliance behavior related to pesticide regulations among paddy farmers in the northern region of Peninsular Malaysia.

This paper is organized into five sections. This current section introduces briefly the background, problem statement and significance of this study. The second section presents the literature review. The data and methodology are described in the third section. The results of this paper will be presented in the fourth section. The fifth section concludes the findings of this paper.

## 2. LITERATURE REVIEW

Typically, the enacted policies, as a rule, must comply with the voluntary process [17]. However, the voluntary or forcedly compliance behavior occurred once influenced by certain factors [18]. Theory of Planning Behavior (TPB) was accordingly introduced by Icek Ajzen (1985) to complement the Theory of Reasoned Action (TRA). Based on the Theory Planned Behavior, behavioral can measure how the actions taken by a person when guided and considered as a prediction [19]. It posits that individual behavior is driven by behavior intentions, where behavior intentions are a function of three determinants: an individual's attitude toward behavior, subjective norms, and perceived behavioral control [20].

In reference to the compliance aspect, intention to comply or disobedient were related to the attitudes, social norms and perceived behavioral control [21]. The intentions reflect on the effect of policy implementation even individual did not reveal the actual behavior [22]. A study in the agricultural sector in Finland found that farmers took an action based on their thinking [23].

Based on compliance behavior, attitudes are influenced by agency perceptions such as institutions and societies [24]. So, the various government policies applied had become an opportunity and may influence the community behavior if the majority of the people adopt it. Moreover, subjective norms are based on motivational beliefs which it can affect some behaviors [25]. Refer to the compliance behavior concept, the motivation is conceptualized as an internal force, while the action produced is viewed as the external effect of this internal force. The greater the intensity of internal pressure, the greater is the degree of motivation to respond emotionally [26]. Behavior can be explained by incorporates awareness elements in subjective norm parameters as internal factors [27]. The perceived behavior control which means the perception of the ease or difficulty of the particular behavior. It is linked to control beliefs, which refers to beliefs about the presence of factors that may facilitate or impede the performance of the behavior [19]. Refer to the compliance behavior, perceived behavioral control with related actions taken by using information has been received [28].

In short literature clearly suggests the importance of attitude, social norm and perceived behavioral control influencing farmers to comply the pesticides regulation. However, background factors are also used to measure compliance behavior. This paper aims to investigate the compliance behavior among paddy farmers using Logit Model.

### 3. DATA COLLECTION TECHNIQUE

Data were collected from the farmers through focus group discussions and survey. General information on the types of pesticides, general perceptions regarding using of pesticides among paddy farmers, and major issues related to the regulation of pesticide use in Malaysia were gathered from the discussions with key informants through a series of focus group discussions.

Primary data, particularly on the perception of the use of pesticide were collected from face-to-face interviews of paddy farmers using a structured questionnaire. The stratified random sampling method is used to select sample respondents separately for MADA Kedah (309 farmers), MADA Perlis (104 farmers), IADA Pulau Pinang (59 farmers), and IADA Perak (178 farmers). The sample size was 650 respondents being interviewed. The questionnaire consists of the four parts. First, in respect of respondent's socio-demography information. Second, about the respondents' attitude. Third, was related to the social norm, and the final section is perceived behavioral control in pesticides regulation.

### 4. METHODOLOGY

In this study, peasant backgrounds such as farmer characteristics, farm characteristics, farm contexts and information related to pesticide use were analyzed using frequency distribution techniques and percentage in influencing the behavior of paddy farmers.

In addition, the logit regression was used to examine the dependent variable may affect the farmer's compliance behavior. Since the compliance behavior could be measured in a binary category (comply or disobedient), the logit model is used to measure the compliance behavior. The logit model is as below [29]:

$$Y_{ij}^* = \beta'x_i + u_i \tag{1}$$

$Y^*$  is the latent variable that represents the graduates' underlying to comply,  $Y^*$ , which is  $Y^* = 1$  (if the farmer is complying) and  $Y^* = 0$  (if otherwise).  $x_i$  is the matrix of the independent variable.

By assuming the error term  $u_i$  is distributed logistic, the probability of choosing whether to comply or disobedient (Prob ( $Y= 1$ )) for farmer depends on the independent variable and thus, the logit model specification is as follow:

$$\begin{aligned} \text{Prob} (Y= 1 \mid x) & \tag{2} \\ &= \text{Prob} (Y > 0 \mid x) \\ &= \text{Prob} (\beta'x_i + u_i > 0 \mid x) \\ &= \text{Prob} (u_i > \beta'x_i \mid x) \\ &= \text{Prob} (u_i < \beta'x_i \mid x) \\ &= F(x\beta) \tag{3} \end{aligned}$$

To obtain the area under the function, we have:

$$\text{Prob} (y_i = 1 \mid x_i) = \frac{\exp(x_i \beta)}{1 + \exp(x_i \beta)} = \frac{1}{1 + \exp(-x_i \beta)} \tag{4}$$

Maximum likelihood estimation is used to obtain the probability,  $x$  and  $\beta$  required. Likelihood equation is as follow if the observation is independent:

$$L(\beta \mid y, X) = \prod_{i=1}^N P_i \tag{5}$$

If the  $P_i$  is replaced in the function  $L(\beta \mid y, X)$ , the values obtained are:

$$L(\beta \mid y, X) = \prod_{y=1} \text{Prob} (y_i = 1 \mid x_i) \prod_{y=0} 1 - \text{Prob} (y_i = 1 \mid x_i) \tag{6}$$

The function is replaced by the probability of the observation of the likelihood function and form the following equation:

$$L(\beta \mid y, X) = \prod_{y=1} F(x_i \beta) \prod_{y=0} 1 - F(x_i \beta) \tag{7}$$

5. RESULTS

The results of this paper are divided into two parts, i.e., descriptive statistics (which consists of socio-demographic characteristics of respondents) and the estimated Logit Model (which estimates the factors that influence the compliance in pesticides regulations).

5.1. Results of Descriptive Statistics

Table 1 presents the characteristics of the respondents of this study. In terms of age, there was 0.3 percent of paddy farmers age of fewer than 30 years, meanwhile, respondents who were between 31 to 60 years old were 41.7 percent. Those who were over 61 years old were 58.6 percent. The average age of the household head was almost 51 years old and their farm size was 3.2 hectare per household. Farmers on average had 9 years of formal schooling which is consistent with the national average of workers in agriculture sectors. Considering the education attainment of household heads, the table shows that a high proportion (about 57.7 percent) of the heads have only secondary school education, followed by those having primary school education (30.5 percent) and household that having higher education only 4.5 percent. It shows that most of the farmers have a basic level of education only.

In terms of experience, there was 19.4 percent of farmers have more than 40 years experience in agricultural activities. The average experience of farmers in agriculture is almost 28 years. It was assumed that farm size and ownership status of the farm can affect farmers behavior in applying the pesticides. Refer to the farm size, there was 11.7 percent of paddy farmers have more than 8 hectares, the majority of them (72.7 percent) only owned 2 hectares of paddy field. In addition, there was 72.4 percent of paddy farmers do their farming activities on their own land, and only 27.6 percent of paddy farmers do their farming in the rented farm.

Information and knowledge about pesticides using and handling can be obtained through formal collaboration with agricultural agencies or pesticides supplier. There was 31.3 percent of paddy farmers had attended training on the handling of pesticides. However, the majority of them (68.7 percent) never attending training related to pesticide handling. Farmers need the moral and physical support to ensure the farming operations efficiently. So, the agricultural agencies have been given key responsibility to manage and control the farming operations. There was 71 percent of paddy farmers stated that they were satisfied with the services of agricultural agencies.

Table 1. Characteristics of respondents

Variable	Category	%	Mean
Age	< 30	0.3	
	31 - 60	41.7	51
	> 61	58.6	
Education	Higher education	4.5	
	Secondary school	57.7	
	Primary school	30.5	
	Informal education	3.3	
	No education	4.0	
Experience	< 10	7.9	
	11 - 40	72.7	28
	> 41	19.4	
Farm size	< 1.9	13.9	
	2 - 7.9	56.2	3.2
	> 8	11.7	
Ownership	Own	72.4	
	Rental/ lease	27.6	
Training	Yes	31.3	
	No	68.7	
Contact with extension	Not at all satisfied	13.6	
	Slightly satisfied	3.1	
	Moderately satisfied	12.9	
	Satisfied	32.6	
	Very satisfied	38.0	

**5.2. Results of the estimated Logit Model**

Table 2 presents the estimated Logit Model. To evaluate the fit of the estimated model to the data, we used the pseudo R2, overall fit test and percentage correctly predicted. It is found that the estimated model has a high value of pseudo R2, significant overall fit test, and a high percentage of correctly predicted. Thus, it can be concluded that the estimated model has high fit with the data.

The estimated Logit Model reveal that the socio-demographic factors such as Age, Experience, Education, Farm size, Training and Contact with extension do not have a significant influence on the compliance behavior of pesticides regulations. However, the Ownership factor is found a significant effect on the compliance behavior among farmers. Other studies have found the variance of ownership can affect farmer behavior. Consistent with this research stated that the ownership of farm may affect the farmer's behavior [30]. If the farm owned by self, farmers will keep the property right and unrestricted to decide on the farm operation. However, the farmer will be hindering the set of conditions if the farm belonging to the other parties.

In addition, the intention factor has a significant relationship with the compliance behavior in pesticides regulations. The significance of this factor clearly denotes that the good intentions lead to complying with pesticides regulations. Other study identified that the intention is a psychological tool may effect in controlling behavior [31]. In addition, this factor also may due to the conscious control guided by the individual as verbally to do good behaviors or otherwise [32].

Intuitively, attitude factor have significant relationships with compliance behavior in pesticides regulations. Through in this study, attitude factors able to form the farmer's behavior to comply or disobey. This study found the same results which the attitude has been a positive relationship with the behaviors when farmers comply with regulations [33] [34].

Based on this study, subjective norms have significant relationships with the farmers' compliance behavior. This situation stated that the compliances may due from the customs and the public acceptance of the regulations [35]. Other study found the same finding in the compliance case studies [36].

The result of this study also found the perceived behavioral control have significant relationship the farmers' compliance behavior. The finding can be explained that the perceived behavioral control depends on the information acceptance and how that factors effective to take actions [28]. The studies also found that the perceived behavioral factor was able to influence the behavior of farmers in the agricultural sectors [37] [38].

**Table 2.** *The estimated Logit Model*

Variable	Coefficient	Standard error
Age	-.137608	.1293132
Experience	-.1153425	.0927664
Education	.0618412	.0915808
Farm size	-.0392998	.0875852
Ownership	-.4902441**	.2468606
Training	.2110556	.2416535
Contact with extension	.0867364	.0909864
Intention	1.274959***	.2527015
Attitude	2.180323***	.2225035
Subjective norm	.888517***	.2325591
Perceived behavioral control	.8404952**	.2720981
cons	***-11.75499	1.483447
N = 645, R square = 0.421, P value = 0.000		

Notes: 1. \*\*\*, \*\* and \* represent significant at 1%, 5% and 10% respectively.

**6. CONCLUSION**

It can be concluded that there are several factors that influence the level of farmers' compliance with the pesticides regulations in the paddy crops. The result showed that farmers have the intention to comply the pesticides regulation. Through in this study, the intention factors are actions taken by farmers before handling and use of the pesticides. However, the findings showed that compliance behaviors in handling and use of pesticides involved the factors of attitudes, subjective norms and

perceived behavioral control. These factors required during and after the using the pesticides in paddy crops. An assessment of this situation indicates that emphasis on the practices and handling of pesticides should be given to farmers through a proper training program. The training program should be started in the process of handling and use of pesticides until entire procedures completed (before, during and after). There must be a proper arrangement for checking of the farmers understanding related to the right ways and techniques of pesticides application. A module related to pesticide handling maybe very useful. At the same time, explanation about the module can be done through the involvement of officers' from agricultural agencies and pesticides suppliers. Through these routine strategies, it seems probable that the situation will encourage farmers to be able for right handling with a better understanding of pesticides used for their benefits without affecting others.

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