CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Pesticide Exposure Questionnaire

The researcher developed the Pesticide Exposure Questionnaire from Agricultural Health Study Questionnaire, USA, and The Institute of Environmental Medicine; WHO. This questionnaire had been developed under the recommendation of the Psychologist, Occupational & Safety Specialist, and Pesticide Specialist. The researcher applied this questionnaire by interviewing with 73 farmers who were 33 Traditional and 40 IPM farmers in Tambon Bang Rieng, Amphoe Khuan Nieng, Changwat Songkhla.

The results showed that farmers had the medium pesticide exposure scores or representing the mean scores of 55.67 points or 60.5% with standard deviation of 8.58. There were 45 farmers representing 61.6% having the medium exposure scores, while 12.4% or 9 farmers had moderately high and high exposure scores. Moreover, Traditional farmers had the average scores of 58.30 points, which were higher than IPM farmers whose scores were 53.50 points.

5.2 Pesticide Concentration in Working Air Condition

The researcher applied NIOSH Manual of Analytical Methods Number 5600: Organophophorus Pesticides to collect 33 air samples, which were twenty-three of chlorpyrifos samples, seven of methyl parathion, and three both of chlorpyrifos and methyl parathion respectively.

The results showed that farmers applied pesticide concentration more than what had been recommended. The reasons why those farmers using higher concentration were to assure that all pests would be eradicated by only one pesticide application. Apart of that they also mixed pesticides more than one type to simultaneously in applying pesticide.

The sample analytical results showed that farmers were exposed to organophosphate pesticide at the concentration between 0.0040 - 0.6055 mg/m^3 and there were four farmers who were exposed to the pesticide over the ACGIH (TWA) Recommendation. In addition, Traditional farmers had been exposed to the pesticide concentration of 0.1865 mg/m^3, which were higher than IPM farmers had (0.0370 mg/m^3).

5.3 Statistical Analysis

After data collecting, the researcher found some interesting factors. Adjusting the hypothesis was required for testing and finding out the proper results. Summaries of the results are shown in the following table.

TABLE 5.1: Summary of the Results from the Test Statistic

Test Statistic	Results	
	Pesticide Exposure Score	**Pesticide Concentration in Working Air Condition**
t-Test		
1. **Farmer Groups** (Traditional & IPM)	**Significant differences** Traditional > IPM Farmers	**Significant Differences** Traditional > IPM Farmers
2. **Farmer Genders** (Male & Female)	**Significant differences** Male > Female Farmers	**No Significant Differences**
3. **Smoking Behaviors** (Smoking & Non-Smoking Farmers)	**Significant differences** Smoking > Non-Smoking Farmers	**No Significant Differences**
ANOVA		
1. **House Locations**	**Significant differences**	**No Significant Differences**
2. **Educational Backgrounds**	**No Significant differences**	**No Significant Differences**
3. **Spraying Equipment**	**Significant differences**	**Significant Differences**
Eta-Correlation		
Spraying Equipment	**r =0.463**	**r =0.516**

Note: at the significant level = 0.05

For the personal factors of farmer, the results concluded that Traditional farmers had been exposed to the pesticide more than IPM farmers, Moreover, male farmers were also exposed to the pesticide in the same concentration as female farmers. Furthermore, the differences in house locations and spraying equipment would effect the pesticide exposure. For example, farmers who located their house in the farm area, would have the higher scores from the Pesticide Exposure Questionnaire and be more exposed to the pesticide than those who located their house around and outside the farm areas.

It could noted that the relationship between Pesticide Exposure Scores and Spraying Equipment was in the same medium level as the relationship between Pesticide Exposure Concentration and Spraying Equipment with Eta-correlation of 0.463 and 0.516 respectively.

However, the research found that educational backgrounds were no significantly reliable to the pesticide exposure scores and pesticide concentration in both Traditional and IPM farmers.

The researcher studied some interesting point, which would relate to the previous factors, and those results were shown in the Table 5.2.

TABLE 5.2: Summary of the Results from Test Statistic of Interesting Variables

Test Statistic	Variable	Result
t-test	Usage of Pesticide Concentration in Solution Compared to Tradition and IPM Farmers	**No Significant Differences**
ANOVA	Pesticide Exposure Concentration Compared to the Differences in Pesticide Types	**No Significant Differences**
Pearson-Correlation	Pesticide Concentration in Solution & Pesticide Concentration in Working Air Condition	**No Correlation**

Note: at the significant level = 0.05

From the preceding results, it could be concluded that Traditional and IPM farmers applied the pesticide in the same concentration. However, when considering the frequency of pesticide application for one month, the researcher found that Traditional farmers applied pesticide (mean = 4.33 times for a month) more than IPM farmers (mean = 2.87 times a month).

It showed that there was no relationship between the pesticide concentration and its concentration in working air condition. Conversely, there was a medium correlation between spraying equipment and pesticide concentration of inhaled air at the relation level of 0.516. It could be concluded that the pesticide concentration, which the farmers would be exposed to, depended mainly on the size and dispersion of mist from the spraying equipment more than pesticide concentration in solution.

5.4 Pesticide Exposure Assessment

5.4.1 Exposure Concentration

In this study, the researcher considered only on the inhalation pathway from spraying, which was the minor part of pesticide exposure and the results showed that farmers in Tambon Bang Rieng were to exposed to pesticide concentration between 0.0040 - 0.6055 mg/m^3 during the spraying period. Moreover, the total amount of organophosphate pesticide, which was exposed into the farmer inhalation system, were between 81.0 – 12,261.4 mg. during all their lifetime.

5.4.2 Intake Concentration

The farmers would intake organophosphate pesticide concentration into their inhalation system between 0.0002 - 0.0279 mg/kg.day. Moreover, the study of pesticide exposure found only one pathway of the exposure, which was the inhalation system. The results showed that farmers of Bang Rieng intook organophosphate pesticide at the level of 0.92 – 279.46% as recommended by ADI. Moreover, the Hazard Quotient of pesticide were 0.01 – 2.79.

5.4.3 Comparison of Exposure Concentration between Traditional and IPM Farmers

The total amounts of organophosphate pesticide which were exposed to the Traditional farmers inhalation system were between 217.1 – 7,845.6 mg., while IPM farmers were exposed to organophosphate pesticide between 107.9 – 3,606.4 mg. during all their lives.

5.4.4 Comparison of Intake Concentration between Traditional and IPM Farmers

Traditional farmers intook the pesticide at the level of 0.0006 – 0.0224 mg/kg.day or 6.2 – 223.6 of chlorpyrifos or 3.1 – 111.8% of methyl parathion as recommended by ADI. While IPM farmers intook the pesticide at the level of 0.0001 – 0.0048 mg/kg.day or 1.4 – 47.7% of chlorpyrifos or 0.7 – 23.9% of methyl parathion as recommended by ADI.

Finally, all results could be concluded that IPM farmers had lower risk from being exposed to organophosphate pesticide than Traditional farmers. This was due to their exposure scores and exposure concentration in working air condition, which were lower than Traditional farmers.

5.5 Recommendation for Management Policy

For the above results, the interview and the observation during the interview, the researcher would propose the recommendation to decrease the exposure and hazardous problems from pesticide as follows:-

1 Farmers should be educated and have knowledge on how to use the pesticide safely. For example, they should wear efficient PPD while mixing and spraying. Moreover, they should not mix a various types of pesticide to spray their farms simultaneously since its toxicity will be gradually accumulated into their bodies and may cause severe diseases such as cancer.

2. Most farmers perceived that herbicide was less dangerous than insecticide. As a result, they were unaware to use the herbicide properly. Farmers should be educated how to use and know the toxicity of insecticide and herbicide. They should also know how to use pesticide properly, starting from reading the instruction, measuring the mixture and mixing the pesticide. Moreover, they should have knowledge on how to protect themselves, how to appropriately keep and eliminate the pesticide containers.

3. Farmers are aware of and want to protect themselves from the hazardous effect from the pesticide usage. However, they don't know how to select and how to use such PPD properly. The Hygienic Vegetable Co-operative should therefore provide information and sell appropriate PPD such as chemical protective mask, gloves, and goggle, and rubber boot, etc. to the farmers.

4. Most of farmers drink water directly from the underground water well while they handle and dispose the pesticide containers improperly by throwing away the empty containers on the ground. The local government or Locality Management Organization and relevant officers in such area should set up an action plan to deal with the problems of eliminating pesticide containers. This will decrease the problems of pesticide leakage and its contamination to the water sources, which will effect the public's health in the future.

5.6 Recommendation for Future Studies

1. This study is focused on the organophosphate pesticides. The farmers used other types of pesticides in their farms especially the herbicides. paraquart-dichloride and alachor, the insecticide methomil, abamectin and cypermectin, and the fungicide carbendazim. Further research should be conducted to study these concentrations in the working air condition and in the ambient air.

2. The pesticide container disposal behavior of farmers is also an attractive topic for the researcher. The interviewed result showed that the disposal of pesticide containers done by farmers were unsafe. In addition, it is found that most of them knew there were closed dipping hole to dispose pesticide containers in

their farms. However, they did not know the location of the hole. The future research should include the pesticide container disposal behavior, its fate and transportation of each pesticide that are spilled or leaked in the holes or on the ground. The result of these studies will improve disposal method and waste management.

3. In Tambon Bang Rieng, there are two primary schools located in the farm area with more than 300 students. However, there are no research conducted to study pesticide exposure to students and its adverse effect.

4. To cover the pesticide exposure studies, the study should relate to all pesticide exposure pathways such as skin absorption, ingestion and inhalation including the pesticide residue in air, soil and water (farming and drinking water) to assess the pesticide exposure, and the risk from pesticide in Tambon Bang Rieng.