Exploratory Research for the Study of Agricultural Chemical Hazard Prevention Behavior of Farmers in ASEAN Countries

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Abstract: - This research is quantitative. Based on a questionnaire to study the behavior of farmers in ASEAN countries to prevent the hazards of agricultural chemicals. The sample used is farmers in ASEAN countries with 400 people. A total of 6 questionnaires were used, all of which passed quality checks with confirmatory factor analysis. The results support all hypotheses. The main results of the analysis were as follows: 1) The prediction coefficient of agricultural chemical hazard prevention behavior was $R^2 = 0.82$ The most influential results from knowledge of chemical use to agricultural chemical hazard prevention behavior of farmers were found to be as follows: $\beta = 0.73$ (p<.01) 2) The behavior of preventing the hazard of agricultural chemicals and the conformity of the reference group in the use of chemicals in pairs with the highest correlation coefficient was equal to 0.79 (p<.01) The variables that should be prepared as policy proposals are knowledge of the use of chemicals. Chemical Attitude Adaptability to the reference group in the use of chemicals (respectively).

Key-Words: - Exploratory Research, Quantitative, Prediction, Correlation, Agricultural Chemical, Hazard Prevention Behavior, Farmer, ASEAN countries.

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1 Introduction

Currently, the use of chemicals in agriculture is increasing in ASEAN countries and other countries. In the world, because farmers have a large demand for produce to be worth the agricultural costs invested, most farmers focus on using chemicals to increase agricultural production according to market demand and to increase income without paying attention to food safety and risks of agricultural products, [1]. In a study on the topic of the Pesticide management approach towards protecting the safety and health of farmers in Southeast Asia, it was noted that the use of chemicals in Asia It was found that the governments of each ASEAN country have managed local authorities and organizations responsible for managing and controlling the use of substances in the agricultural sector by randomly inspecting or controlling the use of chemicals in appropriate amounts, [2]. The countries with the most substance use in ASEAN are the Philippines, Malaysia, and Thailand, respectively In addition, ASEAN countries also pay attention to safety practices in managing substance use. Myanmar Vietnam and Thailand. Instead, they focus on protecting the safety of agricultural products in small quantities, [3]. If you study the agricultural sector of ASEAN countries. It was found that farmers tend to use a lot of chemicals for cultivation, especially rice, corn, sugarcane, cassava, vegetables, plants, and fruits that need beauty. Farmers use chemicals to increase agricultural productivity in control and to preserve seeds for cultivation, making chemicals widely used. Both the type of chemical and the frequency of each time it is used in cultivation, results in the resistance or resistance of pests to chemicals. Therefore, the next time the chemical is sprayed, it will not be as effective as the previous spraying and requires a larger amount. Therefore, farmers need to change the formulation of chemicals to use more aggressive chemicals, which will result in farmers being more vulnerable to exposure to chemicals, which are harmful to both their own health and the person who is exposed to it, as well as everyone who is a consumer. It also has an indirect impact on the environment.

In addition, the problem of environmental degradation from the use of chemicals in the agricultural sector is a major problem that is important and is of interest to the international community around the world, including ASEAN countries, [4]. The use of chemicals in agriculture in each cycle is mixed in the soil and accumulated. Especially in the case of the use of chemicals that affect humans and the environmental ecosystem. In the last 10 years, There has been a tendency for the use of chemicals to increase continuously, and there is a tendency to use chemicals with higher dangers, which are at risk of developing various chronic diseases such as cardiovascular diseases. This is in line with the research of the study of the environmental impact of increasing chemical contamination. The use of chemicals incorrectly and excessively has resulted in higher production costs and affected the health of farmers and consumers, which will lead to a reduction in farmers' earning capacity, [5]. This is a factor that can lead to further poverty. It also affects other organisms, including the agricultural ecosystem which has been greatly degraded. The situation of chemical use at the national level in terms of overall chemical consumption tends to increase continuously. In addition, if you mention ASEAN countries. It will be found that there is an agreement under the three ASEAN cooperation. One of them is that ASEAN member countries have recognized the importance of behavior to prevent the hazards of agricultural chemicals, which is part of the food safety and environmental sustainability issues in line with the United Nations Sustainable Development Guidelines. This can be seen from the promotion of cooperation in raising awareness and promoting the safe use of agricultural chemicals. This includes considering the use of safe and sustainable alternatives. The guidelines are under operation. Food Safety Systems in ASEAN member countries have continuously promoted the safe use of agricultural chemicals, for example, through the issuance of policies to promote the use of alternative pest control methods and the promotion of knowledge capacity. Attitude to agricultural stakeholders to ensure that the produce is safe and sufficient for the consumption of the increasing population because it is found that agricultural chemicals are used continuously and in excessive quantities, which may cause negative effects on the health of farmers and consumers in the long term as well as create negative impacts on the environment, [6].

Based on the information mentioned above. Therefore, the researcher is interested in studying the behavior of farmers in ASEAN countries to prevent the hazards of agricultural chemicals. It is an integration of the use of the planned behavior theory model. Based on the analysis of the influence pathway, the guidelines for developing agricultural chemical hazard prevention behaviors in agriculture are useful for policy formulation and the data from this research can be used to make policy recommendations and proposals so that people in ASEAN countries can be informed and change their behavior accordingly.

2 Literature Review

Increasing quality agricultural products obtaining higher yields per area and being able to enter the market system effectively. One method widely used by farmers in ASEAN is the use of agrochemicals, including fertilizers and high-quality chemicals, to accelerate yields from the use of fertilizers and spraying. Chemicals to control pests and pests are considered a major problem for farmers in the Mekong basin, [7]. Therefore, it was found that the use of fertilizers and chemicals. In the form of trade in ASEAN has increased rapidly. When considering a particular area, it can be said that the increase in agrochemicals is correlated with the increase in agricultural output. For example, the area along the Mekong River in Laos. Chemicals are used and rice yields are higher than in the highlands of the country. Similar to Vietnam, where the Mekong Delta region uses fertilizers and chemicals and produces rice in higher quantities than in the central highlands of the country, the higher production capacity in this area is linked to the use of large quantities of pesticides and makes agricultural land unsafe for agriculture. Organochlorine chemicals that have had a residual effect in the environment for a long time, and some of them have been banned from sale and use. It is still found to be used in many areas of the Lower Mekong Basin, where it is found quite a lot in Cambodia. In addition to the use of chemicals. The use of fertilizers to accelerate yields has also negatively affected the water quality in the water bodies of low-lying areas in ASEAN countries. In the case of runoff. Washing fertilizer into water sources causes aquatic plants to grow rapidly and increase the amount of excessive-high. Due to the intake of the constituent nutrients in fertilizers (nitrates and phosphates), the amount of oxygen in the water is less, affecting fish and other organisms in water bodies, [8].

The use of chemicals is an important part of the agricultural sector that causes negative impacts on the environment, especially in the Mekong Basin region in the ASEAN region. Most of the reasons are due to the incorrect use of chemicals by farmers, and most of the chemicals used are residual chemicals or banned from distribution and use in Thailand and Vietnam, such as paraquat. Chlorpyrifos and glyphosate, etc, [9]. In general, farmers are less aware of the dangers of chemicals. Farmers in some countries pay relatively little attention to the dangers of chemicals. Chemicals selected for some long-term residual effects have been banned and sold. However, it was found that illegal imports continue to occur in some ASEAN countries. It has also been found that these substances have a very long-term residual effect in the environment, [10].

Chemicals also have problems for the environment by producing residues in the soil, as well as being toxic to humans and causing the development of chemical resistance of insects can be obtained by using too high and frequent amounts of substances, [11]. The latter problem has caused an increase in the infestation of endemic insects. In addition, the use of chemicals also has an impact on the quality. Chemical contamination in water bodies can be caused by direct spraying of substances in areas close to water bodies or washed away by rainwater and surface erosion. This includes disposing of used chemical containers and rinsing. Spraying equipment, is a major cause of chemical contamination in soil and water sources, [12]. In addition, the use of chemicals in the upper Mekong River basin may affect the water quality in the Lower Mekong River, for example, the rapid increase in the use of chemicals in Thailand has affected the riverine populations of Cambodia and Vietnam who live inin the end of the river delta which depends on water for their livelihood. In Vietnam, The use of high amounts of chemicals has also affected the water quality of the Mekong River. In Cambodia, the level of organochlorine pesticides has been reported, indicating chemical contamination in the country's watersheds. For the behavior of farmers regarding the use of chemicals. Knowledge should be required in the pre-use, during, and post-use stages of chemical use, and must be carried out in the right way. In addition, the types of chemicals can be classified according to their characteristics, their chemical composition, their chemical composition, their type of pest being controlled, their reaction to the pest, and their chemical forms. Each chemical has a different severity depending on the size of the need for preventive use and the farmer.

This research relies on the integration of planned behavior theory, which is the representation of a person's behavior by being influenced by the intention to show behavior. What influences the intention to show behavior consists of three main factors: attitude towards behavior; The perception of behavioral control also directly influences human behavior [13] and the three main factors that show a person's behavior are caused by the rise of three beliefs: 1) beliefs about behavior, 2) beliefs about reference groups, and 3) beliefs about the ability to control, [14].

For the variable framework in this study (Figure 1), the researcher applied the planned behavior theory model as the basis for studying the behavior of preventing the hazard of agricultural chemicals, which consists of 6 related variables as follows:

1. Prevention Behavior of Agricultural Chemical Hazards is the behavior of farmers to prevent the dangers of chemical use, including the selection of chemicals that are suitable for the purpose. Preparation of equipment for spraying chemicals, reading product labels for instructions for use, and use of chemical mixing equipment. Standing while spraying chemicals choosing the timing of spraying and behaving, or when the chemical is spilled on

clothes and body. Cleansing the body after chemical spraying; cleaning the equipment for spraying disposal of products containing used chemicals and labeling of warnings after chemical spraying.

2. Knowledge of the use of chemicals is the correct knowledge of the use of agricultural chemicals before, during, and after the use of chemicals, or the understanding of farmers about the use of chemicals, such as knowledge about product labels. How to use the right amount of chemicals primary care, dangers and symptoms of chemical illness

3. Chemical use attitude is a person's view, feeling, or attitude towards the prevention of chemical use, or a feeling of benefiting or harming the use of chemicals, which arises from a person's learning experience.

4. Conformity to the reference group in the use of chemicals is the belief of a person who is based on feelings, thoughts, or information from other people or is influenced by the thoughts of people who trust them, which may arise from the person's environment or is the choice to believe from other people, which the person has a great influence on that person.

5. Awareness of chemical use control refers to the opinion of farmers about the risk of being harmed or affected by the use of chemicals, or the perception of the risk of illness from the use of chemicals, or the opinion of farmers about the risk of illness from the use of chemicals. Violence is caused by the use of chemicals that affect the body and the surrounding environment.

6. Intention to use chemicals is the belief or intention to choose chemicals for the benefit of various dimensions or the awareness of farmers about the dangers of chemical poisoning if their use occurs.

This research has a total of 5 hypotheses, including:
1. Farmers' behavior in preventing the hazard of agricultural chemicals is directly influenced by their knowledge of chemical use.
2. Knowledge of the use of chemicals is indirectly influenced by 3 variables: attitude to use chemicals; Adaptability to reference groups in the use of chemicals Chemical Control Awareness
3. Chemical use attitudes and reference group adherence to chemical use have an indirect influence on chemical use intentions.
4. Perception of chemical use control has a direct influence on agricultural chemical hazard prevention behavior.
5. Agricultural chemical hazard prevention behavior is directly influenced by the intention to use chemicals.

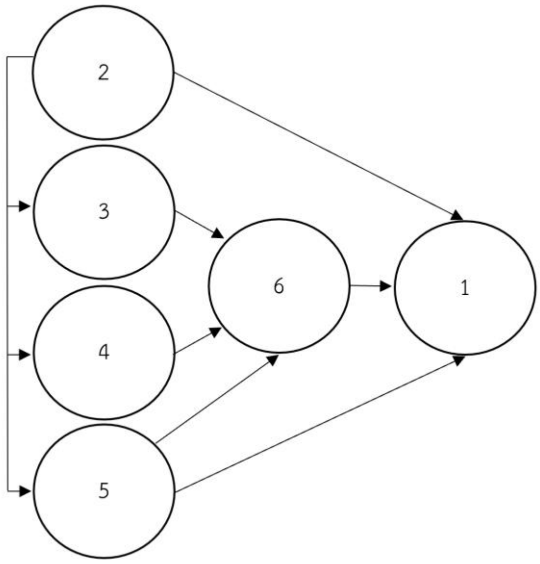

Fig. 1: Research Conceptual Framework
*Note: 1:*Prevention *b*ehavior of *a*gricultural *c*hemical *h*azards*,* 2:Knowledge of *c*hemical *u*se*,* 3*:*Chemical *u*sage *a*ttitude*,* 4*:*Compliance with *r*eference *g*roups in *c*hemical *u*se*,* 5*:*Awareness of *c*hemical *u*se *c*ontrol*, 6:*Chemical *u*se *i*ntention

3 Methodology

3.1 Research Design

This is a quantitative research and opinion survey to study the behavior of farmers in ASEAN countries to prevent the hazards of agricultural chemicals. Based on the analysis of the influence pathway to be able to prove the cause and effect of various coefficients, this research project has passed the certification of Ethical Standard No. HREC131.

3.2 Sample

This research used a sample of farmers in ASEAN countries. The researcher used a ready-made program. G*POWER calculates the size of a large population to cover it widely, [15]. The results indicated a sample size of not less than 325 people, and the researcher used a non-probability sampling method using a specific random sampling method (Purposive Sampling), [16]. The condition is that they must have been farmers for at least 10 years and each family can only answer 1 set of answers. The number of samples in the quota data collection is set at a total of 400 people.

For this study, a total of 415 people were collected, and only 400 people were selected who answered the questionnaire completely and had biosocial background characteristics, including

53.38% male, average age 51 years and 5 months, marital status 41.28%, education level below bachelor's degree 71.43%, average monthly income less than 225 USD 50.87%.

3.3 Measurement Tools

This research used six sets of Summated Rating Scales, which were created by the researcher himself through rigorous quality checks and translation of the questions to match the language and understanding of agriculture in the country. The questionnaire has 6 levels of scale, from "most true" to "not true at all" Content Validity and conformity checks by experts in the field of behavioral science, as well as Confirmatory factor analysis [17] This research has a total of 80 questions that meet the criteria, and the average confidence value of the measurement is 0.806 (Table 1).

Table 1. Quality of questionnaires in the research

No.	Confirmatory Factor Analysis						
	Questions	α	χ2	df	p	TLI	CFI
1	16	0.88	58.42	52	0.08	0.97	0.97
2	14	0.82	52.13	49	0.08	0.96	0.95
3	12	0.81	51.90	42	0.07	0.96	0.96
4	12	0.79	52.46	44	0.07	0.96	0.95
5	14	0.79	52.93	46	0.07	0.96	0.96
6	12	0.75	50.81	42	0.07	0.95	0.95

*Note: 1:*Prevention *b*ehavior of *a*gricultural *c*hemical *h*azards, 2:Knowledge of *c*hemical *u*se, 3:Chemical *u*sage *a*ttitude, 4:Compliance with *r*eference *g*roups in *c*hemical *u*se, 5:Awareness of *c*hemical *u*se *c*ontrol, 6:Chemical *u*se *i*ntention **This research gives more importance to the t value than the r value, with the selection criteria being t ≥ 2.00 and r ≥ 0.20*

3.4 Data Analysis

This research uses statistics to analyze the data, including 1) Correlation Analysis. [18] and 2) Path Analysis, [19].

4 Results

The results of the correlation coefficient analysis (Table 2) showed that the behavior of preventing the hazards of agricultural chemicals and the conformity of the reference group in the use of chemicals in pairs had the highest correlation coefficient of 0.79 (p<.01), followed by knowledge of chemical use equal to 0.77 (p<.01), followed by chemical attitude equal to 0.76 (p<.01). The correlation coefficient between other variables ranged from 0.67 (p<.01) to 0.31 (p<.01).

The results of the influence path analysis showed that the model had a structural relationship (Figure 2 and Table 3) and was in harmony with the empirical data. The first part shows that the prediction coefficient of agricultural chemical hazard prevention behavior is $R^2 = 0.82$, with the largest influence from chemical use knowledge (β = 0.73, p<.01), followed by the influence of chemical use intention (β = 0.41, p<.01).

Table 2. Mean, Standard Deviation, and Correlation Coefficients of Variables in the Combined Group (N=400)

No.	Mean	SD	1	2	3	4	5	6
1	60.12	8.06	1					
2	55.80	7.28	.77**	1				
3	48.94	6.52	.76**	.61**	1			
4	45.23	6.40	.79**	.67**	.58**	1		
5	54.15	7.12	.49**	.52**	.50**	.35**	1	
6	43.38	6.93	.52**	.48**	.54**	.31**	.36**	1

*Note: *p<.05, **p<.01, 1:*Prevention *b*ehavior of *a*gricultural *c*hemical *h*azards, 2:Knowledge of *c*hemical *u*se, 3:Chemical *u*sage *a*ttitude, 4:Compliance with *r*eference *g*roups in chemical *u*se, 5:Awareness of *c*hemical *u*se *c*ontrol, 6:Chemical *u*se *i*ntention

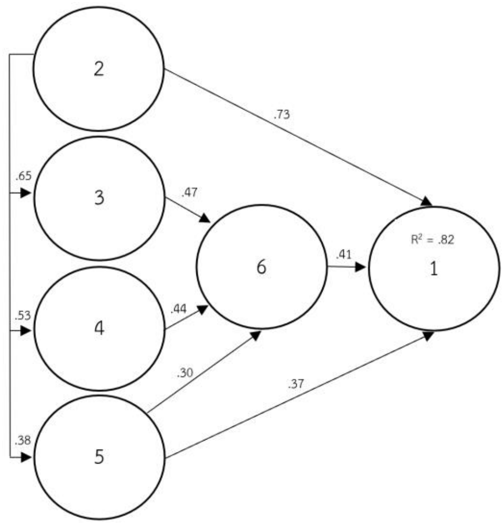

Fig. 2: Results of the Harmonization Test of Agricultural Chemical Hazard Prevention Behavior of Farmers in ASEAN Countries (N = 400 for all coefficients of influence and element weights, significant at the .05 level)

*Note: 1:*Prevention *b*ehavior of *a*gricultural *c*hemical *h*azards, 2:Knowledge of *c*hemical *u*se, 3:Chemical *u*sage *a*ttitude, 4:Compliance with *r*eference *g*roups in *c*hemical *u*se, 5:Awareness of *c*hemical *u*se *c*ontrol, 6:Chemical *u*se *i*ntention

For the perception of chemical use control, it was found that it also influenced the behavior of farmers to prevent agricultural chemical hazards in moderate quantities, which was (β = 0.37, p<.01). In addition, the model shows that knowledge of chemical use has a direct influence on the attitude of chemical use (β = 0.65, p<.01), followed by the reference group in chemical use (β = 0.53, p<.01), followed by the perception of chemical use control (β = 0.38, p<.01). The variables of chemical intention are influenced by all 3 variables, including: 1. Attitudes towards chemical use are (β = 0.47, p<.01) 2. Compliance with the reference group in the use of chemicals is (β = 0.44, p<.01) and 3. Perception of control of chemical use is (β = 0.30, p<.01).

Table 3. Fit Indices of the Latent Model

Statistics	Model Fit Indices	Consideration
$\chi 2$	47.89	Accepted
df	37	Accepted
p-value (>0.05)	0.25	Accepted
RMSEA (≤0.06)	0.02	Accepted
GFI (≥0.90)	0.96	Accepted
AGFI (≥0.90)	0.95	Accepted
CFI (≥0.95)	0.98	Accepted
TLI (≥0.95)	0.97	Accepted
SRMR (≤0.08)	0.03	Accepted

5 Conclusion

The results of the influence route analysis showed that a total of 5 hypotheses were supported as follows: 1) Farmers' behavior of preventing chemical hazards in agriculture is directly influenced by knowledge of chemical use (β = 0.73, p<.01) Supporting hypothesis 1, which shows that if farmers have a lot of knowledge, they will be concerned about their health and self-care every time they use chemicals, and will try to reduce the use of related chemicals. 2) Knowledge of chemical use is indirectly influenced by 3 variables: chemical use attitude (β = 0.65, p<.01), conformity to the reference group in chemical use (β = 0.53, p<.01), perception of chemical use control (β = 0.38, p<.01). For example, local sages, community leaders, 3) Chemical use attitudes (β = 0.47, p<.01) and reference group aversion to chemical use (β = 0.44, p<.01) indirectly influence chemical use intentions, supporting hypothesis 3, which shows that chemical use intentions depend on attitudes and adherence to reference <β groups. The frequency of chemical use and the amount of chemicals that must be controlled in a certain amount will affect the behavior of farmers to prevent harm from agricultural chemicals. 5) Farmers' behavior in preventing chemical hazards in agriculture is directly influenced by the intention to use chemicals (β = 0.41, p<.01).

This research identifies the influence pathways of agricultural chemical hazard prevention behavior of farmers in ASEAN countries based on the application of the planned behavior theory model. In addition, this research also found important variables: 1) knowledge of chemical use, 2) attitude to use chemicals, and 3) conformity to reference groups in chemical use, all of which can be used as policy proposals to encourage farmers in ASEAN to have more preventive behaviors from agricultural chemicals.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

- Damrongsak Junthothai has organized the conceptualization, research ethics, data collection and project administration.
- Naksit Sakdapat has organized the conceptualization, formal analysis and writing original draft preparation.
- Pannika Ngamcharoen has organized the methodology, literature review, investigation, and validation.
- Duchduen Bhanthumnavin has organized the methodology, research design, supervision, resources, and data curation.

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Conflicts of Interest

The authors declare no conflict of interest.