CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This research aimed to ascertain relationships of socio-demographic factors, pesticide use history, and self-protective behaviors (independent variables) with pesticide-related symptoms (dependent variables) among rice farmers, in Sukhothai Province. The subjects consisted of 420 rice farmers in Kongkrailat district that were selected by using multi-stage sampling. Face to face interviewers were conducted to collect data by the researcher and 3 research assistants during March 2006, using standardized, pre-tested questionnaires. The data were described in frequency, percentage, mean, median, and standard deviation. Chi-square statistics were calculated to test for relationship between independent and dependent variables. The results of this study may be summarized as follows:

Socio-demographic characteristics, proportion of male subjects (59.5%) were slightly higher than that of female subjects, 77.9% were older than 34 years of age, and average age was 42.7, 83.1% got married, and 81.0% had education level at primary school, 88.3% had household size ≥3 persons, and average at 3.8 persons. Most of subjects (73.8%) had family' monthly income ≤ 10,000 baht, average at 8,782.1 baht, and 83.7% lived in Kongkrailat district > 25 years. Most subjects (77.1%) had never been trained in safe use of pesticides by government agency, 96.4% used insecticides in major types of pesticide, 97.4% did not plant crops in

addition to rice, and 94.5% used pesticides in the morning. Pesticide use factors, Most of subjects (75.7%) had duration of working as rice farmer > 10 years, 75.0% had duration of using pesticide as rice farmer ≥ 10 years. The average time working as rice farmer was 23.9 years and using pesticide as rice farmer was 14.8. Most of subjects (72.9%) used pesticides > 7 days in last year, with average 12.8 days. All of subjects read pesticide container labels, 79.5% of them used pesticides in the same concentrations as recommended. Duration of each spraying was average 3.4 hours. Most of subjects (85.7%) had duration since most recent expose to pesticide > 7 days, average 43.6 days, and the major method of application was spraying. Most of subjects (83.6%) mixed pesticides > 2 kinds, and 66.0% had duty in handling both mixing and applying. Self-protection behaviors, median score were used to divide the subjects into 2 groups that were high and low, high mean better self-protection 79.0% of the subjects had better behavior while mixing pesticide with (before applying), 61.7 % had better behavior while applying pesticides, 92.1% had better behavior after applying pesticides, and 79.3% had better behavior on day not using pesticides .

The 32 symptoms specified in the questionnaire were classified into 5 body system groups. Most subjects (52.9%) had neuromuscular symptoms during or within 24 hours after use pesticides, and 60.2 percent of them had any symptoms during and within 24 hours after use pesticides. Subjects had neuromuscular symptoms within last year (62.9%), last six month (52.6%), last month (30.5%), and last week (11.7%).

The highest symptom rates were found in age 35-44 years. Age had significant relationship with any symptoms during or < 24 hours after pesticide use ($p = 0.004$). Symptoms rates were lower with higher education, especially for

symptoms during the last year. Education level had significant relationship with symptoms ever in last year including neuromuscular ($p = 0.013$) and any system ($p = 0.049$). There was no consistent association of household size with symptoms. Family' monthly income had significant relationship with symptoms ever during or < 24 hours after pesticide use with neuromuscular ($p = 0.005$), respiratory ($p = 0.001$), and any system ($p = 0.001$) and symptoms ever in last year with respiratory ($p = 0.001$), skin/nails ($p < 0.001$), and any system ($p = 0.028$). Training in safe pesticide use had significant relationship with ever during or < 24 hours after pesticide including any system ($p = 0.029$) and ever in last year including eye ($p = 0.041$) and any system ($p = 0.049$). Duration of using pesticides as rice farmer had significant relationship with symptoms ever during or < 24 hours after pesticide use including respiratory ($p = 0.017$), and any system ($p = 0.026$) and symptoms ever in last year including respiratory ($p < 0.001$), and skin/nails ($p < 0.001$). Number of days of pesticide use in the last year had significant relationship with symptoms ever during or < 24 hours after pesticide use including neuromuscular ($p < 0.001$), and any system ($p < 0.001$) and symptoms ever in last year including neuromuscular ($p < 0.001$), respiratory ($p = 0.010$), digestive ($p = 0.003$), skin/nails ($p < 0.001$), and any system ($p < 0.001$). Concentration of pesticide used had significant relationship with symptoms ever during or < 24 hours after pesticide use including neuromuscular ($p =0.011$), respiratory ($p = 0.011$), and any system ($p = 0.047$) and symptoms ever in last year including neuromuscular ($p = 0.047$), and any system ($p = 0.003$). Duration of applying sessions had significant relationship with symptoms ever during or < 24 hours after pesticide use including neuromuscular ($p <0.001$), and any system ($p = 0.004$) and symptoms ever in last year including neuromuscular ($p < 0.001$),

skin/nails ($p = 0.023$), and any system ($p < 0.001$). Methods of pesticide use had no significant relationship with symptoms ever in last year. However, it had significant relationship with symptoms ever during or < 24 hours after pesticide use including respiratory ($p = 0.004$), and any system ($p = 0.006$).

Number of pesticide mixed had significant relationship with symptoms ever during or < 24 hours after pesticide use including respiratory ($p = 0.004$) and symptoms ever in last year including respiratory ($p = 0.001$), and digestive ($p = 0.005$). The highest duty was both mixing and applying. Main duty in handling had significant relationship with symptoms ever during or < 24 hours after pesticide use including neuromuscular ($p < 0.001$), and any system ($p = 0.001$) and symptoms ever in last year including any system ($p = 0.027$).

There were groups of behaviors that included while mixing (before applying), while applying, after applying, and day not using. Somewhat unexpectedly, the overall association of self-protection with symptom rates was higher before and after pesticide application than during application itself.

5.2 Discussion of the results

Trained in safe pesticide use had association with ever during or < 24 hours after pesticide including any system and ever in last year including eye and any system. Subjects who had never been trained in safe pesticide use generally had lower symptom rates than subjects who had been trained. It might be that subjects who had been trained in safe use were at higher risk of pesticide exposure, or that training programs were not especially effective. Trained in save use pesticides had

association with duty in handling (p = 0.001) and found that the higher trained subjects were both mixing and applying. Trained in safe use pesticides had association with concentration (p = 0.034), and number of pesticides mixed (p = 0.016).

Duration of using pesticides as rice farmer had association with symptoms ever during or < 24 hours after pesticide use including respiratory, and any system and symptoms ever in last year including respiratory, and skin/nails in accordance with the study of Lu (2005) that respiratory symptoms for the past 12 months were associated with certain risk factors such as farm use of pesticides.

Frequency of pesticide use last year had strong association with symptoms ever during or < 24 hours after pesticide use including neuromuscular, and any system and symptoms ever in last year including neuromuscular, respiratory, digestive, skin/nails, and any system in accordance with the study of Warisara Sorat (2004) that acute pesticide poisoning symptoms had significant relationship with neuromuscular, respiratory, digestive and skin.

Pesticide concentration had strong positive association with symptoms ever during or < 24 hours after pesticide use including neuromuscular, respiratory, and any system and symptoms ever in last year including neuromuscular and any system, when mixed more than recommended symptoms were high in accordance with the study of Warisara Sorat (2004) and Lu (2005), and Yassin et al., (2002) that the prevalence of self-reported toxicity symptoms was dependent on mixing and use of high concentrations.

Duration of each pesticide applying had association with symptoms ever during or < 24 hours after pesticide use including neuromuscular, and any system, and symptoms ever in last year including neuromuscular that neuromuscular system had association with duration of applying , skin/nails , and any system. There were similar from Warisara Sorat. (2004) that duration of spraying had relationship with neuromuscular system, but there were some different results from Warisara, who found when duration of spraying was high, symptoms were high (categories by 0-1 hour, 2-3 hours, and > 3 hours). But the current study found highest symptoms at the shortest time (1-2 hours) application and decreased after that, then increased again for using more hours (categories by 1-2 hours, 3 hours, 4 hours, and > 4 hours). When categorized duration of applying by two groups (1-2 hours, and > 2 hours) found that duration of applying had association with neuromuscular system ($p < 0.001$), respiratory system ($p = 0.064$) and any system ($p = 0.001$) during or < 24 hours after pesticide use, and ever in last year including neuromuscular ($p < 0.001$), respiratory ($p = 0.021$), digestive ($p = 0.030$), skin/nails ($p = 0.004$), any system ($p < 0.001$) and consistently found that the shorter duration was associated with higher symptom rates. This suggests that a substantial percentage of subjects (107/420 or 25.5%) was susceptible to developing symptoms after very short exposure to pesticides. They may have stopped applying pesticide quickly, after developing symptoms. Further effort should be made to document sensitive subgroups and to advise them appropriately regarding risks of pesticide use.

Method of pesticide use had no association with symptoms ever in last year however, it had association with symptoms ever during or < 24 hours after pesticide

use including respiratory, and any system in accordance with the study of Warisara Sorat. (2004) when they used more methods symptoms were higher.

Number of pesticides mixed had association with symptoms ever during or < 24 hours after pesticide use including respiratory and symptoms ever in last year including respiratory, and digestive. Somewhat unexpectedly, when the number of pesticides mixed was high, symptoms were lower. It might be that when the subjects mixed more kinds, they had better behavior while mixing or they used high quality equipment that use for mixing only.

Self-protection while mixing, but before applying, had strong association with all symptoms ever during or < 24 hours after pesticide use including neuromuscular, respiratory, digestive, eye, skin, and any system and symptoms ever in last year including neuromuscular, respiratory, digestive, eye, skin, and any system in accordance with Yassin et al., (2002) that the prevalence of self-reported toxicity symptoms was dependent on mixing and use of high concentrations, and Delgado IF, Paumgartten FJ, (2004) that 62% of workers reported at least one illness associated with mixing and applying. Self-protection while applying had significant relationship with symptoms ever during or < 24 hours after pesticide use including neuromuscular ($p = 0.008$) in accordance with Delgado IF, Paumgartten FJ, (2004). Self-protection after use pesticides had association with symptoms ever during or < 24 hours after pesticide use including respiratory, skin/nails, and any system and symptoms ever in last year including neuromuscular, respiratory, skin, and any system. Self-protection on the days when not using had significant relationship with symptoms ever during or

< 24 hours after pesticide use including neuromuscular, and any system and symptoms ever in last year including neuromuscular, any system.

The association of self-protection with symptom rates was clearly stronger during pre-application mixing than during application itself, and the association of self-protection with symptom rates was clearly stronger after pesticide application than during application itself. Thus, self-protective behaviors during application were less strongly associated with symptom rates than were such behaviors before and after application. To some extent, the strong associations of symptoms with protective behavior before and after application could reflect confounding. That is, the same group of people might have used better protection both before and after confounding. Indeed, there was a significant positive association of self-protection before and after application ($p = 0.023$). However, it is unlikely that confounding could fully explain this observation, because self-protection before application was very strongly associated with protection during application ($p<0.001$), but protection during application was only weakly associated with symptoms. Thus, it seems likely that the observed associations of symptoms with self-protection before and after application are largely separate and independent of each other.

Persistent symptoms after most recent pesticide use found that 15.0% of subjects that had symptoms in last year had persistent symptoms after their most recent pesticide use, 14.0% of neuromuscular, 10.8% of respiratory, 4.6% of eyes, 6.4% of digestive, and 4.3% of skin/nails had persistent symptoms and illness after they used pesticides. To the best of my knowledge, such persistent symptoms have

not been characterized previously in Thailand. In the current study, it was not possible to characterize symptoms that began after pesticide use ended (delayed symptoms).

5.3 Scope and Limitation of the study

Scope: study in the rice farmers selected from all 11 sub-districts in Kongkrailat District, Sukhothai Province.

Limitation: This study did not evaluate all types of pesticide, exposure and health effects. Also, the study was done only in one of the nine districts in Sukhothai, so it might not be representative of the whole province, or of larger geographic areas such as Thailand itself. This study did not use Regression statistic that could analyze to observed confounding with each factors, and method very effective about confounding.

5.4 Recommendations

This researcher would like to recommend the application of research results as follows:

Recommendations research results

1. The research found that pesticide-related such as frequency of pesticide use, concentration, and duration of each applying had strong association with symptoms. Self-protection behaviors while mixing and after pesticide use had strong association with symptoms. Thus, the occupational health and health promotion authorities should be concerned about pesticide use and self-protection behaviors and promote a method for rice farmers to reduce chemical exposure and improve chemical management, e.g., integrated pesticide management.

2. This study found that rice farmers took the rice farming for several months and used pesticides many times per year and had been at risk not only acute poisoning symptoms but also chronic illnesses, the related officers should promote the information for concerning them about long term effects of pesticide use.

3. The study found that socio-demographic such as age, marital status, education level, income, and trained in safe use had association with symptoms, the related officers should provide participation and co-operation with other while choosing intervention programs or target groups.

Recommendations for further study

1. Future research should study long-term effects of pesticide use in other method such as case control study and cohort study to ascertain other factors that association with illnesses and chronics disease and delay symptoms.

2. These results suggest that there is a sensitive subgroup who develop symptoms within 1 or 2 hours of applying pesticides. Further research is needed to characterize this subgroup accurately and completely, and to explore ways by which such sensitive subjects can avoid or minimize pesticide exposure.

3. These results suggest that there is a substantial burden of symptoms that persist after pesticide use. To the best of my knowledge, this is the first study to document this in Thailand. Further research is needed to characterize the burden of persistent and delayed symptoms associated with pesticide use, to ascertain risk factors for such symptoms, and to develop methods to reduce this burden.