

## Factors affecting knowledge and behavior of farmers on using pesticide in Tha Sala Sub-District, Rhu-Ruea District, Loei Province, Thailand

Tuan Nguyen Ngoc<sup>1</sup>, Patthanun Kotom<sup>1</sup>, Prapasiri Jaipong<sup>1</sup>, Piyawadee Noinumsai<sup>1</sup>,  
Adisak Kaewkongsap<sup>1</sup>, Sirikadran Yaemkong<sup>2</sup>, Sireethorn Jumpanin<sup>3</sup>,  
and Suphawadee Yaemkong<sup>1,\*</sup>

<sup>1</sup>Pibulsongkram Rajabhat University, Phitsanulok, 65000, Thailand

<sup>2</sup>Uttaradit Rajabhat University, Uttaradit, 53000, Thailand

<sup>3</sup>Tha Sala sub district, Rhu-Ruea district, Loei, 42160, Thailand

### Abstract

A survey was carried out to investigate the factors affecting knowledge and behavior of farmers on using of pesticide in Tha Sala Sub-district, Rhu-Ruea District, Loei Province, Thailand. A total of 263 farmers were randomly selected for being interviewed. The data was collected using a questionnaire. The data was analyzed using a linear model that considered all factors as fixed effects. Least square means for subclasses of each factor were calculated and were compared in t-test calculation with  $\alpha = 0.05$ . Results showed that the knowledge and behavior of farmers was affected by their gender, education level and the kind of hired labor used on their farm ( $P < 0.05$ ). Female farmers exhibited better knowledge and behavior about pesticides than the male farmers that were studied. Farmers who had a high school level education and higher also exhibited better knowledge and behavior about pesticides when compared with farmers who did not complete high school. In addition to this, farmers who invested in hiring labor for their farm had exhibited better knowledge and behavior in using pesticides. Overall farmers in the study exhibited good knowledge and behavior in using pesticides. Despite this they were still lacking in knowledge on safety and reduction of pesticide hazard both in theory and practice. It is therefore concluded that government, organizations and other relevant personal should focus on improving the knowledge of farmers about using pesticides safely or how to control pests without using pesticides in order to develop sustainable agriculture in Thailand.

**Keywords:** pesticide, knowledge and behavior, farmer

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### 1. Introduction

Pesticides are used widely due to their high capability and reliability for crop protection against insects. Despite these benefits, misuse and abuse of pesticides not only has negative effects on human health but can also destroy ecological systems and kill other animals that are not regarded as pests. It has been estimated that there are at least three million cases of pesticide poisoning occur worldwide each year, resulting in 220,000 deaths. Porrini et al. [1] pointed out that pesticides could poison honey bee and ecology in Italy. However, the majority of these poisonings occur in developing countries where less protection against exposure is applied, the knowledge of health risks and safe use is limited, and harmful pesticides are easily accessible [2]. In previous studies, contamination of crops with pesticides was found in vegetables in Ghana [3] and Sri-lanka [4-5]. Thailand is not an exception. Many researchers pointed out that Thailand ranked fourth out of 15 Asian countries in annual pesticide use

and third in pesticide use per unit area. As a result researchers found that 64% of vegetables in Thailand were unsafe due to contamination with pesticides [2, 6]. Even more seriously, all samples were contaminated with multiple residues indicating a high usage of chemicals as farmers rely on what the researchers refer to as a "cocktail of pesticides" in their farming process. In Tha Sala, Phu Ruea District, Loei Province, most of the population rely on agricultural cultivation, such as crops, horticulture and animal husbandry for their income. Recently, researchers found that the farmers themselves were contaminated with organophosphate compounds and carbamate, components of pesticides. Blood tests gave results of contamination with pesticides as very high. They found that 58.20 and 27.50% of blood samples contained levels of pesticides that were unsafe and high risk, respectively [7]. In order to understand the situation further and to start to control this problem enforcement from government and authorities is required. What is also needed is to control

\*Corresponding author; e-mail: suphayaku@hotmail.com

**Table 1:** Least square means and standard errors for gender, education level, labor and main of plant by score of knowledge and behavior in using pesticides of farmer in Tha Sala sub district, Rhu-Ruea district, Loei province

Factors	Percentage* (%)	Score of knowledge in using pesticides (% $\pm$ SD)	Score of behavior in using pesticides (Means $\pm$ SD)	Relation to farmer's health (%)
Gender				
- Male	66.79	77.21 $\pm$ 2.49 <sup>b</sup>	3.44 $\pm$ 0.13 <sup>b</sup>	22.16
- Female	33.01	83.11 $\pm$ 2.51 <sup>a</sup>	3.70 $\pm$ 0.13 <sup>a</sup>	44.83
Education level				
- No education	1.59	76.39 $\pm$ 4.33 <sup>b</sup>	3.38 $\pm$ 0.13 <sup>b</sup>	0.00
- Primary school	60.96	76.98 $\pm$ 2.38 <sup>b</sup>	3.43 $\pm$ 0.23 <sup>b</sup>	26.83
- High school	34.26	82.27 $\pm$ 2.42 <sup>a</sup>	3.66 $\pm$ 0.13 <sup>a</sup>	40.00
- Bachelor degree +	3.19	85.01 $\pm$ 3.37 <sup>a</sup>	3.83 $\pm$ 0.18 <sup>a</sup>	44.44
Type of labor				
- Hired labor	5.77	83.36 $\pm$ 2.26 <sup>a</sup>	3.62 $\pm$ 0.12 <sup>a</sup>	26.00
- No hired labor	94.23	76.96 $\pm$ 3.03 <sup>b</sup>	3.33 $\pm$ 0.16 <sup>b</sup>	28.23
Main crop				
- Rice	48.28	83.29 $\pm$ 3.43 <sup>ns</sup>	3.78 $\pm$ 0.18 <sup>ns</sup>	-
- Fruit	2.68	81.14 $\pm$ 2.53 <sup>ns</sup>	3.70 $\pm$ 0.20 <sup>ns</sup>	-
- Other crops	49.05	82.67 $\pm$ 1.53 <sup>ns</sup>	3.75 $\pm$ 0.08 <sup>ns</sup>	-

\*Suree *et al.* [12]

<sup>a,b</sup> Least square means with different superscripts in the same row are significantly different; <sup>ns</sup>: not significant (P<0.05).

pesticide use at farm levels through up-grading the knowledge and behavior of farmers who directly apply pesticides on their farms.

## 2. Materials and methods

A total of 263 farming households, out of 767 households, from Tha Sala, Phu Ruea District, Loei Province were randomly selected for interview using a prepared questionnaire. The questionnaire included 4 main parts: (1) basic information about the respondents (2) knowledge about the prevention and elimination of toxicity of pesticides and chemicals (3) the farmer's behavior in using pesticides and (4) any effects of using pesticide on the farmer's health including how frequently they go to hospital and the amount of money they spend on medical help.

For the data analysis, gender was defined as male and female. According to the distribution of the dataset, highest level of education of the farmer, was classified as 1) no education, 2) primary school, 3) high school and 4) bachelor or higher degree. Type of labor was defined as hired labor and no hired labor. Main type of crop was classified as 1) rice, 2) fruit, and 3) other crops. Using the survey farmers were given a score for their knowledge and behavior in using pesticides. Correlations between the application of pesticides and the health of farmers were calculated.

Scores for farmer's knowledge of pesticides and behavior when using them were analyzed using the GLM procedure of SAS [8]. The resulting scores for

knowledge of pesticides and behavior when using them included the fixed effects of farmer's gender, the education level of the farmer, the type of labor used on the farm, the main crop on the farm and the pesticide residue on their crops. Residual pesticide effects were assumed to have mean zero and a common variance ( $\sigma^2$ ). Least square means for fixed effects and differences between subclasses within fixed effects were compared using a t-test with  $\alpha = 0.05$ .

## 3. Results

Results showed that female farmers got significantly higher scores than male farmers for knowledge in using pesticides. The scores were 83.11  $\pm$  2.51% and 77.21  $\pm$  2.49% for female and male farmers respectively. Similarly, female farmers obtained an average score of 3.70  $\pm$  0.13 for behavior in using pesticide while male farmers obtained a significantly lower (P<0.05) average of only 3.44  $\pm$  0.13. The results also showed that farmers who had high school level and above education had better understanding of pesticides and behavior when using them when compared to those with lower educational levels (P<0.05). The farmer group who had a level of education of bachelor degree and above got scores of 85.01  $\pm$  3.37% and 3.83  $\pm$  0.18%, respectively for knowledge and behavior in using pesticides. In contrast, the farmers who had no education obtained scores of only 76.39  $\pm$  4.33% and 3.38  $\pm$  0.13%. The scores obtained by farmers who hired labor for their farm were 83.36  $\pm$  2.26% and 3.62  $\pm$  0.12% for

knowledge and behavior in using pesticides respectively. This was significantly higher than that obtained by farmers who did not hire labor ( $76.96 \pm 3.03\%$ ). Scores obtained by farmers who considered rice as the main plantation appeared to be higher than that of other groups. The lowest scores obtained recorded for farmers who considered growing fruit as the main activity were  $81.14 \pm 2.53\%$  and  $3.70 \pm 0.20\%$ , respectively for knowledge and behavior. However, no significant difference was found within the main crop factor for both of knowledge and behavior (Table 1).

The result also found out that these factors could affect the health behavior of farmers in the region. Only 22.16% of the male farmers stated they often needed hospital treatment however the number of female farmers who often needed hospital treatment was double this at 44.83%. The people with higher education appeared to hospital treatment more than those with lower education. The results found that 26.83% of people who completed primary school often go to hospital whereas this number rose to 40.00% for those who completed high school and 44.44% for those with a bachelor degree and above. This factor showed very little difference between farmers who hired labor and those that did not 26.00% and 28.23%. Despite this it was found that the average amount of money spent for medical help by farmers who hired labor was  $709.66 \pm 159.69$  baht. This was significantly ( $P < 0.05$ ) lower than that of farmers who not hire labor. This was found to be  $2,615.38 \pm 422.01$  baht.

#### 4. Discussion

The heads of households that were interviewed in this study were relatively old and the majority were male. This differs from what was reported by Jaipieam et al. [2] who researched vegetable growers in Bang-Rieng Subdistrict, Thailand and Fan et al. [9] who carried out a study in Nepal. Fan et al. [9] stated that average farmer's age was  $46.21 \pm 12.90$  to  $50.56 \pm 10.61$  years old and there were more female than male farmers. In the study, Fan et al. [9] found that both the age and gender of the head of the household affected the knowledge and behavior of farmer about pesticides and their use. Older farmers were found to have more experience and knowledge about using pesticides. They therefore also obtained a better score of behavior for using pesticides. In the study on integrated farms conducted by Setboonsarng [10], the authors, showed that female farmers carried out more of the field work than the male farmers for all activities. Similarly, Paris et al. [11] pointed out that female farmers in Northeast Thailand contributed more to the labor required for rice cultivation. These indicated that female farmers who are more likely to be responsible for applying pesticides than male farmers and knew more how to protect

themselves as well as how to eliminate hazards from the pesticides. It may be that the reason female farmers sort medical help more than men in our study was that they were carrying out more of the field work.

The education level of farmers that was found in the study was, in general, higher than that in many other regions that have been studied by other researchers. Suree et al. [12] reported that most farmers in Tha Sala had finished primary school education level (60.96%) whereas 34.26% had completed high school, 3.19% of farmers had a bachelor or higher and only 1.59% had no education at all. This result agrees with other scholars who showed that education enables most farmers to do research about livestock such as dairy and beef cattle, and chickens [13-15]. Atreya [16] showed that the heads of more than 50% of female headed households in Nepal had never been to school. The education level of farmers also influences their knowledge on the use of pesticides. The farmers who had bachelor degrees and higher could have more knowledge to start with as well as be more willing to receive information and to update their knowledge better than those with lower educational achievement. This result was in agreement with many other previous studies which stated that higher levels of education helped farmers to access and understand information and new technology better and faster [17-18]. In general, it could be said that farmers in the study area had a relatively high level of education when compared to many other regions and the overall rural area in Thailand [17-20]. Interestingly, farmers who hired labor to work in their farm showed better knowledge than those who did not hire labor. Farms who hired labor were normally considered as big farms. The head of the farm also invested more into the system and needs more experience and skill to work on farm when compared to the respondents who did not hire labor. This finding was in line with findings from the study by Borisutsawat [21], Yaemkong et al. [22] and Thijae [23]. The results also showed that farmers who work directly on farm, those who did not hire labor, had more problems with their health. The amount of money they spent on medical support was three times higher than that of people who hire labor. Working directly on a farm leads the farmer to face more risks than those who hire labor. This is especially the case when they work with highly hazardous agrochemicals. Many studies point out that working with pesticides causes various problems with the health of farmers in Thailand [24-25]. Besides the hazards from incorrect application of pesticides to crops or abuse of them, they also affect human health indirectly through residues in the products that are consumed. Suree et al. [12] reported that farmers in the region grew mainly rice and other crops in their fields such as vegetables, cassava and corn. In total these accounted for 97.33% of productions with

the remaining 2.68% of farmers in the study area considering growing fruit trees as their main agricultural activity.

The overall mean score for farmer's knowledge and behavior of the correct use of pesticides was high [12, 26-27]. The same authors, however, found that both the knowledge and behavior of farmers on the risks of pesticides and their elimination was lower than other aspects of their knowledge and behavior. This lower understanding about how to reduce the hazards of pesticide use could result in harm. It found that farmers in the region received limited training from government and authorities related to correct use of pesticides. Most of knowledge farmers had was sourced from private companies or was self learnt. Government, related personals and other organizations should, therefore, provide training and materials to improve the knowledge and practice of Thai farmers in the correct use of pesticides.

## 5. Conclusion

The average score of the knowledge on pesticide use of farmers in Tasala sub-district, Phurua district, Loei province was found to be high. This is especially the case for knowledge about using pesticides. The knowledge of reducing the impact of pesticides and how to eliminate hazard of chemicals was low. The average level of practice was very good. Behavior on the correct use of pre-use pesticides was at the most appropriate level but the behavior in reducing the impact of pesticide use was moderate. The results of this study showed that farmers in the region need more knowledge and training about the risks of pesticides and how to prevent or eliminate the hazards of pesticide use and using them in appropriate methods.

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## References

- [1] Porrini C, Sabatini AG, Girotti S, Fini F, Monaco L, Celli G, Bortolotti L, Ghini S. The death of honey bees and environmental pollution by pesticides: the honey bees as biological indicators. **Bull. Insectology**. 2003; **56**(1):147-152.
- [2] Jaipieam S, Visuthismajarn P, Siriwong W, Borjan M, Robson MG. Inhalation exposure of organophosphate pesticides by vegetable growers in the Bang-Rieng subdistrict in Thailand. **J. Environ. Public Health**. 2009; 1-7.
- [3] Amoah P, Drechsel P, Abaidoo RC, Ntow WJ. Pesticide and pathogen contamination of vegetables in Ghana's urban markets. **Arch. Environ. Contam. Toxicol**. 2006; **50**(1):1-6.
- [4] Hoek WVD, Konradsen F, Athukorala K, Wani-gadewa T. Pesticide poisoning: A major health problem in Sri Lanka. **In: Pesticides: Soc. Sci. Med.** 1998; **46**(4-5): 495-504.
- [5] Senanayake, N. **Studies on organophosphorus insecticide poisoning**. In: Pesticides: Health Impacts and Alternatives. Proceeding of a Workshop Held in Colombo; 2002 [cited 21 January 2018]. Available from: <http://ageconsearch.umn.edu/bitstream/92700/2/WOR45.pdf>
- [6] Walter-Echols G, Yongfan P. **Implementation, Monitoring and observance of the international code of conduct on the distribution and use of pesticides**. Proceedings of Asia regional workshop; 2005 [cited 21 January 2018]. Available from: [http://coin.fao.org/coinstatic/cms/media/9/1317177\\_9257290/2005\\_29.pdf](http://coin.fao.org/coinstatic/cms/media/9/1317177_9257290/2005_29.pdf)
- [7] Loei Provincial Public Health Office. **Problem public health office in Loei Provincial**. 2013 [cited 21 January 2018]. Available from: <http://www.lo.moph.go.th/moph/>
- [8] SAS. SAS 9.13 **Help and documentation**. North Carolina: SAS Institute Inc; 2004.
- [9] Fan L, Niu H, Yang X, Qin W, Bento CP, Ritsema CJ, Geissen V. Factors affecting farmers' behaviour in pesticide use: Insights from a field study in northern China. **Sci. Total Environ**. 2015; **537**: 360-368.
- [10] Setboonsarng S. Gender division of labour in integrated agriculture/aquaculture of Northeast Thailand. **Rural aquaculture**. 2002; 253-274.
- [11] Paris TR, Luis J, Villanueva D, Rola-Rubzen MF, Chi TTN, Wongsanum C. **Labour out migration on rice farming households and gender roles: synthesis of findings in Thailand, the Philippines and Vietnam**. In: FAO-IFADILO Workshop on Gaps, trends and current research in gender dimensions of agricultural and rural employment: differentiated pathways out of poverty. 2009; 221-224.
- [12] Suree N, Phengnoi P, Kotom P, Jaipong P, Noinumsai P, Tuan NN, Yaemkong S, Jumpanin S, Yaemkong S,. Pesticide using knowledge and behavior of farmer in Tha Sala Sub-District, Rhu-Ruea District, Loei Province. **Khon Kaen Agr. J**. 2018; **46**: 605-611.
- [13] Yaemkong S, Ngoc TN, Kolnathon P, Yaemkong S. Smallholder dairy cattle production in Northern East of Vietnam. **Naresuan Phayao J**. 2018; **11** (2): 45-48.

- [14] Yaemkong S. Efficiency development of beef cattle production of small scale farmers in Chattrakarn district, Phitsanulok Province. **Rajabhat J. Sci. Humanit. Soc. Sci.** 2016; **17**(1): 32-38.
- [15] Yaemkong S, Rattanapradit P, Nguyen Ngoc T, Charoensuk R, Chirarat N, Soipethand U, Yaemkong S. Diversity of traditional knowledge and local wisdom of indigenous chickens farmers in Bang Krathum, Nakhon Thai, Mueang and Chat Trakan Districts Phitsanulok Province. **Journal of Applied Animal Science.** 2017; **10**(3): 39-46.
- [16] Atreya K. Pesticide use knowledge and practices: A gender differences in Nepal. **Environ. Res.** 2007; **104**(2):305-311.
- [17] Yeamkong S, Koonawootrittriron S, Elzo MA, Suwanasopee T. Effect of experience, education, record keeping, labor and decision making on monthly milk yield and revenue of dairy farms supported by a private organization in Central Thailand. **Asian-Aust. J. Anim. Sci.** 2010; **23**: 814-824.
- [18] Yaemkong S, Nguyen Ngoc T, Yaemkong S. Factors affecting and obstacle of beef cattle production in Phitsanulok Province, Thailand. **Journal of Applied Animal Science.** 2018; **11** (1): 31-38.
- [19] Uthaiwan W. **Factors affecting knowledge and practices of dairy farmers in Changwat Chiang Mai [thesis].** Chiang Mai University: Chiang Mai; 1992.
- [20] Rhone JA, Koonawootrittriron S, Elzo MA. A survey of decision making practices, educational experiences, and economic performance of two dairy farm populations in Central Thailand. **Trop. Anim. Health Prod.** 2008; **40**:475-482.
- [21] Borisutsawat K. **Factors affecting adoption of technology by dairy producers at Nongpho Dairy Cooperative [thesis].** Bangkok, Kasatsert University; 1996.
- [22] Yaemkong S, Rattanapradit P, Laorodphan N, Jaipong P, Buarapa P, Singchuang W. Factor of farmers affecting on phenotypic characteristics of native chickens in Phitsanulok Province. **Khon Kaen Agr. J.** 2016; **44** (Suppl. 2): 885-893.
- [23] Thijae K. **Sustainable environmental management of small dairy farmers in Chiang Mai Province [thesis].** Chiang Mai, Chiang Mai University; 1999.
- [24] Paipard N, Supannatas S, Suttiwapa T. Effects of pesticide use on farmer's health and the environment in Rong Kham district, Kalasin province. **Khon Kaen Agr. J.** 2014; **42** (3): 301-310.
- [25] Yurayardsamphan N. **Agrochemical use and health problems of Longan Growers in Doi Lo Sub-district, Doi Lo District, Chiang Mai Province [thesis].** Chiang Mai, Chiang Mai University; 2011
- [26] Yaemkong S, Kotom P, Jaipong P, Noinumsai P, Tuan NN, Yaemkong S, Iamaong S. Knowledge and behavior regarding pesticide use among agriculturists in Sap Sombun subdistrict, Wichian Buri district, Phetchabun province. **Academic Journal Uttaradit University.** 2017; **12** (2): 15-25.
- [27] Promthat D. Farmer's behavior of safety vegetable production Phra Nakhorn Sri Ayutthaya Province. **Journal of Thai Interdisciplinary Research.** 2015; **10**(3): 9-16.