Factors Influencing Farmers in Cameron Highlands to
Use Insecticide in Cabbage Cultivation

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Abstract: The alarming negative effects of insecticide used in farming have caused growing concerns by many people. Due to that, various strategies were established to curb the overuse of insecticide, particularly on cabbage cultivation in Cameron Highlands, which is one of the major vegetable producing regions in Malaysia. Unfortunately, the rates of insecticide use remain highly variable. It is the responsibility of the government to shoulder and tackle this problem effectively, especially in finding out the main reasons why insecticide is preferable as the main insect pest control management. This study employed Theory of Planned Behavior (TPB) and Technology Acceptance Model (TAM) to understand farmers’ specific attitudes (SA), subjective norms (SN), perceived behavioural control (PBC) and past behavior (PB) towards insecticides use in Cameron Highlands. Simple random sampling procedure was used in selecting 370 cabbage farmers for the study. Five-point Likert scale questionnaires were used to collect data. The data was collected through survey interviews and was analyzed using inferential statistic (correlation and regression). Results of the analysis showed a significant relationship between SA, SN, PBC, PB and the farmers’ intention to apply insecticide in the coming season. PBC was the most important influential factor for behavioural intention, followed by PB, SA and NS.

Key words: Insecticide • Theory of Planned Behaviour • Technology Acceptance Model

INTRODUCTION

Cabbage (Brassica olearaceae var. capitata) is one of the main vegetables consumed by people in Malaysia. The total local production of cabbage is 1,108,325.62 metric tons and Cameron Highlands produces 87% of the total Malaysian cabbage production [1]. The cabbage produced is mostly consumed by local consumers and exported mainly to Singapore. Cabbage is intensively cultivated particularly by farmers in Cameron Highlands to meet the increasing demand. However, the intensification of cabbage farming is threatened by a common problem of high pest infestation, mostly by insect pests scientifically called Plutella xylostella. This pest infestation has affected the mass farming production in many parts of the world. This unfortunately causes more than 90% crop loss [2].

Insecticides are famously used and have been the primary strategy to control P. xylostella for more than 40 years [3]. Hence, more than 90% of cabbage farmers in Cameron Highlands use insecticide to control P. xylostella [4]. However, it creates another concern on the long-term impacts of vegetable production in Cameron Highlands, particularly on health hazards, insecticide residues, insect resistance and contamination of the environment. Due to the dire need to adopt pests control as well as to facade a high-quality appearance of products, high insecticide residues have been detected on vegetables which causes rejection by consumers in Singapore [5]. Other than Singapore, the issue of insecticide residues in food and environment has also been one of the major concerns of the Malaysian government, Food Agriculture Organization (FAO) and World Health Organization (WHO).
Growing concerns over this matter have increased more public interests especially on finding alternative ways or control methods, such as through integrated pest management (IPM), crop rotation and biological control. However, despite the use of safer control methods, insecticides are still highly trusted by farmers particularly as the problem of pests attack remains the same. Therefore, this study is to examine farmers’ specific attitudes (SN), subjective norms (SN), perceived behavioural control (PBC) and past behaviour (PB) towards insecticides use in Cameron Highlands.

Research Objectives: The study of behavioural approach was carried out in Cameron Highlands in June and July 2014. The purpose of this research was to determine the influential factors which cause the cabbage farmers in Cameron Highlands to use insecticide, using TPB and TAM. The specific research objectives were i) to study the relationship between SA, SN, PBC, PB and behavioural intention; ii) to study the contribution of SA, SN, PBC, PB on behavioural intention.

Theoretical Frameworks

Theory of Planned Behaviour (TPB): TPB is extended from the Theory of Reasoned Action [6]. TPB provides a theoretical framework to investigate the factors which influence behavioural choices or decision making. This study uses TPB as the main theoretical basis to identify the factors which influenced cabbage farmers in Cameron Highlands to use insecticide as their pest control management particularly to control *P. xylostella*. The theory assumes that people would behave rationally, when they consider the implications of their actions. The TPB hypothesizes that the immediate determinant of behaviour is the individual’s intention to perform, or not to perform certain behaviour. Intention is influenced by three factors (Figure 1). The three factors are specific attitude (SA), subjective norms (SN) and perceived behavioural control (PBC). SA refers to individual’s favourable or unfavourable evaluation in performing the behaviour. SN is based on individual’s perception on what important people in their lives would want them to perform the behaviour. PBC reflects the extent to which individuals perceived the behaviour to be under volitional control [7].

Technology Acceptance Model (TAM): TAM has been extensively applied by many researchers to determine users’ acceptance towards various types of technologies. Apart from that, it has also been used to explain users’ adoption of technologies. Numerous empirical studies have found TAM to be a robust and parsimonious model in explaining technology usage. TAM is perceived as useful and user friendly or easy to use [8]. Usefulness refers to users’ feelings or perception of improved performance when they use the technology. It is also perceived to be easy to use or user friendly due to it concerns how users perceived their exerted efforts in using the technology. In the context of this study, the adoption of insecticide requires farmers to feel confidence on the effectiveness of insecticide as a useful technology to control insect pests. In addition, farmers should have a strong believe that insecticide is easy to be used. According to TPB, these two aspects of TAM will affect user’s attitude. In addition, TAM states that personal perception on the usefulness of certain method will have a direct effect on user’s behavioural intention. In addition, personal perception on the ease of use would indirectly affect behavioural intention through perceived usefulness (Figure 2).

Research Model: In our study, TPB was used as the basic theoretical foundation, past behaviour was an added construct as an extension for TPB and TAM in the research model (Figure 3). Two theoretical perspectives were combined for the following reasons. First, although previous research has found TAM to be a parsimonious and robust model, TAM only employs two variables, there are users’ attitude and users’ believe (Perceived usefulness) to explain behavioural intention. However, a user’s behavioural intention toward the use of insecticide will also be affected by other factors such as the opinions of other important persons (SN) [9]. Furthermore, even if users have a strong intention to perform a behaviour, they will not be able to do so without the necessary resources and skills (PBC) [10]. Secondly, while TPB provides us the basic theoretical framework in analysing insecticide usage, it does not inform us on what attitudinal toward believe would affect a user’s attitude to use insecticide. Attitudinal belief in TAM is more specific and relevant to the insecticide used in this study. Thirdly, past behaviour is another construct added to the framework, this is due to reports of empirical studies that it affected behavioural decision making [11]. Lastly, the actual usage is not included in this model due to time; cost and labour factors as well as the researchers have chosen cross sectional study.
MATERIALS AND METHODS

Research Design: This is a quantitative study using a survey design. The questionnaire was adapted from previous researches related to insecticide use and application of TPB and TAM [12,13].

Research Sample: The population in this study was cabbage farmers who used insecticide to control P. xylostella in Cameron Highlands. The sample size was determined according to Krejcie Morgan’s table. 370 cabbage farmers in Cameron Highlands were randomly selected as respondents and they were interviewed using the questionnaire. The interviews were conducted using appropriate languages (Bahasa Melayu and Mandarin). The cabbage farmers in Cameron Highlands were purposely chosen as the samples of this study because Cameron Highlands is the main national cabbage production and most of the cabbage farmers are using insecticides to control P. xylostella.

Research Instrument: To serve the purpose of this study, the questionnaire is divided into two parts, Part A and B. Part A consists of questions related to the dependent variable (Intention) and four independent variables (SA, SN, PBC and PB). Part B focuses on demographic questions. There are 56 items comprising the constructs for intention (7 items), SA (12 items), SN (13 items), PBC (11 items), PB (4 items) and demographic (9 items). All items were arranged in a proper sequence as items with the same response options were grouped together. In addition, difficult and demographic items were prepared at the end of the questionnaire to avoid negative effects on the willingness of respondents to answer the questionnaire honestly. Scale interval of 5-point Likert scale was used for the questions in part A while nominal and ordinal questions were prepared for items in Part B. The items were designed based on previous researches related to insecticide use behaviour and application of TPB and TAM. The reliability of the instrument was based on the value of Alpha Cronbach which was 0.961.
Research Location: The district of Cameron Highlands (4°28' N, 101°28' E) is about 715 km² in area (Figure 4). The height is between 900 and 1800 m above sea level and the highest peak is 2032 m. Cameron Highlands is significantly cooler than Malaysia’s lowlands. The district experiences a mild temperature between 14 –24°C throughout the year and the average rainfall normally recorded around 2660 mm. There are various natural types of soil in Cameron Highlands and they are mainly derived from granite, sandy and also sandy clay loam textures [14]. The natural types of soil and whether contribute to the importance of agricultural activities in Cameron Highlands.

Cameron Highlands is the major cabbage growing region in Malaysia. An amazing 4,948.50 ha land areas in Cameron Highland are cultivating cabbage which contribute 87% of local production [15]. The cabbage cultivation areas are divided into three different zones.
There are Northern, Central and Southern zones, as shown in Figure 4. Northern zone consists of the Blue Valley, Kampung Raja and Kuala Terla areas, whereas the Central zone covers Tanah Rata, Brinchang, Tringkap, Kea Farm and Sungai Palas. However, Ringlet, Bertam Valley and Habu are cultivation areas in the Southern zone.

Data Analysis: The data was analysed using IBM SPSS statistics version 22 software. Data analysis was performed through inferential analysis (Pearson correlation and Multiple regression) and presented in tables and equation.

RESULTS

Relationship Between SA, SN, PBC, PB and the Intention to Use Insecticide: Pearson correlation analysis was conducted to identify the relationship between SA, SN, PBC, PB and the farmers’ intention to use insecticide. Results of the analysis are shown in Table 1. The analysis showed a significant relationship between SA ($r = 0.566$), SN ($r = 0.458$), PBC ($r = 0.643$), PB ($r = 0.566$) and insecticide use intention.

Contribution of SA, SN, PBC, PB Towards the Intention to Use Insecticide: Multiple regression analysis was conducted to identify the contribution of SA, SN, PBC and PB to the intention to use insecticide. The stepwise regression analysis shows that PBC ($F = 259.427$, Sig = 0.000), PB ($F = 165.949$ and Sig = 0.000), SA ($F = 128.158$ and Sig = 0.000) and NS ($F = 98.477$, Sig = 0.000) are significant variance predictors of farmers’ intention to use insecticides. Contribution by SA, NS, PBC and PB on the intention to use insecticides was shown in Table 2.

Table 2 shows that PBC accounted for 41.3% (Beta = 0.264, $t = 4.634$, Sig = 0.000 and $R^2 = 0.413$), PB contributed 6.1% (Beta = 0.298, $t = 6.694$, Sig = 0.000 and $R^2 = 0.453$), SA accounted for 3.7% (Beta = 0.233, $t = 4.833$, Sig = 0.000 and $R^2 = 0.471$) and NS contributed 0.7% (Beta = 0.118, $t = 2.261$, Sig = 0.024 and $R^2 = 0.479$). The findings from the regression equation regression:

$$Y = -0.100 + 0.347(X_1) + 0.272(X_2) + 0.276(X_3) + 0.118(X_4) + 0.184$$

Y - Intention to use insecticides
X1 - PBC
X2 - PB
X3 - SA
X4 - NS
Constant - 0.100
Standard Error - 0.184

DISCUSSION

This study aims to investigate the relationship among several factors (SA, SN, PBC and PB) with behavioural intention of using insecticides as P. xylostella pest control management practiced by cabbage farmers in Cameron Highlands. TPB and TAM are used as the framework of this study.

The result shows that there are diversities of correlation and regression coefficients for each construct of SA, SN, PBC and PB in predicting intention behaviour in this study. There was a significant relationship between SA, SN, PBC and PB with the intention to use insecticide. However, PBC is the most important predictor in influencing behavioural intention compared to SA, SN and PB in this study. This result is supporting the findings of a study on the intention of farmers in Netherlands to reduce insecticide use in Netherlands [16]. Based on this result, it is found that any improvement efforts in solving the insecticide problem should be focused on the PBC factors. PBC is the most important antecedent of the intention to use insecticide because the farmers are aware of their opportunities, skills or resources to do so. In this study, the farmers are aware and believe that insecticide can be easily purchased at the nearest shops, know their ability to use insecticide and believe that they have the equipment to do so. Researchers recommend the Government to enforce stricter rules on the insecticides use. This is to ensure that farmers cannot simply buy and use pesticides indiscriminately. In addition, it is recommended for the subsidies to be provided only to farmers who practice sustainable agricultural activities.

PB is the second largest contributor in predicting the intention to use insecticide. Apart from that, this study has proven that PB is also an important predictor in influencing behavioural intention when compared to SA and SN. This suggests that the PB factors should not be ignored in the study of TPB.
Table 2: Contribution of SA, NS, PB and PBC on the intention to use insecticide

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>Standard Error</th>
<th>Beta</th>
<th>T</th>
<th>Sig.</th>
<th>R2</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBC</td>
<td>0.347</td>
<td>0.075</td>
<td>0.264</td>
<td>4.634</td>
<td>0.000</td>
<td>0.413</td>
<td>41.3%</td>
</tr>
<tr>
<td>PB</td>
<td>0.272</td>
<td>0.041</td>
<td>0.298</td>
<td>6.694</td>
<td>0.000</td>
<td>0.453</td>
<td>6.1%</td>
</tr>
<tr>
<td>SA</td>
<td>0.276</td>
<td>0.057</td>
<td>0.233</td>
<td>4.833</td>
<td>0.000</td>
<td>0.471</td>
<td>3.7%</td>
</tr>
<tr>
<td>NS</td>
<td>0.118</td>
<td>0.052</td>
<td>0.101</td>
<td>2.261</td>
<td>0.024</td>
<td>0.479</td>
<td>0.7%</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.100</td>
<td>0.184</td>
<td></td>
<td>-0.541</td>
<td>0.589</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We also found that SA is accounted for 3.7% and it is the third predictor compared to other variables. This finding is in contrast with Bond et al. [17] who reported that SN is the largest contributor as a predictor of farmers’ intention to use insecticides. This finding suggests the SA constructs which were built using the technology acceptance model (TAM) in this study did not cover a wider diversity in measuring farmers’ important attitudes and beliefs.

We also found that SN showed the lowest correlation of coefficients and contributed only 0.7%. Hence, it is the lowest predictor on farmers’ intention to use insecticides compared to other variables. This result is consistent with studies of TPB meta-analysis which found SN is a poor predictor of behavioural intention [18]. This shows that social pressure from family, friends and other important people have less significant impact on the farmers’ intention to use insecticides in Cameron Highlands. However, a study in Laos found that SN is the best predictor of intention in the study of farmers’ decision to use insecticide as pest control management [19]. SN influences seem to be more dominant in suggesting that farmers’ perceptions of the expectation from referent groups on them play an important role in farmers’ decision in Laos. This finding may indicate that farmers in Laos have collectivistic culture and their behaviours are influenced by others. While farmers in Cameron Highlands may be considered as more individualistic in performing certain behaviours and they are less influenced by others. This explains the farmers’ situation in Laos, where the influence of SN construct is larger than other constructs.

Regression analysis showed that research model can predict 51.8 % of variance. There are other possibilities for the remaining percentage of approximately 48.2 % was contributed by other factors on the intention to use insecticides that are not taken into account in this study [20]. It is predicted that 51.8 % of the intention variance in this study indicates that not all factors that influence the farmers to use insecticides to control *P. xylostella* are included in this study. However, these findings are consistent with reports from other studies that the variance in behavioural intention is different. The influence of intention variance has significantly influenced the predictive ability of a model. The variance can be less than 40%, approximately 50% and greater than 90% [21-23]. In addition, the meta-analysis of TPB studies found that the variance in behavioural intentions contributed between 27% and 39% or between 39% and 77% [24, 25] depending on the behaviour of individual or population in the study. This difference may also due to the measurement of intention predictors. This confirms the importance of developing valid measurements for each component of this theory.

**CONCLUSION**

This finding indicates that behavioural predictors of intention vary depending on behaviour, individuals or populations in the study. Therefore, studies on TPB should be conducted to identify the most influential factors on the intention to use insecticides. Findings of the TPB studies would help the authorities to identify other appropriate problem solving methods. In this study, the strongest predictor of intention to use insecticide is PBC. Therefore, strategic plans in research, policies, extension and education related to insecticide use and pest management in Cameron Highlands should focus on PBC factors to ensure sustainable agricultural activities.

**REFERENCES**


