PESTICIDE RISK REDUCTION PROGRAM TO IMPROVE PROTECTIVE BEHAVIOR AND REDUCE HEALTH RISK OF PESTICIDE USE AMONG RICE FARMERS IN KONGKRAILAT DISTRICT, SUKHOTHAI PROVINCE

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โปรแกรมการลดความเสี่ยงจากการใช้สารเคมีกำจัดศัตรูพืช
เพื่อปรับเปลี่ยนพฤติกรรมการป้องกันและลดความเสี่ยงทางสุขภาพ
จากการใช้สารเคมีกำจัดศัตรูพืชในชาวนา อำเภอกงไกรลาศ จังหวัดสุโขทัย

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธารณสุขศาสตรดุษฎีบัณฑิต
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ภัทรพล มากมี : โปรแกรมการลดความเสี่ยงจากสารเคมีกำจัดศัตรูพืชเพื่อปรับเปลี่ยนพฤติกรรมการป้องกันและลดความเสี่ยงทางสุขภาพจากการใช้สารเคมีกำจัดศัตรูพืชในชาวนาอำเภอกงไกรลาส จังหวัดสุโขทัย . (PESTICIDE RISK REDUCTION PROGRAM TO IMPROVE PROTECTIVE BEHAVIOR AND REDUCE HEALTH RISK OF PESTICIDE USE AMONG RICE FARMERS IN KONG KRAILAT DISTRICT, SUKHOTHAI PROVINCE) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ศ.นพ. สุรศักดิ์ ฐานีพานิชสกุล237 หน้า.

ปัญหาจากการใช้สารเคมีกำจัดศัตรูพืชที่ไม่ถูกต้อง ยังคงเป็นสิ่งที่สำคัญสำหรับผู้ที่เกี่ยวข้องกับโรคจากการประกอบอาชีพของประเทศไทย และมีการศึกษาค่อนข้างน้อยเกี่ยวกับผลกระทบของโปรแกรมที่ มีการปรับเปลี่ยนพฤติกรรม การใช้สารเคมีและลดความเสี่ยงทางสุขภาพจากการใช้สารเคมีกำจัดศัตรูพืช การศึกษานี้เป็นการวิจัยแบบกึ่งทดลองแบบมีกลุ่มควบคุม โดยมีวัตถุประสงค์เพื่อพัฒนาความรู้ ทัศนคติ พฤติกรรมการการป้องกันจากการใช้ และลดผลกระทบทางสุขภาพ จากการ ใช้สารเคมีกำจัดศัตรูพืช กลุ่มตัวอย่างชาวนาจำนวน 182 คน ในอำเภอกงไกรลาศ จังหวัดสุโขทัย ระหว่างเดือนธันวาคม 2554 – มิถุนายน 2555 โดยกลุ่มทดลองจำนวน 91 คนได้รับโปรแกรมการลดความเสี่ยง ใช้เวลา 1 เดือน โดยมีการประเมินจำนวน 3 ครั้งเพื่อเปรียบเทียบ ก่อนได้รับโปรแกรมการลดความเสี่ยง หลังดำเนินการ 1 เดือนและ 4 เดือนหลังได้รับโปรแกรม

ผลการศึกษาพบว่ากลุ่มตัวอย่างทั้ง 2 กลุ่มเข้าร่วมโปรแกรม ครบทุนคน ตลอดช่วงเวลาที่ดำเนินการศึกษาและติดตามประเมินผล โปรแกรมการลดความเสี่ยงทางสุขภาพ เมื่อเปรียบเทียบระหว่างกลุ่มทดลองและกลุ่มควบคุม ในช่วงเวลาที่แตกต่างกันมีประสิทธิผลในการปรับปรุง ความรู้ ทัศนคติ พฤติกรรม ลดอัตราการเกิดระดับซีรั่มโคลีนเอสเทอเรสไม่ปลอดภัยและ และลดอัตราการเกิดอาการทางระบบประสาท โดยมีค่าความแตกต่างระหว่างกลุ่มทดลองเมื่อเปรียบเทียบเวลาที่ต่างกัน โดยมีประสิทธิผล เพิ่มคะแนนความรู้เฉลี่ย เท่ากับ 4.2 คะแนน (95%CI 3.7 – 4.8; p<0.001) ภายหลังรับโปรแกรม 1 เดือนและ 3.5 คะแนน (95%CI 2.8 – 4.3; p<0.001) ใน 4 เดือนหลังรับโปรแกรม ทัศนคติโดยเพิ่มคะแนนเฉลี่ยทัศนคติที่ 8.9 คะแนน(95%CI 6.5 - 11.4; p<0.001) 1 เดือนและ 13.2 คะแนน (95%CI 8.9 – 17.5; p<0.001) 4 เดือนหลังรับโปรแกรม เพิ่มคะแนนพฤติกรรมการป้องกันที่ 8.6 คะแนน (95%CI 7.4 – 9.9; p<0.001) 1 เดือนและ 6.2 คะแนน (95%CI 3.9 –8.5; p<0.001) 4 เดือนหลังรับโปรแกรม นอกจากนั้น ยังมี ประสิทธิผลในการการลดระดับซีรั่มโคลีนเอสเตอเลส ในระดับไม่ปลอดภัย ที่ 56.2 เปอร์เซ็นต์ (95%CI - 70.8 ถึง - 41.7; p<0.001) 1 เดือนและ 44.6 เปอร์เซ็นต์ (95%CI -64.5 ถึง -24.6; p<0.001) 4 เดือนภายหลังการรับโปรแกรม ส่วนการลดผลกระทบทางสุขภาพพบว่าลดอัตราการเกิดอาการทางระบบประสาท ที่ 27.8 เปอร์เซ็นต์(95%CI -43.8 ถึง -11.8; p=0.001) 1 เดือนและที่ 25.4 เปอร์เซ็นต์ (95%CI -45.7 ถึง -4.2; p=0.019) 4 เดือนภายหลังการรับโปรแกรม , ลดอาการเจ็บป่วยระบบทางเดินหายใจภายหลังการรับโปรแกรม 1 เดือนที่ 25.4 เปอร์เซ็นต์ (95%CI -41.9 ถึง -8.9; p=0.003) และ ระบบสายตาที่ 1 เดือนภายหลังโปรแกรมที่ 34.3 เปอร์เซ็นต์ (95%CI – 53.6 ถึง – 15.1; p=0.003)

การสร้างการรับรู้ความเสี่ยงที่หลากหาย เช่นการนำข้อมูลเบื้องต้นของพื้นที่ การสร้างการเรียนรู้ทางสังคม เช่น การเรียนรู้จากเพื่อนร่วมงาน และ การคำนึงถึงปัจจัยที่เกี่ยวข้องกับการสื่อสารความเสี่ยง ในโปรแกรมการลดความเสี่ยงจากการใช้สารเคมีกำจัดศัตรูพืช สามารถนำไปประยุกต์ใช้กับเพิ่มการรับรู้เกี่ยวกับการใช้สารเคมีกำจัดศัตรูพืชที่ปลอดภัยและการลดความเสี่ยงในกลุ่มชาวนาในพื้นที่นาข้าวอื่นได้ โดยประยุกต์ตามความเหมาะสม ความสำเร็จของโปรแกรมขึ้นอยู่กับปัจจัยด้านการสื่อสารความเสี่ยงที่ประกอบด้วยผู้รับโปรแกรม สื่อการสอน ข้อความและผู้สื่อสาร

สาขาวิชา สาธารณสุขศาสตร์ ลายมือชื่อนิสิต

ปีการศึกษา 2555 ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก

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PHATARAPHON MARKMEE: PESTICIDE RISK REDUCTION PROGRAM TO IMPROVE PROTECTIVE BEHAVIOR AND REDUCE HEALTH RISK OF PESTICIDE USE AMONG RICE FARMERS IN KONGKRAILAT DISTRICT, SUKHOTHAI PROVINCE. ADVISOR: PROF. SURASAK TANEEPANICHSKUL, M.D., 237 pp.

The problem of inappropriate pesticide usage is an important concern for public health and occupational authorities in Thailand. To date there have been few intervention studies aimed at improving pesticide-related protective behavior and reducing health risk. In this quasi-experimental study, the researcher conducted a pesticide risk reduction intervention program. The objectives were to improve knowledge, attitude, and protective behavior, and to reduce health risk of pesticide use, among 182 rice farmers from December 2011 to June 2012 in Sukhothai province, Thailand. The intervention group, comprising 91 farmers, received 1-month intervention program. Outcomes were measured before intervention (baseline), and at 1 and 4 months after intervention. The effects of intervention were evaluated with difference-of-difference analysis, with normal and binomial distributions for continuous and dichotomous outcomes, respectively. The link function was identity in all difference-in-difference models, which gave modeled intervention effects and statistical significance tests of those effects, at each of the 2 follow-up times. (The intervention effect is defined as the baseline-to-follow-up difference in outcome in the intervention group minus the corresponding difference in the control group.)

All 182 participants had attended all follow-up times. After adjusted mean difference, the intervention program improved the knowledge by a mean score 4.2 (95%CI 3.7–4.8; p<0.001) one month after the intervention and by a mean score of 3.5 (95%CI 2.8–4.3; p<0.001) 4 months later, attitude by a mean score of 8.9 (95%CI 6.5-11.4; p<0.001) one month after the intervention and by a mean score of 13.2 (95%CI 8.9–17.5; p<0.001) 4 months later, protective behavior by a mean score of 8.6 (95%CI 7.4–9.9; p<0.001) one month after the intervention and by a mean score of 6.2 (95%CI 3.9–8.5; p<0.001) 4 months later, reduced the prevalence of unsafe serum cholinesterase level after adjusted percent-points by 56.2 percent-points (95%CI −70.8 to −41.7; p<0.001) one month after the intervention and by 44.6 percent-points (95%CI −64.5 to −24.6; p<0.001) 4 months later, reduce prevalence of neuromuscular symptom after adjusted percent-points by 27.8 percent-points (95%CI −43.8 to −11.8; p=0.001) one month after the intervention and by 25.0 percent-points (95%CI −45.7 to −4.2; p=0.019) 4 months later, respiratory symptom after adjusted percent-points by 25.4 percent-points (95%CI −41.9 to −8.9; p=0.003) one month after the intervention, eyes symptom after adjusted percent-points by 34.3 percent-points (95%CI −53.6 to −15.1; p=0.001) one month after the intervention

Thus, multidimensional of risk such using some of the data from baseline to formative self or cultural background in the intervention area, social learning such colleague workers and concern on risk communication factors should be considered for implementation to improve the risk perception and safe use of pesticide in other rice farm areas. The success of program depends on the risk communication factors, including audiences, medium, messages, and messengers.

Field of Study : Public Health Student's Signature ....
Academic Year : 2012 Advisor's Signature ....

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CHAPTER I

INTRODUCTION

1.1 Background and Significance of the problem

Thailand is currently the leading country in exporting rice products to the world market (Office of Agricultural Economics, 2011). Pesticides are widely available in Thailand. The “green revolution” has resulted in immense agricultural productivity throughout the world over the past half century. An important part of the technological innovations accompanying this revolution is the introduction of a variety of chemicals generically known as “pesticide” in the farming areas. Moreover, under "liberalization" of the trade system, many pesticides were imported into Thailand for using with commercial planting in agricultural farms. Pesticides are sold in market with more than 2,000 brand names. However, two types of pesticide are mostly used, namely insecticide (51%) and herbicide (38%). This remains true even though since 1997 82 kinds of pesticides have already been banned in Thailand (Integrated Pest Management [IPM], 2005). Using pesticides is one of the methods that farmers choose to control pests. The use of pesticide has increased in Thailand. Agrochemical expenses during the year 2006 to 2009 were 10,530; 12,898; 15,062; and 19,181 million Baht per year, respectively. The volumes of agrochemical imports were as high as 75,473; 95,763; 116,322; and 109,907 tons per year, respectively (Department of Agriculture, 2010).

Pesticides can cause a lot of harmful effects to users if farmers use them inappropriately. The acute effects of pesticide exposure range from mild to fatal. They may include symptoms such as skin reactions and eye burns, headache, nausea, blurred vision, muscle cramping, vomiting, and difficult breathing. Information on the chronic health effects of pesticides suggests that they might be carcinogenic (World Health Organization [WHO], 1990), although this has not yet been proved.

From reviewing many data from the past to present, it was found that the Thai farmers, especially the rice farmers, still use pesticide inappropriately. Statistics from the Ministry of Public Health on occupational poisoning show some decreasing number from a high of 5,154 in 1989 to 3,165 in 1994 although there has been no change in the type of pesticides used or the application of technology. The study estimated that there could be up to 39,600 pesticide-poisoning cases per year (Ministry of Public Health [MOPH], 2003). Researchers found that approximately half of Thai farmers employ it in higher dose than recommended concentrations. They applied pesticides without protective clothing, and applied them unduly frequently (MOPH, 2003). Many of the sprayers were women. 80% of women were reported with symptoms of acute pesticide poisoning including dizziness, muscular pain, headache, nausea, weakness, and difficulty breathing. For the first half of 1996, 1,760 people were admitted to hospital and 16 people died (MOPH, 2003).

The problem of inappropriate pesticide usage among agriculturist farmers is an important concern for the Ministry of Public Health (MOPH, 1998). Associations with cumulative exposure persisted after excluding individuals who had a history of pesticide poisoning or had experienced an event involving high personal pesticide exposure (Kammel et al., 2005). Although pesticide poisoning in Thailand has decreased since 2000 to 2007 and increased again in 2008 and 2009 (Table 1), Sukhothai Province, in northern Thailand has decreased since 2005 to 2007 and increased again 2008 (Table 2).

Table 1: Number of case/death and morbidity of pesticide poisoning per 100,000 population among 1998 - 2009, from Epidemiology of Surveillance system (506), Bureau of Epidemiology, Ministry of Public Health.

Year	**Number**		**Morbidity rate/100,000 pop.**
	Case	**Death**	
2000	3109	21	5.03
2001	2653	15	4.27
2002	2571	11	4.04
2003	2349	6	3.76
2004	1864	9	2.98
2005	1321	0	2.12
2006	1251	0	2.00
2007	1452	0	2.31
2008	1705	0	2.70
2009	1691	0	2.66

Source: Bureau of Epidemiology, Ministry of Public Health, (2010). Retrieved 10 April 2010 from http://epid.moph.go.th/

Table 2: Morbidity rate of pesticide poisoning per 100,000 populations among 2005 - 2009 in Sukhothai province, from Epidemiology of Surveillance system (506), Bureau of Epidemiology, Ministry of Public Health, Thailand

Year	**Number**		**Morbidity rate/100,000 pop.**
	Case	**Death**	
2005	66	0	10.80
2006	50	0	8.20
2007	34	0	5.60
2008	60	0	9.92
2009	55	0	9.12

Source: Bureau of Epidemiology, Ministry of Public Health, (2010).

Retrieved 10 April 2010 from http://epid.moph.go.th/

Most pesticides are used in rice farming. The rice farmers use them with their expectation to kill insect and grass, protect their crops, and get more benefit from the crops. The use of pesticide is largely directed by self behavior. In "political environment in which regulations do not cover how farmers apply pesticides, it is important to know what drives farmer' s voluntary behavior of pesticide use" (Lichtenberg and Zimmerman; 1999) . A prior study on the influence of pesticide safety knowledge, beliefs, and intention found that knowledge levels were positively related to intentions, beliefs and self –efficacy to use personal protective gear, but not significantly related to risk perceptions and peer norms concerning pesticide safety (Perry MJ, Marbella A, Layde PM, 2000). From review the effective of interventions to reduce pesticide overexposure and poisoning in worker populations found that most studies evaluated exposure during differing configurations of PPE (Personal Protective Equipment) or during difference mixing or handling methods. Most studies were small field tests of protective equipment involving less than 20 workers. Some studies examined biological indices of exposure such as cholinesterase or urinary metabolites. PPE was effective in reducing exposure. No controlled studies were found that addressed reducing pesticide poisonings (Keifer, 2000).

Kongkrailat District is the largest rice farming area in Sukhothai Province, especially in Banmaisukasame sub-district is the biggest farm size in Kongkrailat district. Researcher, Public health worker, who provides the medical care, health promotion and rehabilitation for people, and has realized that health problems of farmers from pesticides substance tend to increase in the future in accordance with the change in society and technology which are disadvantage to health and economy of farmers and country. There are efforts in raising awareness against the hazard from using pesticide substance, but little success, even though good protection might be accomplished through cooperation among farmers. In response to multiple health risks that rice farmers experience and need for appropriate interventions, and for studies to test effects of these interventions, the present study was designed to increase protective behavior and to reduce risk of pesticide exposure.

1.2 Research Question

1. Does a pesticide risk reduction program effectively improve knowledge, attitude, and protective behavior of pesticide use among rice farmers in Kongkrailat District, Sukhothai Province?
2. Does pesticide risk reduction program effectively reduce health risk of pesticide use, as measured by symptom prevalence and serum cholinesterase levels, among rice farmers in Kongkrailat District, Sukhothai Province?

1.3 Research Objective

To study the effectiveness of a pesticide risk reduction program on the safe use of pesticide by measuring knowledge, attitude, protective behaviors, serum cholinesterase level and pesticide-related symptoms among rice farmers in Kongkrailat District, Sukhothai Province.

Specific objectives

1. To provide the background and information of pesticide used and exposure in rice farmers in Kongkrailat District, Sukhothai Province.
2. To study protective behaviors and history of pesticide poisoning in rice farmers in Kongkrailat District, Sukhothai Province.
3. To study the change in knowledge, attitude,protective behaviors, serum cholinesterase level and pesticide-related symptoms of pesticide use in rice farmers in Kongkrailat District, Sukhothai Province.

1.4. Research Hypotheses

1. The pesticide risk reduction program will increase mean scores knowledge, attitude, and protective behaviors in pesticide use.
2. The pesticide risk reduction program will increase serum cholinesterase level, as measured colorimetrically with a reactive paper assay.
3. . The pesticide risk reduction program will reduce prevalence of symptoms related to acute pesticide poisoning.

1.5 Conceptual Framework

The conceptual frame work of this study is to examine the effectiveness of pesticide risk reduction program towards knowledge, attitude, protective behaviors, serum cholinesterase level and pesticide-related symptoms. Independent variable (pesticide risk reduction program) and dependent variable (knowledge, attitude, protective behaviors, serum cholinesterase level and pesticide-related symptoms) are shown in figure 1.

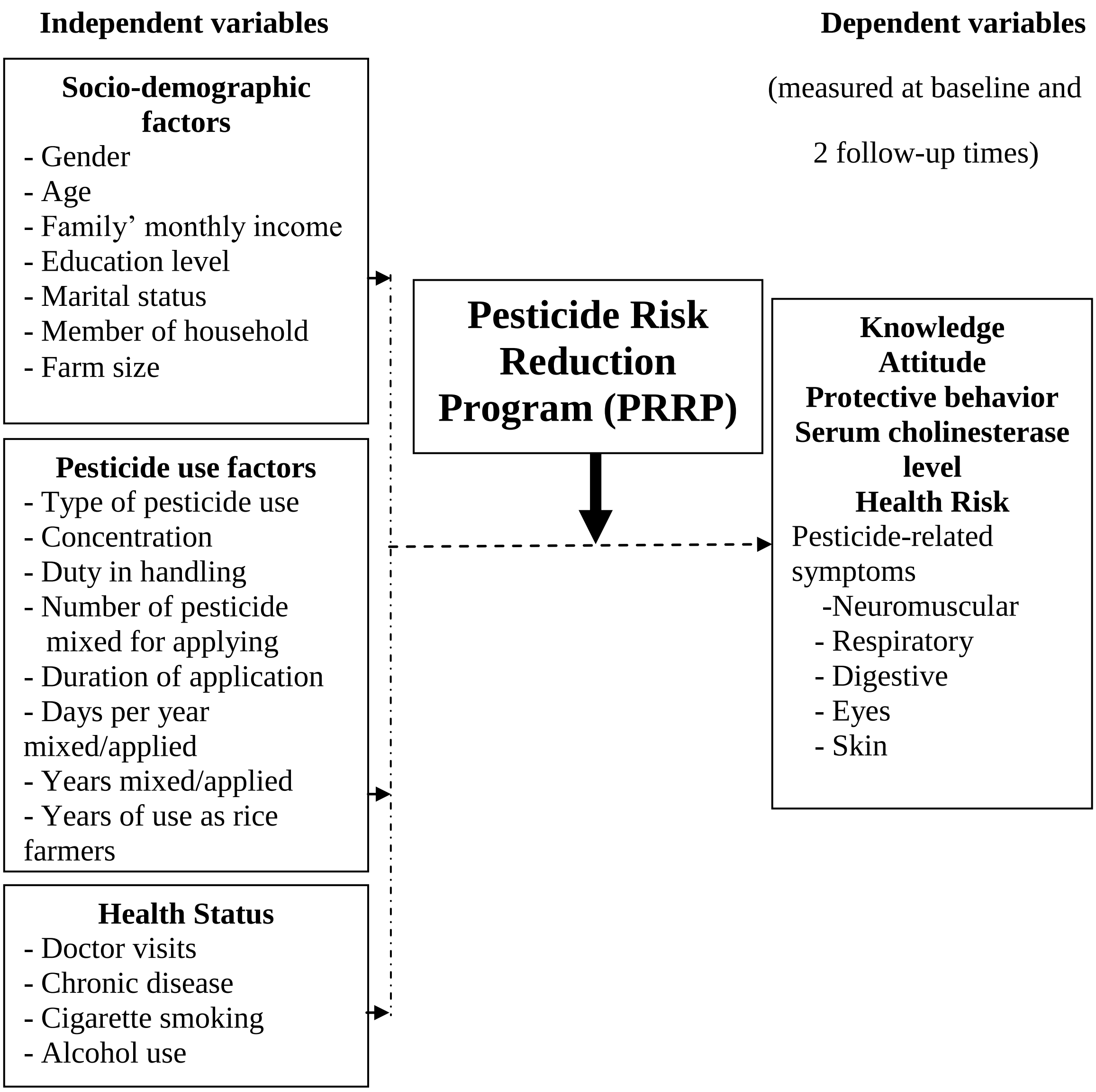


Figure 1: Conceptual framework

1.6 Variables to be studied

The following variables are studied in this research.

Independent Variables

Socio-demographic data: refer to gender, age, family's monthly income, educational level, marital status, farm size and member of household.

Pesticide use factors: refer to practice in pesticide use such as days per year mix/applied, concentration of pesticide used, method of pesticide use, duty in handling insecticide, Number of pesticides mixed each applying, years of using pesticide as rice farmer, and type of pesticide use and safety behaviors.

Health status: refer to perceived general health, doctor visits, chronic disease, smoking status, and alcohol consumption.

Pesticide risk reduction program: refer to all activities that educate and train in safe use of pesticide

Dependent variables

Protective behaviors refer to appropriate personal protective equipment including use gloves, chemical mask, coverall, glasses, and boots and practice that against expose to pesticide while mixing or spraying and after applying.

Cholinesterase activity refers to anticholinesterase level including normal, safe, risky and unsafe.

Pesticide related-symptoms: refer to physician-diagnosed pesticide poisoning or symptoms at least one symptom during or 24 hours after apply pesticides, such as **neuromuscular** : dizziness, headache, twitching eyelids, blurred vision, insomnia, staggering gait, seizure, shaky heart (irregular rhythm), exhaustion, sweating, muscle weakness, tremor, muscle cramps, excessive salivation, and numbness**, respiratory :** burning nose, nose bleed, runny nose, dry throat, sore throat, cough, chest pain (tightness or burning), and wheezing**, digestives**: nausea, diarrhea, and stomach cramps**, eyes :** burning-stinging- itchy eyes, red eyes, and excessive tearing, **skin/nails** : skin rash, itchy skin. This history of pesticide poisoning does not include intention.

1.6.1 Operational Definitions

Rice farmers mean are a field worker equal or more than 18 years of age, and work in the rice farms. Their fieldwork must include the exposure to pesticide, such as mixing and applying pesticides in the field.

Pesticide means all chemicals spraying used for pest control in rice farms: insecticides, herbicides, and fungicides.

Days per year mix/applied means the number of days to use pesticides that farmers apply last year.

Concentration of pesticide used, 3-level scale in relation to recommended usage, i.e. less than recommended, as recommended, and more than recommended in the pesticide labels.

Number of pesticides mixed for applying means mixing two or more pesticides, and using only one pesticide.

Method of pesticide use means the pattern or characteristics in pesticide use of farmers that uses for destroying pesticides such as spraying, scattering or mixing.

Duration of each applying episode means the number of hours per each episode of spraying pesticide.

Duty in handling pesticide means the role of responsibility concerning the application of pesticides such as mixing pesticides, spraying pesticides, mixing and spraying pesticides together, preparing pesticides or other responsibilities in all activities of pesticide use.

Years of using pesticides as rice farmer means the number of years that using as rice farmer and expose to pesticides.

1.7 Expected outcome and benefits

1. Rice farmers can improve protective behaviors and reduce health risk from pesticide use.
2. To provide a scientific basis of policy that reduces harmful health effect from pesticide use in agriculture workers.
3. To develop pesticide risk reduction program for health promotion and prevention in acute poisoning symptoms and chronic illness of pesticide use in other areas in Thailand.

CHAPTER II

LITERATURE REVIEW

This chapter presents the literature review and theories supported dissertation, divides into the following topics:

- Pesticides use in rice farms.
- The symptoms and illnesses associated with pesticide exposure.
- Regulations in using pesticide.
- Risk perception and risk communication
- Relevant scientific finding in pesticide health effects and interventions.

2.1 Pesticides use in rice farms

A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest (US EPA, 2010). A pesticide may be a chemical substance, biological agent (such as a virus or bacterium), antimicrobial, disinfectant or device used against any pest. Pests include insects, plant pathogens, weeds, mollusca, birds, mammals, fish, nematodes (roundworms), and microbes that destroy property, spread disease or are a vector for disease or cause a nuisance. Although there are benefits to the use of pesticides, there are also drawbacks, such as potential toxicity to humans and other animals. According to the Stockholm Convention on Persistent Organic Pollutants, 10 of the 12 most dangerous and persistent organic chemicals are pesticides (Gilden et al., 2010 and FAO, 2002).

2.1.1 Pesticide Classification

Subclasses of pesticides include: herbicides, insecticides, fungicides, rodenticide, pediculocides, and biocides (Gilden et al, 2010).

Pesticides can be classified by target organism, chemical structure, and physical state (CSA and AMA, 1997). Pesticides can also be classed as inorganic, synthetic, or biologicals (biopesticides), although the distinction can sometimes blur. Biopesticides include microbial pesticides and biochemical pesticides (US EPA, 2010). Plant-derived pesticides, or "botanicals", have been developing quickly. These include the pyrethroids, rotenoids, nicotinoids, and a fourth group that includes strychnine and scilliroside (Kamrin, 1997).

Many pesticides can be grouped into chemical families. Prominent insecticide families include organochlorines, organophosphates, and carbamates. Organochlorine hydrocarbons (e.g. DDT) could be separated into dichlorodiphenylethanes, cyclodiene compounds, and other related compounds. They operate by disrupting the sodium/potassium balance of the nerve fiber, forcing the nerve to transmit continuously. Their toxicities vary greatly, but they have been phased out because of their persistence and potential to bio accumulate (Kamrin, 1997). Organophosphate and carbamates largely replaced organochlorines. Both operate through inhibiting the enzyme acetylcholinesterase, allowing acetylcholine to transfer nerve impulses indefinitely and causing a variety of symptoms such as weakness or paralysis. Organophosphates are quite toxic to vertebrates, and have in some cases been replaced by less toxic carbamates (Kamrin, 1997). Thiocarbamate and dithiocarbamates are subclasses of carbamates. Prominent families of herbicides include pheoxy and benzoic acid herbicides (e.g. 2, 4-D), triazines (e.g. atrazine), ureas (e.g. diuron), and Chloroacetanilides (e.g. alachlor). Phenoxy compounds tend to selectively kill broadleaved weeds rather than grasses. The phenoxy and benzoic acid herbicides function similar to plant growth hormones, and grow cells without normal cell division, crushing the plants nutrient transport system. Triazines interfere with photsynthesis. Many commonly used pesticides are not included in these families, including glyphosate (Kamrin, 1997).

- Algicides or algaecides for the control of algae
- Avicides for the control of birds
- Bactericides for the control of bacteria
- Fungicides for the control of fungi and oomycetes
- Herbicides (e.g. glyphosate) for the control of weeds
- Insecticides (e.g. organochlorines, organophosphates, carbamates, and pyrethroids) for the control of insects - these can be ovicides (substances that kill eggs), larvicides (substances that kill larvae) or adulticides (substances that kill adults).
- Miticides or acaricides for the control of mites
- Molluscicides for the control of slugs and snails
- Nematicides for the control of nematodes
- Rodenticides for the control of rodents
- Virucides for the control of viruses

In general, we can classify agricultural pesticides into 6 categories (Siter et al., 2001).

a) Insecticide

The classification of insecticides is done in several different ways:

- Systemic insecticides are incorporated by treated plants. Insects ingest the insecticide while feeding on the plants.
- Contact insecticides are toxic to insects brought into direct contact. Efficacy is often related to the quality of pesticide application, with small droplets (such as aerosols) often improving performance.
- Natural insecticides, such as nicotine, pyrethrum and neem extracts are made by plants as defenses against insects. Nicotine based insecticides have been barred in the U.S. since 2001 to prevent residues from contaminating foods.
- Inorganic insecticides are manufactured with metals and include arsenates, copper compounds and fluorine compounds, which are now seldom used, and sulfur, which is commonly used.
- Organic insecticides are synthetic chemicals which comprise the largest numbers of pesticides available for use today.
- Mode of action – how the pesticide kills or inactivates a pest – is another way of classifying insecticides. Mode of action is important in predicting whether an insecticide will be toxic to unrelated species, such as fish, birds and mammals.

Heavy metals, e.g. arsenic have been used as insecticides; they are poisonous and very rarely used now by farmers.

In this research will present only insecticide used in rice farms consists of as follow:

a.1) Organophosphate

Phosphorus is a major component of this insecticide and organophosphate compound has a short half-life so it is easily degraded. The toxicity of organophosphate affects human by irreversible inhibiting acetyl cholinesterase at nerve endings. Exposure may be fatal. The next large class developed was the organophosphates, which bind to acetylcholinesterase and other cholinesterases. This results in disruption of nerve impulses, killing the insect or interfering with its ability to carry on normal functions. Organophosphate insecticides and chemical warfare nerve agents (such as sarin, tabun, soman and VX) work in the same way. Organophosphates have an additive toxic effect to wildlife, so multiple exposures to the chemicals amplify the toxicity (Palmer et al., 2010).

a.2) Carbamate

Carbamate insecticides are similar to the organophosphate on their acute toxic effects and are inhibitors of the enzyme cholinesterase. However, the inhibition of the enzyme is reversible. Carbamate insecticides have similar toxic mechanisms to organophosphates, but have a much shorter duration of action and are thus somewhat less toxic.Widely used toxic carbamate includes aldicarb (TemiK), methomyl (Lannate), carbofuran (Furadan), and oxamyl (Vydate).

a.3) Pyrethroids

To mimic the insecticidal activity of the natural compound pyrethrum another class of pesticides, pyrethroid pesticides, has been developed. These are nonpersistent, which is a sodium channel modulators, and are much less acutely toxic than organophosphates and carbamates. Compounds in this group are often applied against household pests (Palmer et al.,2010).

a.4) Neonicotinoids

Neonicotinoids are synthetic analogues of the natural insecticide nicotine (with a much lower acute mammalian toxicity and greater field persistence). These chemicals are nicotinic acetylcholine receptor agonists. Broad-spectrum – systemic insecticides, they have a rapid action (minutes-hours). They are applied as sprays, drenches, seed and soil treatments – often as substitutes for organophosphates and carbamates. Treated insects exhibit leg tremors, rapid wing motion, stylet withdrawal (aphids), disoriented movement, paralysis and death (Palmer et al., 2010).

a.5) Biological insecticides

Recent efforts to reduce broad spectrum toxins added to the environment have brought biological insecticides back into vogue. An example is the development and increase in use of Bacillus thuringiensis, a bacterial disease of Lepidopterans and some other insects. Toxins produced by different strains of this bacterium are used as a larvicide against caterpillars, beetles, and mosquitoes.

Because it has little effect on other organisms, it is considered more environmentally friendly than synthetic pesticides. The toxin from B. thuringiensis (Bt toxin) has been incorporated directly into plants through the use of genetic engineering. Other biological insecticides include products based on entomopathogenic fungi (e.g. Beauveria bassiana, Metarhizium anisopliae), nematodes (e.g. Steinernema feltiae) and viruses (e.g. Cydia pomonella granulovirus) (Palmer etal., 2010).

b) Herbicides

An herbicide, commonly known as a weed killer, is a type of pesticide used to kill unwanted plants (Kellogg et al., 2000). Selective herbicides kill specific targets while leaving the desired crop relatively unharmed. Some of these act by interfering with the growth of the weed and are often synthetic "imitations" of plant hormones. Herbicides used to clear waste ground, industrial sites, railways and railway embankments are non-selective and kill all plant material with which they come into contact. Smaller quantities are used in forestry, pasture systems, and management of areas set aside as wildlife habitat. Some plants produce natural herbicides, such as the genus Juglans (walnuts), or the tree of heaven; the study of such natural herbicides, and other related chemical interactions, is called allelopathy. Herbicides are widely used in agriculture and in landscape turf management. In the U.S., they account for about 70% of all agricultural pesticide use. Prior to the widespread use of chemical herbicides, cultural controls, such as altering soil pH, salinity, or fertility levels were used to control weeds. Mechanical control (including tillage) was also (and still is) used to control weeds. The first widely used herbicide was 2, 4-dichlorophenoxyacetic acid, often abbreviated 2, 4-D. It was first commercialized by the Sherwin-Williams Paint Company and saw use in the late 1940s. It is easy and inexpensive to manufacture, and kills many broadleaf plants while leaving grasses largely unaffected (although high doses of 2,4-D at crucial growth periods can harm grass crops such as maize or cereals). The low cost of 2,4-D has led to continued usage today and it remains one of the most commonly used herbicides in the world. Like other acid herbicides, current formulations utilize either an amine salt (usually trimethylamine) or one of many esters of the parent compound. These are easier to handle than the acid. 2,4-D exhibits relatively good *selectivity*, meaning, in this case, that it controls a wide number of broadleaf weeds while causing little to no injury to grass crops at normal use rates. A herbicide is termed selective if it affects only certain types of plants, and nonselective if it inhibits a very broad range of plant types. Other herbicides have been more recently developed that achieve higher levels of selectivity than 2, 4-D. The 1950s saw the introduction of the triazine family of herbicides, which includes atrazine, which have current distinction of being the herbicide family of greatest concern regarding groundwater contamination. Atrazine does not break down readily (within a few weeks) after being applied to soils of above neutral pH. Under alkaline soil conditions atrazine may be carried into the soil profile as far as the water table by soil water following rainfall causing the aforementioned contamination. Atrazine is thus said to have *carryover*, a generally undesirable property for herbicides. Glyphosate, frequently sold under the brand name Roundup, was introduced in 1974 for non-selective weed control. It is now a major herbicide in selective weed control in growing crop plants due to the development of crop plants that are resistant to it. The pairing of the herbicide with the resistant seed contributed to the consolidation of the seed and chemistry industry in the late 1990s. Many modern chemical herbicides for agriculture are specifically formulated to decompose within a short period after application. This is desirable as it allows crops which may be affected by the herbicide to be grown on the land in future seasons. However, herbicides with low residual activity (i.e., that decompose quickly) often do not provide season-long weed control.

c) Fungicides

Fungicides comprise a heterogeneous group of chemical compounds including Captan, Cymeb, Maneb, Mabam and benlet. With a few exceptions, the fungicides have not attracted the detailed toxicological research as have insecticides. Although many of the fungicide compounds, used to control fungus diseases on plants, seeds, and produce, are rather non-toxic acutely, there are some notable exceptions. The mercury containing fungicides comprise the group that has been of greatest concern for hazard to health, and they have been responsible for many deaths or permanent neurological disability resulting from the misdirection of mercury fungicide treated seed grains into human and animal food (Palmer et al., 2010).

d) Algicide

Copper sulphate is very harmful to algae and is widely used. Mixing chlorine with copper sulphate is popular practice because chlorine could eliminate some other algae as well as eradicate bad odour of decayed algae. Algicide compounds include calcium carbonate, sodium arsenite, sodium chloraate, ammonium sulfamate and dichlorphenoxyacetic acid (Palmer et al., 2010).

e) Rodenticides

Varieties of chemicals, which are difficult to classify, have been used in the control of rat and mice. Although they are used to kill mammals, which resemble man in their physiology and biochemistry, there are wide differences in degree of hazard to man. In some cases, the rodenticidal selectivity of these compounds is based on the peculiar physiology of rodents, which differs from that of primates and other species, and in some cases it is merely a question of taking advantage of the habits of rodents as opposed to species that are to be protected. In addition to potential widespread destruction of food and fiber by rodents. Another primary reason for their control is to eliminate intermediate hosts in the transmission of various vector borne diseases, i.e. bubonic plague. Since rodenticides can be used as baits and placed in restricted places, their likelihood of becoming widespread contaminants of the environment is much less than that associated with the use of insecticides and herbicides. The toxicological problem posed by rodenticides, therefore, is primarily acute accidental or suicidal ingestion.

A group of rodenticides include zinc phosphide, sodium monofluoroacetate and cyanogas.

f) Nematocide (worm killers)

Birlane, Sumithion and Sevin are the most widely used nematocides in Thailand.

2.1.2 Routes of entry

For pesticide to causes illness or death in human, they must get into the body. They can occur in one of three ways: through the skin, the lungs, or the alimentary tract (Jeyaratnam, 1990).

Skin

Pesticide uptake occurs mainly through the skin and eyes by inhalation, or by ingestion. The fat-soluble pesticides and, to some extent, the water-soluble pesticides are absorbed through in tact skin. Sore and abrasions may facilitate uptake through the skin. Skin absorption is probably of particular importance when pesticides are used in developing countries. Because adequate protective clothing is often not available or not worn. If a pesticide has direct contact with the skin, it can pass quickly through the dermis and epidermis into the blood. This is the most common route of entry into the body, as contamination of the skin can occur easily and often goes unnoticed.

Such skin contact may be: a result of:

(1) spills or splashes on to the skin when handling a pesticide:

(2) Wearing clothes gloves hats, boots, or socks contaminated with pesticides.

(3) Cleaning or handling equipment that has pesticide on it; and

(4) Being accidentally sprayed either directly or by spray drifting from the next field.

The danger of pesticides entering through the skin is greatest when:

(1) the temperature is high;

(2) the skin is wet; and having an abrasion in the skin.

Lungs

Pesticide that is present in the air is breathed into the lungs. The pesticide passes from the lungs into the blood and is then carried all over the body.

Lung contact may occur:

(1) during mixing and preparation of pesticides for spraying;

(2) during spraying, and

(3) when entering a treated area before the dust settles or the spray dries.

Digestive System

When pesticides are taken directly into the mouth and swallowed, they enter the body from the stomach and intestine. While most people would not intentionally eat or drink a pesticide, they may do so by:

(1) consuming food or drink that have been contaminated by spills of pesticide or by being stored near pesticides;

(2) consuming food or drink that has been prepared or stored in empty pesticide containers;

(3) handling and eating food with hands that are contaminated with pesticide;

(4) touching the mouth with contaminated hands.

Most of the pesticides are toxic chemicals, which induce adversely affect health when absorbed in sufficient dosage, This is perhaps best illustrated in the widespread use of organophosphate and crabmeat ester pesticides. There have been many reports of acute poisoning associated with the use of these groups of pesticides (Lee , 1992: 123-126).

Acute occupational exposure may also occur during the manufacture, formulation, packaging, and transport of pesticides, and transport of pesticides, and among people re-entering a previously treated area.

Accidents resulting from unsafe packing and leakage of pesticides during storage or transport may involve large numbers of people. On a number of occasions food has been contaminated in this way. Parathion and endrin have been involved most frequently in such accidents.

2.2 The symptoms and illness associated with pesticide exposure

Acute effects

A large number of reports are available on the acute effects associated with high occupational exposure to pesticides. These include reports of acute chemical burns of the eyes, skin damage, neurological effects, and liver effects. Organophosphate insecticides exert their acute effects in both insects and mammals by inhibiting acetyl cholinesterase (AchE) in the nervous system with subsequent accumulation of toxic levels of acetylcholine (Ach) which is a neurotransmitter. In many cases, the organophosphorylated enzyme is fairly stable, so that recover from intoxication may be slow. The severity of any adverse effects from exposure to a pesticide depends on the dose, the route of exposure, hour easily the pesticide is absorbed, the types of effect of the pesticide and its metabolites, and its accumulation and persistence in the body,

The toxic effects also depend on the health status of the individual; malnutrition and dehydration are likely to increase sensitivity to pesticides.

The vapors of pesticides or aerosol droplets smaller than 5, µm (micrometers) in diameter are absorbed effectively through the lungs. Larger inhaled particles or droplets may be swallowed after being cleared from the airways, Ingestion can also occur from the contaminated hands may also lead to intake of pesticides, for example from cigarettes,

In the body, the pesticide may be metabolized, or it may be stored in the fat or excreted unchanged, Metabolism will probably make the pesticide more water-soluble and thus more easily excreted, the clinical picture of organophosphate intoxication results from the accumulation of ACh at nerve endings. The symptoms may be summarized as follows,

a) muscarinic manifestations.
   - increased bronchial secretion, excessive sweating, salivation and lachrymation;
   - pinpoint pupils, bronchoconstriction, abdominal cramps(vomiting and diarrhea);and
   - bradycardia (unduly slow heartbeat).
b) Nicotinic manifestations
   - fasciculation of fine muscles and, in more severe cases, of diaphragm and respiratory muscles: and
c) Central nervous system (CNS) manifestations
   - headache, dizziness, restlessness, and anxiety;
   - mental confusion, convulsions and coma; and
   - depression of the respiratory center.

All these symptoms can occur in different combinations and can vary in time of onset, sequence, and duration, depending on the chemical, dose and route of exposure. Mild poisoning might include muscarinic and nicotinic signs only. Severe cases virtually always show CNS involvement. The clinical picture may include respiratory failure, sometimes leading to pulmonary edema, due to the combination of the above (Lee , 1992).

2.3 Regulations in using pesticide.

Protective equipment and personal hygiene

The various items of protective clothing that may have to be used are described below, with descriptions their proper care.

(1) Hats. These should be made of impervious material with a broad brim to protect the face and neck. Unless made from cheap material, they should be able to withstand regular cleaning.

(2) Veil. A plastic mesh net will have on adequate protection of the face from the larger spray droplets and permit adequate visibility.

(3) Capes. Short capes of light plastic may be suspended from the hat to protect the shoulders.

(4) Overalls. All of above should be made of light, durable cotton fabric. They must be washed regularly. The frequency depends on the pesticides being used. Washing with soap, detergent, or soda is adequate in the case of organophosphorus and crabmeat compounds A rinse in light kerosene may be needed for compounds such as organochlorines and this should be followed by washing with soap, detergent, or soda.

(5) Rubber boots should be worn to protect the feet and legs.

(6) Gloves. Poly (vinylchloride) or rubber gloves or gauntlets should be used when handling concentrates with an organic solvent base. Cotton gloves offer some protection for hands when regularly washed. Impervious gloves must be cleaned regularly, inside and out, but are unsuitable for continuous wear.

(7) Face masks. Masks of gauze or similar material are capable of filtering the particles from a water-dispersible powder spray and may be worn to reduce inhalation of the spray and dermal exposure of the face, if such protection is considered desirable. They must be washed regularly and, in some instances, fresh masks may need to be used for the second half of the day's spraying, so that the face is not contaminated.

Scrupulous attention to personal hygiene among spray operators is essential. For professional spray men operating in the tropics, safety precautions may depend largely on personal hygiene, including washing and changing of clothes. A drill for carrying out and supervising personal hygiene, and the regular washing of protective clothes and cleaning of equipment should be organized along the following lines:

(a) Spray men should be provided with at least two uniforms to allow for a change when required.

(b) Washing facilities with sufficient water and soap should be made available in the field at appropriate locations.

(c) All working clothes must be washed regularly. The frequency depending on the toxicity of the formulation.

(d) Particular attention should be given to washing gloves as wearing of contaminated gloves may be more dangerous than not wearing gloves at all.

(e) Spray operators must clean hand and take a shower themselves before eating.

(f) Smoking during work should be forbidden.

(g) When work involves insecticides of relatively high toxicity, the hours of work must be arranged so that exposure to the material used is not excessive; transport should be arranged so that there is not a long delay between the end of the day's operations and the return to the base for washing.

Personal protective equipment, decontamination supplies, and pesticide safety and training are among the requirements of the standard. Showering and changing areas employer supplied laundry services for work clothes, and protective equipment reduce worker exposure and prevent transfer of workplace hazards to the home. In the absence of employer supplied laundry services, workers should be advised to wash work clothes separately from other clothes, and not to wear work clothes at home (Lee , 1992).

2.4 Risk perception and risk communication

2.4.1 Risk perception

Within the social sciences, risk perception refers to people's beliefs, attitudes, judgments and feeling toward risk, and incorporates the wider social and cultural values and dispositions people adopt hazards (Slovic, 1992; Pidgeon et al., 1992). Hazards are defined in line with Kates and Kasperson (1983) as "threats to people and the things the value". Risk incorporates both the likelihood of a hazard emerging into an actual adverse effect, and the (perceived) severity of the effect— lost, injury or some other form danger (Krimsky and Plough, 1988). This understanding of perceived risk is wide-ranging as it incorporates the idea that people evaluate the characteristics of hazards (e.g., social scale, locus of responsibility), rather than a single abstract concept (e.g., quality adjusted life year). Perception of risk is thus multi-dimensional implying that a particular hazard means different thing to different people within different contexts. Pidgeon et al. (1992) highlight that risk perception, ***cannot be reduced to a single subjective correlate of particular mathematical model of risk, such as the product of probabilities and consequences, because this imposes unduly restrictive assumptions about what is an essentially human and social phenomenon***. In the field of risk perception there are several approaches to analyzing the content and formation of risk beliefs and attitudes.

There are many theories to develop risk perception in individual such Health Belief Mode, Cultural Theory. In this dissertation developed Cognitive Social Psychological Model to develop risk perception.

2.4.1.1 Cognitive Social Psychological Model

The cognitive Social Psychological Model (CSPM) builds on concepts form the **Theory of Planed Behavior** (Fishbein and Azjen, 1975) and **Social Learning Theory** (Rotter, 1954). The theory of planned (commonly used for understanding behavior to do with health risk) theorizes that behavior decisions are made indirectly based on the relationship between a rang of factors and the intention to behave in a particular way (Langford et al., 2001a). These factors are:

Attitude; the belief (i.e., expectation) a person has that an incident will occur and the importance (i.e., value) placed on this belief.

Subjective norm; an individual is exposed to social pressure to conform to particular attitudes or behaviors.

Perceived behavior control; in risk circumstances, a person has general beliefs of control and power with respect to the self and society.

Social learning theory focuses on expectations and values associated with risks. This theory emphasizes the concept of “locus of control” (i.e., whether control of a situation is perceived to lie internally within the individual or external with other people; Rotter, 1966).

The CSPM, in attempt to understand risk perception, also (Kown and Oei, 1994) draws on analysis of the difference between:

- ***cognitive schema***; structures seen as core beliefs about the self and the world witch remain constant over time, that is, “attitudinal certainties” deeply engrained into an individuals belief system and often maintained by new information collected (Eiser, 1994) and
- ***surface cognitive products***; attitudes or reactions at the surface of consciousness which are seen as cognitive, affective or physical manifestations (Langford and McDonald, 1997).

According to Langford et al. (2000a), ***cognitive products*** within the cognitive social psychology model of risk perception are the individual’s attitudes towards self, society and environment in relation to a particular risk issue.

These attitudes are further divide into three main sections: self-efficacy, behavioral expectations and an importance value given to risk. ***Self-efficacy*** refers to attitude an individual has in regard to his/her ability to control (or not control) a risk issue. ***Behavioral expectation***s relate to the individual's behavior in relation to the risk (e.g., wearing or not wearing protective clothing when using a pesticide), as well as the individual's expectations of society's or an institution's response to a risk issue (e.g., that protective clothing will be provided by the employer). ***Importance value*** has to do with the interest an individual has in particular risk and whether a pesticide poisoning has affected the individual; whether pesticide are political issue. These three factors are basically the three factors of attitude.

Risk perceptions are not static but instead change over time as new information is gathered or received. Attitudes influencing perception are seen to go through three main *stages*: develop of attitude through receiving new information, and transition from one attitude to another through exposure to new events (Langford et al., 1999).

Figure 2 is "a conceptual representation of pathways linking deeper cognitive structures to surface products, and statements of risk perception and preference, integrating the theories to provide a structure which can be empirically tested and potentially provide useful information for policy makers' (Langford et al., 2000a). The main components of the CSPM of individuals' (i.e., perception), outlined in Figure 2, are described in more detail below:

Worldviews encompass stable cognitive schema based on the formative self (i.e., genetic disposition and early development/experiences), as well as cultural background, personally, attitudes and individual behaviors (Langford et al., 1992).

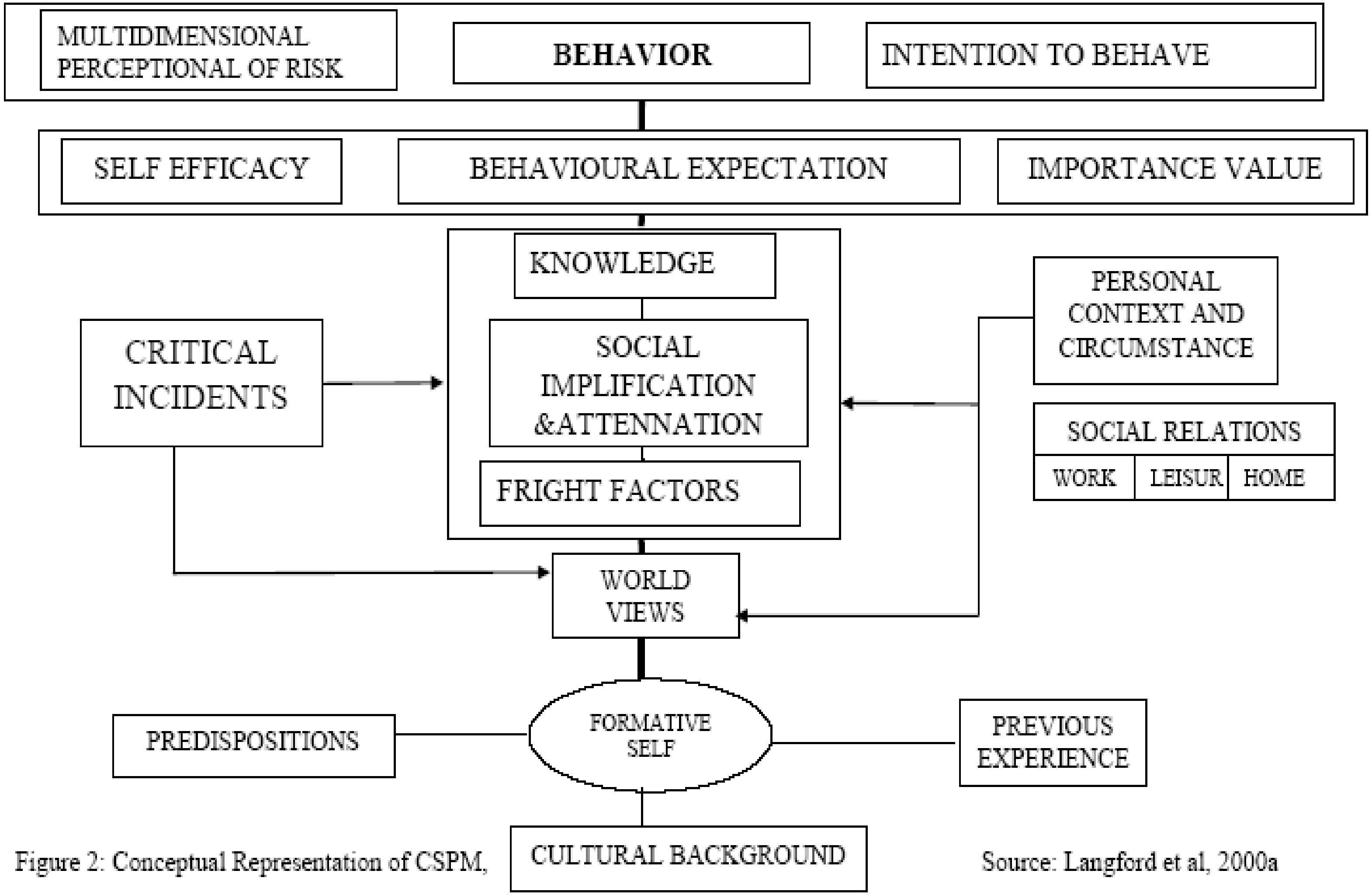


Figure 2: Conceptual Representation of CSPM, Source: Langford et al, 2000a

However, according to Rayner (1992), these are difficult to determine, can be altered over time, and are influenced by many vary circumstances. Langford et al. (200b), in their study on perceptions of sewage in bathing water, assessed respondents' worldviews through documenting the respondents' views of what constituted nature (i.e., their "myths of nature" [Thomson, 1990]).

Personal contexts and circumstances are seen as "the present world the individual lives and works in both geographically and socio-economically" (Langford, 2000a).

Socially, these incorporate factors such as occupation (e.g., farm workers), life style (e.g., living in substandard conditions in close proximity to other farm workers, alcohol addiction, and domestic violence), life-stage (e.g. having children, aged) and social relations patterns (e.g., group membership). As Teigen et al. (1988) explain, risk interpretations have interpersonal variation because individuals both live in different risk environments and perceive their environments differently. For the individual, personal history and experience with hazards will play a vital role in influencing perception and thus causing variation in perception from one individual to next. For example, the long-time farm worker who has worked with pesticides for years and perhaps experienced a poisoning incident will formulate a different concept of pesticide "risk" exposure than the long-time farm worker who has never experienced a poisoning incident or town desk job worker who has no experience of farm work.

Critical incidents, ether experienced personally (e.g., being poisoned, being made sick) or received as information (e.g., from family, friends, work colleagues who experience a poisoning), can fundamentally alter the perception of risk for an individual (Georgiou et al, 1998; Langford et al, 2000a). Accumulation of information about a risk or exposure to hazards can potentiate a change in belief about technological hazards that will later be triggered by a particular incident.

Although the CSP Model is relatively new approach to describing risk perception, it appears to be useful in describing different associations between varying sets of variables used by individuals in constructing risk perceptions (Langford et al, 2000a) shown in figure 2 . The CSPM has shown that, in addition to information on personal characteristics, knowledge and experience, so that this dissertation uses CSP Model to provides the cognitive of rice farmers in formulating their views and attitudes towards risks associated with pesticide use, pesticide exposure, and protective behaviors and use this model to develop intervention for increasing knowledge, attitude, protective behaviors, serumcholinesterase level and reduce health risk of pesticide use by measuring pesticide-related symptoms.

2.4.2 Risk communication

The notification of “risk communication”, according to Rohrmann (2000), refers to “a social process by which people become informed about hazards, are influenced towards behavioral change and can participate in decision-making about risk issues. This social process and the reason for engaging in it vary in relation to those social actors designing and administering the risk communication strategies, as well as those social actors seeking information or participating in decision-making. Within the risk communication literature there appear to be three schools of thought of how risk communication can control risk—(1) risk communication as public relations (i.e., everything is safe, (2) risk communication as a business strategy (i.e., transferring liability to end users; risk sharing), and (3) risk communication as a risk management (i.e., eliciting safety behaviors). Within each of schools of though the objective and gold of the risk communication vary, overlap and sometimes even conflict with the other schools of thought; that is, the term risk communication has different connotation and different outcomes for the various risk communication practitioners and participants. For example the view that risk communication is business strategy would focus on corporate profits rather than promotion in human health, which would be the focus in risk communication as a risk management strategy.

Risk communication research has emerged form several interrelated factors, including the legal and/or normal obligations placed on governments and industry to inform potentially exposed populations of environmental, technological and health hazards; as well as public policy dilemmas rising from social conflicts over risks (e.g., sitting of hazardous facilities; Kimsky and Plough, 1988), a leading psychologist and researcher in the field of decision-making, designed an eight-stage chronology summarizing the overall development of risk communication over the past 20 years. According to Fischhoff (1998b), each stage is characterized by the main communications strategy practitioners in the three schools was effective and reflects what was learnt about the limits of previous strategies. Thus, each stage builds on the former, without replacing that stage. Fischhoff's stage in risk communication (shown in Figure 3) vary from content-oriented risk communication intended to persuade (i.e., traditional authoritarian risk communication based on technological rationality), to process-oriented risk communication incorporating partnership (i.e., risk communication base on cultural rationality (Chess, 2001).

Developmental Stage in Risk Communication

1. All we have to do is get the numbers right.
2. All we have to do is tell them the numbers.
3. All we have to do is explain what we mean by the numbers.
4. All we have to do is show them that they have accepted similar risks in the past.
5. All we have to do is show them it is a good deal for them.
6. All we have to do is treat them nice.
7. All we have to do is make them partners.
8. All of the above.

Figure 3: Developmental Stage in Risk Communication, Source: Fischhoff, 1995; Chess, 2001.

For the purpose of evaluating the effectiveness of pesticide risk reduction program (PRRP) as a risk communication tool for Kongkrailat District, Sukhothai Province rice farmers this section briefly discusses four factors that need to be considered when communicating risks, as well as the three schools of thought concerning risk communication. However, the main focus of this section and dissertation in protective behaviors when using pesticides especially while mixing, spraying and after using pesticides as risk communication tool for risk management.

2.4.2.1 Risk communication factors

When communicating risks to the public, there are several factors that need to be considered which influence both how the information is communicated and how it is received. These factors are: the target audience; the messenger; the message itself; and the medium for transferring the message. Fessenden-Raden et al (1987) stated that,

"No matter how accurate it is, risk information may be misperceived or rejected if those who give information are unaware of the complex, interactive nature of risk communication and the various factors affecting the reception of the message."

Below is a brief discussion of the characteristics of each of these four factors.

2.4.2.1.1 The Audience

All approaches to risk communication make assumptions about the audiences (i.e., received factor; e.g., uniformed, passive, credulous, decision-makers; shown in Figure 3)

Typical findings are that success of any communication depends upon the characteristics of the sender of the message, and the receiver. For risk communication research, a clear conclusion to be drawn from this work is that if message is not appropriately matched to the frame of the audience then the communication may fail (or even prove to be counterproductive*; Pidgeon et al, 1992).*

The following characteristics are some of those which need to be taken into consideration when conducing an analysis of audience (Fassenden-Raden et al, 1997, and Baxter and Eyles, 1997):

- The individual’s or collective’s (e.g., community , workers) values and world views (e.g., preservation of nature);
- Level of past experiences with the risk (e.g., Has any one been poisoned before?);
- Previous experience with the communicating organization (i.e., attitudes towards the communicating organization or the organization responsible for the risk);
- Reading level of the target audience;
- Education level of the target audience;
- Current level of knowledge about the risk (e.g., what extent is the individual/community knowledgeable about the risk?;risk perception);
- Health of the individual and family members (e.g., has individual, or a member of his or her family, suffered from health problems that individuals may attribute the risk?); and
- Local conditions (e.g., what else happening in the community that might affect how the information?).

Audiences are not homogeneous and in order for risk communications to effective and successful, audience characteristics have to be calculated into the risk communication strategy (e.g., more than one risk communication strategy/message may have to used).

2.4.2.1.2 The Messenger

Messenger characteristics (i.e., source factor) are also influencing factor on risk communication. Potentially, there may be multiple messengers providing risk information to the target audiences. Messengers are often viewed as "official" messengers (e.g., government agencies, chemical companies) or "unofficial" messengers (e.g., friends, neighbors, activist groups, media; Fessenden-Raden et al, 1997). Trust of the messenger on part of the audience plays a vital role in whether the message being communicated will be accepted or not. That is, the credibility of the messenger is judged by the audience.

2.4.2.1.3 The Message

Risk messages within the three schools of risk communication use the ether one or both of two mechanisms to achieve their goals—informing and influencing. However, these mechanisms are not mutually exclusive and coexist in risk messages, sometimes even appearing in a single risk message.

As note above, there are "official" risk messages and "unofficial" risk messages (Fessenden-Raden et al, 1997). Official risk messages are those statements communicated by the "experts", for example, scientists, government officials, chemical companies' technical staff; whereas, unofficial risk messages are referred to as statements communicated by layperson and mass media. There are times when the content of the risk messages from these two groups conflicts with one another causing confusion for the target audience(s). In general, risk messages are hard to formulate in ways that are accurate, comprehensible, and not misleading (National Academy of Sciences, 1989). According to Fischhoff et al (1995), risk messages tend to make sweeping general statements rather than offering numerical information/statistics regarding the magnitude of the risk. Risk messages are often controversial because the hazards they describe are themselves controlversial (i.e., the expert draw varying conclusions about the hazards). "Experts are frequently accused of hiding their subjective preferences behind technical jargon and complex, co-called objective analysis” (National Academy of Sciences, 1989).

According to the National Academy of Sciences (1989) risk massages should have the following traits for effective risk communication:

1) Emphasize information relevant to any practical actions that individuals can take;
2) Be couched in clear plain language;
3) Respect the audience and its concerns; and
4) Seek to inform the recipient, unless conditions clearly warrant the use of influencing techniques.

Some of the important massage of the pesticide risk reduction program base in the WPS (Work Protection Standard) (EPA, 1993) training criteria are:

- Where and in what forms pesticide may by encountered during work activities.
- Routes through which pesticides can enter the body.
- Signs and symptoms of common pesticide poisoning.
- Emergency first aid for pesticide injuries or poisonings.
- How to obtain emergency decontamination procedures, including emergency eye flushing techniques.
- Warning from pesticide residues on clothing.
- Warning work clothing that protect the body from pesticide residues.
- Washing/Showing with soap and water, shampooing hair and putting on clean clothes after work.
- Warning about taking pesticides or pesticide containers home.

- Warnings about how pesticides help to control pests but cause injury and illness in workers.
- Warnings about how pesticides may harm workers in many ways, sometimes after many mouths or years following initial exposure.
- Warnings about how pesticides may be on or in plants, soils, irrigation water, or drifting from nearby applications (all plants and soils should be considered as contaminated with pesticides).
- Warning about following directions and/or signs to keep out of treated or restricted areas.
- Warnings about washing before eating, drinking, using chewing gum or tobacco, or using toilet.
- Warnings about washing immediately with nearest clean water if pesticides are spilled or sprayed on the body.
- An explanation of WPS requirements designed to protect workers, including application and entry restrictions, posting of warning sign, oral warning, and availability of specific information about applications.

2.4.2.1.4 The Medium

Risk communication messages, developed by messengers, are transmitted to diverse target audiences through various modes of delivery, that is, mediums. The characteristics of risk communication distribution medium (i.e., channel factor; Petty and Cacioppo, 1981) are influenced by audience culturally supported media of communication. For example, when pesticide safety training is required, some societies rely on electronic, self-taught risk communication programs, while others use theatrical presentations to communities of workers.

2.4.2.1.5 Summary of Risk Communication Factors

All risk communication factors – audience, messenger, message and medium—play a crucial role in whether a risk communication strategy is effective or not and are important components in this dissertation for the analysis of the effectiveness of the pesticide risk reduction program as a risk communication tool.

2.4.3. Risk Perception and Risk Communication Interaction

The risk perception and risk communication literature have been presented in this chapter as separate sections. However, a central focus of this dissertation is the interaction between the two. This section, therefore, discusses important parts of the literature where risk perception and risk communication interact.

2.4.3.1. Perception

Perception is a significant concern for risk communication. /risk perception research has provided risk communication researchers with insights into the various issues in relation to people's attitudes, beliefs and interpretations of risk. However, most of the risk communication literature refers to risk perception from the perspective of how to use communication to control, manipulate and change perceptions in order to achieve a desired precautionary behavior.

2.4.3.2 The role Trust in Risk Perception and Risk communication

The issue of an audience's trust in the institutions and persons tasked with managing risk in a country is a point of contact between risk perception and risk communication research. Langford (2002) expresses the concept of trust as a central theme in examining risk perception and risk communication in contemporary society, "with trust representing a highly complex process linked to notions of individual and social freedom and responsibility". Walker et al., (1998) argue that the issue of public trust (or more correctly, distrust) of risk management organizations is key to understanding the public's perception of the means through which risk is communicated to the public.

The assumption is that when individuals (i.e., the audience) lack information, knowledge, interest, time, abilities or other resources to make decisions about risk, they rely on others whom they perceive as having the resources and competence, and /or the individual's interests at heart (e.g., scientific and technical "experts"). Thus these individuals (i.e., audience) are viewed as trusting those in positions of power and authority without questioning what those incumbents say or do. In risk communication, this is expressed in terms of trust in the risk message and the messenger of the risk communication.

According to Pidgeon et al., (1992), trust penetrates the risk communication debate in two unrelated ways. The first being the issue of credibility of a communicator (i.e., messenger) is dependent on trust placed in this person; the second being the issue of risk assessments incorporating social farming assumption. The argument is that if the source is not trusted than the massage is not trusted. Several factors affect how trust of the source communicating the risk(s) is viewed. Figure 4 gives a summary of various factors different authors have identified. However, the fact that authors have identified varying factors indicates that the "social reality" of the perceiver influences which factors of trust are important for them and these will vary with cultural and ethnic variances in society.

Perceived Factors Influencing Trust	
- Competence and expertise	- Fulfilling responsibilities
- Objectivity	- Caring and empathy
- Fairness	- Predictability
- Consistency	- Dedication
- Good will	- Honesty and openness
- Commitment to a goal	- Consensual values

Figure 4: Perceived Factors Influencing Trust
Source: Adapted from Bennett (1999); Kasperson et al. (1992); Johson (1999)

2.4.4. Summary

In this dissertation will develop both risk perception and risk communication to adopt measurement tool and intervention program. At the pre-baseline, the major objective is to identify information, risk perception that developed Cognitive Social Psychological Model (CSPM) for example knowledge, attitude, behavioral expectation (protective behavior) and importance value to provide behavior expectation to behavior. So, this pesticide risk reduction program will develop this model in term of the tool to behavior (protective behavior on pesticide use) by personal context and circumstance, formative self; previous experience and critical incidents and develop risk communication factor including message, medium and messenger.

2.5 The relevant scientific finding in pesticide health effects and intervention.

2.5.1Pesticide and health effects

In Thailand

Warisara. (2004), studied the relationship between health believe, pesticide use and safety behaviors with acute poisoning of 338 rice farmers, found that the majority of farmers had a moderate level of belief in the danger of pesticides and their susceptibility to pesticides, and also a moderate belief in the benefits of and barriers to taking action about pesticide use. However, their safety behavior was at a low level. Acute pesticide poisoning symptoms mostly found were nervous symptoms: headache and fainting; respiratory symptoms: runny nose and cough; digestive symptoms: nausea vomiting; toxic allergic symptoms of skin: skin rash; and toxic allergic symptoms with eyes: runny eyes / tearing. Unsafe use of pesticide and low knowledge of proper pesticide use is related to poor health in farmers. Where there were high perceptions of the existence of barriers to take action in safety behavior, there were correspondingly low safety behaviors ($r = -0.176$, p-value<0.001). Pesticide usage such as frequency of pesticide use, duration of spraying, concentration of pesticide use and method of pesticide use had a significant relationship with acute pesticide poisoning symptoms. Based on the finding of this study, she suggested that the responsible organizations should provide the knowledge on appropriate and safe use of pesticide and develop an education program on using personal protective equipment for farmers. Moreover, other methods for farmers to avoid using pesticides should also be promoted.

Jintana et al. (2009) Studies biological monitoring that is an essential component for assessing the exposure of individuals to organophosphate pesticides. The objective of this study was to determine cholinesterase activity, pesticide exposure and health effects in the exposed population. A total of 90 individuals occupationally exposed to Ops (Organophosphate pesticides) and 30 controls were recruited in this study. Erythrocyte acetyl cholinesterase (AChE) and butyryl cholinesterase (BuChE) activities were measured in two periods of low- and high-exposure. There were statistically significant decrease in AChE and BuChE activities in the high-exposure period (20.73 ± 0.99 U/gHb and 3.73 ± 0.19 U/mL, respectively,$P < 0.001$) compared to the low-exposure period (29.81 ±1.19 U/gHb and 4.92 ± 0.19 U/mL, respectively). All enzyme activities in the exposed group were statistically lower than in the control group. Analysis of the relation between cholinesterase activity and symptoms showed significant evidences. They suggested the association between occupational pesticide exposure and inhibition of cholinesterase. Thus, medical monitoring of cholinesterase inhibition and intervention programs regarding safety practices during work are important issues aimed at minimizing adverse health effects of pesticide.

Kachaiyaphum et al.(2010) studied that purposed to estimate the prevalence of, and factors associated with, abnormal serum cholinesterase (SChE) levels among 350 chilli-farm workers in Chatturat District, Chaiyaphum Province. A reactive-paper finger-blood test was used to assess SChE levels. They found that the prevalence of abnormal SChE levels was 32.0%. The most common pesticide-related symptoms were dizziness (38.0%), headache (30.9%), nausea/vomiting (26.9%), and fever (26.9%). 7 factors were independently associated with abnormal SChE level: male gender, single/separated/divorced, being a permanent worker, spraying pesticide more than 3 times per month, having moderate or poor pesticide-use behaviors, and low perceived susceptibility and severity of pesticide use. They recommended it would be beneficial to decrease pesticide use and encourage alternative measures. Effective preventive interventions to increase correct perceptions of pesticide use, the use of personal protective measures and continuing monitoring for blood cholinesterase, especially for male permanent farm workers.

Outside Thailand

Delgado & Paumgartten (2004) studied pesticide use and poisoning among farmers from the county of Paty do Alferes, Rio de Janeiro, Brazil found that the most widely used pesticides were insecticides such as abamectin, organophosphate compounds, and pyrethroids, and fungicides such as mancozeb, chlorothalonil, and copper products. As a rule, pesticides are handled carelessly, and 92% of workers involved in the mixing, loading, and spraying of insecticides and fungicides used no protective clothing or equipment whatsoever. 62% of workers reported at least one illness associated with mixing or spraying pesticides. The most frequently reported symptoms were headache, nausea, vomiting, dizziness, skin irritation, and blurred vision, and 21% of affected workers required medical care. In more than half (51%) of the cases, workers reported using organophosphate insecticides from toxicological class I when they felt sick.

Strong et al. (2004) studied relationship between self-reported symptoms and indicators of exposure to pesticides in 211 farm workers in Eastern Washington, found that the health symptoms most commonly reported included headaches (50%), burning eyes (39%), pain in muscles, joints, or bones (35%), a rash or itchy skin (25%), and blurred vision (23%). Exposure to pesticides was prevalent. The proportion of detectable samples of various pesticide residues in house and vehicle dust was weakly associated with reporting certain health symptoms, particularly burning eyes and shortness of breath. No significant associations were found between reporting health symptoms and the proportion of detectable urinary pesticide metabolites.

Lu (2005) looked into the risk factors associated with pesticides exposure among cut-flowers in 102 respondents in Baranggay Bahong, La Trinidad, Philippines, found that 32% were symptomatic or had experienced pesticide-related illnesses since their first use of pesticides. The majority of the pesticides used by the farmers were Categories Ib and II, which are moderately, or highly hazardous chemicals. Individuals with signs and symptoms most often centered on the eye, ear, nose and throat (EENT) (44 respondents reporting these symptoms) followed by general and neuralgic (16 respondents) and the integumentary (14 respondents). The most common general signs and symptoms manifested were weakness followed by fatigue and muscle pain then by chills and fever. The most common EENT manifestations were eye itchiness and blurring of vision. For neurological signs and symptoms, dizziness followed by headache was reported. Logistic regression showed that illnesses for the past 12 months were associated with certain risk factors such as farm use of pesticides, exposure to pesticide while applying it, respiratory inhalation of pesticide vapours and mists ($p = 0.05$). Moreover, those who re-entered a recently sprayed area were 20 times more likely to get ill during the past 12 months than those who did not. Those who used pesticide-contaminated pieces of fabric to wipe sweat off their faces were 2% more likely to get ill, and those who had spills on their bodies while applying pesticide were 26 times more likely to get ill.

Kammel et al. (2005) studied 18,782 white male licensed private pesticide applicators enrolled in agriculture Health Study; U.S.A. Applicators provided information on lifetime pesticide use and 23 neurologic symptoms typically associated with pesticide intoxication. An indicator of more symptoms (≥ 10 vs. < 10) during the year before enrollment was associated with cumulative lifetime days of insecticide use: odds ratios (95% confidence intervals) were 1.64 (1.36–1.97) for 1–50 days, 1.89 (1.58–2.25) for 51-500 days, and 2.50(2.00-3.13) for > 500 days, compared with never users. A modest association for fumigants [>50 days, 1.50 (1.24-1.81)] and weaker relationships for herbicides [>500 days, 1.32 (0.99-1.75)] and fungicides [>50 days, 1.23 (1.00-1.50)] were observed. Pesticide use within the year before enrollment was not associated with symptom count. Only associations with insecticides and fumigants persisted when all four-pesticide groups were examined simultaneously. Among chemical classes of insecticides, associations were strongest for organophosphates and organochlorines. Associations with cumulative exposure persisted after excluding individuals who had a history of pesticide poisoning or had experienced an event involving high personal pesticide exposure. These results suggested that self-reported neurologic symptoms are associated with cumulative exposure to moderate levels of fumigants and organophosphate and organochlorine insecticides, regardless of recent exposure or history of poisoning.

Sekiyama et al.(2007) studied pesticide usage condition among Indonesian farmers and its association with symptoms of pesticide toxicity. The study found that the most frequently used pesticides included dithiocarbamates, pyrethroids and organophosphates. In approximately 80% of sprayings, category II pesticides (World Health Organization (WHO) categorization; "moderately hazardous") were used. Some practices such smoking and drinking during spraying was frequently practiced. The relationship farmers who wore a long sleeve shirt and headgear showed health symptoms less frequently. Moreover, farmers who had skin contact with the spray solution during measuring or mixing (excluding the hands), who wore wet clothing (skin exposure to pesticide), and who smoked and rubbed their eyes during spraying showed more symptoms. Among these factors, headgear use, wearing wet clothing (skin exposure to pesticide), and smoking during spraying were the significant determining factors for developing health symptoms. Preventing such behaviors will be an effective method of reducing health problems among the subject farmers.

Dasgupta et al.(2007) Information on the health impacts of pesticides is quite limited in many developing countries, with many surveys relying solely on farmer self-assessments of their health status. To test the reliability of self-reported data, an acetyl cholinesterase enzyme (AChE) blood test was conducted for 190 rice farmers in the Mekong Delta, Vietnam. Results reveal a high prevalence of pesticide poisoning by organophosphate and carbamate exposure, where over 35% of test subjects experienced acute pesticide poisoning (a reduction of AChE >25%), and 21% chronically poisoned (>66% AChE reduction). Using the medical test results as benchmarks, we find that farmers' self-reported symptoms have very weak associations with actual poisoning. To investigate the possible determinants of pesticide poisoning, a probit model was constructed with pesticide amount, toxicity, training, and the use of protective measures as explanatory variables. The results indicate that although the absolute amount of pesticides used does not increase the probability of poisoning, a 1% increase in the use of highly hazardous pesticides (WHO Ia or Ib) increases the probability of poisoning by 3.9% and an increased use of protective measures decreases the probability of poisoning by 44.3%. We also find significant provincial differences in poisoning incidence after we control for individual factors. The provincial effects highlight the potential importance of negative externalities, and suggest that future research on pesticide-related damage should include information on local water, air and soil contamination.

Calvert et al., (2008) studied acute pesticide poisoning cases in agricultural workers between the ages of 15 and 64 years that occurred from 1998 to 2005. The objective in the study was to ascertain the magnitude, characteristics and trend of acute pesticide poisoning among agricultural workers. They found that 3,271 cases included in the analysis, 2,334 (71%) were employed as farm workers. The remaining cases were employed as processing/packing plant workers (12%), farmers (3%), and other miscellaneous agricultural workers (19%). The majority of cases had low severity illness (N = 2,848, 87%), while 402 (12%) were of medium severity and 20 (0.6%) were of high severity. One case was fatal. Rates of illness among various agricultural worker categories were highly variable but all, except farmers, showed risk for agricultural workers greater than risk for non-agricultural workers by an order of magnitude or more. Also, the rate among female agricultural workers was almost twofold higher compared to males. The study suggested that acute pesticide poisoning in the agricultural industry continues to be an important problem. These findings reinforce the need for heightened efforts to better protect farm workers from pesticide exposure.

Beseler and Stallones (2009) evaluated the association between respiratory symptoms and pesticide poisoning in a cross-sectional survey of farm residents. A total of 761 farm operators and their spouses, representing 479 farms in northeastern Colorado, were recruited from 1993 to 1997. A personal interview asked whether the resident had experienced a pesticide poisoning and several respiratory conditions including cough, allergy, wheeze, and organic dust toxic syndrome (ODTS). Spirometry testing was performed on 196 individuals. After that was examined the relationship of pesticide poisoning and forced vital capacity (FVC) and forced expiratory volume (FEV1). The study found that pesticide poisoning was associated with all four respiratory conditions, and stayed significant in adjusted models of allergies and cough in non-smokers. In age- and gender-adjusted models, pesticide poisoning was significantly associated with lower FVC and FEV1 in current smokers and in those who were not heavy drinkers. Although this study should be reproduced in a larger sample, it suggests that further evaluation of the respiratory effects of pesticide exposure is warranted.

Jonathan and Hofmann (2009) described agricultural workers' perceptions of environmental and occupational health issues. Interviews were conducted with 389 agricultural workers in the Yakima Valley of central Washington State in the summers of 2004 and 2005. Undergraduate students from the community conducted interviews in Spanish or English. Environmental and occupational health issues were ranked by frequency of concern, and differences by demographics were evaluated using multivariate analyses. In both 2004 and 2005, agricultural workers expressed high levels of concern about working in hot weather, agricultural injuries, pesticides, and pediatric asthma. Agricultural workers' perceptions of environmental and occupational health issues differed by specific demographics, particularly age and ethnicity. Consideration should be given to these issues when designing research studies, creating educational materials, and developing interventions related to environmental and occupational hazards among agricultural workers.

Sosan , Akingbohungbe , Durosinmi , and Ojo , 2010 monitored erythrocyte cholinesterase enzyme activity (AChE) and hemoglobin values before and after insecticide application in blood among 76 farmers from Southwestern Nigeria. Eight farmers had 30% to 50% baseline AChE activity, which suggests chronic organophosphate insecticide poisoning. AChE activity inhibition suggestive of occupational exposure (20% to 30%) was manifested by 28% of the farmers, whereas 30% to 50% inhibition suggestive of hazard was manifested by 11%. Significantly depressed post-insecticide application hemoglobin values were similarly recorded among the farmers. AChE activity inhibition, depression in hemoglobin values, and the years of involvement of the farmers in insecticide application on cacao, were positively correlated. The study suggested that occupational exposure hazard due to organophosphate insecticides is therefore real among cacao farmers in Southwestern Nigeria. Regular bio-monitoring of blood for AChE activity and hemoglobin level is necessary.

Slager et al.(2010) studied association between rhinitis and pesticide use among private pesticide applicators in the agricultural health study**.** The objective was to analyze cross-sectional data on rhinitis in the past year and pesticide use from 21,958 Iowa and North Carolina farmers in the Agricultural Health Study, enrolled

1993-1997, to evaluate pesticide predictors of rhinitis. Polytomous and logistic regression models were used to assess association between pesticide use and rhinitis while controlling for demographics and farm-related exposures. Sixty-seven percent of farmers reported current rhinitis and 39% reported 3 or more rhinitis episodes. The herbicides glyphosate [odds ratio (OR) = 1.09, 95% confidence interval (95% CI) = 1.05-1.13] and petroleum oil (OR = 1.12, 95% CI = 1.05-1.19) were associated with current rhinitis and increased rhinitis episodes. Of the insecticides, four organophosphates (chlorpyrifos, diazinon, dichlorvos, and malathion), carbaryl, and use of permethrin on animals were predictors of current rhinitis. Diazinon was significant in the overall polytomous model and was associated with an elevated OR of 13+ rhinitis episodes (13+ episodes OR = 1.23, 95% CI = 1.09-1.38). The fungicide captan was also a significant predictor of rhinitis. Use of petroleum oil, use of malathion, use of permethrin, and use of the herbicide metolachlor were significant in exposure-response polytomous models. This study found that specific pesticides may contribute to rhinitis in farmers; agricultural activities did not explain.

Zhang et al.(2011) studied 910 pesticide applicators from two villages in southern China participated in face-to-face interviews. Respondents who self-reported having two or more of a list of sixty-six symptoms within 24 hours after pesticide application were categorized as having suffered acute pesticide poisoning. The association between the composite behavioral risk score and pesticide poisoning were assessed in a multivariate logistic model. A total of 80 (8.8%) pesticide applicators reported an acute work-related pesticide poisoning. The most frequent symptoms among applicators were dermal (11.6%) and nervous system (10.7%) symptoms.

Poisoning was more common among women, farmers in poor areas, and applicators without safety training (all $p < 0.001$). After controlling for gender, age, education, geographic area and the behavioral risk score, farmers without safety training had an adjusted odds ratio of 3.22 (95% CI: 1.86-5.60). The likelihood of acute pesticide poisoning was also significantly associated with number of exposure risk behaviors. A significant "dose-response" relationship between composite behavioral risk scores calculated from 9 pesticides exposure risk behaviors and the log odds of pesticide poisoning prevalence was seen among these Chinese farmers (R2 = 0.9246).

Jensen et al. (2011) studied pesticide use and self-reported symptoms of acute pesticide poisoning in 89 pesticide sprayers in Boeung Cheung Ek (BCE) Lake, Phnom Penh, Cambodia. The study showed that 50% of the pesticides used belonged to WHO class I + II and personal protection among the farmers were inadequate. A majority of the farmers (88%) had experienced symptoms of acute pesticide poisoning, and this was significantly associated with the number of hours spent spraying with Organophosphates and carbamate (OR = 1.14, CI 95%: 1.02-1.28). The higher educated farmers reduced their risk of poisoning by 55% for each extra personal protective measure they adapted (OR = 0.45, CI 95%: 0.22-0.91). The study suggest that improving safe pesticide management practices among the farmers and enforcing the effective banning of the most toxic pesticides will considerably reduce the number of acute pesticide poisoning episodes.

2.5.2 Pesticide and Intervention

Perry and Layde (2003) studied about farm pesticides- outcome of a randomized controlled intervention to reduce health risks. A randomized controlled design was used with random selection of participants, random assignment to intervention and control groups, and baseline and post intervention assessments. Four hundred Wisconin dairy farmers certified to apply pesticides to field crops were recruited to participate over a 1-year evaluation period. Three-hours educational sessions were conducted with approximately 100 randomly assigned participants. Session targeted four educational messages: (1) existing evidence of excess cancers among farmers, (2) simulation of pesticide exposure presented through slide show and description, (3) feedback of self-reported data collected from the farmer reporting on frequency of exposure and gear se, and (4) cognitive behavioral strategies that can be adopted to reduce pesticide hazard. Six-month post intervention analyses showed that an educational intervention had significant effects on the use of gloves and gear during the most recent application and an actual reduction in the total number of pesticides used.

Janthong et al. (2005) studied about health promotion program for the safe use of pesticides; the purpose of this study was to determine the knowledge, attitudes and practices (KAP) concerning the safe use of pesticides of Thai farmers in Don Kha sub-district, Bang Phae district, Rachaburi province. Thirty-three voluntary Thai farmers of thirty-three farming families, recruited by convenience sampling, participated in training program for six months. Data were collected questionnaire interviews, and KAP on the safe use of pesticides were compared by paired t-test, Research finding show that that the mean scores of KAP in the posttest were significantly higher than the pretest.

Wutthichai (2006) studies the effectiveness of participatory Learning Program on pesticide utilization among agriculturists in Srinakorn district, Sukhothai province found that after the participatory learning program was implement, the experimental group had significantly higher mean scores of knowledge, attitude, and practice than that before receiving the program. On the contrary the mean scores of the control group were unchanged between pre-and post test evaluation. Therefore the participatory learning program was effective in increasing knowledge, attitude, and practice of participants.

Kishore et al. (2007) studied the effectiveness of health education program in two villages of Udupi district of South India were identified by spot mapping and targeted for a public education program on safe handling of pesticides, the impact of which was assessed using a knowledge attitude and practice (KAP) questionnaire. Education was provided using a structured individualized training program to 74 pesticide handlers. Three point KAP assessments were carried out at baseline, immediately after training and after 1 month of training. Nonparametric Kruskal–Wallis tests and Friedmann tests were used to compare scores at different time points and between groups. They found that Occurrence of occupation related poisoning was 33% and common in three villages of the district. The average baseline KAP score of 30.88 ± 10.33 improved after education significantly ($P < 0.001$) at first follow-up 45.03 ± 9.16 and at second follow-up 42.9 ± 9.54. A decline of score between the first and second follow-up may be attributed to decline in knowledge retention. Demographics like gender, literacy and presence of children affected KAP score and there was no influence of geography, age or frequency of pesticide use. They recommend that continuous education and training programs for agricultural workers will promote awareness and minimize the hazards of occupational pesticide exposure.

Nolan and James (2009) studied risk perception, risk communication, and the effectiveness of pesticide labels in communicating hazards to South African farm workers, in USA, found that South African farm worker's pesticide risk perceptions are high. Findings further indicate that approximately 50 percent or more of the farm workers had misleading, incorrect and critically confused interpretations of the pesticide label components. Perceptions and label ineffectiveness were further highlighted by various influencing factors identified such as "authority influences" (e.g., by farm owner, pesticide company representatives), social farming effects (e.g., women not receiving pesticide training as women's work is not believed to lead to pesticide exposures although they mix pesticides and work in sprayed fields), and industry's "safe-use" training programs (e.g., claiming intrinsically that all pesticides are safe). Another study finding was that five pairs of risk perception (RP) and risk communication (RC) factors significantly reinforce the interaction between each other. These factors of interaction identified were eternalized risk (RP) with familiarity (RC), externalized risk (RP) with emic view (RC), relative risk (RP) with etic view (RC) and tangible risk (RP) with emic view (RC). Environmental sociologists should challenge traditional risk perception and risk communication research approaches by incorporating this interaction element into future research, especially in developing countries.

2.5.3. Summary

Most of interventions determined only KAP both before and after intervention. Few studies had control groups. So, this dissertation had determined the effective all KAP, especially protective behavior, exposure assessment: cholinesterase levels were measured, and health risk of pesticide use was measured by symptoms prevalence. Two times follow-up was implemented to examine the effective of pesticide risk reduction program.

CHAPTER III

RESEARCH METHODOLOGY

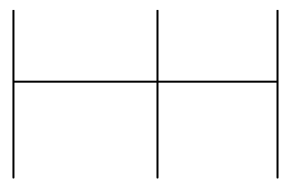
This study was conducted in 3 parts: Part 1 was pre-test study to provide the background and general information of pesticide use and to assess the knowledge, attitude, practice and health risk of pesticide use and use some information for the messages in the pesticide risk reduction program , Part 2 was a quasi-experimental study to develop and implement pesticide risk reduction program (PRRP) among rice farmers, and Part 3 process of evaluation to evaluate the effectiveness of pesticide risk reduction program (PRRP) intervention in Kongkrailat district, Sukhothai Province.

3.1 Research Design

This research is a quasi-experimental design to examine the effective of the pesticide risk reduction program (PRRP) on protective behaviors among rice farmer in Kongkrailat District, Sukhothai Province. The sample consists of experimental group who received pesticide risk reduction program on safe use of pesticide, and control group, who did not attend this program. The research design is as follows:

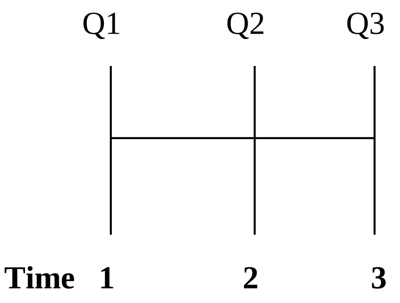
Experimental group

Q1X Q2 Q3



Time 1 2 3

Control group



X indicates the different aspect of pesticide risk reduction program (PRRP) on the safe use of pesticide.

Q1 indicates the assessment of knowledge, attitude, protective behavior, serum cholinesterase and pesticide related- symptoms (baseline) among participants both experimental groups and control groups before program implementation.

Q2 indicates the assessment of knowledge, attitude, protective behavior, serum cholinesterase and pesticide related- symptoms at the first time (post-test 1) among participants both experimental groups and control groups after program implementation 1 month.

Q3 indicates the assessment of knowledge, attitude, protective behavior, serum cholinesterase and pesticide related- symptoms at the second time (post-test 2) among participants both experimental groups and control groups after program implementation 4 months.

In the third part was evaluation effectiveness of the pesticide risk reduction program (PRRP) including knowledge, attitude, protective behavior, serum cholinesterase and pesticide related- symptoms with 2 times of follow up.

3.2 Study area

Pre-test questionnaires: village 6 of Banmaisukasame and village 6 of Kokrat sub-district, Kongkrailat district, Sukhothai Province were purposively selected for collecting data by face to face interview with questionnaires at participant households in the villages about 50 minutes. In this process had done by researcher both self administrator and interviewer administrator and discuss with participants if there were unclear questions or words.

A quasi-experiment study: Banmaisukasame sub-district was purposively selected for the intervention group and Kokrat sub-district purposively selected for the control group. The distance between intervention and control areas is about 6 kilometers both village and farm areas. Both sub-district use water supply from Prompiram dam, Phisanuloke Province and have similar period time of growing rice farms. Evaluation: two times follow –up after intervention at 1 and 4 month is to evaluate the effective of pesticide risk reduction program (PRRP) in Kongkrailat district, Sukhothai Province both intervention and control groups. The time period period of growing (cultivation cycle) was about 105–120 days per time, so that 4 months follow-up was appropriate for testing the effectiveness of the program at same time of pesticides application at follow-up1 and follow-up2.

3.3 Study Population and Sample

The target population of this research was all pesticide applicators in rice farms that lived in Kongkrailat district, Sukhothai province.

Inclusion criteria

The selection criteria were pesticide applicators that:

- had age between 18 and 65 years old.

- apply pesticide such as mixing, loading, spraying, and washing equipments at least one year.

- work on rice farm at least one year.

- can read and write.

- no communication problems

- informed consent for the applicators who are willing to participate in the study

Exclusion criteria

- had communication problems

The target population was divided into two groups consisting of an intervention group and a control group. The intervention group was randomly selected from participants in Banmaisukasame sub-district. The control group was randomly selected from participants in Kokrat sub-district.

3.4 Sampling technique and sample selection

Part I: Pretest Questionnaires

The selection criteria were pesticide applicators in rice farms that had at least 18 years old. Multi-stage sampling was implemented for selecting subjects, as described below.

Stage 1: Sampling of the District.

There are 9 districts in Sukhothai Province. Sampling district was used one district. Kongkrailat district was purposive selected from 9 districts.

Stage2: Sampling of the sub-districts (Tambon)

There are 11 sub-districts in Kongkrailat District. Sampling sub-districts were used two sub-districts; purposive selected from 11 sub districts in responsibility of banmaisukasame health center and Kokrat health center (Banmaisukasame sub-district and some village of Kokrat sub-district).

Stage 3: sampling of the villages

The simple random sampling of one village in each sub-districts and simple random sampling households were drawn from administrative/census lists from each of the villages. A total of 60 households were selected in each sub-district**.**

Stage 4: sampling of the Households

The random sampling of one subject per household was drawn from administrative/census lists from each of the households. A total of 60 subjects were selected, one subject per household. The sampling stages are shown in figure 5.

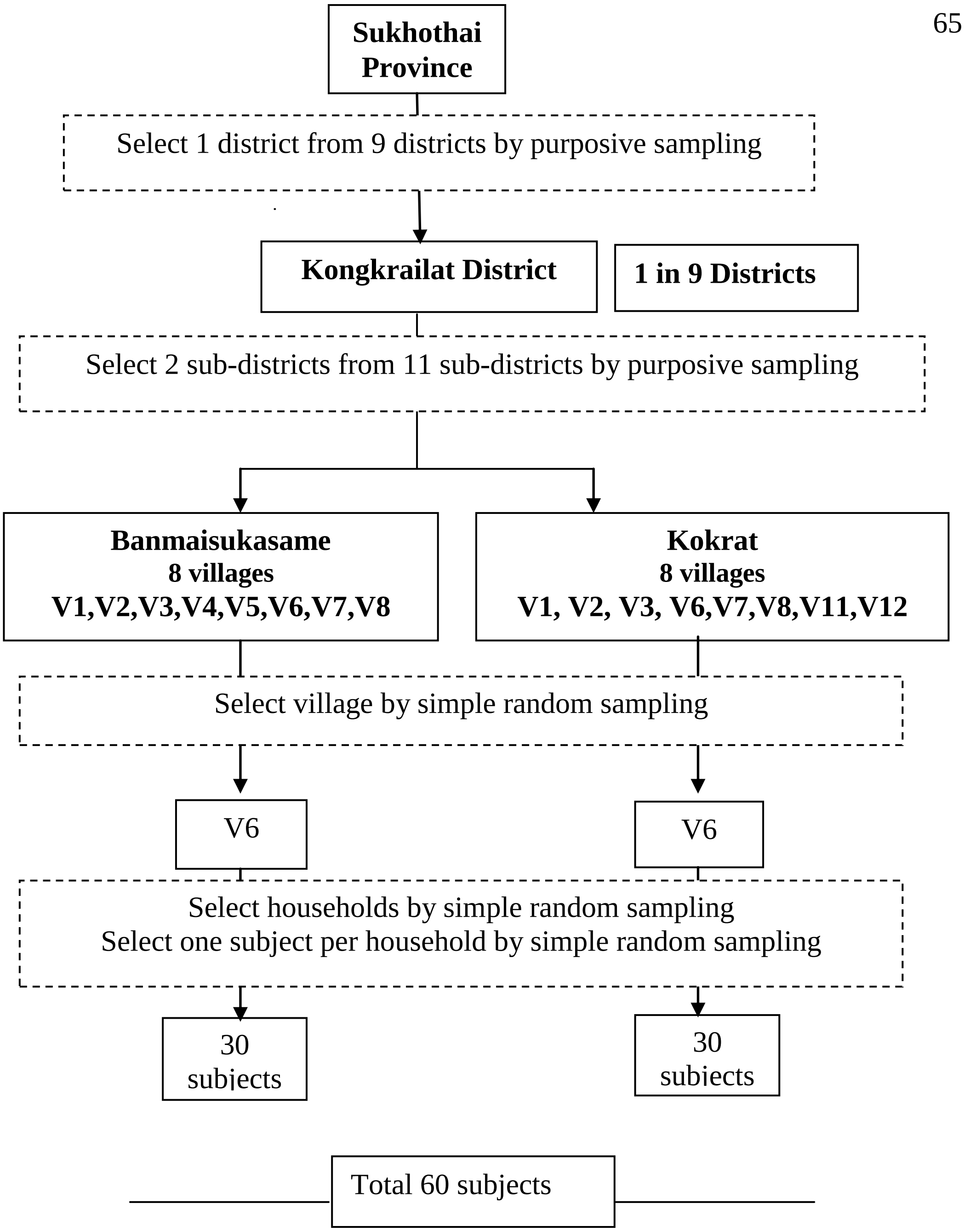


Figure 5: Diagram of sampling technique pre-test questionnaires

Part II: Implementation

The research area were selected by using the following steps: (Figure 6)

Process 1: Sampling of districts

Sukhothai Province was divided into 9 districts. Kongkrailat district was selected by using purposive sampling.

Process 2: Sampling of sub-districts

Kongkrailat district has consisted of 11 sub-districts. Two sub-districts, Banmaisukasame and Kokrat sub-district were selected by using purposive sampling according to the similarity area of cultivated land and be the area with all year round rice farms. Both sub-districts were the top three of farm size areas and had higher in pesticides application in Kongkrailat districts. Moreover, both sub-districts had a potential in term of research assistants and participants.

Banmaisukasame sub-district, highest of farm size areas in Kongkrailat district was selected to be experimental groups and researcher has work in Banmaisukasame Health Center with good relationship with participants and also support resource from this health center, Thus Kokrat sub-district in responsibility of Kokrat health center, the second of farming areas in Kongkrailat district and similar in period time of growing was selected to be the control group.

Process 3: Sampling of households

There were 7 villages (exclude village 6 in Banmaisukasame sub-district done in phase 1) and 4 villages in Kokrat sub-district (exclude village 6 in Kokrat sub-district done in part 1). The total of sample size, 182 households (91 household from each sub-district), were selected by using simple random sampling from participants enroll in each sub district. Each 91 households were randomly selected from all lists of participant's households in each sub-district.

Process 4: Sampling of the subjects

The subjects were selected to be the representative of households (one subject per household) by using random sampling under the criteria as follow;

- must be the rice farmers
- must apply pesticide at least one year
- must be at least 18 years old and not more than 65 years old
- must be willing to participate in this study

All subjects had signed an informed consent to indicate their willingness to participate in the study. During implementation in the experiment group, the subjects excluded from this study were under the criteria of:

- Sickness
- Absent at least one time of health education program
- Need to leave from this study

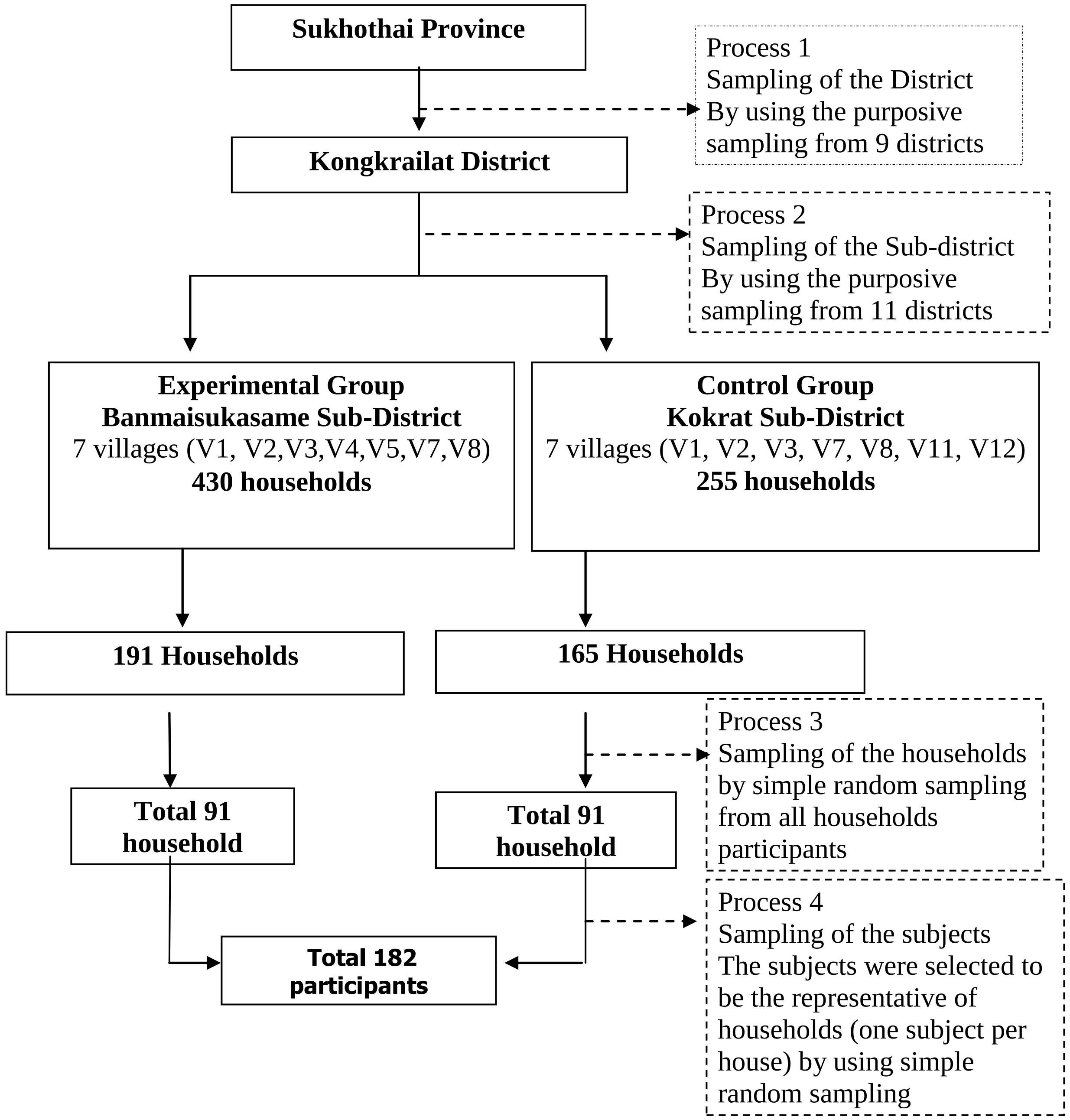


Figure 6: Diagram of sampling technique for quasi-experiment

3.5 The sample size calculation

3.5.1 Sources of background data for calculation of sample size

Previous studies were used to provide a basis for sample size calculation for this study. I used reported self protective behavior and pesticide related-symptoms, in observed prevalence with low and high self protective behaviors as observed in these studies. Then calculated sample sizes that were necessary to detect the observed differences, at alpha = 0.05 and power=.80, using OpenEpi version 2, open source calculator SS Cohort sources of background data are tables 27 in Markmee, 2005 (420 subjects). They are as follows:

Table 3: The result self protective behavior and pesticide related-symptoms from study of Markmee (2005) (n=420).

Pesticide Related-symptoms	Observed Prevalence (%)		Sample size need to detect Observed difference (OpenEpi)		Total
	Low	High	Low	High	
Neuromuscular	67.0	41.9	69	69	138
Respiratory	53.4	28.6	68	68	134
Digestive	20.5	7.5	126	126	252
Eye	25.0	11.7	146	146	292
Skin	18.2	9.9	296	296	592
Any symptom	77.3	55.7	82	82	164

3.5.2 Sample size calculation

Part 2, Sample size requirements varied from 134 to 592 subjects for different specific items in relevant previous studies. For specific calculation, data from Markmee (2005) was used as a basis. Calculation was made using OpenEpi version 2, open source calculator SS Cohort, sources of background data are tables 27 in Markmee, 2005 (420 subjects). This gave a sample size requirement of 84 subjects in each group. In table 3, 82 subjects in each group were sufficient to detect most of pesticide related-symptoms in proportion that had been observed in previous studies, 182 subjects were sufficient to detect outcome that might lost follow up 10% (91 subjects in experimental group and 91 in control group) that appropriate for symptoms, which for the most part were neuromuscular and respiratory symptoms.

3.6 Structure of pesticide risk reduction program

Pesticide risk reduction program in this dissertation was applied base on risk perception and risk communication model including 4 days program:

The first day was workshop. The messages consisted of:

3.6.1. Pesticide utilization and pesticide problems in Thailand (1 hour).

This section was presented on power point presentation, the message including pesticide import, pesticide use, and pesticide health effect data in Thailand from previous to present. The messengers were researcher or expert from Kongkrailat district agricultural office. This message intended for communication with participants in perception on Worldviews in Cognitive Social Psychological Model (CPSM).

3.6.2 Pesticide data, protective behavior and health risk data from data collection at the first part (2 hours).

This section was presented on pesticide use data, protective behaviors, health risk, and health effects in this area. The messages was used the data from the pretest questionnaires purposed to communicate pesticide use such pesticide class used in area and identify problems unappreciated in use of pesticide and discuss on the data. This might relate Worldview, Cultural Background, and Formative Self in CSP Model. It was present by researcher.

3.6.3 Classification and hazards of pesticides (1 hour)

This section was power point presentation; the messages consist of pesticide classification such as classification by biological, chemical and by hazardous This objective was to improve knowledge of pesticide used in participants and presented by expert from the ninth Bureau of Control and Prevention, Phitsanuloke Province, Ministry of Public Health.

3.6.4 Health risk (both acute and chronic health effects) (2 hours).

This section was power point presentation; the messages consist of health risk of pesticide use both acute symptoms and illness, and chronic health effects The purpose was to improve knowledge of pesticide used in and presented by expert from the ninth Bureau of Control and Prevention, Phitsanuloke Province, Ministry of Public Health or researcher or doctor at Kongkrailat district hospital.

During this day, the researcher purposed to increase knowledge of pesticides use and tried to use some information in the intervention area. Then, developed media such power point presentation, handbook follow by pesticide classes, family names, common name and health effects to train them for example herbicide, insecticide, fungicide, and rodenticide as shown figure 7 - 12.

Figure7: herbicide use by common name; 2-4D sodium salt

Figure 8: insecticide use by family name; Organophosphate, common name; chlopyrifos

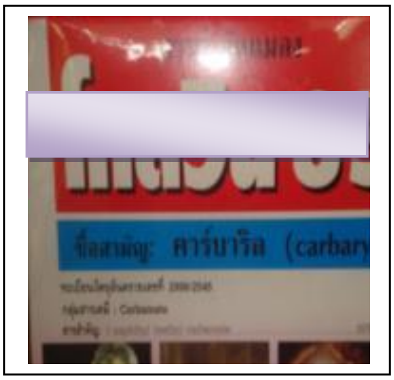


Figure 9: insecticide use by family name; carbamate, common name carbaryl

Figure 10: insecticide use by family name; carbamate, common name; methomyl

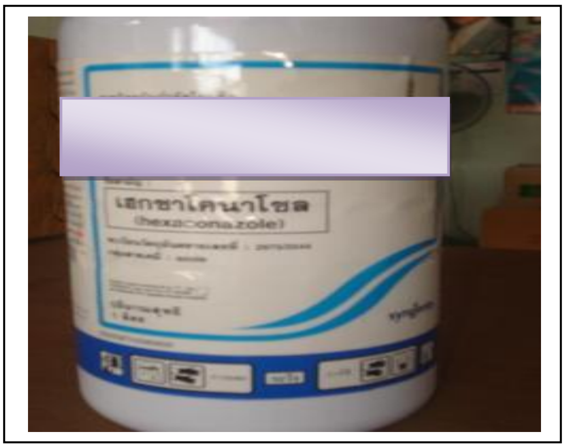


Figure 11: fungicide use by common name hexaconazole

Figure 12: rodenticide use by common name zinc phosphide

The second day was workshop. The message consisted of:

3.6.5. Pesticide information in the label (1 hour).

This section was power point presentation; the message communicated in pesticide information in the labels such as pesticide class, hazardous, and signs or warning in the labels. It purposes was to increase knowledge of pesticide use information from industries. The messengers were health worker from health center in Kongkrailat districts. Groups discussion and presentation were implemented to learn pesticide labels from pesticides use in intervention area as shown in figure 13.

Figure 13: Learning with pesticide use label in intervention area

3.6.6. Route of exposure (1hour).

This section was a PowerPoint presentation; the message communicated in pathway of pesticide causing illness or death. The messengers were researcher or expert from the ninth Bureau of Control and Prevention, Phitsanuloke Province, Ministry of Public Health. It was one of factors to increase self efficacy in the CSP Model.

3.6.7. Guideline of safe use of pesticides (2 hours).

This section was a PowerPoint presentation and demonstrates; the message was the main point of the messages that related behavioral expectation and importance value in CSP Model. The messengers were researcher or expert from the ninth Bureau of Control and Prevention, Phitsanuloke Province, Ministry of Public Health.

3.3.8. Appropriate personal protective equipment (2hours).

This section had power point presentation and demonstrates; the message was the main point of the messages that related behavioral expectation, importance value, and intentions behavior and risk perception in CSP Model. The messengers were researcher or expert from the ninth Bureau of Control and Prevention, Phitsanuloke Province, Ministry of Public Health.

Overall this section tried to formative their knowledge, attitude, and protective behavior and demonstrate the appropriate person protective equipment and train in behavior expectation as show in figure 14and 15.

Figure 14: Demonstrate full personal protective behavior

Figure 15: Appropriate PPE use in rice farm

The third day was knowledge management, in this day the content learned about history of pesticide poisoning by participants who had experience in pesticides poisoning and the massage consisted of:

3.6.9. Emergency first aid for pesticide injure or pesticide poisoning.

This section was both demonstrate and power point presentation 2 hours consisting of guideline in emergency first aid for pesticide injures or pesticide poisoning, after that were social learning and learning in previous experience with neighbor workers. Group discussion was implemented divided into 6 groups (15 participants per group). The main topic was the major behaviors that participants had pesticide health effects or pesticide poisoning; why, and how to reduce health risk of pesticide use, and the major; what are appropriate personal protective equipment. These topics were presented in the topic from each group to other groups. Then, researcher and expert from The Office of Disease Prevention and Control 9, Phisanuloke province summarized the content and discussion. This section was social relations to improve social amplification and fright factors to behavioral expectation. This section was intended to improve attitude in the seriousness of unsafe use of pesticides by learning with pesticide poisoning patient in health center that had symptoms and medical care as shown in figure 16.

Figure 16: Learning health effects with pesticide poisoning patients in health center

The fourth day; field application for pesticides application in the field and groups discussion all activity in the field and summary all program.

Field application purposed to demonstrate participants the advantage of the use of personal protective equipment when using pesticide, and how to protect the hazard in pesticide use. Group discussion and conclusion the program were implemented to make participants clear about this program, and then explain the method of follow-up by interviewer administrator. This section addressed the risk of current situation when applying pesticides and tried to train them to use appropriate personal protective equipment as shown in figure 17.

Figure17: Field application to learn with current situation of health risk

Learning with colleague workers (4 times group learning) was done at the villages divided into 6 groups (15 participants per group). This section was social relations to improve social amplification and fright factors to behavioral expectation.

The first time (1.5 hours), topic was the major behaviors that participants had pesticide health effects or pesticide poisoning; why, and how to reduce health risk of pesticide use.

The second time (1.5 hours), topic was appropriate personal protective equipment.

The third time (1.5 hours), topic was some protective behaviour reducing pesticides exposure.

The fourth time (1.5 hours), topic was summarized overall program and recommendation.

In this section, all participants were assigned to different groups and learned with their work colleagues at the community in corporation with research. The time were morning and evening as show in figure 18 and 19.

Figure 18: Learning with colleague workers in the community

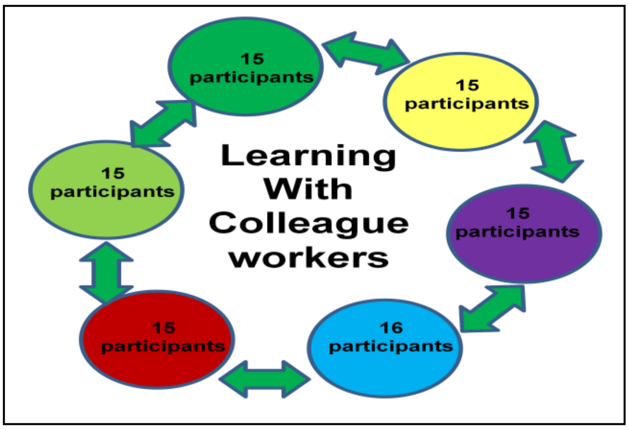


Figure 19: Learning with colleague workers flame.

Overall program had 24 hours over 1 month.

Attendance evaluations of participants in each session were done by researcher and research assistances. Materials included pesticide handbooks, posters and power point presentation. Some activities were done during each day implementation developed by suggestion from expert in Cognitive Social Psychological Model. Group discussion and conclusion the program were implemented to make participants clear about this program, and then explain the method of follow-up by interviewer administrator.

Attendance evaluations of participants in each session were done by researcher and research assistances. Materials included pesticide handbooks, posters and power point presentation. Some activities were done during each day implementation developed by suggestion from expert in Cognitive Social Psychological Model.

3.7 Research instrument for data collection

The questionnaires used in the project were modified and adjusted from Agriculture Health Study of America (2010), Sorat (2004), and Jariya (2006) to appropriate to particular study. Outcome measurements, dependent variables consist of 3 parts: protective behaviors (knowledge, attitude, and practice), exposure assessment (serum cholinesterase activity) and health risk (pesticide related-symptoms). Hypothesis of this study was pesticide risk reduction program (independent variable) would increase mean scores of knowledge, attitude, protective behavior, decrease prevalence of level of cholinesterase on risky and unsafe, and decrease prevalence of acute pesticide related symptoms. Pesticide Risk Reduction Program applied some activities from Cognitive Social Psychological Model (CSP Model), however there were some factors that affects behaviors such personal factors, pesticide use factors and health status factors (independent variables).

The reliability attitude and safety behavior of the Likert scale was used the formula of Cronbach's alpha. The instrument of this research was standardized questionnaire, which consisted of 7 parts as follows:

3.7.1 General information

General data included age, gender, marital status, education level,

Age: it was calculated in years.

Gender: this variable was categorized into male and female

Marital status: this variable was categorized into three groups as single, married, and divorced/separated/widowed

Education level: this variable was categorized into 3 groups as illiteracy/primary school (grade 1-6), secondary school (grade 7-9), and high school (grade 10-12) or more than high school.

Member of household: it was calculated in persons.

Family' monthly income: this variable was categorized into 4 groups as less than 10,000 baht, 10,000 – 20,000 baht, 20,001-30,000 and > 30,000 baht per month.

Trained in safe use of pesticides: this variable was categorized into 2 groups as never and ever been trained.

Duration of using pesticide as rice farmer: it was calculated in years.

Other farm crops: it was categorized into yes or no

Farm size: it was calculated in rai.

Frequency of farm per year: it was calculated in time.

Pesticide payment per year: it was calculated in baht.

3.7.2 Health status and health behaviors (independent variables)

Smoking: it was categorized into 3 groups as never, past, and current smoking.

Drinking: it was categorized into 3 groups as never, less than or equal 3 times per month, 1-4 times per week, and every/almost every day.

Chronic disease: it was categorized into yes or no

3.7.3 Pesticide use factors (independent variables)

Years of use as rice farmers: it was calculated in years.

Years of mixed/applied: it was calculated in years

Day per year mixed/applied: it was calculated in days.

Duration of each pesticide applying: it was calculated in hour. The values were categorized into two groups as 1 - 3, and >3 hours per session.

Duty in handling pesticides: The values were categorized into four groups as mixing only, applying only, and both mixing and applying, and other responsibility.

The concentration of pesticide use: The values were categorized into 3 groups as less than recommended, same as recommended, and more than recommended.

The number of pesticide mixed for applying: The values were categorized into two groups as one or two kinds, and three kinds or more**.**

Type of pesticide use: It was categorized by yes or no by pesticide classes such herbicide, insecticide, fungicide.

3.7.4 Knowledge of pesticide use

This part consists of knowledge and understanding about safe use of pesticide. A total of question in this part is 20 questions. The question had 2 choice answers (“Yes” or “No”. The answers are scored as follow;

Correct answer obtaining 1 score

Incorrect answer obtaining 0 score

Missing answer obtaining 0 score

Possible score scores were ranged between 0-20 points.

3.7.5 Attitude of pesticide use

The instrument for attitude was divided into 3 sections: (1) attitude toward the using pesticide 10 questions, (2) attitude toward the seriousness in using pesticide 10 questions, and (3) attitude toward the benefits of taking action and barriers to take action in using pesticides 10 questions.

There was a total of 30 questions. Each question was scored on a five-point Likert scale, strongly agree, agree, uncertain, disagree, and strongly disagree. All of them had the meaning as follows:

Strongly agree means rice farmers thought that the massage was coincide with his or her feeling, opinion or belief following his perception the most.

Agree means rice farmers thought that the massage was coincide with his or her feeling, opinion or belief following his perception.

Uncertain means rice farmers uncertain with the massage in that sentence which was coincided or against his feeling, opinion or belief following perception.

Disagree means rice farmers thought the massage opposes his or her feeling, opinion or belief following his perception.

Strongly disagree means rice farmers thought the massage opposes all of his or her feeling, opinion or belief following his perception.

Rate scale

The target group could choose one choice and the criteria of measurement is as follows:

	Positive attitude	Negative attitude
Strong agree	4	0
Agree	3	1
Uncertain	2	2
Disagree	1	3
Strongly disagree	0	4

Possible scores are 0 – 120 points.

3.7.6 Protective behavior (Dependent variables)

The instrument for self-protective behavior was divided into 3 sections: (1) when mixing pesticide 5 questions, (2) when applying 12 questions, and (3) after using pesticides 6 questions. Self-protective behavior among rice farmers were divided into four parts and comprised of total 23 questions concerning with their practicing in term of frequency to perform it. The target group had to choose only one choice and received points as follows:

	Appropriate behavior	**Inappropriate behavior**
Always or often	3 points	0 points
Sometimes	2 points	1 points
Rarely	1 point	2 point
Never	0 points	3 points

Possible score scores were ranged between 0-69 points.

3.7.7 Level of serum cholinesterase (Dependent variables)

The finger-blood of respondents was collected by capillary tube and centrifuged onsite. Then, the serum was test using reactive – paper, to determine the cholinesterase level. The test kit was produced by the Government Pharmaceutical Organization of Thailand. The sensitivity was 77%, specificity 90%, and positive predictive values 85% for testing serum cholinesterase level. There were measured in four categories including normal, safety, risky and unsafe and four level colors to determine magnitude of change in cholinesterase activity through the production of acetic acid, as follow:

Reactive paper color	*Rating*	*SChE level (units/ml)*
Yellow	Normal	$\geq$ 100
Yellow-green	Safe	87.5 – 99.9
Green	Risky	75.0 – 87.4
Blue	Unsafe	< 75.0

This method is generally used to measure anti-cholinesterase for a long time by Ministry of Public Health. It has been done by nurse from health center. The result was presented to participants. If the result of blood test was unsafe or risky routine health education of health center would be communicated to participants.

3.7.8 Pesticide related-symptoms (Dependent variables)

There were 31 symptoms specified in the questionnaire. These were categorized into 5 groups by organ system as follows:

Neuromuscular (15 symptoms): dizziness, headache, twitching eyelids, blurred vision, insomnia, staggering gait, seizure, shaky heart (irregular rhythm), exhaustion, sweating, muscle weakness, tremor, muscle cramps, excessive salivation, and numbness

Respiratory (8 symptoms): burning nose, nose bleed, runny nose, dry throat, sore throat, cough, chest pain (tightness or burning), and wheezing

Digestives (3 symptoms): nausea, diarrhea, and stomach cramps

Eyes (3 symptoms): burning-stinging- itchy eyes, red eyes, and excessive tearing

Skin/nails (2 symptoms): skin rash, itchy skin

In this study had measured all of all pesticide-related symptoms both self-report symptoms in the past week and in the past month and categorized in to 2 categories ; had symptom at least one and no symptoms in each system organs. After collecting data it was observed that symptom prevalence in the past month but not in the past week was low. This raised the strong possibility of in accurate in reporting for the longer time of recall. Therefore, the researcher used only data of self-reported symptoms in the past week after using pesticides to test the effectiveness of the program.

3.8 Pre-test of Questionnaire

Before going to the process of data collection, the researcher submitted the draft questionnaire to thesis advisors in order to check its content validity. Then, the questionnaires were adjusted in according to comments and suggestions of thesis advisor. The questionnaires were pre-tested 60 farmers in village 6 of Banamisukasame sub-district and village 6 of Kokrat sub-district in Kongkrailat district that was not chosen in my study in part2. Two villages selected were similar in duration time of growing and similar in using water supply from Prompiram Dam, Phisanuloke Province.

The results were then analyzed for its reliability. For the part of self-protection factors was Cronbach's alpha method. Pilot test was used for clarity of questionnaires, if pilot subjects did not understand some words or difficult to answer, researcher would change them for clarity. However, some questionnaires that were difficult to understand such as frequency of pesticide use last year and pesticide poisoning history were clarified for the final version. Cronbach's alpha for attitude was 0.75 and self-protective behavior was 0.72.

3.9 Data collection

Data collection process of this research had the details as described below:

3.9.1 Researcher brought the letters to explain the objective of research from the Collage of Public Health, Chulalongkorn University to the District Health Office, Kongkrailat District, Sukhothai Province.

3.9.2 At a one-day conference, eight research assistants were hired and trained to administer the questionnaires (conduct questionnaire interviews). Research assistants were public health technicians or nurses working in Kongkrilat district, Sukhothai province. They worked for data collection, and evaluation on activities such attendance and participation of participants.

3.9.3 In village 6 of Banmaisukasame sub-district and village 6 of Kokrat sub-district (not included in the full-scale study in part 2), the questionnaires were pilot tested with 60 rice farmers who had similar characteristics to the full-scale study subjects as 30 samples in Banmaisukasame Sub-district and 30 samples in Kokrat sub-district. These questionnaires were examined and tested for reliability as well as adjusted before applied to the selected sample. A combination of self-administered and interviewer administered were used for full-scale questionnaires at part 1.

3.9.4 Participants were follow-up by cooperation with 2 health centers and health village volunteers in two sub-districts.

3..5 Outcome measurement was 4 month follow-up and two times follow-up at 1 month, and 4 month after intervention. Interviewers – administrators were used for follow-up (part 3).

3.10 Data analysis

Data collected are analyzed as follows:

3.10.1 Descriptive statistics including frequencies and percentage were used for socio-demographic factors, pesticide use behaviors, self-protective behaviors, and symptoms. Mean, Median, and Standard deviation (S.D.) of score were calculated in the socio-demographic, pesticide use behavior, knowledge, attitude, and protective behaviors.

3.10.2 Analysis: At baseline, to compare personal characteristics (independent variables) and outcome of measurement (dependent variables) between intervention and control group, Independent t-test was used to compare continues data and Chi-square test was used to compare categories data.

3.10.3 Evaluation, researcher assessed the effects of the intervention on knowledge, attitude, pesticide use behaviors, serum cholinesterase level, and symptoms at two time points: one month after intervention and four month after intervention. The effect size of intervention was measured with difference –of-difference analysis. At each follow-up time, the magnitude of the intervention effect = (follow-up – baseline) $_{intervention}$ minus (follow-up – baseline) $_{control}$. Researcher used

SPSS (version17) for analysis to estimate difference-of-difference effect sizes, corresponding 95% CIs and p-values, and confounding and used the SPSS procedure with and identity link function and binomial distribution (dichotomous outcomes) so that the parameter estimates of the model were absolute risk differences associated with the independent variables (Spiegelman and Hertzmark, 2005).

Some of the dependent variables were dichotomous and some were continuous. Dichotomous variables included presence/absence of symptoms. Continuous variables included overall scores for knowledge, attitude, and protective behaviors, as well as subgroup scores for attitude and behavior. Dichotomous variables included prevalence of unsafe level of reactive paper, and symptom prevalences as described above.

Effects of intervention were evaluated with multiple regression models that included variables for intervention status (group), time of study, and time-group interactions. The interactions provided the specific tests of intervention effects at the respective data collection times after baseline. Models were adjusted for repeated within-subject measurements of outcomes at the 3 data collection times. This adjustment was made for continuous outcomes with linear mixed models. For dichotomous outcomes, this adjustment was made with generalized estimating equations (GEE) applied to generalized linear models. In these models, the distribution was binomial and the link function was identity. This link function gives absolute effects of independent variables (as opposed to odds ratios or relative risks.) In this way, interpretation of output from the GEE modes for dichotomous outcomes is similar to interpretation of the linear mixed models used for continuous outcomes.

Regression models were adjusted for baseline characteristics that differed between the intervention and control groups, and for any other characteristics that were associated with the respective outcomes. Adjustment was made for independent variables for which $p \leq 0.10$ in bivariate analysis of the respective outcome variables. Linear mixed models were used to derive both unadjusted and adjusted intervention effects on continuous outcomes.

GEE models were used to derive unadjusted effects of intervention on dichotomous outcomes. Fully adjusted GEE models for dichotomous outcomes did not run. The researcher compared linear mixed models and GEE models for unadjsted and partially adjusted intervention effects on dichotomous outcomes. The two types of models gave very similar results regarding both magnitude and p-values of intervention effects. Thus, the researcher used linear mixed models to derive fully adjusted intervention effects on dichotomous outcomes, as well as on continuous outcomes.

Continuous outcomes were analyzed with repeated-measures analysis of variance, in addition to the mixed model method described above.

To test the effectiveness and compare able groups characteristics statistical tests used in this study, the statistically significant level was set at alpha = 0.05 (that is, p-values < 0.05 are considered statistically significant).

3.11 Ethical consideration

1. This study was reviewed and approved the study protocol by ethical committee of Chulalongkorn University No. COA No.016/2555

2. The participants had to agree willingly participate to the study protocol by signing an informed consent form.

CHAPTER IV

RESEARCH RESULTS

This quasi-experimental research investigated the effectiveness of a pesticide risk reduction program (PRRP) on pesticide use among rice farmers in kongkrailat district, Sukhothai province, Thailand. Experimental group was in Banmaisukasame sub-district and control group was in Kokrat sub-district. Measurements were made pre- and two times post-test questionnaires at baseline, the first month and fourth month after program. The study results are presented in 2 parts: (1) personal characteristics consisting of demographic characteristics, pesticide use history, health status, knowledge, attitude, protective behavior, serum cholinesterase level and pesticide-related symptoms, and (2) effectiveness of pesticide risk reduction program. Section 2 is further divided into section 2a, analysis unadjusted for covariates, and section 2b, analysis adjusted for covariates.

4.1 Personal characteristics

4.1.1 Socio-demographic factors and pesticide use-related (independent variables)

Independent t-test for continuous data was conducted to compare personal characteristics between control group and intervention group. Demographic and pesticide use-related characteristics of experimental and control groups are shown in Table 4. Average age of experimental and control groups were 43.2 and 46.0 years, respectively. There were similar in age both groups (p=0.095). Number of household was statistically significant difference between control and intervention groups (p= 0.001). Experimental group was higher regarding number in household than control group. Year of rice farming was highly statistical significant difference between intervention and control groups (p <0.001). Year of rice farmers was higher in control group. Average farm size in control group was 34.1 rais and intervention group was 38.9 rai, otherwise, there were no statistical significant difference between groups (p = 0.171). Pesticide expenditure in last year was highly statistical significant difference control and intervention groups (p<0.00). Intervention group was higher average pesticide expand (37,263.7 baht) than control group (19,387.7 baht). Number of year use pesticide, day per year, and duration time of each applying pesticide were highly statistical significant difference between control and intervention groups (p < 0.001). Average of year use pesticide in control group (21.1) was higher than intervention group (11.9). Average day use pesticide per year in intervention group was 54.8 and 18.7 in control group. Duration time of each application in control group was higher than intervention group. However, lifetime exposure days and life time exposure hours were higher in intervention group. Lifetime exposure days were statistical significant difference between both groups (p = 0.030). Intervention group had lifetime exposure days (631.7) higher than control group (380.4). Lifetime exposure hours had no statistical significant difference between groups (p = 0.199).

Table 4: Demographic and pesticide use-related characteristics by intervention status, at baseline (Independent t-test)

Characteristic	Control (n=91)		Intervention (n=91)		p-value
	Mean	SD	Mean	SD	
Age (yr)	46.0	10.1	43.2	11.9	0.095
Number in household	3.8	1.3	4.5	1.6	0.001
Year of rice farmer	28.5	12.1	18.2	11.8	<0.001
Farm size (rai)	34.1	18.0	38.9	28.4	0.171
Pesticide expend in last year (baht)	19,387.7	16,270.0	37,263.7	35,770.4	<0.001
Year applied pesticide	21.1	8.3	11.9	8.4	<0.001
Day per year use	18.7	18.1	54.8	60.1	<0.001
Duration time each applying (hr)	3.8	1.5	3.1	0.9	<0.001

Table 5: Demographic and pesticide use-related characteristics by study group, at baseline (Chi-square test)

Characteristic		**Control (n=91)**	**Intervention (n=91)**	**p-value (X^2 test)**
Male gender	n	40	45	
	%	44.0	49.5	0.458
>4 household members	n	23	38	
	%	25.3	41.8	0.019
Married status	n	82	80	
	%	90.1	87.9	0.635
Secondary school or higher	n	30	27	
	%	33.0	29.7	0.632
Family monthly 'income<10000 baht	n	49	38	
	%	53.8	41.8	0.103
Grow 3 times per year	n	42	22	
	%	46.2	24.2	0.002
Ever smoke	n	22	23	
	%	24.2	25.3	0.864
Ever drink	n	35	37	
	%	38.5	40.7	0.762
Drink one time a week or more	n	24	18	
	%	26.4	19.8	0.291
Have chronic disease	n	13	14	
	%	14.3	15.4	0.835
Mix pesticide > recommendation	n	27	43	
	%	29.7	47.3	0.015

Chi-square test for categorical data was used to compare characteristics between control group and intervention group. Most of gender both intervention and control groups were female. Gender had no statistical significant difference between control and intervention group (p = 0.458). Both control and intervention groups had household member less than 4. Intervention group had household member more than 4 (41.8%) more than intervention group (25.3%). Most of intervention and control group were married, and had no significant difference between groups (p=0.635). Most of both groups had education level primary school or less. Education had no significant difference between groups (p = 0.632).Family monthly income less than 10,000 was 53.8% in control group and 41.8% in intervention group. It had no significant difference in family monthly' income both control and intervention group. Frequency of growing had significant difference in control and intervention groups (p=0.002). Control group had a higher rate of growing 3 times (46.2%) than intervention group (24.2%). Almost all of intervention group and control group had never been trained (95.6%). All subjects had duty in handling both mixing and spraying, and had number of pesticide mixed more than 3 kinds. Smoking, drinking, and frequency of drinking had no significant difference between control and intervention group (p=0.864, 0.762, and 0.291 respectively). History of doctor visit in last year had significant difference between intervention and control group (p= 0.038). Control group had doctor visit more than 3 times (38.5%) higher than intervention group (24.2%). Most of chronic disease both groups were hypertension. The groups had no significant difference in chronic disease (p=0.835). 47.3% of intervention group and 29.7% of control group had mixed pesticide more than recommendation. This difference was significant (p=0.015). It was shown in Table5.

Table 6: History of exposure to body when using pesticides, by study group, at baseline

Part of body		Control (n=91)	Intervention (n=91)	p-value (X^2 test)
Head and face	n	66	53	
	%	72.5	58.2	0.043
Arms	n	70	74	
	%	76.9	81.3	0.466
Legs	n	62	68	
	%	68.1	74.7	0.325
Feet	n	49	73	
	%	53.8	80.2	<0.001
Inhalation	n	69	49	
	%	75.8	53.8	0.002
Digestive	n	8	37	
	%	8.8	40.7	<0.001

In Table 6 show that history of exposure to pesticide in body when applying. Expose to pesticide by arms and legs had no significant difference between control and intervention group. Control group had higher percentage of expose to head and face (72.5) than intervention group (58.2). 75.8% of control group had inhalation exposure higher than intervention group (5.8%). Otherwise, in intervention group had exposed to legs and digestive (80.2% and 40.7%) higher than control group (53.8% and 8.8% respectively). Feet, inhalation, and digestive exposure had significant difference between control and intervention group.

Table 7: Pesticide use history by classification, family name and study group**,** at baseline

Pesticide classification/family name		Control (n=91)	Intervention (n=91)	p-value (X^2 test)
Herbicide				
2-4D	n	77	87	
	%	84.6	95.6	0.013
Paraquat	n	27	63	
	%	29.7	69.2	<0.001
Glyphosate	n	81	90	
	%	89.0	98.9	0.005
Butachlor	n	64	80	
	%	70.3	87.9	0.004
Any herbicide	n	91	91	1.000
	%	100	100	
Insecticide				
Chlorpyrefos	n	89	81	
(Oganophosphate)	%	97.8	89.0	0.017
Acephase	n	4	24	
(Oganophosphate)	%	4.4	26.4	<0.001
Triazophos	n	2	48	
(Oganophosphate)	%	2.2	52.7	<0.001
Omethoate	n	1	32	
(Oganophosphate)	%	1.1	35.2	<0.001
Phethoate	n	29	26	
(Oganophosphate)	%	31.9	28.6	0.628
Fenobucarb	n	5	25	
(Carbamate)	%	5.5	27.5	<0.001

Table 7: Pesticide use history by classification, pesticide family name and study group, at baseline (continued)

Pesticide classification/family name		**Control (n=91)**	**Intervention (n=91)**	**p-value**
Methomyl	n	69	55	
(Carbamate)	%	75.8	60.4	0.026
Cartaphydrochloride	n	1	18	
(Carbamate)	%	1.1	19.8	<0.001
Cabosulfan	n	1	24	
(Carbamate)	%	1.1	26.4	<0.001
Cypermethrin	n	24	71	
(pyrethroids)	%	26.4	78.0	<0.001
Abamectin	n	90	90	
	%	98.9	98.9	1.000
Any organophosphate	n	90	91	
	%	98.9	100	0.316
Any carbamate	n	71	62	
	%	78.0	68.1	0.133
Fungicide				
Propiconazole	n	68	82	
	%	74.7	90.1	0.006
Carbendazim	n	2	19	
	%	2.2	20.9	<0.001
Hexaconazole	n	15	34	
	%	16.5	37.4	0.001
Validamycin	n	8	13	
	%	8.8	14.3	0.246
Copper hydroxide	n	1	13	
	%	1.1	14.3	0.001

Table 7: Pesticide use history by classification, pesticide family name and study group, at baseline (continued)

Pesticide classification/family name		Control (n=91)	Intervention (n=91)	p-value
Propineb	n	7	32	
	%	7.7	35.2	<0.001
Tricyclazole	n	34	59	
	%	37.4	64.8	<0.001
Any fungicide	n	84	91	
	%	92.3	100	0.007
Rodenticide				
Zinc phosphide	n	31	63	
	%	34.1	69.2	<0.001
bromadiolone	n	6	7	
	%	6.6	7.7	0.773
Any rodenticide	n	36	65	
	%	39.6	71.4	<0.001
Other pesticide	n	14	19	
Saponin (Bio-pesticide)	%	15.4	20.9	0.336

Pesticide use history in rice farms shown in Table 7 were divided in to 4 classes including herbicide, insecticide, fungicide, and rodenticide. Herbicide mostly used both intervention and control groups were 2-4D sodium salt (95.6% and 84.6%), glyphosate (98.9%and89.8%), and butarchlor (87.9% and 70.3%). All of herbicide family names had significant difference in both groups. There were many family names of insecticide use in rice farms both intervention and control groups. Most of common names of insecticide had significant difference between and control groups except phethoate (OP) and abamectin. Major of insecticides use both intervention and control groups were chlorpyrefos (89.0% and 97.8%)**,** and abamectin (98.9% and

98.9%). Most of them used insecticide by family names organophosphase (OP) and carbamate groups. Common name of insecticide family name carbamate mostly used was methomyl. Otherwise, there were no significant difference on insecticide use by family name organophosephase and carbamate in both intervention and control groups. Most of fungicide used in both intervention and control groups were propiconazole, and common name of fungicide use consisting of propiconazole, cabendazim, hexaconazole, copper hydroxide, propinap, and tricyclazole had significant difference in control and intervention groups except validamycin. Among rodenticides, zinc phosphide was higher in intervention group (69.2%) than control group (34.1%), and had significant difference between both groups. Most of subjects used bio pesticide by common name soponin. There were no significant differences on bio pesticide (saponin) use between intervention and control groups.

4.1.2 Knowledge, attitude, protective behavior, serum cholinesterase levels, and pesticide-related symptoms (dependent variables)

Independent t-test for continuous data was used to compare outcome of measurement between control group and intervention group. In Table 8, the highest of knowledge scores was 20 points. Average knowledge scores in control group were 15.9 and intervention group were 15.2. Knowledge scores had significant difference between control and intervention group ($p = 0.019$), although the magnitude of the difference was small. The highest of attitude scores were 120 points divided in to 3 groups: attitude toward the using pesticides (40 points), attitude toward serious in using pesticides (40 points), and attitude toward benefit of taking and barriers to taking action (40 points). All of attitude scores had significant difference between control and intervention group ($p < 0.001$). All attitude scores, control group was higher than intervention group, although magnitudes of differences were not large. The highest protective behavior scores were 69 points divided into 3 groups: mixing (15 points), applying (36 points), and after using (18 points). Protective behavior scores had no significant difference between control and intervention group.

Table 8: Baseline knowledge, attitude, and protective behavior scores by study group

Characteristic	**Control (n=91)**		**Intervention (n=91)**		**p-value (X^2 test)**
	Mean	**SD**	**Mean**	**SD**	
Knowledge score	15.9	2.0	15.2	2.3	0.019
Attitude score					
Toward the using pesticides	27.6	3.7	25.2	3.8	<0.001
Toward the seriousness in using pesticides	28.9	3.9	25.8	4.8	<0.001
Toward the benefits of taking and barriers to taking action	32.9	3.6	30.6	3.9	<0.001
Total attitude score	89.4	8.4	81.5	9.4	<0.001
Protective score					
Mixing	12.5	1.9	12.6	1.9	0.525
Applying	21.3	3.8	21.5	4.7	0.692
After using	17.0	1.9	16.5	2.3	0.121
Total protective score	50.7	5.9	50.7	6.5	0.943

Table 9: Baseline serum cholinesterase level from reactive paper (highest level, unsafe), by study group

Serum cholinesterase levels		Control (n=91)	Intervention (n=91)	p-value
Unsafe level	n	46	59	
	%	50.5	64.8	0.043

Serum cholinesterase levels were measured by reactive paper divided into 4 groups: Normal, Safety, Risky, and unsafe. Overall reactive paper at baseline was found that had no normal level, 4 subjects (2.2%) had safety, 73 subjects (40.1%) had risky and 105 subjects (57.7%) had unsafe level. The researcher had categorized into to groups; unsafe and other levels that appropriated to compare the association between groups. Chi-square test was used to compare category data between intervention and control group. Most of intervention group had unsafe in serum cholinesterase level (64.8%) and 50.5% in control group. Cholinesterase activity had significant difference between control and intervention groups (p = 0.043) shown in table 9. Otherwise, the magnitude of baseline difference was not large.

In Table 10, history of 31 pesticide-related symptoms divided into 5 groups by body system: neuromuscular (15 symptoms), respiratory (8 symptoms), digestive (3 symptoms), eyes (3symptoms), and skin (2 symptoms). Symptoms in last week, most of symptoms in intervention group were neuromuscular, respiratory, eyes, skin, and digestive symptoms (78.0%, 62.6, 53.8%, 49.5%, and 29.7% respectively), and control group were neuromuscular, respiratory, eyes, skin, and digestive symptoms (38.5%, 33.0, 15.4%, 14.3%, and 7.7% respectively). All baseline symptom prevalence were higher in intervention group, and differed significantly between the control and intervention groups. Prevalence of symptoms in past month but not in the past week, most of symptoms were neuromuscular in intervention (30.8%) and skin symptoms in control groups (14.3%). Neuromuscular and respiratory symptoms had significant difference between control and intervention group. However, this study used only symptoms in the past week for examine the effectiveness of pesticide risk reduction program, because recall beyond the past week is uncertain.

Table 10: Baseline pesticide-related symptoms by body system and study group

Symptoms		Control (n=91)	Intervention (n=91)	p-value (X^2 test)
Symptoms in past week				
Neuromuscular	N	35	71	
	%	38.5	78.0	<0.001
Respiratory	N	30	57	
	%	33.0	62.6	<0.001
Digestive	N	13	27	
	%	14.3	29.7	0.019
Eyes	N	14	49	
	%	15.4	53.8	<0.001
Skin	N	7	45	
	%	7.7	49.5	<0.001
Symptoms in past month but not past week				
Neuromuscular	N	28	11	
	%	30.8	12.1	0.002
Respiratory	N	22	11	
	%	24.2	12.1	0.034
Digestive	N	9	11	
	%	9.9	12.1	0.635
Eyes	N	8	10	
	%	8.8	11.0	0.619
Skin	N	11	13	
	%	12.1	14.3	0.661

4.2Effectiveness of Pesticide Risk Reduction Program (PRRP)

4.2a Effectiveness of Pesticide Risk Reduction Program (PRRP) unadjusted

4.2a.1 Overall effectiveness of Pesticide Risk Reduction Program

General linear model repeated measures ANOVA was conducted to characterize the overall effect of pesticide risk reduction program for continuous outcome. This assessment considered the intervention as a whole, and did not consider the 2 follow-up times individually. Overall effectiveness of pesticide risk reduction program was highly statistically significant effect in mean knowledge score, attitude in using pesticide score, attitude in serious score, attitude benefit score, total attitude score, practice when mixing score, practice when applying score, practice after using score, and total practice score at ($p<0.001$ for Wilks'Lambda in Multivariate test) in table 11.

Table 11: Overall effectiveness of Pesticide risk reduction program on knowledge, attitude, and practice score

Multivariate test (Wilks' Lambda test)

Variable	**F**	**Hypothesis ndf**	**Error ddf**	**P-value**
Knowledge score	121.114	2.000	179.000	<.001
Attitude in using pesticide score	45.542	2.000	179.000	<.001
Attitude in serious	52.902	2.000	179.000	<.001
Attitude in benefit	42.126	2.000	179.000	<.001
Total attitude score	91.539	2.000	179.000	<.001
Practice when mixing score	40.015	2.000	179.000	<.001
Practice when applying score	168.514	2.000	179.000	<.001
Practice after using score	8.466	2.000	179.000	<.001
Total practice score	134.480	2.000	179.000	<.001

General linear Model repeated measures ANOVA. ndf=numerator degrees of freedom, ddf=denominator degrees of freedom.

4.2a.2 Effectiveness of Pesticide Risk Reduction Program in knowledge

General Linear Model (GLM) parameter estimates only to calculate the magnitude of the intervention effects at 2 follow-up times. The p-value in the GLM parameter estimates does not give test of significance for the intervention effects. Possible knowledge score was 0 to 20 points. Before intervention found that knowledge score in control group was statistical significant difference compare to intervention group (p-value = 0.019). At one month after intervention, the magnitude knowledge scores was 4.2 points [3.418 – (- 0.769)] and four month later was 3.5 [2.769 – (- 0.769)] shown in table 12.

Table 12: Mean knowledge score by intervention status and measurement times

Parameter Estimates

Knowledge score	Parameter	B	Std. Error	t	P-value	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Baseline	Intercept	15.956	.230	69.328	<.001	15.502	16.410
	intervention	-.769	.325	-2.363	.019	-1.411	-.127
Follow-up1	Intercept	15.495	.166	93.478	<.001	15.167	15.822
	intervention	3.418	.234	14.579	<.001	2.955	3.880
Follow-up2	Intercept	16.000	.178	89.960	<.001	15.649	16.351
	intervention	2.769	.252	11.010	<.001	2.273	3.266

General linear Model repeated measures ANOVA

Average knowledge score in control group (15.96) was higher than intervention group (15.19) at baseline. After intervention one month found that intervention group was rapidly increase and higher (18.91) than control group (15.49), and four month after intervention in intervention group (18.77) was higher than control group (16.00) shown in figure 20.

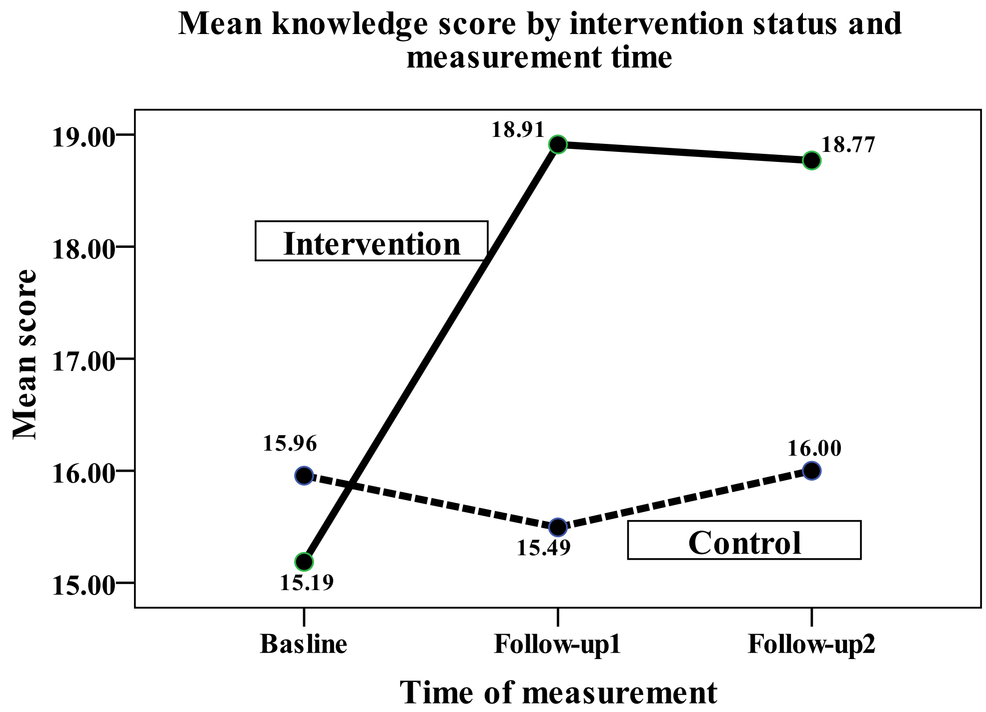


Figure20: Mean knowledge score by intervention status and measurement time

4.2a.3 Effectiveness of Pesticide Risk Reduction Program in attitude (unadjusted)

Attitude was divided into 3 groups: attitude toward the using pesticide, toward seriousness in using pesticide and toward benefit of taking and barriers to taking action in using pesticides. Possible score in each group was 0 - 40 points, and highest score was 120 points. At baseline time found that average attitude toward using pesticide score in control group was statistically significant difference compare to intervention group (p- value <0.001). At one month after intervention, the magnitude attitude toward using scores was 3.4 points [0.956 – (- 2.440)] and four month later was 5.3 [2.824 – (- 2.440)] shown in table 13.

Table13: Attitude toward using pesticide score by intervention status and measurement times

Parameter Estimates

Attitude toward using	**Parameter**	**B**	**Std. Error**	**t**	**P-value**	**95% Confidence Interval**	
						Lower Bound	**Upper Bound**
Baseline	Intercept	27.626	.394	70.058	<.001	26.848	28.404
	intervention	-2.440	.558	-4.375	<.001	-3.540	-1.339
Follow-up1	Intercept	31.198	.349	89.321	<.001	30.509	31.887
	intervention	.956	.494	1.935	.054	-.019	1.931
Follow-up2	Intercept	29.516	.386	76.489	<.001	28.755	30.278
	intervention	2.824	.546	5.175	<.001	1.747	3.901

General linear Model repeated measures ANOVA

Figure 21 shows that average attitude toward using pesticide scores in control group (27.63) had higher than control group (25.19) at baseline. After intervention one month, average attitude toward using pesticide scores in intervention group (32.15) had higher than control group (31.20) and after intervention 4 months, average attitude toward using pesticide scores in intervention group (32.34) had higher than control group (29.20). Average attitude in using pesticide score in control group had increased at the first time follow-up and decreased at the second time follow-up and in the intervention group rapidly increased at the first time follow-up and slowly increased at the second time follow-up. However, average score in intervention group had higher than control group both the first and second times follow-up.

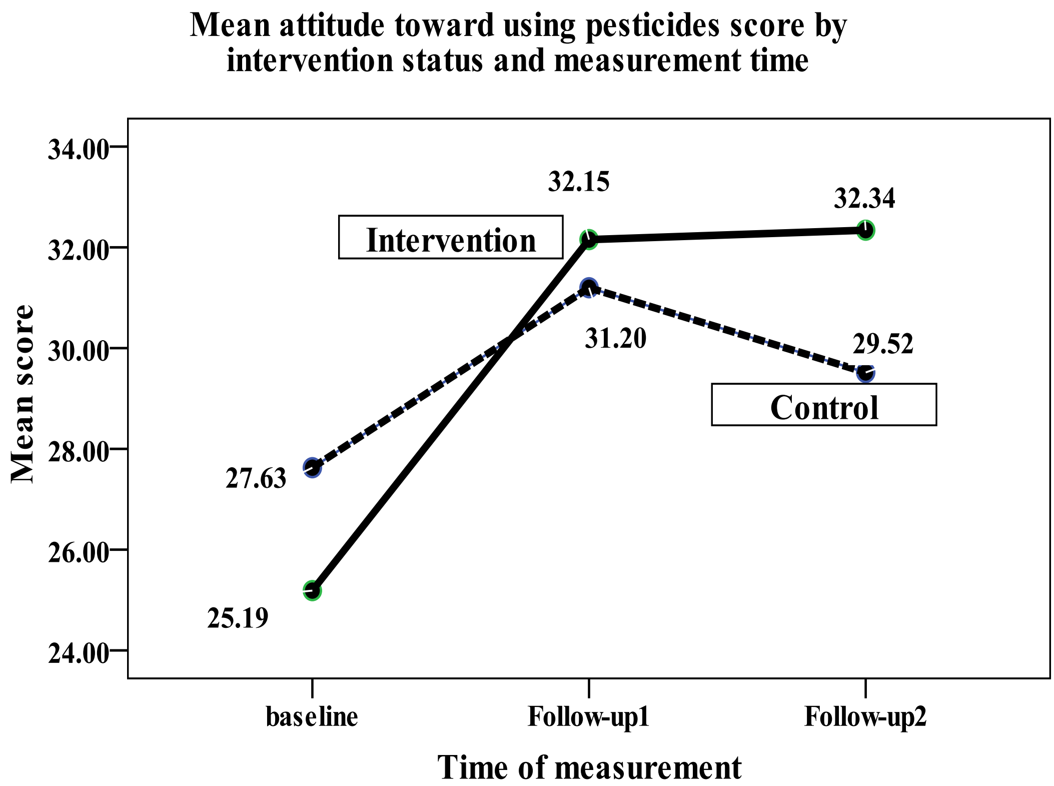


Figure 21: Mean attitude toward using pesticide score by intervention status and measurement time

At baseline time found that average attitude toward serious score in control group was statistically significant difference compare to intervention group (p- value <0.001). At one month after intervention program, At one month after intervention, the magnitude attitude toward seriousness scores was 4.8 points [1.648 – (- 3.154)] and four month later was 6.6 [3.440 – (- 3.154)] shown in table 14.

Mean attitude serious score in control group was higher than intervention group at baseline time. After intervention one month and 4 month was found that mean attitude serious score in intervention group was higher than control group shown in figure 22.

Table14: Attitude toward seriousness using pesticide score by intervention status and measurement times

Attitude toward serious	Parameter	B	Std. Error	t	P-value	95% Confidence Interval	
						Lower Bound	Upper Bound
Baseline	Intercept	28.923	.459	63.035	<.001	28.018	29.828
	intervention	-3.154	.649	-4.860	<.001	-4.434	-1.873
Follow-up1	Intercept	30.187	.322	93.748	<.001	29.551	30.822
	intervention	1.648	.455	3.620	<.001	.750	2.547
Follow-up2	Intercept	28.648	.404	70.984	<.001	27.852	29.445
	intervention	3.440	.571	6.026	<.001	2.313	4.566

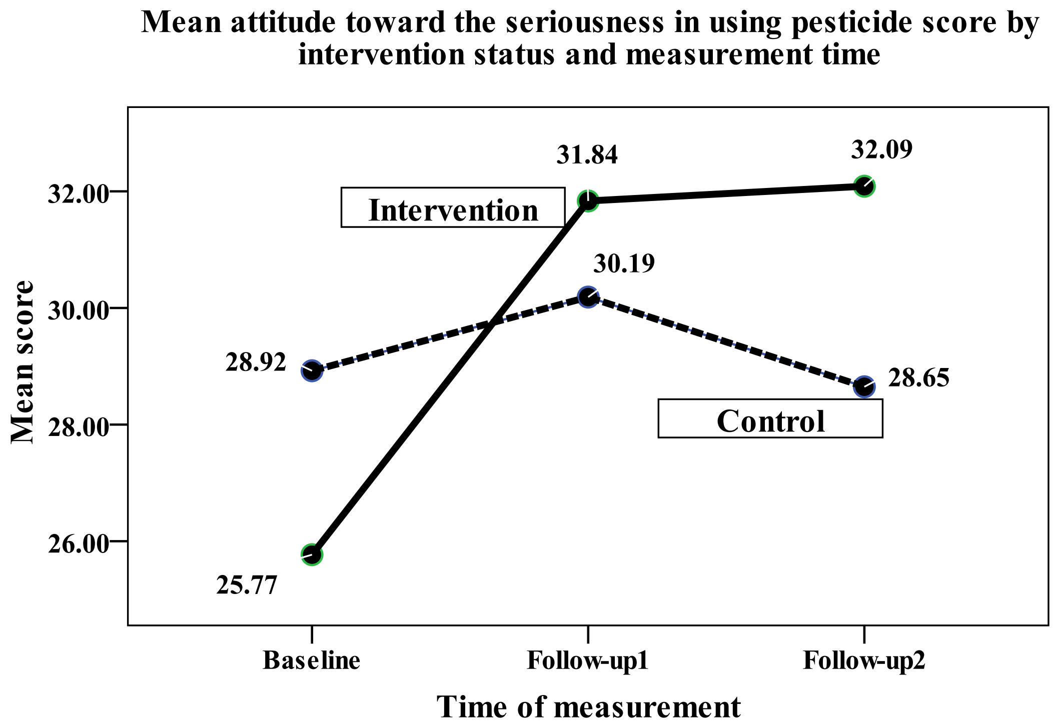


Figure 22: Mean attitude toward seriousness of using pesticide score by intervention status and measurement time

Table15: Attitude toward the benefits of taking and barriers to taking action score by intervention status and measurement times

Attitude toward benefits	**Parameter**	**B**	**Std. Error**	**t**	**P-value**	**95% Confidence Interval**	
						Lower Bound	**Upper Bound**
Baseline	Intercept	32.857	.398	82.549	<.001	32.072	33.643
	intervention	-2.264	.563	-4.022	<.001	-3.374	-1.153
Follow-up1	Intercept	33.341	.329	101.432	<.001	32.692	33.989
	intervention	.033	.465	.071	.944	-.884	.950
Follow-up2	Intercept	31.582	.393	80.410	<.001	30.807	32.357
	intervention	2.363	.555	4.254	<.001	1.267	3.459

General linear Model repeated measures ANOVA

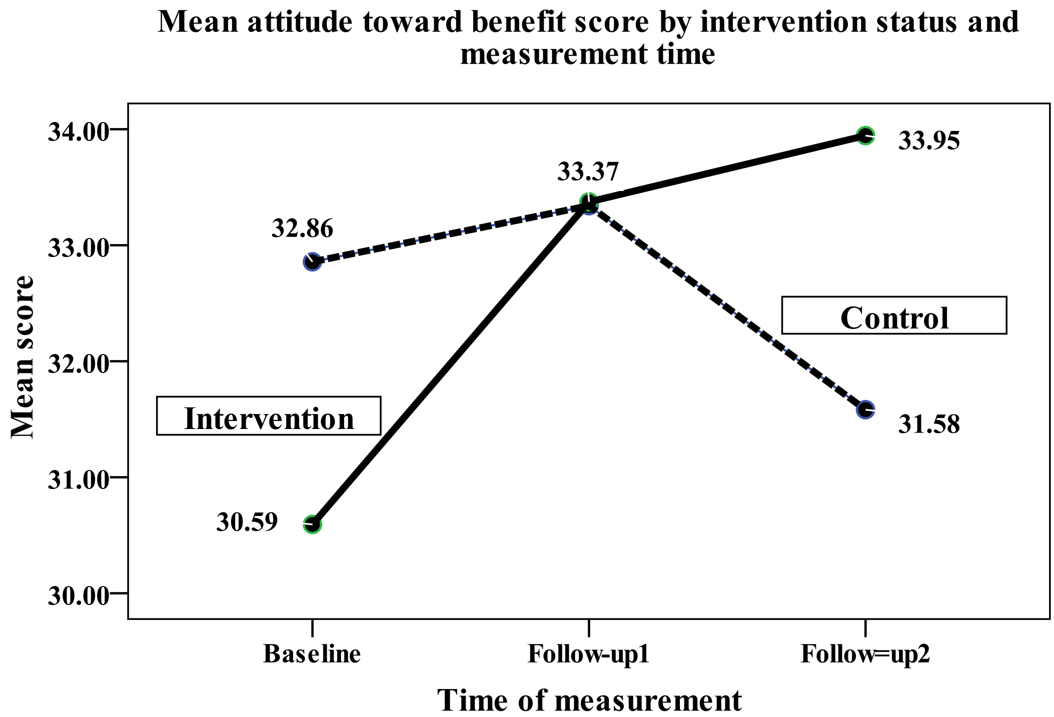


Figure 23: Mean attitude toward the benefits of taking and barriers to taking action score by intervention status and measurement time

At one month after intervention, the magnitude attitude toward the benefits of taking and barriers to taking action scores was 2.3 points [0.033 – (- 2.264)] and four month later was 4.6 [2.363 – (- 2.264)] shown in table 15. At baseline time was found that the control group had attitude toward benefits mean score higher than the intervention group. At one month after intervention program the mean score had similar in both groups. At four month later, the attitude toward benefits mean score was higher in the intervention group than the control as shown in figure 23.

Table16: Total attitude score by intervention status and measurement times

Total attitude score	Parameter	B	Std. Error	t	P-value	95% Confidence Interval	
						Lower Bound	Upper Bound
Baseline	Intercept	89.407	.935	95.613	<.001	87.561	91.252
	intervention	-7.857	1.322	-5.942	<.001	-10.467	-5.248
Follow-up1	Intercept	94.725	.789	120.079	<.001	93.169	96.282
	intervention	2.637	1.116	2.364	.019	.436	4.839
Follow-up2	Intercept	89.747	.956	93.896	<.001	87.861	91.633
	intervention	8.626	1.352	6.382	<.001	5.959	11.294

At baseline time found that average total attitude score in control group was statistically significant difference compare to intervention group (p- value <0.001). At one month after intervention program, At one month after intervention, the magnitude total attitude scores was 10.5 points [2.637 – (- 7.857)] and four month later was 16.5 [8.626 – (- 7.857)] shown in table 16.

Mean attitude serious score in control group was higher than intervention group at baseline time. After intervention program one month and 4 month was found that mean total attitude score in intervention group was higher than control group shown in figure 24.

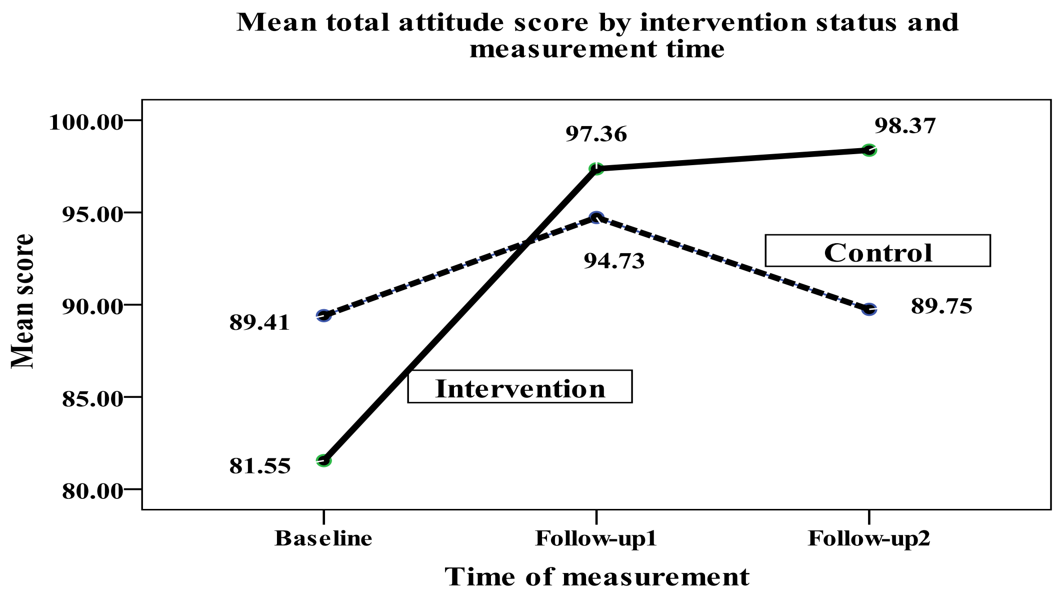


Figure 24: Mean total attitude score by intervention status and measurement time

4.2a.4 Effectiveness of Pesticide Risk Reduction Program in protective behavior

Protective behavior had divided into 3 groups including protective when mixing, when applying, and after using pesticides. The protective behavior score when mixing pesticides had similar at baseline time (p= 0.525). At one month after intervention, the magnitude protective when mixing mean score was 1.3 points [1.495 – 0.176] and four month later was 0.4 [0.549 – 0.176] as shown in Table 17.

At baseline, the protective when mixing mean score had similar. The mean score in intervention group was higher than control group at one month and four month after intervention as shown in Figure 25.

Table17: Protective behavior when mixing score by intervention status and measurement times

Practice when mixing score	Parameter	B	Std. Error	t	P-value	95% Confidence Interval	
						Lower Bound	Upper Bound
Baseline	Intercept	12.473	.195	63.932	<.001	12.088	12.857
	intervention	.176	.276	.637	.525	-.369	.720
Follow-up1	Intercept	12.604	.144	87.762	<.001	12.321	12.888
	intervention	1.495	.203	7.358	<.001	1.094	1.895
Follow-up2	Intercept	13.451	.131	102.780	<.001	13.192	13.709
	intervention	.549	.185	2.969	.003	.184	.915

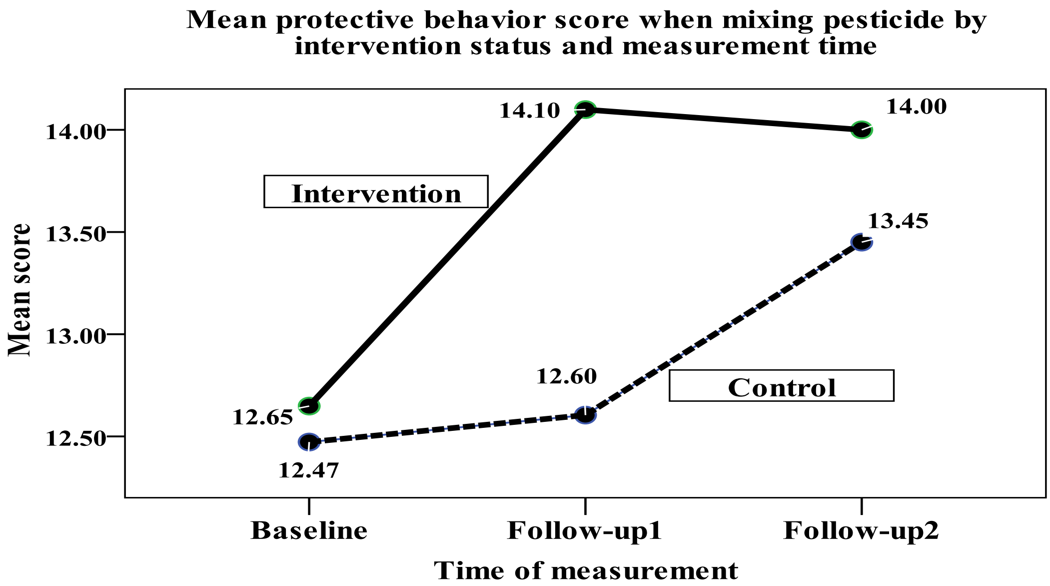


Figure25: Mean protective behavior when mixing score by intervention status and measurement time

The possible protective behavior when applying score was 0-36 points. At baseline time, there was no statistically significant between control and intervention group. At one month after intervention, the magnitude protective when applying mean score was 6.6 points [6.835 – 0.253] and four month later was 3.7 [3.978 – 0.253] as shown in table 18. At baseline, the protective when applying mean score had similar. The mean score in intervention group was higher than control group at one month and four month after intervention as shown in Figure 26.

Table18: Protective behavior when applying score by intervention status and measurement times

Practice when applying score	**Parameter**	**B**	**Std. Error**	**t**	**P-value**	**95% Confidence Interval**	
						Lower Bound	**Upper Bound**
Baseline	Intercept	21.297	.450	47.365	<.001	20.409	22.184
	intervention	.253	.636	.397	.691	-1.002	1.507
Follow-up1	Intercept	21.341	.340	62.732	<.001	20.669	22.012
	intervention	6.835	.481	14.207	<.001	5.886	7.784
Follow-up2	Intercept	23.879	.390	61.236	<.001	23.110	24.649
	intervention	3.978	.551	7.213	<.001	2.890	5.066

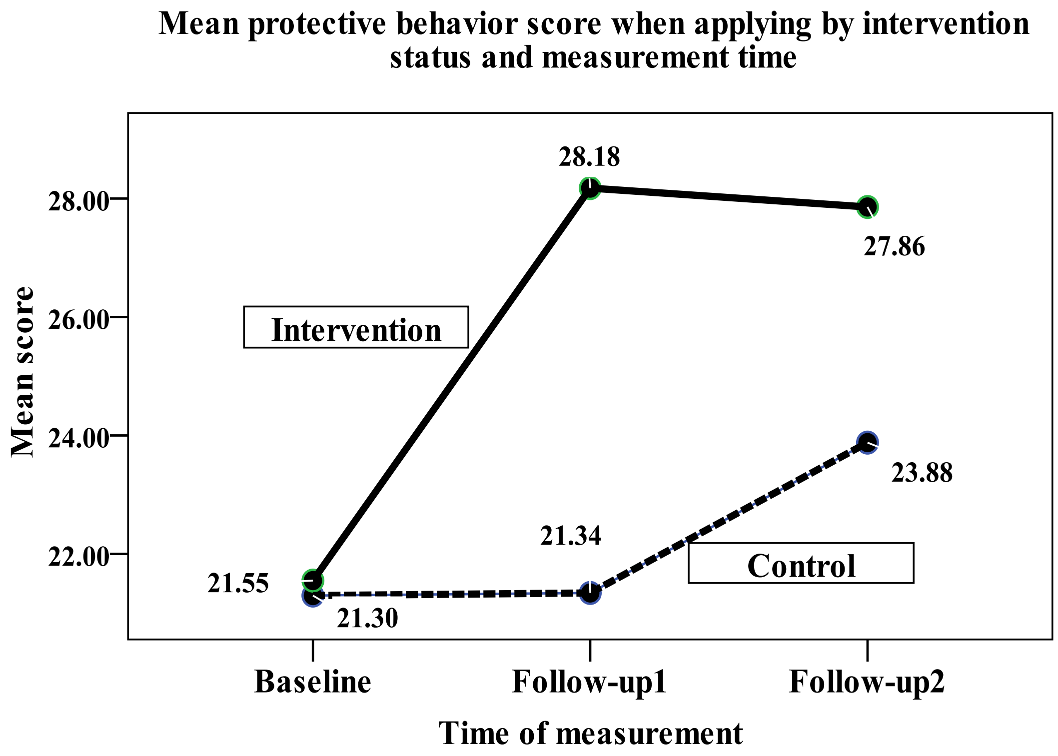


Figure26: Mean protective behavior when applying score by intervention status and measurement time

At one month after intervention, the magnitude protective after using mean score was 0.8 points [0.319 – (- 0.495)] and four month later was 1.1 [0.659 – (- 0.495)] as shown in table 19. At baseline time was found that the control group had mean score higher than the intervention group. At one month after intervention program the mean score had similar in both groups. At four month later, mean score was higher in the intervention group than the control. The protective after using pesticides score in intervention group had increased in both measurement times as shown in figure 27.

Table19: Protective behavior after using score by intervention status and measurement times

Practice after using score	Parameter	B	Std. Error	t	P-value	95% Confidence Interval	
						Lower Bound	Upper Bound
Baseline	Intercept	16.978	.225	75.574	<.001	16.535	17.421
	intervention	-.495	.318	-1.556	.121	-1.121	.132
Follow-up1	Intercept	17.209	.129	133.614	<.001	16.955	17.463
	intervention	.319	.182	1.750	.082	-.041	.678
Follow-up2	Intercept	16.967	.124	136.739	<.001	16.722	17.212
	intervention	.659	.175	3.757	<.001	.313	1.006

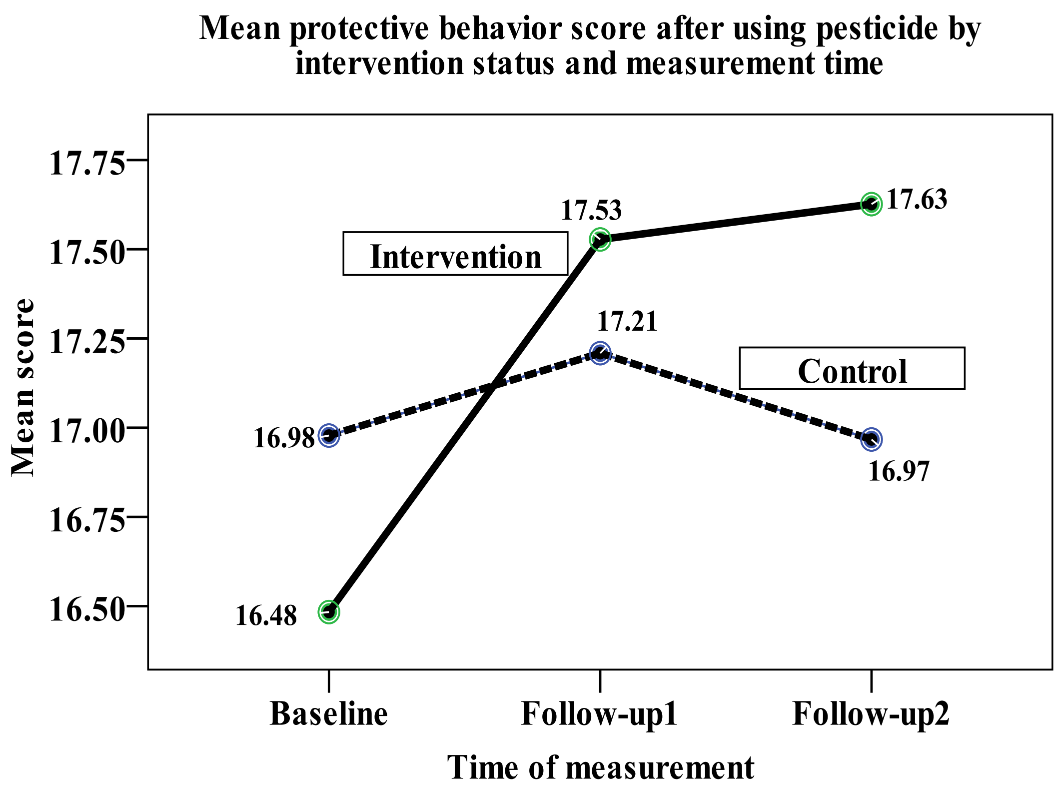


Figure27: Mean protective behavior after using score by intervention status and measurement time

At baseline, the total protective behavior score had similar between control and intervention group (p=0.943). At one month after intervention, the magnitude total protective mean score was 8.7 points [8.648 – (-0.066)] and four month later was 5.2 [5.187 – (- 0.066)] as shown in table 20. At baseline time, the total score was similar in both groups. The intervention group had mean score higher than control in both measurement times as show in figure 28.

Table20: Total protective behavior score by intervention status and measurement times

Total practice score	**Parameter**	**B**	**Std. Error**	**t**	**P-value**	**95% Confidence Interval**	
						Lower Bound	**Upper Bound**
Baseline	Intercept	50.747	.650	78.048	<.001	49.464	52.030
	intervention	-.066	.920	-.072	.943	-1.880	1.749
Follow-up1	Intercept	51.154	.476	107.365	<.001	50.214	52.094
	intervention	8.648	.674	12.835	<.001	7.319	9.978
Follow-up2	Intercept	54.297	.504	107.694	<.001	53.302	55.292
	intervention	5.187	.713	7.274	<.001	3.780	6.594

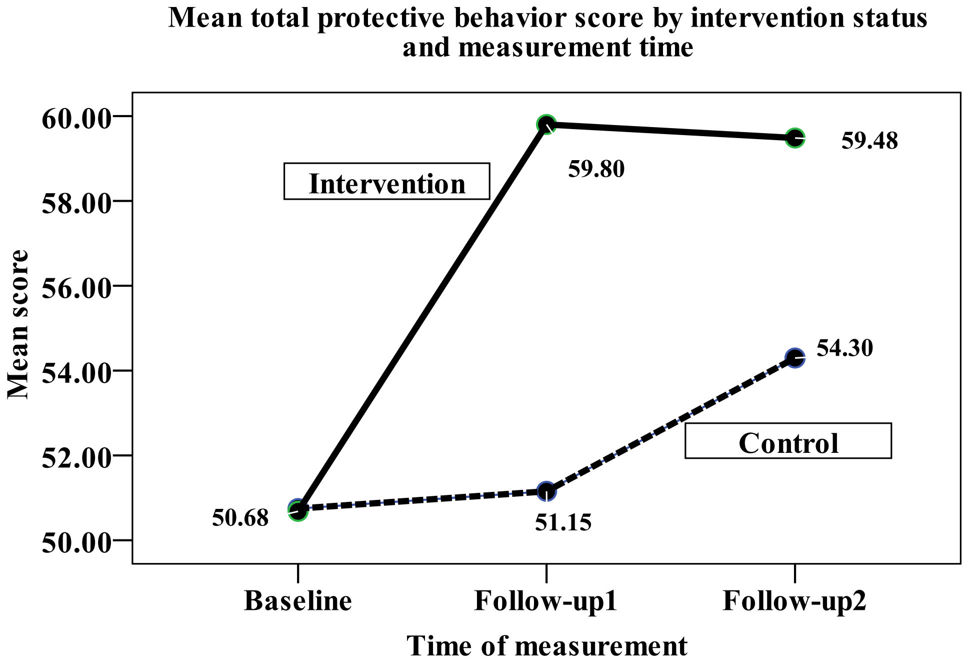


Figure28: Mean total protective score by intervention status and measurement time

General linear model was used to fine individual of protective behavior in frequency of activities that divided into 2 categories; always or sometimes and rarely or never. Protective behavior when mixing pesticides, in table 21 shows that at baseline time, the intervention program was increased the prevalence of always or sometimes wear the plastic gloves and wash hand immediately after mixing both one month and four months after intervention program, and increased the prevalence of mixing as indicated on the labels at one month after intervention.

Protective behavior when applying pesticides, the prevalence of sometimes or always of activities in intervention groups had higher than control and the intervention improved at both measurement time consisting of wear hat , use mask cover nose and mouse, wear eye glasses, and wear boots. Only one activity; not drink water or eat food during applying had improved at one month after intervention (p=0.001) as shown in table 22.

Prevalence of activities on protective behavior after using pesticide was high overall activities all measurement times. Individually, it was found that the intervention improved some activities including change clothes immediately when arrive home at four month after intervention, wash (clean protective equipment after using) at one month after intervention, and clean spray equipment away from the source of utilized water in both follow-up times as show in table 23.

Table 21: Frequency practice of protective behavior when mixing pesticides by intervention status and measurement time

Practice when mixing (frequency always or sometime)		**Baseline**			**One month after intervention**			**Four month after intervention**		
		Control (n=91)	**Intervention (n=91)**	**magnitude**	**Control (n=91)**	**Intervention (n=91)**	**magnitude**	**Control (n=91)**	**Intervention (n=91)**	**magnitude**
Wear the plastic gloves	n	57	65		57	89		78	89	
	%	62.6	71.4	8.8	62.6	97.8	26.4	85.7	97.8	3.3
Cover nose (use mask)	n	87	86		87	90		91	91	
	%	95.6	94.5	-1.1	95.6	98.9	4.4	100	100	1.1
Mix as indicated on the labels	n	86	87		86	91		90	91	
	%	94.5	95.6	1.1	94.5	100	4.4	98.9	100	0.0
Use stick to stir	n	90	81		91	91		90	91	
	%	98.9	89.0	-9.9	100	100	9.9	98.9	100	1.1
Wash hand immediately after mixing	n	78	91		79	91		85	91	
	%	85.7	100	14.3	86.8	100	-1.1	93.4	100	-7.7

General linear Model repeated measures ANOVA

Table 22: Frequency practice of protective behavior when applying pesticides by intervention stat and measurement time

Practice when applying (frequency sometime or always)		Baseline			One month after intervention			Four month after intervention		
		Control (n=91)	Intervention (n=91)	magni tude	Control (n=91)	Intervention (n=91)	magni tude	Control (n=91)	Intervention (n=91)	magni tude
Wear hat	n	85	88		85	91		81	91	
	%	93.4	96.7	3.3	93.4	100	3.3	89.0	100	7.7
Use mask cover nose , Mouth	n	43	23		43	90		65	90	
	%	47.3	25.3	22.0	47.3	98.9	73.6	71.4	98.9	49.5
Wear eyeglasses (goggle)	n	16	28		16	90		38	89	
	%	17.6	30.8	13.2	17.6	98.9	68.1	41.8	97.8	42.8
Wear boots	n	50	64		50	70		56	72	
	%	54.9	70.3	15.4	54.9	76.9	6.6	61.5	79.1	2.2
Wear plastic gloves	n	60	48		60	91		71	88	
	%	65.9	52.7	-13.2	65.9	100	47.3	78.0	96.7	31.9
Wear long sleeves shirt	n	88	88		88	91		90	90	
	%	96.7	96.7	0.0	96.7	100	3.0	98.9	98.9	0.0

General linear Model repeated measures ANOVA

Table 22: Frequency practice of protective behavior when applying pesticides by intervention stat and measurement time (cont.)

Practice when applying (frequency sometime or always)		Baseline			One month after intervention			Four month after intervention		
		Control (n=91)	**Intervention (n=91)**	**magni tude**	**Control (n=91)**	**Intervention (n=91)**	**magni tude**	**Control (n=91)**	**Intervention (n=91)**	**magni tude**
Wear coverall	n	5	13		5	11		17	14	
	%	5.5	14.3	8.8	5.5	12.1	-2.2	18.7	15.4	-12.1
Not smoke cigarette or chew gums	n	86	86		86	90		85	88	
	%	94.5	94.5	0.0	94.5	98.9	4.4	93.4	96.7	3.3
Not drink water or eat food	n	73	73		73	87		77	84	
	%	80.2	80.2	0.0	80.2	95.6	15.4	84.6	92.3	7.7
Spray in the same direction of wind	n	74	74		74	77		78	87	
	%	81.3	81.3	0.0	81.3	84.6	3.3	85.7	95.6	9.9
Spray the pesticide and walk Backward	n	7	11		7	13		19	20	
	%	7.7	12.1	4.4	7.7	14.3	2.2	20.9	22.0	-3.3
Spray only in the windless and less strong sunlight time	n	86	89		86	90		89	89	
	%	94.5	97.8	3.3	94.5	98.9	1.0	97.8	97.8	-3.0

General linear Model repeated measures ANOVA

Table 23: Frequency practice of protective behavior after using pesticides by intervention stat and measurement time

Practice when applying (frequency sometime/ always)	Baseline			One month after intervention			Four month after intervention		
	Control (n=91)	Intervention (n=91)	magni tude	Control (n=91)	Intervention (n=91)	magni tude	Control (n=91)	Intervention (n=91)	magni tude
Clean hands with detergent or soap immediately	88	85		91	91		91	90	
	96.7	93.4	-3.3	100	100	3.3	100	98.9	2.2
Change clothes immediately when arrive home.	88	81		91	91		84	91	
	96.7	89.0	-7.7	100	100	7.7	92.3	100	15.4
Take a bath immediately after arriving home.	90	90		90	91		90	91	
	98.9	98.9	0.0	98.9	100	1.1	98.9	100	1.1
Washing work clothes separately out of normal clothes.	90	90		90	91		91	90	
	98.9	98.9	0.0	98.9	100	1.1	100	98.9	-1.1
Wash (clean_ protective equipment after using.)	82	86		82	90		90	91	
	90.1	94.5	4.4	90.1	98.9	4.4	98.9	100	-3.3
Clean spray equipment away from the source of utilized water.	85	80		91	91		83	91	
	93.4	87.9	-5.5	100	100	12.1	91.2	100	14.3

General linear Model repeated measures ANOVA

4.2a.3 Effectiveness of Pesticide Risk Reduction Program in symptoms after using pesticide (unadjusted)

Generalized Estimating Equation for dichotomous dependent variables was conducted to predict the effect of pesticide risk reduction program. Outcomes of measurement were prevalence of symptom at least one occurred during or 24 four after using pesticides including 5 systems organ; neuromuscular, respiratory, digestive, eyes, and skin. According to symptoms in the past month had low prevalence of self report symptoms that might be recall bias. Researchers used prevalence of symptoms in the past week to test the effectiveness of program.

4.2a.3.1 Effectiveness of Pesticide Risk Reduction Program (unadjusted) in prevalence of neuromuscular symptoms at least one after using pesticide

At baseline, prevalence of neuromuscular symptom at least one had statistically significant difference between intervention and control. At one month after intervention, the magnitude prevalence of neuromuscular symptoms at least one after using pesticide was decreased 34.1 percent-points [5.5 – 39.6] and four month later was decreased 30.8 percent-points [8.8-39.6], as shown in table 24. All of measurement times, the intervention group had prevalence of neuromuscular symptom higher than the control. Otherwise, the intervention had decreased from baseline to one month and four month later as shown in figure 29.

Table24: Prevalence of neuromuscular symptom in past week by intervention status and measurement times

Parameter estimates

Neuromuscular symptoms	Parameter	B	Std. Error	t	P-value	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Baseline	Intercept	.385	.048	8.077	<.001	.291	.479
	intervention	.396	.067	5.874	<.001	.263	.528
Follow-up1	Intercept	.484	.053	9.190	<.001	.380	.587
	intervention	.055	.074	.738	.461	-.092	.202
Follow-up2	Intercept	.407	.052	7.783	<.001	.304	.510
	intervention	.088	.074	1.190	.236	-.058	.234

General linear Model repeated measures ANOVA

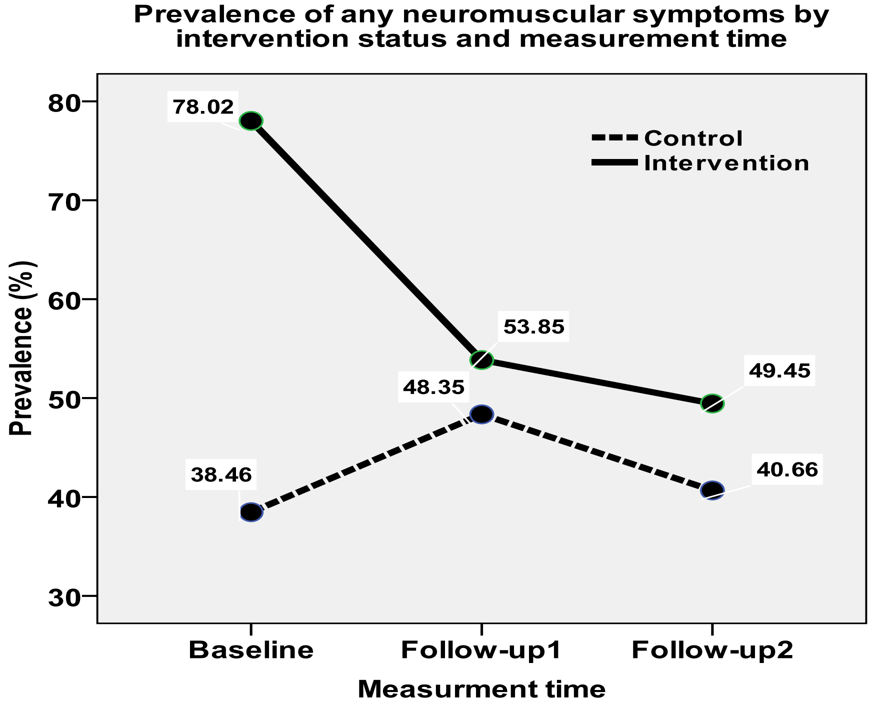


Figure29: Prevalence of neuromuscular symptom (%) in past week by intervention status and measurement time

4.2a.3.2 Effectiveness of Pesticide Risk Reduction Program in prevalence of respiratory symptoms at least one after using pesticide

At baseline, prevalence of respiratory symptom at least one had statistically significant difference between intervention and control. At one month after intervention, the magnitude prevalence of respiratory symptoms at least one after using pesticide was decreased 46.2 percent-points [-16.5 – 29.7] and four month later was decreased 34.1 percent-points [- 4.4 – 29.7], as shown in table 25. At baseline time, the intervention group had prevalence of respiratory symptom higher than the control. Otherwise, the intervention had decreased from baseline to one month and four month later. At one month and four month later after intervention program, the intervention had decreased and had lower than the control as shown in figure 30.

Table25: Prevalence of respiratory symptom in past week by intervention status and measurement times

Parameter estimates

Respiratory symptoms	Parameter	B	Std. Error	T	P-value	95% Confidence Interval Lower Bound	Upper Bound
Baseline	Intercept	.330	.050	6.557	<.001	.230	.429
	intervention	.297	.071	4.173	<.001	.156	.437
Follow-up1	Intercept	.374	.047	7.933	<.001	.281	.467
	intervention	-.165	.067	-2.475	.014	-.296	-.033
Follow-up2	Intercept	.330	.049	6.784	<.001	.234	.426
	intervention	-.044	.069	-.640	.523	-.180	.092

General linear Model repeated measures ANOVA

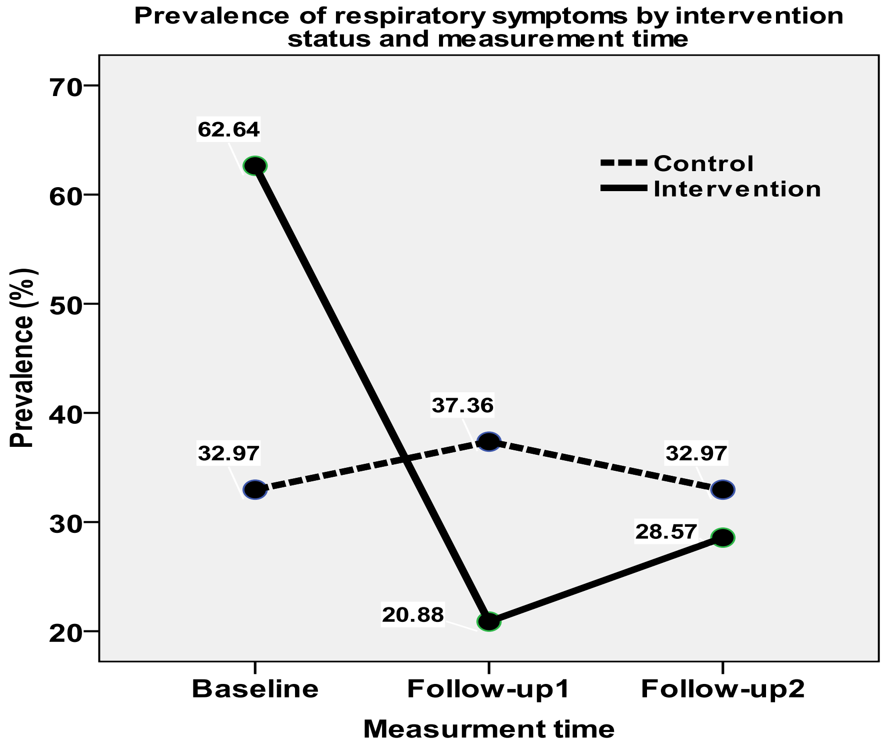


Figure30: Prevalence of respiratory symptom (%) in past week by intervention status and measurement time

4.2a.3.3 Effectiveness of Pesticide Risk Reduction Program in prevalence of digestive symptoms at least one after using pesticide

At baseline, prevalence of digestive symptom at least one had statistically significant difference between intervention and control. At one month after intervention, the magnitude prevalence of digestive symptoms at least one after using pesticide was decreased 14.3 percent-points [1.1 – 15.4] and four month later was decreased 15.4 percent-points [0.0 – 15.4], as shown in table 26. At one month after intervention, the intervention group had prevalence of digestive symptom higher than the control and similar at four month later. Otherwise, the intervention had decreased from baseline to one month as shown in figure 31.

Table26: Prevalence of digestive symptom in past week by intervention status and measurement times

Parameter estimated

Digestive symptoms	Parameter	B	Std. Error	t	P-value	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Baseline	Intercept	.143	.043	3.331	.001	.058	.227
	intervention	.154	.061	2.536	.012	.034	.274
Follow-up1	Intercept	.121	.035	3.452	.001	.052	.190
	intervention	.011	.050	.222	.825	-.087	.109
Follow-up2	Intercept	.154	.038	4.045	<.001	.079	.229
	intervention	.000	.054	.000	1.000	-.106	.106

General linear Model repeated measures ANOVA

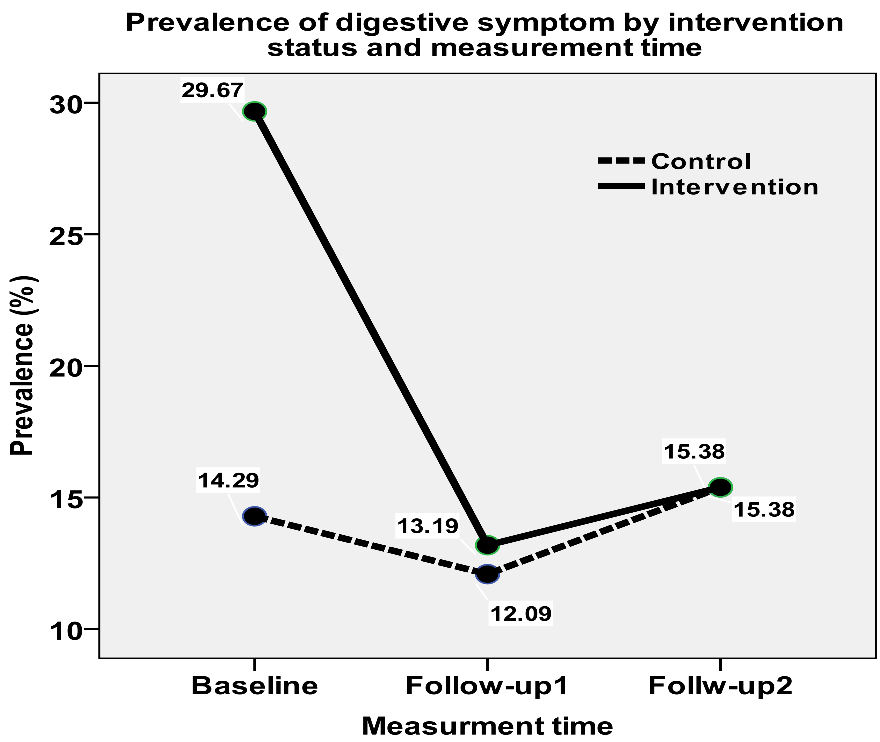


Figure31: Prevalence of digestive symptom in past week by intervention status and measurement time

4.2a.3.4 Effectiveness of Pesticide Risk Reduction Program in prevalence of eyes symptoms at least one after using pesticide

At baseline, prevalence of eyes symptom at least one had statistically significant difference between intervention and control. At one month after intervention, the magnitude prevalence of eyes symptom at least one after using pesticide was decreased 56.0 percent-points [-17.6 – 38.5] and four month later was decreased 47.3 percent-points [-8.8 – 38.5], as shown in table 27. At baseline, the intervention group had prevalence of eyes symptom higher than the control. Otherwise, the intervention had decreased from baseline, and lower than the control at one month and four month later as shown in figure 32.

Table27: Prevalence of eyes symptom in past week by intervention status and measurement times

Parameter estimated

Eyes symptoms	Parameter	B	Std. Error	t	P-value	95% Confidence Interval	
						Lower Bound	Upper Bound
Baseline	Intercept	.154	.046	3.354	.001	.063	.244
	intervention	.385	.065	5.929	<.001	.257	.513
Follow-up1	Intercept	.275	.040	6.864	<.001	.196	.354
	intervention	-.176	.057	-3.106	.002	-.288	-.064
Follow-up2	Intercept	.209	.039	5.376	<.001	.132	.285
	intervention	-.088	.055	-1.601	.111	-.196	.020

General linear Model repeated measures ANOVA

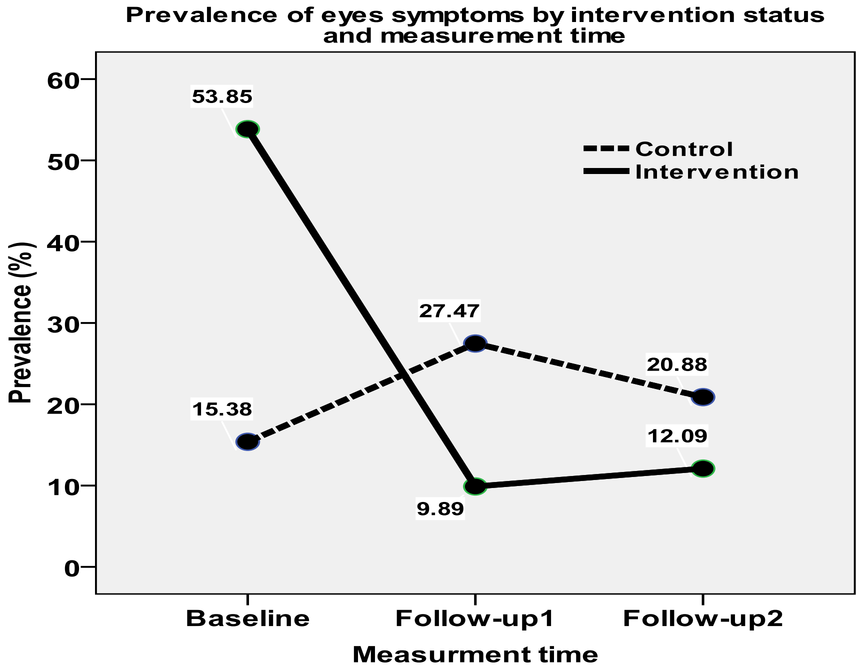


Figure32: Prevalence of eyes symptom (%) in past week by intervention status and measurement time

4.2a.3.5 Effectiveness of Pesticide Risk Reduction Program in prevalence of eyes symptoms at least one after using pesticide

At baseline, prevalence of skin symptom at least one had statistically significant difference between intervention and control. At one month after intervention, the magnitude prevalence of skin symptoms at least one after using pesticide was decreased 16.5 percent-points [25.3 – 41.8] and four month later was decreased 29.7 percent-points [12.1 – 41.8], as shown in table 28. All measurement times, the intervention group had prevalence of skin symptom higher than the control. Otherwise, the intervention had decreased from baseline, one month, and four month later as shown in figure 33.

Table28: Prevalence of skin symptom in past week by intervention status and measurement times

Parameter estimated

skin symptoms	Parameter	B	Std. Error	t	P-value	95% Confidence Interval	
						Lower Bound	Upper Bound
Baseline	Intercept	.077	.042	1.822	.070	-.006	.160
	intervention	.418	.060	6.992	<.001	.300	.535
Follow-up1	Intercept	.176	.047	3.778	<.001	.084	.268
	intervention	.253	.066	3.840	<.001	.123	.383
Follow-up2	Intercept	.198	.046	4.329	<.001	.108	.288
	intervention	.121	.065	1.871	.063	-.007	.248

General linear Model repeated measures ANOVA

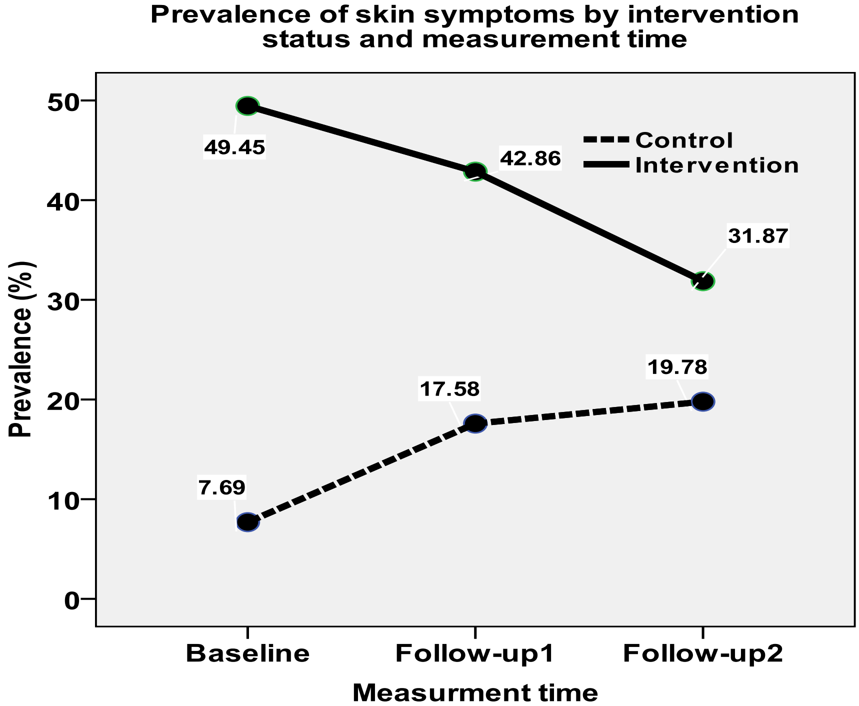


Figure33: Prevalence of skin symptom (%) in past week by intervention status and measurement time

4.2a.4 Effectiveness of Pesticide Risk Reduction Program in Prevalence of reactive paper unsafe level

At baseline, prevalence of serum cholinesterase unsafe level had statistically significant difference between intervention and control. At one month after intervention, the magnitude prevalence of reactive paper unsafe level had decreased 47.3 percent-points [-33.0 – 14.3] and four month later was decreased 41.8 percent-points [- 27.5 – 14.3], as shown in table 29. At baseline, the intervention group had prevalence of reactive paper unsafe higher than the control. Otherwise, the intervention had decreased from baseline, and lower than the control at one month and four month later as shown in figure 34.

Table29: Prevalence of Serum Cholinesterase level unsafe by intervention status and measurement times

Parameter estimated

Serum Cholinesterase unsafe level	Parameter	B	Std. Error	t	P-value	95% Confidence Interval	
						Lower Bound	Upper Bound
Baseline	Intercept	.505	.052	9.810	<.001	.404	.607
	intervention	.143	.073	1.960	.052	-.001	.287
Follow-up1	Intercept	.626	.050	12.630	<.001	.529	.724
	intervention	-.330	.070	-4.701	<.001	-.468	-.191
Follow-up2	Intercept	.769	.049	15.785	<.001	.673	.865
	intervention	-.275	.069	-3.986	<.001	-.411	-.139

General linear Model repeated measures ANOVA

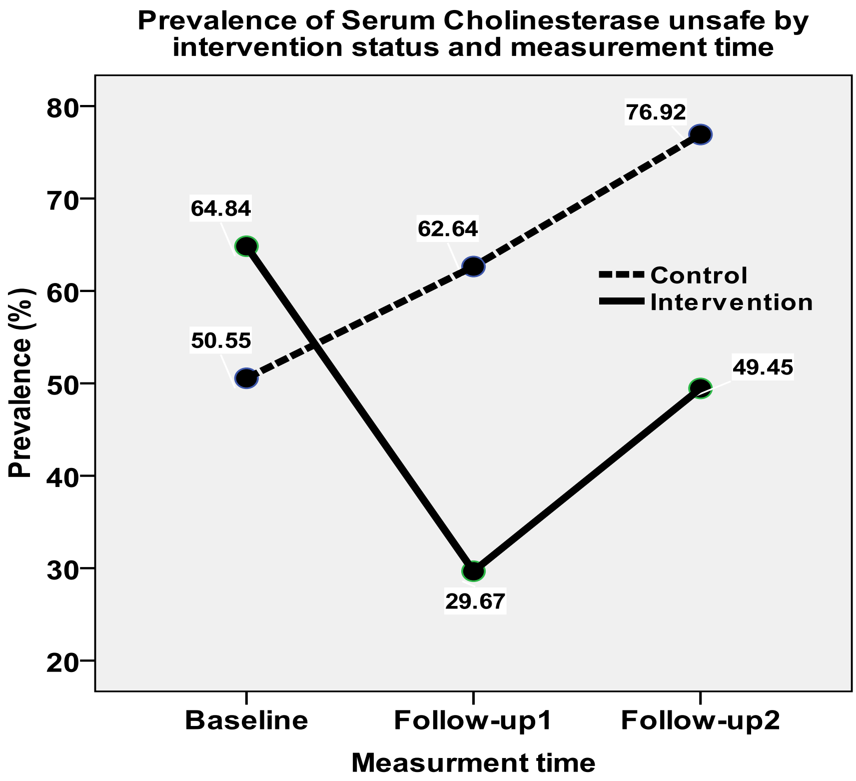


Figure34: Prevalence of Serum Cholinesterase level unsafe (%) by intervention status and measurement times

4.2a.5 Effect size and statistical significance of Pesticide Risk Reduction Program in continues dependent variables (unadjusted)

For continues dependent variables, linear mixed models were used to characterize and test the significance of intervention effects at the 2 follow-up times. The intervention had effect (unadjusted) knowledge by a mean score 4.2 ($p<0.001$) at one month and by a mean score 3.5 four months later, total attitude score by a mean score 10.5 ($p<0.001$) at one month and by a mean score 16.5 four months later, total protective behavior score by a mean score 8.7 ($p<0.001$) at one month and by a mean score 5.2 four months later except protective behavior when mixing four months after intervention as shown in table 30.

Table30: Effect size of knowledge, attitude, and practice by intervention status and measurement time

Characteristics		Baseline		Follow-up 1		Follow-up 2		Effect size (difference in difference)			
		Control (n = 91)	Intervention (n = 91)	Control (n = 91)	Intervention (n = 91)	Control (n = 91)	Intervention (n = 91)	1 month after end of intervention		4 month after end of intervention	
								Mean Change (95%CI)	P -value	Mean Change (95%CI)	P -value
Knowledge (Score)	Mean	16.0	15.2	15.5	18.9	16.0	18.8	4.2		3.5	
	SD	2.0	1.9	2.3	1.1	2.0	1.3	(3.7 – 4.7)	<0.001	(2.9 – 4.2)	<0.001
Attitude (score)											
Toward the using	Mean	27.6	25.2	31.2	32.1	29.5	32.3	3.4		5.3	
	SD	3.8	2.6	3.9	3.0	4.3	3.0	(2.6 - 4.2)	<0.001	(4.0 – 6.5)	<0.001
Toward the Seriousness	Mean	27.6	25.2	31.2	32.1	29.5	30.9	4.8		6.6	
	SD	3.7	3.8	3.9	2.6	4.3	3.0	(3.8 – 5.8)	<0.001	(5.1 – 8.0)	<0.001
Toward the benefits of taking action	Mean	32.9	30.6	33.3	33.4	31.6	33.9	2.3		4.6	
	SD	3.6	3.9	3.6	2.6	4.4	2.9	(1.8 – 2.8)	<0.001	(3.3 – 5.9)	<0.001
Total attitude score	Mean	89.4	81.5	94.7	97.4	89.7	98.4	10.5		16.5	
	SD	8.4	9.4	8.8	5.9	10.6	7.3	(8.8 – 12.2)	<0.001	(13.5 – 19.5)	<0.001
Protective behavior											
Mixing	Mean	12.5	12.6	12.6	13.3	13.4	14.0	1.3		0.4	
	SD	1.9	1.9	1.7	1.6	1.5	0.9	(1.0 – 1.6)	<0.001	(-0.2 – 0.9)	0.167
Applying	Mean	21.3	21.5	21.3	28.2	23.9	27.9	6.6		3.7	
	SD	3.8	4.7	3.8	2.5	4.5	2.7	(5.9 – 7.3)	<0.001	(2.4 – 5.1)	<0.001
After using	Mean	17.0	16.5	17.2	17.5	17.0	17.6	0.8		1.1	
	SD	1.9	2.3	1.5	0.8	1.4	0.8	(0.4 – 1.2)	<0.001	(0.6 – 1.7)	<0.001
Total protective Score	Mean	50.7	50.7	51.1	59.8	54.3	59.5	8.7		5.2	
	SD	5.9	6.5	5.7	3.0	5.8	3.5	(7.6 – 9.8)	<0.001	(3.4 – 7.1)	<0.001

Mix Model adjust repeated measure time and time interaction, Unadjusted

4.2a.6 Effect size of Pesticide Risk Reduction Program in dichotomous dependent variables (unadjusted)

For dichotomous dependent variable, Generalized Estimating Equations (GEE) were used together with generalized linear models for adjust repeated measure for differences between intervention effects at different time. The distribution was binomial and the link function was identity. The intervention program had effectively reduced prevalence of serum cholinesterase unsafe level by 47.3 percent-points ($p<0.001$) at one month and 41.8 percent-points ($p<0.001$) at four months after intervention, prevalence of neuromuscular symptom by 34.1 percent-points (<0.001) at one month and 30.8 percent-points ($p<0.001$) at four months after intervention, prevalence of respiratory symptom by 46.2 percent-points ($p<0.001$) at one month and 34.1 percent-points ($p<0.001$) at four months after intervention, prevalence of digestive symptom by 14.3 percent-points ($p=0.004$) at one month and 34.1 percent-points ($p=0.006$) at four months after intervention, prevalence of eyes symptom by 56.0 percent-points ($p<0.001$) at one month and 47.3 percent-points ($p<0.001$) at four months after intervention, and prevalence of skin symptom by 16.5 percent-points ($p<0.001$) at one month and 29.7 percent-points ($p<0.001$) at four months after intervention, as shown in table 31.

Table31: Effect size of reactive paper unsafe and prevalence of symptoms by intervention status and difference time

Characteristics		Baseline		1 month after intervention		4 month after intervention		Effects size (difference in difference)			
								1 month after end of intervention		4 month after end of intervention	
		Control (n = 91)	Intervention (n = 91)	Control (n = 91)	Intervention (n = 91)	Control (n = 91)	Intervention (n = 91)	% Change (95%CI)	P -value	%Change (95%CI)	P -value
Serum Cholinesterase	N	46	59	57	27	70	45	-47.3		-41.8	
Unsafe level	%	(50.5)	(64.8)	(62.6)	(29.7)	(76.9)	(49.5)	(-59.5 to -35.0)	<0.001	(-57.5 to -26.0)	<0.001
Symptoms											
Neuromuscular	N	35	71	44	49	37	45	-34.1		-30.8	
	%	(38.5)	(78.0)	(48.4)	(53.8)	(40.7)	(49.5)	(-45.6 to -22.5)	<0.001	(-46.4 to -15.2)	<0.001
Respiratory	N	30	557	34	19	30	26	-46.2		-34.1	
	%	(33.0)	(62.6)	(37.4)	(20.9)	(33.0)	(28.6)	(-59.4 to -32.9)	<0.001	(-50.2 to -17.9)	<0.001
Digestive	N	13	27	44	49	14	14	-14.3		-15.4	
	%	(14.3)	(29.7)	(48.4)	(53.8)	(15.4)	(15.4)	(-24.0 to - 4.5)	0.004	(-26.4 to -4.4)	0.006
Eyes	N	14	49	25	9	19	11	-56.0		-47.3	
	%	(15.4)	(53.8)	(27.5)	(9.9)	(20.9)	(12.1)	(-69.3 to -42.8)	<0.001	(-61.4 to -33.2)	<0.001
Skin	N	7	45	16	39	18	29	-16.5		-29.7	
	%	(7.7)	(49.5)	(17.6)	(42.9)	(19.8)	(31.9)	(-26.0 to -6.9)	<0.001	(-42.4 to -17.0)	<0.001

Generalized Estimating Equation with times and time interaction, Unadjusted

4.2a.7 Absolute differences and proportion of mean change of effect compare to overall baseline of knowledge, attitude, and practice by measurement time

The intervention program had effectively improved in absolute mean score compare to overall baseline of knowledge, attitude, and protective behavior all of measurement times as shown in table 32.

Table32: Absolute differences and proportion of effect compare to overall baseline of knowledge, attitude, and practice by measurement time

Charac-teristics (score)	Overall mean at baseline	Intervention effect unadjusted: 1 month after end of intervention			Intervention effect unadjusted: 4 month after end of intervention		
		Mean Change (95%CI)	P - value	Absolute (As% of baseline mean)	Mean Change (95%CI)	P - value	Absolute (As% of baseline mean)
Knowledge	15.6	4.2 (3.7 – 4.7)	<0.001	27.0	3.5 (2.9 – 4.2)	<0.001	22.5
Attitude (score)							
Toward the using	26.4	3.4 (2.6 - 4.2)	<0.001	12.9	5.3 (4.0 – 6.5)	<0.001	20.1
Toward the seriousness	27.3	4.8 (3.8 – 5.8)	<0.001	17.6	6.6 (5.1 – 8.0)	<0.001	24.1
Toward the benefits	31.7	2.3 (1.8 – 2.8)	<0.001	7.2	4.6 (3.3 – 5.9)	<0.001	14.5
Total	85.5	10.5 (8.8 – 12.2)	<0.001	12.3	16.5 (13.5 – 19.5)	<0.001	19.3
Protective behavior							
Mixing	12.6	1.3 (1.0 – 1.6)	<0.001	10.3	0.4 (-0.2 – 0.9)	0.167	3.2
Applying	21.4	6.6 (5.9 – 7.3)	<0.001	30.8	3.7 (2.4 – 5.1)	<0.001	17.3
After using	16.7	0.8 (0.4 – 1.2)	<0.001	4.8	1.1 (0.6 – 1.7)	<0.001	6.6
Total	50.7	8.7 (7.6 – 9.8)	<0.001	17.2	5.2 (3.4 – 7.1)	<0.001	10.3

4.2a.8 Absolute differences and proportion of effect compare to overall baseline of symptoms prevalence and reactive paper unsafe by measurement time

The intervention program had effectively reduced in absolute mean score compare to overall baseline of prevalence of unsafe reactive paper, neuromuscular symptoms, respiratory symptom, digestive symptom, eyes symptom, and skin symptom all of measurement times as shown in table 33.

Table33: Absolute differences and proportion of effect compare to overall baseline of symptoms prevalence and reactive paper unsafe by measurement time

Symptom In the past Week	Over all % at base line	Intervention effect unadjusted					
		1 month after end of intervention			4 month after end of intervention		
		% Change (95%CI)	P - value	Absolute (As% of baseline)	% Change (95%CI)	P - value	Absolute (As% of baseline)
paper unsafe	57.7	-47.3 (-59.5 to -35.0)	<0.001	82.0	-41.8 (-57.5 to -26.0)	<0.001	72.5
Neuro-muscular	58.2	-34.1 (-45.6 to -22.5)	<0.001	58.5	-30.8 (-46.4 to -15.2)	<0.001	71.8
Respiratory	47.8	-46.2 (-59.4 to -32.9)	<0.001	96.6	-34.1 (-50.2 to -17.9)	<0.001	64.4
Digestive	22.0	-14.3 (-24.0 to - 4.5)	0.004	65.1	-15.4 (-26.4 to -4.4)	0.006	155.2
Eyes	34.6	-56.0 (-69.3 to -42.8)	<0.001	161.8	-47.3 (-61.4 to -33.2)	<0.001	136.6
Skin	28.6	-16.5 (-26.0 to -6.9)	<0.001	57.8	-29.7 (-42.4 to -17.0)	<0.001	104.0

Generalized estimating Equation, adjust repeated measure time and time interaction

4.2b Effect size of Pesticide Risk Reduction Program (adjusted) on continuous dependent variables (adjusted)

4.2b.1 Effect size of Pesticide Risk Reduction Program on continuous dependent variables (adjusted)

At baseline, factors that had significant difference between control and intervention group were 16 factors: socio-demographic; household members, pesticide expend, and frequency of growing per year, pesticide use factors: number year as rice farmer, number year use pesticide, day use pesticide per year, average time each applying, most recent expose to pesticide, recommendation, any fungicide, and any rodenticide, history of expose to pesticide: exposed head, exposed feet, exposed inhalation, and exposed digestive in table 3 - 6 . However, to examine factors that association with both independent and dependent variables (confounding factors) for adjusting, simple regression analysis was used to examine continuous outcomes and set significant level at 0.10.

4.2b.1.1 Factors associated with knowledge

Factors associated with knowledge score were frequency of growing per year (p=0.042) and average time each applying in hour (p=0.076) as shown in table 34.

Table 34: Factors associated with knowledge score

Factor associated with intervention status	**β**	**SE**	**p-value**
Household members	-0.243	0.350	0.488
Pesticide expend	0.000	0.000	0.126
Frequency of growing per year	0.734	0.360	0.042
Number year as rice farmer (year)	-0.018	0.013	0.165
Number year use pesticide (year)	0.018	0.017	0.301
Day use pesticide per year (day)	-0.004	0.003	0.273
Average time each applying (hour)	-0.235	0.131	0.076
Day most recent expose to pesticide (day)	0.016	0.023	0.484
Family' monthly income	0.359	0.330	0.278
Recommendation	-0.302	0.339	0.374
Fungicide use	-0.891	0.857	0.299
Rodenticide use	-0.505	0.330	0.128
Exposed head	0.097	0.347	0.780
Exposed feet	0.305	0.351	0.385
Exposed inhalation	-0.348	0.347	0.315
Exposed digestive	-0.434	0.382	0.257

Factors associated with attitude toward using pesticides score were pesticide expend (p=0.037), frequency of growing per year (p=0.002), day use pesticide per year (0.078), day most recent expose to pesticides (0.064), family monthly income (0.079), recommendation (0.001), rodenticide use (0.045), and history of exposed inhalation (p=0.033) as shown in table 35.

Table 35: Factors associated with attitude toward using pesticides score

Factor associated with intervention status	**β**	**SE**	**p-value**
Household members (person)	0.498	0.620	0.423
Pesticide expend (baht)	0.000	0.000	0.037
Frequency of growing per year (time)	2.008	0.628	0.002
Number year as rice farmer (year)	0.010	0.023	0.646
Number year use pesticide (year)	0.049	0.031	0.112
Day use pesticide per year (day)	-0.011	0.006	0.078
Average time each applying (hour)	0.322	0.234	0.170
Day most recent expose to pesticide (day)	0.075	0.040	0.064
Family monthly income	1.027	0.582	0.079
Recommendation	-2.007	0.584	0.001
Fungicide use	0.571	1.524	0.708
Rodenticide use	-1.181	0.584	0.045
Exposed head	0.792	0.614	0.199
Exposed feet	-0.015	0.624	0.981
Exposed inhalation	1.302	0.607	0.033
Exposed digestive	-0.599	0.678	0.378

*Significant at p-value < 0.100

Factors associated with attitude toward serious pesticides score were frequency of growing per year (p=0.001), number year as rice farmer (p=0.084), day use pesticide per year (0.078), number year use pesticide (p=0.003), day most recent expose to pesticides (0.023), and rodenticide use (0.045) as shown in table 36.

Table 36: Factors associated with attitude toward serious score

Factor associated with intervention status	**β**	**SE**	**p-value**
Household members (person)	-0.200	0.731	0.785
Pesticide expend (baht)	0.000	0.000	0.255
Frequency of growing per year (time)	2.413	0.237	0.001
Number year as rice farmer (year)	0.046	0.026	0.084
Number year use pesticide (year)	0.108	0.035	0.003
Day use pesticide per year (day)	-0.002	0.007	0.744
Average time each applying (hour)	0.361	0.275	0.191
Day most recent expose to pesticide (day)	0.108	0.047	0.023
Family monthly income	-0.311	0.690	0.653
Recommendation	-1.050	0.705	0.138
Fungicide use	-1.274	1.792	0.478
Rodenticide use	-1.312	0.687	0.058
Exposed head	0.408	0.725	0.574
Exposed feet	-0.230	0.734	0.755
Exposed inhalation	0.678	0.721	0.348
Exposed digestive	-1.021	0.796	0.202

Factors associated with attitude toward benefit score were number year use pesticide (p=0.074), day use pesticide per year (p=0.004), average time each applying (hour)(p=0.054), day most recent expose to pesticide (0.009), recommendation (p<0.001), rodenticide use (p=0.005), and exposed inhalation (0.024) as shown in table 37.

Table 37: Factors associated with attitude toward benefit score

Factor associated with intervention status	**β**	**SE**	**p-value**
Household members (person)	0.537	0.621	0.389
Pesticide expend (baht)	0.000	0.000	0.485
Frequency of growing per year (time)	0.787	0.644	0.223
Number year as rice farmer (year)	0.035	0.022	0.126
Number year use pesticide (year)	0.055	0.031	0.074
Day use pesticide per year (day)	-0.017	0.006	0.004
Average time each applying (hour)	0.451	0.233	0.054
Day most recent expose to pesticide (day)	0.106	0.040	0.009
Family monthly income	0.174	0.588	0.768
Recommendation	-2.246	0.580	<0.001
Fungicide use	-2.069	1.520	0.175
Rodenticide use	-1.630	0.579	0.005
Exposed head	0.891	0.614	0.149
Exposed feet	-0.435	0.624	0.487
Exposed inhalation	1.384	0.607	0.024
Exposed digestive	-0.196	0.681	0.774

Factors associated with total attitude score were pesticide expend (p=0.094), frequency of growing per year (p=0.001), number year use pesticide (p=0.004), day use pesticide per year (p=0.043), average time each applying (p=0.049), most recent expose to pesticide (p=0.004), recommendation (p<0.001), and exposed inhalation (p=0.026) as shown in table 38.

Table 38: Factors associated with total attitude score

Factor associated with intervention status	**β**	**SE**	**p-value**
Household members (person)	0.834	1.531	0.586
Pesticide expend (baht)	0.000	0.000	0.094
Frequency of growing per year (time)	5.209	1.544	0.001
Number year as rice farmer (year)	0.091	0.055	0.102
Number year use pesticide (year)	0.211	0.074	0.004
Day use pesticide per year (day)	-0.031	0.015	0.043
Average time each applying (hour)	1.135	0.574	0.049
Day most recent expose to pesticide (day)	0.290	0.098	0.004
Recommendation	-5.304	1.433	<0.001
Family monthly income	0.890	1.446	0.539
Fungicide use	-2.771	3.755	0.461
Rodenticide use	-4.122	1.422	0.004
Exposed head	2.091	1.512	0.168
Exposed feet	-0.679	1.537	0.659
Exposed inhalation	3.364	1.494	0.026
Exposed digestive	-1.816	1.671	0.279

Factors associated with protective behavior when mixing pesticide score were pesticide expend (p=0.005), frequency of growing per year (p=0.026), family monthly income (p=0.090), exposed head (p<0.001), exposed feet (p=0.016), and exposed inhalation (p=0.001) as shown in table 39.

Table 39: Factors associated with protective behavior when mixing score

Factor associated with intervention status	**β**	**SE**	**p-value**
Household members (person)	-0.448	0.291	0.125
Pesticide expend (baht)	0.000	0.000	0.005
Frequency of growing per year (time)	0.673	0.300	0.026
Number year as rice farmer (year)	-0.016	0.011	0.127
Number year use pesticide (year)	-0.012	0.014	0.423
Day use pesticide per year (day)	-0.001	0.003	0.624
Average time each applying (hour)	-0.069	0.111	0.534
Day most recent expose to pesticide (day)	-0.005	0.019	0.784
Family monthly income	0.468	0.274	0.090
Recommendation	0.088	0.284	0.758
Fungicide use	0.286	0.718	0.691
Rodenticide use	0.098	0.278	0.725
Exposed head	-1.085	0.279	<0.001
Exposed feet	-0.705	0.289	0.016
Exposed inhalation	-0.991	0.280	0.001
Exposed digestive	-0.508	0.318	0.112

Factors associated with protective behavior when applying pesticide score were household members (p=0.005), pesticide expend (p=0.002), day use pesticide per year (p=0.097), average time each applying (p=0.090), any fungicide (p=048), history of expose to pesticide exposed head (0.006), exposed inhalation (p=0.001), and exposed digestive (p=0.054) as shown in table 40.

Table 40: Factors associated with protective behavior when applying score

Factor associated with intervention status	**β**	**SE**	**p-value**
Household members (person)	-1.869	0.659	0.005
Pesticide expend (baht)	0.000	0.000	0.002
Frequency of growing per year (time)	0.175	0.700	0.803
Number year as rice farmer (year)	0.004	0.024	0.877
Number year use pesticide (year)	0.304	0.033	0.302
Day use pesticide per year (day)	-0.011	0.007	0.097
Average time each applying (hour)	-0.431	0.253	0.090
Day most recent expose to pesticide (day)	-0.038	0.044	0.388
Recommendation	0.311	0.653	0.635
Family monthly income	-0.370	0.636	0.561
Fungicide use	3.263	1.636	0.048
Rodenticide use	-0.261	0.640	0.684
Exposed head	-1.805	0.650	0.006
Exposed feet	-0.488	0.676	0.471
Exposed inhalation	-2.264	0.644	0.001
Exposed digestive	-1.418	0.730	0.054

Factors associated with protective behavior after using pesticide score were household members (p=0.085), day use pesticide per year (p=0.019), rodenticide use (p=0.032), history of expose to pesticide: exposed inhalation (p=0.094), and exposed digestive (p=0.031) as shown in table 41.

Table 41: Factors associated with protective behavior after using pesticide score

Factor associated with intervention status	**β**	**SE**	**p-value**
Household members (person)	-0.581	0.336	0.085
Pesticide expend (baht)	0.000	0.000	0.154
Frequency of growing per year (time)	-0.114	0.352	0.747
Number year as rice farmer (year)	0.019	0.012	0.115
Number year use pesticide (year)	0.010	0.017	0.545
Day use pesticide per year (day)	-0.008	0.003	0.019
Average time each applying (hour)	0.093	0.128	0.468
Day most recent expose to pesticide (day)	0.018	0.022	0.425
Family monthly' income	0.252	0.320	0.432
Recommendation	-0.189	0.328	0.565
Fungicide use	0.463	0.831	0.578
Rodenticide use	-0.685	0.318	0.032
Exposed head	-0.485	0.334	0.149
Exposed feet	-0.476	0.338	0.161
Exposed inhalation	-0.560	0.332	0.094
Exposed digestive	-0.794	0.366	0.031

Factors associated with total protective behavior score were household members ($p=0.003$), pesticide expend ($p=0.001$), day use pesticide per year ($p=0.035$), any fungicide use ($p=0.093$), exposed head ($p<0.001$), exposed feet ($p=0.087$), exposed inhalation ($p<0.001$), and exposed digestive ($p=0.010$) as shown in table 42.

Table 42: Factors associated with total protective behavior score

Factor associated with intervention status	**β**	**SE**	**p-value**
Household members (person)	-2.899	0.950	0.003
Pesticide expend (baht)	0.000	0.000	0.001
Frequency of growing per year (time)	0.962	1.009	0.342
Number year as rice farmer (year)	0.007	0.035	0.844
Number year use pesticide (year)	0.033	0.048	0.495
Day use pesticide per year (day)	-0.020	0.010	0.035
Average time each applying (hour)	-0.407	0.367	0.269
Day most recent expose to pesticide (day)	-0.026	0.064	0.688
Family monthly' income	0.349	0.920	0.705
Recommendation	0.209	0.945	0.825
Fungicide use	4.011	2.372	0.093
Rodenticide use	-0.849	0.923	0.359
Exposed head	-3.374	0.933	<0.001
Exposed feet	-1.669	0.970	0.087
Exposed inhalation	-3.815	0.920	<0.001
Exposed digestive	-2.720	1.046	0.010

Mixed model analysis was used to adjust confounding factors. The intervention program had strongly effect knowledge by a mean score 4.2 ($p<0.001$) at one month after intervention and 3.5 ($p<0.001$) four months later, attitude toward using pesticide by a mean score 3.5 ($p<0.001$) at one month after intervention and 3.5 ($p<0.001$) four months later, attitude toward serious by a mean score 4.1 ($p<0.001$) at one month after intervention and 5.3 ($p<0.001$) four months later, attitude toward benefit by a mean score 1.9 ($p<0.001$) at one month after intervention and 3.4 ($p<0.001$) four months later, total attitude by a mean score 8.9 ($p<0.001$) at one month after intervention and

13.2 (p<0.001) four months later, protective when mixing by a mean score 1.4 (p<0.001) at one month after intervention , protective when applying by a mean score 6.4 (p<0.001) at one month after intervention and 4.2 (p<0.001) four months later, protective after using by a mean score 0.6 (p<0.001) at one month after intervention and 1.0 (p<0.001) four months later, and total protective by a mean score 8.6 (p<0.001) at one month after intervention and 6.2 (p<0.001) four months later as shown in table 43.

Table 43: Effect size of knowledge, attitude and practice mean score by intervention status and difference time (adjusted)

Continuous outcomes (score)	**Intervention effect adjusted confounding factors**			
	1 month after end of intervention		**4 month after end of intervention**	
	Mean change (95%CI)	**P -value**	**Mean change (95%CI)**	**P -value**
Knowledge	4.2 (3.7 -4.8)	<0.001	3.5 (2.8 – 4.3)	<0.001
Attitude use score	3.5 (2.4 – 4.5)	<0.001	4.3 (2.7 – 5.9)	<0.001
Attitude serious	4.1 (2.8 – 5.4)	<0.001	5.3 (3.4 – 7.2)	<0.001
Attitude benefit	1.9 (1.2 – 2.6)	<0.001	3.4 (1.7 – 5.1)	<0.001
Total attitude	8.9 (6.5 – 11.4)	<0.001	13.2 (8.9 – 17.5)	<0.001
Practice when Mixing	1.4 (1.0 – 1.8)	<0.001	0.4 (-0.3 – 0.9)	0.255
Practice when applying	6.4 (5.5 – 7.2)	<0.001	4.2 (2.5 – 5.9)	<0.001
Practice after Using	0.6 (0.1 – 1.1)	<0.001	1.0 (0.3 – 1.7)	0.008
Total practice	8.6 (7.4 – 9.9)	<0.001	6.2 (3.9 – 8.5)	<0.001

General linear mixed model, adjust repeated measure time, confounding factors

4.2b.2 Effect size of Pesticide Risk Reduction Program in dichotomous dependent variables (adjusted)

To examine factors associated with both independent and dependent variables (confounding factors) for adjusting, binary logistic regression analysis was used to examine dichotomous outcome and set significant level at 0.10. Factors associated with neuromuscular symptom were pesticide expend (p=0.063), number year as rice farmer (p=0.008), number year use pesticide (p=0.016), day use per year (p=0.002), day most recent expose to pesticide (p<0.001), family monthly income (p<0.002), recommendation (p=0.001), any rodenticide use (p<0.002), and exposed digestive (p=0.046) as shown in table 44.

Table 44: Factors associated with prevalence of neuromuscular symptom

Factor associated with intervention status	β	SE	p-value
Household members (person)	-0.053	0.318	0.867
Pesticide expend (baht)	0.000	0.000	0.063
Frequency of growing per year (time)	-0.528	0.329	0.109
Number year as rice farmer (year)	-0.032	0.012	0.008
Number year use pesticide (year)	-0.039	0.016	0.016
Day use pesticide per year (day)	0.014	0.005	0.002
Average time each applying (hour)	-0.048	0.120	0.687
Day most recent expose to pesticide (day)	2.228	0.329	<0.001
Family monthly' income	0.677	0.217	0.002
Recommendation	1.132	0.332	0.001
Fungicide use	0.646	0.779	0.407
Rodenticide use	0.942	0.309	0.002
Exposed head	-0.334	0.320	0.297
Exposed feet	0.502	0.319	0.115
Exposed inhalation	-1.172	0.317	0.587
Exposed digestive	0.740	0.371	0.046

Factors associated with respiratory symptom were pesticide expend (p=0.045), frequency of growing per year (p=0.003), day use pesticide per year (p<0.001), day most recent expose to pesticide (p<0.001), family monthly income (p=0.001), recommendation (p<0.001), any rodenticide (p< 0.001), history of expose to pesticide with exposed feet (p=0.003), and exposed digestive (p<0.001) as shown in table 45.

Table 45: Factors associated with prevalence of respiratory symptom

Factor associated with intervention status	**β**	**SE**	**p-value**
Household members (person)	0.480	0.316	0.129
Pesticide expend (baht)	0.000	0.000	0.045
Frequency of growing per year (time)	-1.041	0.348	0.003
Number year as rice farmer (year)	-0.009	0.011	0.451
Number year use pesticide (year)	-0.013	0.016	0.451
Day use pesticide per year (day)	0.014	0.004	<0.001
Average time each applying (hour)	0.118	0.120	0.323
Day most recent expose to pesticide (day)	1.409	0.277	<0.001
Family monthly' income	-1.047	0.308	0.001
Recommendation	1.623	0.332	<0.001
Fungicide use	1.757	1.091	0.107
Rodenticide use	1.171	0.313	<0.001
Exposed head	-0.334	0.320	0.297
Exposed feet	1.000	0.332	0.003
Exposed inhalation	0.349	0.313	0.265
Exposed digestive	1.441	0.380	<0.001

Factors associated with digestive symptom were household members (p=0.018), pesticide expend (p=0.071), frequency of growing per year (p=0.012), day use pesticide per year (p=0.009), family monthly income (p=0.005), recommendation (p<0.001), any rodenticide (p=0.016), and exposed feet (p=0.001) as shown in table 46.

Table 46: Factors associated with prevalence of digestive symptom

Factor associated with intervention status	**β**	**SE**	**p-value**
Household members (person)	-0.981	0.451	0.018
Pesticide expend (baht)	0.000	0.000	0.071
Frequency of growing per year (time)	-1.274	0.510	0.012
Number year as rice farmer (year)	-0.009	0.014	0.533
Number year use pesticide (year)	-0.014	0.019	0.471
Day use pesticide per year (day)	0.009	0.003	0.009
Average time each applying (hour)	0.176	0.141	0.211
Day most recent expose to pesticide (day)	-0.246	0.274	0.369
Family monthly' income	-1.110	0.392	0.005
Recommendation	1.715	0.391	<0.001
Fungicide use	19.986	15191.5	0.999
Rodenticide use	0.941	0.392	0.016
Exposed head	-0.567	0.365	0.121
Exposed feet	1.768	0.554	0.001
Exposed inhalation	-0.267	0.368	0.467
Exposed digestive	0.504	0.393	0.200

Factors associated with eyes symptom were pesticide expend (p=0.001), frequency of growing per year (p<0.001), number year as rice farmer (p=0.011), number year use pesticide (p=0.094), day use pesticide per year (p<0.001), most recent expose to pesticide (p=0.031), family monthly income (p=0.001), recommendation (p<0.001), any rodenticide (p<0.001), exposed feet (p=0.004), and exposed digestive (p=0.003) as shown in table 47.

Table 47: Factors associated with prevalence of eyes symptom

Factor associated with intervention status	**β**	**SE**	**p-value**
Household members (person)	0.096	0.329	0.770
Pesticide expend (baht)	0.000	0.000	0.001
Frequency of growing per year (time)	-1.618	0.443	<0.001
Number year as rice farmer (year)	-0.032	0.012	0.011
Number year use pesticide (year)	-0.028	0.017	0.094
Day use pesticide per year (day)	0.012	0.003	<0.001
Average time each applying (hour)	0.113	0.124	0.365
Day most recent expose to pesticide (day)	0.553	0.252	0.031
Family monthly’ income	-1.127	0.331	0.001
Recommendation	1.204	0.326	<0.001
Fungicide use	20.628	15191.52	0.999
Rodenticide use	1.263	0.343	<0.001
Exposed head	-0.233	0.325	0.473
Exposed feet	1.055	0.371	0.004
Exposed inhalation	0.124	0.327	0.707
Exposed digestive	1.055	0.354	0.003

Factors associated with skin symptom were pesticide expend (p=0.003), frequency of growing per year (p=0.030), number year as rice farmer (p<0.001), number year use pesticide (p=0.0001), day use pesticide per year (p<0.001), family monthly income (p=0.004), recommendation (p<0.001), any rodenticide (p<0.001), exposed feet (p=0.004), and exposed digestive (p=0.003) as shown in table 48.

Table 48: Factors associated with prevalence of skin symptom

Factor associated with intervention status	**β**	**SE**	**p-value**
Household members (person)	0.537	0.340	0.114
Pesticide expend (baht)	0.000	0.000	0.003
Frequency of growing per year (time)	-0.894	0.411	0.030
Number year as rice farmer (year)	-0.049	0.014	<0.001
Number year use pesticide (year)	-0.063	0.018	0.001
Day use pesticide per year (day)	0.018	0.004	<0.001
Average time each applying (hour)	0.074	0.131	0.573
Day most recent expose to pesticide (day)	0.207	0.262	0.430
Family monthly' income	-0.996	0.348	0.004
Recommendation	1.474	0.347	<0.001
Fungicide use	20.342	15191.51	0.999
Rodenticide use	1.327	0.373	<0.001
Exposed head	-0.235	0.341	0.491
Exposed feet	1.126	0.408	0.006
Exposed inhalation	-0.084	0.342	0.806
Exposed digestive	1.359	0.364	<0.001

Factors associated with reactive paper unsafe were frequency of growing per year (p=0.075), day use pesticide per year (p=0.002), day most recent expose to pesticide (p= 0.024), exposed head (p=0.037), and exposed digestive (p=0.038) as shown in table 49.

Table 49: Factors association with prevalence of reactive paper unsafe level

Factor associated with intervention status	β	SE	p-value
Household members (person)	-0.421	0.317	0.184
Pesticide expend (baht)	0.000	0.000	0.915
Frequency of growing per year (time)	0.611	0.343	0.075
Number year as rice farmer (year)	-0.011	0.343	0.341
Number year use pesticide (year)	-0.010	0.012	0.544
Day use pesticide per year (day)	0.013	0.016	0.002
Average time each applying (hour)	-0.085	0.004	0.480
Day most recent expose to pesticide (day)	-0.049	0.120	0.024
Family monthly' income	0.163	0.022	0.587
Recommendation	0.445	0.313	0.156
Fungicide use	1.274	0.851	0.134
Rodenticide use	0.340	0.302	0.261
Exposed head	-0.681	0.327	0.037
Exposed feet	0.164	0.318	0.606
Exposed inhalation	-0.206	0.316	0.514
Exposed digestive	0.769	0.371	0.038

Day most recent exposed to pesticide had associated with prevalence of neuromuscular symptom, respiratory symptom, eyes symptom, and serum cholinesterase unsafe level. We tried to adjusted by GEE with 7 days most recent exposed to pesticides. The intervention program had effectiveness all prevalence of neuromuscular, respiratory, digestive, eyes, skin symptoms, and prevalence of reactive paper unsafe level both one month and four months after intervention program as shown in table 50.

Table 50: Effect size of reactive paper unsafe level and prevalence of symptoms by intervention status and difference time (adjusted most recent exposed to pesticide7 days)

Dichotomous outcomes	Intervention effect when adjusted most recent exposed to pesticides			
	1 month after end of intervention		4 month after end of intervention	
	%Change (95%CI)	P -value	%Change (95%CI)	P -value
Reactive paper Unsafe level	-49.2 (-62.5 to -35.8)	<0.001	-41.6 (-59.0 to -24.3)	<0.001
Neuromuscular	-30.3 (-42.5 to -18.2)	<0.001	-31.0 (-47.4 to -14.7)	<0.001
Respiratory	-38.8 (-52.3 to -25.2)	<0.001	-28.2 (-44.7 to -11.6)	0.001
Digestive	-9.0 (-17.7 to -0.4)	<0.001	-10.6 (-21.2 to – 0.1)	0.048
Eyes	-49.3 (-62.3 to -36.6)	<0.001	-44.0 (-59.0 to -29.0)	<0.001
Skin	-13.0 (-22.8 to -3.3)	0.009	-25.0 (-11.6 to 13.4)	<0.001

Generalized estimating Equation, adjust repeated measure time and day most recent exposure

Generalized estimating equation (GEE) did not run when fully adjustment. Otherwise, the results of intervention effect were similar to unadjusted and partial adjusted in table 51.

Table 51: Compare the intervention effect between GEE and Mixed models unadjusted

Dichotomous outcome	GEE unadjusted β	Std. error	Wald Chi-square	p-value	Mixed models unadjusted β	Std. error	t	p-value
Neuromuscular symptom								
Follow-up 1	-0.341	0.590	33.37	<0.001	-0.340	0.059	-5.75	<0.001
Follow-up 2	-0.308	0796	11.93	<0.001	-0.307	0.080	-3.84	<0.001
Respiratory symptom								
Follow-up 1	-0.462	0.068	46.47	<0.001	-0.461	0.068	-6.73	<0.001
Follow-up 2	-0.341	0.083	17.03	<0.001	-0.341	0.083	-4.10	<0.001
Digestive symptom								
Follow-up 1	-0.143	0.049	8.25	0.004	-0.143	0.050	-2.86	0.005
Follow-up 2	-0.154	0.056	7.50	0.006	-0.154	0.056	-2.72	0.007
Eyes symptom								
Follow-up 1	-0.560	0.068	68.29	<0.001	-0.560	0.068	-8.21	<0.001
Follow-up 2	-0.473	0.072	43.14	<0.001	-0.472	0.072	-6.53	<0.001
Skin symptom								
Follow-up 1	-0.165	0.049	11.41	0.001	-0.165	0.049	-3.63	0.001
Follow-up 2	-0.297	0.065	20.91	<0.001	-0.297	0.065	-4.55	<0.001
Reactive paper unsafe level								
Follow-up 1	-0.473	0.063	57.04	<0.001	-0.472	0.062	-7.51	<0.001
Follow-up 2	-0.418	0.080	29.98	<0.001	-0.417	0.080	-5.17	<0.001

The effectiveness of intervention program when compared between GEE and Mixed models when adjusted day most recent exposure were similar as shown in table 52.

Table 52: Compare the intervention effect between GEE and Mixed models unadjusted

Dichotomous outcome	GEE adjusted day most recent expose to pesticide				Mixed models adjusted day most recent expose to pesticide			
	β	**Std. error**	**Wald Chi-square**	**p-value**	**β**	**Std. error**	**t**	**p-value**
Neuromuscular symptom								
Follow-up 1	-0.303	0.061	24.02	<0.001	-0.282	0.062	-4.56	0.001
Follow-up 2	-0.310	0.083	13.83	<0.001	-0.287	0.083	-3.45	<0.001
Respiratory symptom								
Follow-up 1	-0.388	0.069	31.28	<0.001	-0.391	0.070	-5.58	<0.001
Follow-up 2	-0.282	0.084	11.12	0.001	-0.283	0.861	-3.29	0.001
Digestive symptom								
Follow-up 1	-0.090	0.044	4.17	0.041	-0.112	0.051	-2.17	0.031
Follow-up 2	-0.106	0.053	3.92	0.048	-0.119	0.061	-1.96	0.052
Eyes symptom								
Follow-up 1	-0.049	0.066	55.35	<0.001	-0.500	0.070	-7.10	<0.001
Follow-up 2	-0.440	0.078	32.86	<0.001	-0.430	0.078	-5.53	<0.001
Skin symptom								
Follow-up 1	-0.130	0.050	6.83	0.009	-0.137	0.051	-2.70	0.008
Follow-up 2	-0.250	0.068	13.40	<0.001	-0.267	0.070	-3.82	<0.001
Reactive paper unsafe level								
Follow-up 1	-0.492	0.068	52.11	<0.001	-0.473	0.068	-7.09	<0.001
Follow-up 2	-0.416	0.088	22.25	<0.001	-0.401	0.088	-4.54	<0.001

Finally the full adjustment in this study was used mixed model analysis to test the effectiveness of the intervention program. The intervention program had reduced the prevalence of reactive paper unsafe level by 56.2 percent-points ($p < 0.001$) at one month and 44.6 percent-points at four months after intervention, prevalence of neuromuscular symptom by 27.8 percent-points ($p = 0.001$) at one month and 25.0 percent-points at four months after intervention, prevalence of respiratory symptom by 25.4 percent-points (p = 0.003) at one month after intervention, prevalence of eyes symptom by 34.3 percent-points (p = 0.001) at one month after intervention as shown in table 53.

Table 53: Effect size of reactive paper unsafe level and prevalence of symptoms by intervention status and difference time (adjusted)

Dichotomous outcomes	**Intervention effect when adjusted confounding factors**			
	1 month after end of intervention		**4 month after end of intervention**	
	%Change (95%CI)	**P -value**	**%Change (95%CI)**	**P -value**
Reactive paper Unsafe level	-56.2 (-70.8 to -41.7)	<0.001	-44.6 (-64.5 to -24.6)	<0.001
Neuromuscular	-27.8 (-43.8 to -11.8)	0.001	-25.0 (-45.7 to -4.2)	0.019
Respiratory	-25.4 (-41.9 to -8.9)	0.003	-14.7 (-35.3 to 5.8)	0.159
Digestive	-8.1 (-19.8 to 3.5)	0.172	-10.8 (-24.8 to 3.1)	0.128
Eyes	-34.3 (-53.6 to -15.1)	0.001	-16.6 (-36.8 to 3.7)	0.109
Skin	2.2 (-11.4 to 15.9)	0.749	-14.7 (-33.4 to 3.9)	0.121

General linear mixed model, adjusted

CHAPTER V

DISCUSSION AND RECOMMENDATIONS

5.1 Conclusions and Discussion of the results

This quasi-experimental study investigated the effectiveness of a pesticide risk reduction program (PRRP) on pesticide use among rice farmers in kongkrailat district, Sukhothai province, Thailand. The experimental group was in Banmaisukasame sub-district and the control group was in Kokrat sub-district. Evaluation the effectiveness of the program was accomplished by measuring outcomes pre- and two times post-intervention (the first month and fourth month after the intervention program), using standardized questionnaires and reactive paper assays.

All the participants attended at all measurement times. The average age and farm size were similar in both the groups. The years of rice farming, pesticide expenditure in last year, years of application of pesticides, number of days of pesticide use per year, and duration of each application showed statistically significant difference between the intervention and control groups. The years of rice farming, years of application of pesticides, and duration of each application were higher in the control group. On the other hand, the average expenditure for pesticides and number of days of pesticide use per year was higher in the intervention group.

In both the intervention and control groups, the majority were females. Gender, marital status, education, and family’s monthly income showed no statistically significant difference between the control and intervention groups. Both the groups had less than four household members on average. Most of the subjects in the intervention and control groups were married, and most of them had an education level of primary school or less. The frequency of cultivation showed a significant difference between groups. The control group had farming three times per year higher than the intervention group. Most of the intervention and control groups had never been trained in pesticide use (95.6%). All of them had the duty of handling, mixing, and spraying, and mixed more than three kinds of pesticides. The intervention group mixed pesticides at a level higher than the recommended level.

Pesticide use history in rice farms was divided into five classes, including herbicide, insecticide, fungicide, rodenticide, and other pesticides. The herbicides that were frequently used by subjects in the intervention and control groups, respectively, were as follows: 2-4D sodium salt (95.6 and 84.6%), glyphosate (98.9 and 89.8%), and butarchlor (87.9 and 70.3%). Many of the insecticide family names were used in rice farms by both intervention and control groups. The most common insecticides used by both the groups were chlorpyrefos (control: 89.0% and intervention: 97.8%) and abamectin (control: 98.9% and intervention: 98.9%). Most of them used insecticides by family names, such as organophosphate (OP) and carbamate groups. The most commonly used insecticide of the family carbamate was methomyl. There was no significant difference between groups in the use of OP and carbamate insecticide families. Common names of fungicide used were propiconazole, cabendazim, hexaconazole, copper hydroxide, propinap, validamycin, and tricyclazole. The most common names of fungicide used in the intervention and control groups were propiconazole. Most of fungicide's common names had significant difference in control and intervention groups except validamycin that were similar in both groups. The use of the rodenticide zinc phosphide was significantly higher in the intervention group (69.2%) than the control group (34.1%). There were no significant differences with respect to bio-pesticide use between the intervention and control groups.

History of exposure to pesticides when using as well as exposure of arms and legs to pesticides showed no significant difference between the control and intervention groups. The control group reported higher frequencies of exposure of head and face to pesticides and inhalation than the intervention group. On the other hand, the intervention group reported higher frequency of exposure of feet and digestive system to pesticides.

At baseline, the practice mean scores when mixing, when applying, and after using pesticides, as well as the total scores exhibited no significant difference between the control and intervention groups. At 1 month and 4 months after intervention, the intervention group presented higher mean and total scores when mixing, when applying, and after using pesticides than the control. Prevalence of neuromuscular symptoms was higher in the intervention group at baseline, 1 month after intervention, and 4 months later. Otherwise, in intervention group, it had decreased at one month after intervention and 4 month later.

The program was effective regarding knowledge, attitude, practice score of pesticides use, and reactive paper unsafe level both one month and 4 months after intervention program.

The program had good effect on some symptoms such as neuromuscular and respiratory. But interpretation of findings on symptoms is less clear, because baseline symptom prevalence was considerably higher in intervention group than control.

Also, fully adjusted models for symptoms were run using linear mixed models, not GEE models. Further discussion of this point is presented below.

The messages of the intervention program were designed by the researchers using pre-test data from intervention area to formative self or cultural background such pesticide class and common name, protective behavior that were the current of risk. The messengers were supported by health workers in Kongkrailat district, Kongkrailat hospital, and experts from the ninth Bureau of Control and Prevention, Phisanuloke Province, Ministry of Public Health.The media were the pesticides handbook, VDO, power point presentation, and field application in the intervention area.

Learning with colleague workers such as PPE used, history of pesticides use 4 times groups learning in the communities were implement, which were different from those employed in other studies.

To the best of the researchers' knowledge, this is the first pesticide-related intervention study in Thailand to assess intervention effects at 2 follow-up times.

The intervention program combined several components. It was not possible to formally evaluate the relative importance of these components in bringing about the overall beneficial effect of the intervention. Such evaluation would require several separate interventions, each limited to only one component. In such a design, each separate intervention would constitute its own arm of the data analysis.

General linear model repeated measure ANOVA was used to test the overall effectiveness of the program by group activities. It was found that the intervention program had accomplished the practice of wearing plastic gloves during mixing of pesticides and washing hands immediately after mixing. In addition, the intervention program made the farmers to wear hat, use mask, wear goggles, wear boots, and wear plastic gloves during application of pesticides. With regard to practices after application of pesticides, the intervention program was effective in making the farmers clean spray equipments away from the source of utilized water. After adjusting for repeated measure time, time of interaction, and confounding factors by general linear mixed model, it was found that the intervention program had greatly improved the protective behavior score when mixing at one month after intervention, when applying, after using and total protective behavior in both measurement times accept practice when mixing at four months after end of intervention. When adjusted for repeated measure time, time interaction, and most recent exposure to pesticides by generalized estimated equation, the intervention program was associated with overall reduction in neuromuscular symptom prevalence.

The findings of this study show that pesticide risk reduction program was effective in improving the protective behavior score of pesticide use by rice farmers both 1 month and 4 months after the intervention, except for practice when mixing 4 months after intervention.

World Health Organization (WHO) has mentioned the importance of educating the public as well as agriculture and health-care workers about health risks. Public education programs have been found to increase the farmer' realization of the serious health consequences associated with the rational use of pesticides (Macini et al., 2005); raise awareness of farmers on hazardous pesticide use and encourage them to use low toxic pesticides (Food and fertilizer technology center for the Asian and Pacific region, 2004); reduce the total of pesticides used; increase the use of Personal protective equipment (PPE) (Perry and Layde, 2003); read the pesticide label before application (Prochaska, 1998); and create awareness among pesticide users on the potential hazard associated with indiscriminate use of pesticides (Mendel et al., 2000). Pesticide Risk Reduction Program (PRRP) was developed base on cognitive social psychological model (CSPM) used for understanding behavior to do with health risk, theorized that behavior decisions are made indirectly, based on the relationship among a range of factors; attitude, subjective norm, perceived behavior control, and the intention to behave in a particular way. Such multidimensional perception of risk was the plan of the intervention program in the present research. The messages of the intervention program were particularly designed by the researchers using some of the data from baseline to formative self or cultural background (Langford et al, 2000) in the intervention area, such as pesticides class, family name, and history of pesticide poisoning. The risk communication factors; the audience, messenger, message, medium (Fessenden-Raden et al., 1987) were concern in the intervention program. The messengers were supported by health workers in Kongkrailat public health office, Kongkrailat hospital, and experts from the ninth Bureau of Control and Prevention, Phitsanuloke Province, Ministry of Public Health. Materials included pesticide handbooks, posters, and power point presentation. Field application and learning with colleague workers were implemented, which were different from those employed in other studies. The time period of rice farming was about 105 days. The highest frequency of cultivation was three times per year. Thus, periods of 1 month and 4 months were appropriate to test the effectiveness of the program. Similarly, the time of farming was the first criteria for selected groups of participants. The measurement of serum cholinesterase followed the guideline of the Ministry of Public Health (Division of Occupational Health, 1986). It was done by nurses from 2 health centers.

Overall factors association with serum cholinesterase level were household member ($p=0.015$), day most recent expose to pesticide ($p=0.002$), history of exposed head and face ($p=0.005$).The prevalence of unsafe reactive paper was higher in the intervention than control group at base line. The study found that day most recent exposure to pesticide associated with serum cholinesterase (Kachaiyaphum et al., 2010). The intervention group had average day most recent (4.49 days) lower than control group (9.19 days). Overall average day most recent pesticides exposure was 6.84 days at baseline, 5.56 days at one month after intervention, and 6.9 days at four month later, showed difference between the control and intervention group, and association with attitude toward use scores ($p=0.023$), total attitude scores ($p=0.004$), and prevalence of unsafe reactive paper ($p=0.002$). There was negative direction association between day most recent and prevalence of neuromuscular symptom at baseline ($\beta = -0.307$, $p<0.001$). The fully adjusted generalized estimating equation (GEE) models did not run (they either did not converge, or computational matrices were not positive definite). Otherwise, when compared the results of unsafe paper between generalized estimating equation (GEE) and mixed models unadjusted and partially adjusted (day most recent exposure to pesticides), and the adjustment of day most recent expose to pesticides in this study was 5 days. The intervention effects were similar in both unadjusted and partially adjusted.

Linear mixed models were employed to test for fully adjusted intervention effects on both continuous and dichotomous outcomes. Mixed models are entirely appropriate for continuous outcomes. Binomial or poisson models are generally preferred for dichotomous outcomes. In this analysis, binomial models were used to test unadjusted and partially adjusted effects of intervention. Binomial models for full adjustment did not converge, and thus could not be used for full adjustment. Before using mixed models for full adjustment, results of binomial and mixed modeling were compared for unadjusted and partially adjusted intervention effects. The two types of models gave very similar results regarding both magnitude and statistical significance of intervention effects. Thus, it is highly likely that mixed models gave accurate estimates of magnitude and significance of fully adjusted intervention effects. Before adjustment was found that the program had statistically significant effects all symptoms prevalence and reactive paper unsafe level all measurement times. Otherwise, fully adjusted intervention effects were found that the intervention had statistically significant effects on reactive unsafe level, neuromuscular symptoms both follow-up times, respiratory and eyes symptoms at one month after intervention.

Prevalence of symptoms was higher in the intervention group than the control group at baseline. It was found that the number of days of pesticides use was higher in the intervention group than the control. The number of days of pesticides use was associated with the symptoms, while the most recent exposure to pesticides had a strong association with intervention status, measurement time, and symptoms (Kammel et al., 2005, and Markmee and Chapman 2010). As recall bias might occur for long period of measurement, so the researcher analyzed only symptoms reported in the past week. After adjusting overall confounding factors, it was found that the intervention program was effective in reducing the prevalence of neuromuscular symptoms both 1 month and 4 months after the intervention, and respiratory and eyes symptoms at one month after intervention.

5.2 Limitations

5.2.1 Serum cholinesterase by reactive paper is a metric of exposure only to cholinesterase inhibiting pesticides (organophosphates and carbamates). It does not reflect exposure to all pesticides. The reactive paper finger-blood test is a screening test, which should be confirmed by the Biggs or Ellman method. Ideally, the blood test should be performed twice; once for baseline testing to determine the body' normal cholinesterase level, and with the first 3 days of pesticide spraying, or no later than 30 day after the spraying period (Division of Occupational Health, 1986). Otherwise, most rice farmers applied 3 or more kinds of pesticides in each application, and most of them used at least one kind of organophosphate or carbamate insecticide in each application.

5.2.2 Self-reported symptoms in this study were measured neuromuscular, respiratory, digestive, eyes, and skin symptoms that occurred during or 24 h after using pesticides. Recall bias might occur for long period of measurement time.

5.2.3 The intervention was generally associated with reduction in prevalence of pesticide-related symptoms. In unadjusted and partially adjusted models, the intervention was clearly associated with such reduction. In fully adjusted models, such associations persisted, but were not quite as strong or significant as in unadjusted or partially adjusted models. At the same time, as mentioned above, baseline symptoms prevalence were consistently higher in the intervention group than the control group. It is therefore conceivable that the apparent beneficial effect of the intervention on symptom prevalence could have been attributable partly to regression of prevalence to the mean in the intervention group from baseline to follow-up. The extent to which such regression to the mean may have influenced observed intervention effects on symptom prevalence cannot be quantified.

To minimize this issue in future research, randomized studies of interventions, as opposed to the quasi-experimental research reported here, would be desirable. Also, in future quasi-experimental studies of such interventions, effort should be made to ensure that baseline symptom rates do not differ substantially between the intervention and the control groups.

5.3 Recommendations

This intervention program should be implemented in other rice farm areas, as well as other agricultural areas. The success of this program likely depends on the risk communication factors, including audiences, messages, medium, and messengers.

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

This intervention program should be implemented in other rice farm areas. The success of this program depends on the risk communication factors, including audiences, messages, medium, and messengers. In addition, further studies testing the effectiveness of the intervention programs should evaluate health risk such symptom prevalence by the effects of each pesticide classes or common names such herbicide, fungicide and rodenticide, and some biological of herbicide exposure such should be implement. Multi-health risk of pesticides exposure, long term health effects should be concerned. Some personal protective equipment had not appropriate or uncomfortable to use.

Occupational authorities should provide appropriate personal protective equipment and promote the rice farmers to use for preventing their health risk both acute and chronic health effects.

Finally, further research to evaluate the separate components of this multi-faceted intervention should be considered, in an effort to identify the most effective component(s), and thereby develop maximally cost-effective pesticide-related interventions in the future.

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APPENDICS

APPENDIX A

QUESTIONNAIRES PHASE 1 PRETEST QUETIONNIRE(ENGLISH)

Rice Farmers Questionnaires

Interviewer id □□

Subject id □□□

Please check (/) on the only one answer below:

Part 1: General data and demographic factors

1. What is today………………………………..mm/dd/yyyy?

Socio-demographic characteristics of farmers:

1.) How old are you?………………….years.

2.) Gender: 1. Male [ ] 2. Female [ ]

3. How many persons in your family?……………….persons

4.) Marital status
- 1. Single [ ]
- 2. Married [ ]
- 3. Divorced/ separated [ ]
- 4. Widow [ ]

5.) Your highest education level:
- 1. Illiteracy [ ]
- 2. Primary school [ ]
- 3. Secondary school [ ]
- 4. High school [ ]
- 5. More than high school [ ]

6.) Your family' monthly income

[ ] < 10,000 baht [ ] 10,000 – 20,000 baht

[ ] 20,001- 30,000 baht [ ] > 30,000 baht

7.) Last year, have you ever grown other crops?

[ ] Never [ ] Ever please specific………………………………….

8). How long have you been a rice farmer? …………years (or months – specify)

9.) Status of your rice farm area

[ ] Owner [ ] Rent [ ] both owner and rent

10.) How many farm size you have?................................rai

11. Average time you had rice farm per year……………….times

12. How much your payment of pesticide last year? (Exclude hormone).……... baht

13.) Have you ever been trained in application of pesticides by the government agency such as Ministry of agriculture, Ministry of public health?

[ ] 1.) Yes, if yes how long since your most recent training?……year

[ ] 2.) No

Part 2 Health Status information

14). what is your smoking status?

[ ] Never

[ ] Past

[ ] Current smoking

15). what is your alcohol use?

[ ] Never

[ ] less than or equal 3 times per month

[ ] 1-4 times per week

[ ] every/almost every day

16.) **Last year**, how many times you had visit doctors or health workers?

[ ] Never [ ] Ever ……………………times

17.) Please answer “No” or “Yes” for each.

Has a doctor ever told you that you had (been diagnosed with)?

Condition	**No**	**Yes**
1. Rheumatoid arthritis	[ ]	[ ]
2. Heart disease	[ ]	[ ]
3. Hypertension	[ ]	[ ]
4. Chronic bronchitis	[ ]	[ ]
5. Emphysema	[ ]	[ ]
6. Tuberculosis	[ ]	[ ]
7. Asthma	[ ]	[ ]
8. Pneumonia	[ ]	[ ]
9. Diabetes	[ ]	[ ]
10. Thyroid disease	[ ]	[ ]
11. Chronic kidney disease, including infections	[ ]	[ ]
12. liver disease	[ ]	[ ]
13. Head injury requiring medical attention	[ ]	[ ]
14. Other please specify……………………………….	[ ]	[ ]

Part 3 Pesticide use information

18.) For how long have you used pesticides, of any kind, in your farming?
(Count applying and mixing pesticides.) …………. years (or months – specify**)**

19.) In the last year, you have used pesticides during a total of about how many days?
(Count all types of pesticide use, including mixing and applying) ……………days

20.) On average, when you use pesticides, you use them for about how many hours? …………….hours

21.) Which part(s) of your body were mostly exposed to pesticide in each use last year? (Mark all that apply)

[ ] Head and/or face
[ ] Arms/hand
[ ] Legs/Groin area
[ ] Feet
[ ] Chest/back/abdomen
[ ] Digestive tract (from ingesting/swallowing)

22.) The pesticide concentration that you mix or apply is usually

[ ] Less than recommended
[ ] Same as recommended
[ ] More than recommended

23.) The number of pesticides usually used when you mix or apply pesticides. (Check only one choice.)

[ ] Only one kind
[ ] Two kinds
[ ] Three kinds or more

24. For following pesticides, be sure to answer ("Yes" or "No") for each pesticide listed.

Name of Pesticide	**Common Name**	**Have you ever personal mixed or applied this pesticide in last year.**
1. Herbicide		( ) Yes ( ) No
	1.1 2,4D	( ) Yes ( ) No
	1.2 Paraquat	( ) Yes ( ) No
	1.3 Glyphosate	( ) Yes ( ) No
	1.4.Butachlor - Propranyl	( ) Yes ( ) No
	1.5 Atrazine	( ) Yes ( ) No
	1.5Other specify……………..	( ) Yes ( ) No
2. Insecticide		( ) Yes ( ) No
2.1 Organophosphate	2.1.1Chlorpyrifos	( ) Yes ( ) No
	2.1.2Acephase	( ) Yes ( ) No
	2.1.3Triazophos	( ) Yes ( ) No
	2.1.4Omethoate	( ) Yes ( ) No
	2.1.5Phethoate	( ) Yes ( ) No
	2.1.6 specify………………….	( ) Yes ( ) No
2.2 Carbamate	2.2.1 Fenobucarb	( ) Yes ( ) No
	2.2.2Carbaryl	( ) Yes ( ) No
	2.2.3Cabendazin	( ) Yes ( ) No
	2.2.4Abamectin	( ) Yes ( ) No
	2.2.5Methomyl	( ) Yes ( ) No

Name of Pesticide	Common Name	**Have you ever personal mixed or applied this pesticide in last year.**
2.2 Carbamate	2.2.6 Cartaphydrochloride	( ) Yes ( ) No
	2.2.7 Cabosulfan	( ) Yes ( ) No
	2.2.8 other specify……………..	( ) Yes ( ) No
2.3 Pyrethroid	2.3.1 Cypermethrin	( ) Yes ( ) No
2.4 Neonicotinoid	2.4.1 Thiamethoxam	( ) Yes ( ) No
	2.4.2 imidaclopid	( ) Yes ( ) No
	2.4.3 other specify………….	( ) Yes ( ) No
2.5 Other specify		( ) Yes ( ) No
3. Fungicide	3.1Propiconazole	( ) Yes ( ) No
	3.2 Carbendazim	( ) Yes ( ) No
	3.3Hexaconazole	( ) Yes ( ) No
	3.4Validamycin	( ) Yes ( ) No
	3.5Copper hydroxide	( ) Yes ( ) No
	3.6propineb	( ) Yes ( ) No
	3.7Phosphonic acid	( ) Yes ( ) No
	3.8 other specify………….	( ) Yes ( ) No
4. Rodenticide	4.1Zinc phosphide	( ) Yes ( ) No
	4.2Bromadiolone	( ) Yes ( ) No
5. Other	5.1Bio pesticide	( ) Yes ( ) No
	5.2 other specify………….	( ) Yes ( ) No

Part 4 Knowledge of pesticide use

statement	Yes	No	know	Unknown
1.Most of route of pesticide exposure is dermal exposure.				
2.  in the label refer to use equipment protect eyes.				
3.  in the label refer to use equipment to protect nose and mouse.				
4.  in the label refer to use glove to protect hand				
5. After applying pesticide, changing your cloth and immediately take a bath cannot protect pesticide poisoning.				
6. Use normal cloth to close mouse and nose can protect pesticide for respiratory exposure.				
7. You can smoke, drink water or eat food while mixing or applying pesticide.				
8.Use cloth glove or normal medical glove can protect your hand from pesticide.				
9. Color stria in the bottom of label shows hazardous of pesticide for example red stria refers to extremely hazard.				
10. Take anti histamine such dimenhydrinate before mixing or applying can protect pesticide poisoning.				
11. While mixing pesticide, it is not necessary to use groves and mask, because of using few times.				
12. Applying pesticide for a long time makes your body have immunization for pesticide poisoning.				

Statement	Yes	No	know	Unknown
13. Routes of entry of pesticide are oral, dermal and inhalation.				
14. Some types of pesticides can cause cancer if you have little exposed and long term exposure.				
15. Read label carefully before mixing and applying is necessary.				
16. Take a bath immediately can reduce pesticide poisoning.				
17. Always use personal protective equipment while applying pesticide.				
18. Washing work cloths should separately out of normal cloths.				
19. Use more quantity of pesticide but short time has no hazard.				
20. Appropriate time for applying pesticide is morning and evening.				

Part 5 Attitude of pesticide use

Instruction: Interviewer gives a check mark (/) in the bracket corresponding to interviewee's feeling, opinion or belief. You can choose only one answer by having the criteria as follow.

Strongly agree means rice farmers thought that the massage was coincide with his or her feeling, opinion or belief following his perception the most.

Agree means rice farmers thought that the massage was coincide with his or her feeling, opinion or belief following his perception.

Uncertain means rice farmers uncertain with the massage in that sentence which was coincided or against his feeling, opinion or belief following perception.

Disagree means rice farmers thought the massage opposes his or her feeling, opinion or belief following his perception.

Strongly disagree means rice farmers thought the massage opposes all of his or her feeling, opinion or belief following his perception.

Part 5 divided into 3 sections

Section 1: Attitude toward the using pesticides 10 questions

Section 2: Attitude toward the seriousness in using pesticides 10 questions

Section 3: Attitude toward the benefits of taking action and barriers to take action in using pesticides 10 question

Section5. 1: Attitude toward the using pesticides

Statement	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1. Although your health is strong, if you get the pesticide, it will have the opportunity to allergic to pesticides.					
2. Using bare hand mix pesticide, it doesn't make pesticide allergy.					
3. The person who has ever had pesticide allergy will have the immunity and not sick again.					
4. After crop-dusting pesticides, if you eat something without cleaning our hand, you will be able to allergic to pesticides.					
5. After crop-dusting pesticides, although you don't take a bath, cleaning your cloths can protect from allergy.					
6. Using only one kind of pesticide will be safer than multiple pesticides mixing.					
7. You can eat or drink something safety at crop-dusted pesticide area.					

Statement	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
8. If your health is strong, you will be able to smoke while you are crop-dusting pesticide.					
9. Crop-dusting above the wind has the opportunity to have allergy less than against the wind.					
10. The vessel containing pesticide after cleaned already can bring to use safety.					

Section 5.2: Attitude toward the seriousness in using pesticides

Statement	Strongly Agree	Agree	Uncertain	Dis agree	Strongly Disagree
1. Intensity of pesticides can make agriculturist dangerous and die finally.					
2. Danger from pesticide is so dangerous that unable to protect or cure anyway.					
3. If you often crop-dust or touch the pesticides, you will have the opportunity to paralyze temporarily.					
4. The first step, if the intense pesticide is split on your body, you should go to the hospital immediately.					
5. Some pesticides will not be harmful to body.					
6. The person who is allergic to pesticide may have other disease intervened easily.					

Statement	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
7. Using pesticide for a long time will not be harmful to the body because it can destroy the poison.					
8. Pesticide a\can cause the cancer.					
9. Crop-dusting pesticide several years, the body can endure to the poison better.					
10. All of pesticide are intense and dangerous to the body unequally.					

Section5.3: Attitude toward the benefits of taking and barriers to taking action in using pesticides.

Statement	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1. If you wear only long shirt and trousers to crop-dust, you will be comfortable and not oppressed to work but it risks to be allergic to pesticides.					
2. Smoking together with crop-dusting is very dangerous for health but you can smoke after you stop crop-dusting for a while.					
3. Wearing surgeon’s mask while you are crop-dusting, you will breathe uncomfortable and hot but you can ensure in safety.					

Statement	**Strongly Agree**	**Agree**	**Uncertain**	**Disagree**	**Strongly Disagree**
4. Wearing rubber gloves while crop-dusting is necessary but you are annoyed and slip.					
5. Buying equipment to protect all danger, although it is expensive, it is worth for paying.					
6. Preparing complete suits such as hat, gloves, bots, mask, apron etc. to protect the danger should be set but it is trouble. So it is rarely used.					
7. Wearing boots for working will make you walk slowly but it can more protect pesticide.					
8. Taking a bath immediately after crop-dusting can reduce the danger but there is not much water in the countryside, so agriculturists seldom do it.					
9. Separating the clothes worn to crop-dust from others in the family is wasteful but everyone will be safe.					
10. Using mouth to blow, when the nozzle is choked, is dangerous but it is the fast and comfortable method to help obstruction to come of easily.					

Part 6 Protective behaviors in pesticide use

Introduction: Interviewer checks (/) in the bracket, according to the respondent's answer, following criteria:

Always or usually done means the farmer practice preventive behavior every time or 7 or more of 10 times for using pesticides

Sometimes done means the farmer sometimes practice preventive behavior when using pesticide 4 to 6 from 10 times of using pesticide

Rarely done means the farmer rarely practice preventive behavior when he uses pesticide or doing 1 to 3 from 10 times of using pesticides.

Never done means the farmer never practice preventive behavior when using pesticide

6.1. While using the pesticides

6.1.1 Mixing the pesticides

Activities	Always	Sometimes	Rarely	Never
1. Wear the plastic gloves during the mixing				
2. Cover your nose during the mixing				
3. Mix the pesticides as indicated on the labels				
4. Use stick to stir the pesticide mixers				
5. Wash your hand after mixing immediately				

6.1.2 Applying the pesticides

Activities		Always	Sometimes	Rarely	Never
6.	Wear the hat during the spraying				
7.	Use mask to cover nose and mouth				
8.	Wear eyeglasses				
9.	Wear boots				
10	Wear plastic gloves				
11.	Wear long sleeves shirt				
12.	Wear coverall				
13.	Smoke cigarette or chew gums				
14.	Drink water or eat food				
15.	Spray in the same direction of wind				
16.	Spray the pesticide and walk backward				
17.	Spray only in the windless and less strong sunlight time				

6.2 .After using it

Activities		Always	Sometimes	Rarely	Never
18.	Clean your hands with detergent or soap immediately after using it.				
19.	Change your clothes immediately when you arrive home.				
20.	Take a bath immediately after arriving home.				
21	Washing work clothes separately out of normal clothes.				
22.	Wash (clean_ protective equipment after using.)				
23.	Clean spray equipment away from the source of utilized water.				

Part 7: Pesticide related symptoms

Did you experience symptoms in last months during or after 24 hours after applying pesticide as indicated below?

Introduction: Interviewer checks (/) in the bracket

- If you had symptoms before or after 24 hours after pesticide uses mean that you have no symptoms. Please checks (/) in the bracket "No"
- If you had symptoms during or 24 hours after pesticide uses mean that you have no symptoms. Please checks (/) in the bracket "Yes"

Symptoms	**a). last week**		**b.) last month**	
	Yes	**No**	**Yes**	**No**
Neuromuscular				
1. dizziness				
2. headache				
3. twitching eyelids				
4. blurred vision				
5. insomnia				
6. staggering gait				
7. seizure				
8. shaky heart (irregular rhythm)				
9. exhaustion				
10. sweating				
11. muscle weakness				
12. tremor				
13. muscle cramps				
14. excessive salivation				
15. numbness				

Symptoms	**a). last week**		**b.) last month**	
	Yes	**No**	**Yes**	**No**
Respiratory				
16. burning nose				
17. nose bleed				
18. Runny nose				
19. dry throat				
20. sore throat				
21. Cough				
22. chest pain (tightness or burning)				
23. Wheezing				
Digestive				
24. Nausea				
25. Diarrhea				
26. stomach cramps				
Eye				
27. burning-stinging- itchy eyes				
28. red eyes				
29. Excessive tearing				
Skin				
30. Skin rash				
31. itchy skin				

Part 8 Level

Level of Serum Cholinesterase	**a). at baseline**	**b.) 1 month after intervention**	**c.) 4 month after intervention**
	Date………….	Date…………	Date………
Unsafe			
Risky			
Safety			
Normal			

APPENDIX B

QUESTIONNAIRES (THAI)

แบบสำรวจข้อมูลรายบุคคล
ผู้ใช้สารเคมีกำจัดศัตรูพืชในชาวนา
อำเภอกงไกรลาศ จังหวัดสุโขทัย

เลขที่ผู้สัมภาษณ์ ☐☐

เลขที่แบบสัมภาษณ์ ☐☐☐

บ้านเลขที่................หมู่ที่…………..ตำบล.................................. อำเภอกงไกรลาศ จังหวัดสุโขทัย

วันที่สัมภาษณ์ วันที่...........เดือน.........................พ.ศ..................ชื่อผู้สำรวจ................................

ส่วนที่ 1 ข้อมูลทั่วไปและข้อมูลส่วนบุคคล กรุณากาเครื่องหมาย (/) ที่ท่านต้องการตอบข้างล่างนี้

1.)ปัจจุบันท่านมีอายุ………………..ปี	SO1
2.) เพศ ( ) 1. ชาย ( ) 2. หญิง	SO2
3.)จำนวนสมาชิกในครัวเรือนทั้งหมด………….คน	SO3
4.) สถานภาพสมรส ( ) 1. โสด ( ) 2. สมรส ( ) 3. หย่า/แยกกันอยู่ ( ) 4. หม้าย	SO4
5.) ระดับการศึกษาสูงสุด ( )1. ไม่ได้เรียน ( ) 2. ประถมศึกษา ( )3. มัธยมศึกษาตอนต้น (ม.1-ม.3) ( ) 4. มัธยมศึกษาตอนปลาย (ม.4-ม.6) /ปวช. ( ) 5. ปวส./อนุปริญญา/ปริญญาตรี/สูงกว่าปริญญาตรี	SO5
6.) รายได้เฉลี่ยครัวเรือนต่อเดือน(คิดเฉพาะรายได้) ( )1. น้อยกว่า 10,000 บาท ( ) 2. ระหว่าง 10,000 – 20,000 บาท ( ) 3. ระหว่าง 20,001 – 30,000 บาท ( ) 4. มากกว่า 30,000 บาท	SO6
7. ในรอบปีที่ผ่านมา นอกจากการทำนาแล้ว ท่านปลูกพืชชนิดอื่นด้วยหรือไม่ ( )1. ไม่มี **( )2. มี** โปรดระบุ...	SO8
8. ท่านประกอบอาชีพทำนามาแล้วกี่ปี (นับตั้งแต่อายุ 15 ปี)................................ปี	SO9

9. ลักษณะพื้นที่ทำนา ( ) 1. เป็นเจ้าของ ( ) 2. เช่าพื้นที่ทำกิน ( )3. เป็นเจ้าของพื้นที่ร่วมกับเช่าพื้นที่ทำกิน	SO10
10. ขนาดพื้นที่ทำนาโดยเฉลี่ยในแต่ละปี......................................ไร่	SO11
11. ความถี่ในการทำนา ....ครั้งต่อปี โดยมีช่วงระยะเวลาที่ทำนาในแต่ละครั้งดังนี้	SO12
12.ค่าใช้จ่ายในการซื้อสารเคมีกำจัดศัตรูพืช ไม่รวมฮอร์โมนต่อปี........................บาท	SO13
13.) ท่านเคยได้รับการอบรมเกี่ยวการใช้สารเคมีกำจัดศัตรูพืชอย่างปลอดภัย จากหน่วยงานราชการบ้างหรือไม่ เช่น จากกระทรวงเกษตรและสหกรณ์การเกษตร กระทรวงสาธารณสุข เป็นต้น	SO7
( ) 1. ไม่เคย ( ) 2. เคย, ถ้าเคย ครั้งหลังสุด อบรมมาแล้ว………… เดือน..............ปี	SO7.1
ส่วนที่ 2 ข้อมูลสถานะสุขภาพและพฤติกรรมสุขภาพ 14.)ท่านสูบบุหรี่หรือไม่ ( ) 1. ไม่เคยสูบ ( ) 2. เคยสูบแต่เลิกแล้ว.............................ปี ( )3. สูบ, สูบมาแล้ว................ปี, จำนวนมวนที่สูบต่อวัน…………….มวน	HS1
15.) ท่านดื่มเครื่องดื่มที่มีแอลกอฮอล์หรือไม่ เช่นสุรา/ไวน์/เบียร์ ( ) 1. ไม่เคยดื่ม ( ) 2. เคยดื่ม แต่เลิกแล้ว ....ปี	HS2
( ) 3. ดื่ม ดื่มมาแล้ว......................ปี , ความถี่ในการดื่ม ( ) 3.1 น้อยกว่าหรือเท่ากับ 3 ครั้งต่อเดือน ( ) 3.2 ประมาณ 1-4 ครั้งต่อสัปดาห์ ( ) 3.3 ทุกวันหรือเกือบทุกวัน	HS2.3
16.) ในรอบปีที่ผ่านมา ท่านเคยเจ็บป่วยต้องพบแพทย์ เจ้าหน้าที่สาธารณสุขหรือไม่	HS3
( ) 1. เคย จำนวน..........................ครั้ง ( ) 2. ไม่เคย	HS3.1

ตารางในข้อ 11:

ม.ค.	ก.พ.	มี.ค.	เม.ย.	พ.ค.	มิ.ย.	ก.ค.	ส.ค.	ก.ย.	ต.ค.	พ.ย.	ธ.ค.

17.) ท่านได้รับการวินิจฉัยโรคจากแพทย์หรือเจ้าหน้าที่สาธารณสุขว่าป่วยเป็นโรคดังต่อไปนี้หรือไม่

โรค	ไม่ใช่	ใช่	Code
1. ข้ออักเสบรูมาตอยด์			HS4.1
2. โรคหัวใจ			HS4.2
3. ความดันโลหิตสูง			HS4.3
4. หลอดลมอักเสบเรื้อรัง			HS4.4
5. ถุงลมโป่งพอง			HS4.5
6. วัณโรค			HS4.6
7.หอบหืด			HS4.7
8. โรคปอดบวม			HS4.8
9. เบาหวาน			HS4.9
10.โรคต่อมทัยรอยด์			HS4.10
11. โรคไตเรื้อรังทุกชนิด			HS4.11
12. โรคตับทุกชนิด			HS4.12
13. อุบัติเหตุที่ศีรษะทุกชนิด			HS4.13
14. มะเร็งทุกชนิด			HS4.14
15. โรคเรื้อรังอื่น ๆ โปรดระบุ………………………………………..			HS4.15

ส่วนที่ 3 ข้อมูลการใช้สารเคมีกำจัดศัตรูพืช

อดีตที่ผ่านมา ท่านเคยผสมหรือฉีดพ่นสารเคมีด้วยตนเอง(สารเคมีในที่นี้หมายถึงสารกำจัดวัชพืช สารกำจัดแมลง สารป้องกันและกำจัดโรคพืช สารกำจัดเชื้อรา) 18. จำนวนปีที่เคยผสมหรือฉีดพ่นด้วยตนเอง...............................ปี 19. จำนวนวันที่ผสมหรือฉีดพ่น โดยเฉลี่ยต่อปี.........................วัน 20. ระยะเวลาโดยเฉลี่ยในการใช้สารเคมีแต่ละครั้ง.........................ชั่วโมง	U1 U1.1 U1.2 U1.3
21.) ส่วนใดของร่างกายของท่านที่เคยสัมผัสสารเคมีกำจัดศัตรูพืช (ตอบได้มากกว่า 1 ข้อ) ( ) 1.ศีรษะและ/หรือใบหน้า ( ) 4.เท้า ( ) 2.แขน ( ) 5. ปอดและหายใจเอาละอองสารเคมี ( ) 3.ขา ( ) 6. ทางเดินอาหารจากการปนเปื้อนจากการกิน	U2.1 U2.2 U2.3 U2.4 U2.5 U2.6
22.) **ในรอบปีที่ผ่านมา** การผสมสารเคมีส่วนมากท่านผสม [ ]1.) น้อยกว่าที่ระบุไว้ในฉลาก [ ] 2.)เท่ากับที่ระบุไว้ในฉลาก [ ] 3.)มากกว่าที่ระบุไว้ในฉลาก	U4
23.) ในการใช้หรือผสม จำนวนชนิดของสารเคมีที่ท่านใช้ส่วนใหญ่มีกี่ชนิด [ ] 1 ชนิด [ ] 2 ชนิด [ ] 3 ชนิดขึ้นไป	U6

24.)ข้อมูลการใช้สารเคมีกำจัดศัตรูพืช ในรอบปีที่ผ่านมา

1. สารกำจัดวัชพืช

1.1 กลุ่ม 2-4D	1.2 กลุ่ม Paraquat (พาราควอท)	1.3 กลุ่ม Glyphosate (ไกลโฟเซท)	Herb1
( ) ไวท๊อกโอโมน ช้างแดง	( ) กรัมม๊อกโซน	( ) ไกลโฟเซต48 ตราพระอาทิตย์	Herb2
( ) ทูโฟดี ตราหัวเสือลูกโลก	( ) น็อกโซน	( ) วันอัพ	Herb3
( ) เอชโซนัด95 ตราหมาแดง	( ) ……………………………..	( ) สิงห์โกล 48	Herb4
( ) ช้างแดงเอสเตอร์ ตราช้างแดง	( )...	( ) บาสต้า	
( ) อามูเร่	( )……………………………..	( )……………………………..	
( ) นูต้า ดี	( )……………………………	( )…………………………….	
( ) ไฟราแทน 95	*1.4 กลุ่มอื่น ระบุ /ไม่ทราบกลุ่ม*		
( ) เอสเตอร์	( ) นีกัส	( ) ทิลเลอร์	
( )………………………………	( ) ฟาเซ็ต	( ) มายก็อต	
( )………………………………	( ) บิวตาร์โปร	( ) อัลมิกซ์	
( )...	( ) โกลมิต	( ) ไพแองเกอร์	
( )...	( )...	( )...................................	

2. สารกำจัดแมลง

กลุ่ม 1 โอกาโนฟอสเฟต (OP)	**2. กลุ่มคาร์บาเมท**	**3. กลุ่มไพรีทรอยด์**	Insec1
( ) แม็คโครดาน 5 จีอาร์	( ) สิงห์บีเอ็ม	( ) บังก้า 35	Insec2
( ) ซุนวู	( ) โกลวิน 85	( ) บังก้า 10	Insec3
( ) คิงเพาเวอร์	( ) มาเบน เอฟ	( )...................................	Insec4
( ) มิสเตอร์ดี 40	( ) สิงห์วิสตัน	( )……………………..	
( ) สิงห์ฟอส	( ) โกลแจ๊กซ์	( ).................................	
( ) โลก้า	( ) อะบาเม็คติน	( )………………………	
( ) อัลตั้นแฟ้ม	( ) แลนเนท	*4. กลุ่มอื่น/ไม่ทราบกลุ่ม*	
( ) เซฟวิ่งรีฟอส	( ) สิงห์เนท 40	( ) อะบาเม็คติน	
( ) ไพรีเซ็ค	( ) สิงห์แทบ 50	( ) …………………….	
( ) เมเจอร์เฟ่น	( ) อีสคาร์	( )……………………….	
( ) คลอไพริฟอส	( ) เมนู	( )...................................	
( ).....................................	( ) เซฟวิน	( )……………………..	

3. สารกำจัดเชื้อรา

( ) อามูเร่	( ) บีม	( )ฟังกูราน	Fung 1
( ) มาเบนเอฟ	( ) ราคอนติ	( ) แอนทาโคล	Fung 2
( ) ดูนัวส์	( ) วานตอง	( ) โกลลีเอท	Fung 3
( ) แอนวิล	( ) ซีซีมัยซิน	( )อื่น.................………….	Fung 4
( )อื่นๆ.............................	( )......................................	( )……………………………	
( )......................................	( )......................................	( )…………………………….	

4. สารเบื่อหนู

( ) ซิ้งเอ็น	( )อื่นๆ............................	( )...	Roden1
( ) จาการ์-อาร์	( ) อื่นๆ..........................	( )…………………………….	Roden2
( ) เอส โอ เค	( )อื่นๆ............................	( )…………………………….	Roden3

5..สารกำจัดไส้เดือน

( ) เชอรี่แดง	อื่นๆ..................................	( )................................	Nemat1
( ) รวงข้าวเพชร(กากซา)	อื่นๆ..................................	( )…………………	Nemat2
( ) อะบาเม็คติน	อื่นๆ..................................	( )……………………	Nemat3
อื่นๆ..............................	( ).....................................	( )……………………	

ส่วนที่ 4 ความรู้เกี่ยวกับการใช้สารเคมีกำจัดศัตรูพืช

ข้อความ	**ใช่**	**ไม่ใช่**	***ทราบ***	***ไม่ ทราบ***
1.ทางเข้าสู่ร่างกายของสารเคมีกำจัดศัตรูพืชที่มากที่สุดคือผิวหนัง				
2. เครื่องหมาย  หมายถึงสวมอุปกรณ์ป้องกันตา				
3. เครื่องหมาย  หมายถึง สวมอุปกรณ์ป้องกันจมูกและปาก				
4. เครื่องหมาย  หมายถึง สวมถุงมือป้องกัน สัมผัสถูกมือ				
5. หลังการฉีดพ่นสารเคมี การเปลี่ยนเสื้อผ้าทันทีโดยไม่อาบน้ำ ก็สามารถป้องกันการเกิดอาการแพ้สารเคมีได้				
6. การใช้ผ้าธรรมดา ปิดปาก ปิดจมูก สามารถป้องกันการเข้าสู่ร่างกายของสารพิษโดยทางเดินหายใจได้ทุกชนิด				
7. ท่านสามารถสูบบุหรี่, ดื่มน้ำ เคี้ยวหมากฝรั่ง หรือรับประทานอาหารได้ในขณะผสม หรือฉีดพ่นสารเคมี				
8.การใช้ถุงมือผ้า หรือถุงมือที่ยางธรรมดาสามารถป้องกัน ผิวหนังจากสารเคมีได้ ทั้งขณะผสมและการฉีดพ่น				
9. แถบสี ด้านล่างของฉลากข้างขวดสารเคมี บอกถึงความรุนแรงในการเกิดพิษของสารเคมี เช่น แถบสีแดง หมายถึงมีพิษร้ายแรงมาก สีเหลืองหมายถึงพิษปานกลาง และสีน้ำเงินมีพิษน้อย				
10. การรับประทานยาแก้แพ้ ก่อนผสมหรือฉีดพ่นสารเคมี สามารถป้องกันการเกิดอาการแพ้พิษสารเคมีได้				
11. ในการผสมสารเคมี ไม่จำเป็นต้องสวมถุงมือ ใช้ผ้าปิดปากปิดจมูกหรือใส่หน้ากากป้องกันสารพิษเนื่องจากเสียเวลาไม่มาก จนไม่ทำให้เกิดอันตราย				
12. การฉีดพ่นสารเคมีกำจัดศัตรูพืชมานานหลายปี ทำให้ร่างกายของท่านมีภูมิต้านทานต่อการแพ้พิษจากสารเคมีได้และไม่ทำให้เกิดอันตราย				
13. ทางเข้าสู่ร่างกายของสารเคมีประกอบด้วยทางปาก การหายใจ และผิวหนัง				
14. สารเคมีกำจัดศัตรูพืชบางชนิด หากได้รับเพียงเล็กน้อย แต่ได้รับบ่อยครั้งและเป็นเวลานานอาจส่งผลให้เกิดโรคมะเร็งได้				

ข้อความ	ใช่	ไม่ใช่	*ทราบ*	*ไม่ทราบ*
15. การอ่านฉลากอย่างละเอียดก่อนการผสมหรือใช้สารเคมีเป็นสิ่งที่จำเป็น				
16. การอาบน้ำทันทีหลังการฉีดพ่นสารเคมีทุกครั้ง สามารถลดอันตรายจากสารเคมีได้				
17. การใช้อุปกรณ์ป้องกันส่วนบุคคลครบชุด ควรปฏิบัติทุกครั้งที่มีการฉีดพ่นสารเคมี				
18. การซักเสื้อผ้าที่ใช้ในการฉีดพ่นสารเคมี ควรแยกจากเสื้อผ้าอื่น				
19. แม้จะใช้สารเคมีในปริมาณที่มาก แต่ใช้ติดต่อกันไม่นานก็ไม่มีอันตราย				
20. เวลาที่เหมาะสมในการฉีดพ่นสารเคมีกำจัดศัตรูพืชคือในตอนเช้าหรือตอนเย็น				

ส่วนที่ 5 ทัศนคติต่อการใช้สารเคมีกำจัดศัตรูพืช

คำแนะนำ: โปรดทำเครื่องหมาย / ในช่องคำตอบตามความรูสึก ความคิดเห็น และความเชื่อของชาวนา โดยพิจารณาหลักเกณฑ์ดังนี้

เห็นด้วยอย่างยิ่ง หมายถึง ชาวนาคิดว่าข้อความนั้นตรงกับความรู้สึก ความคิดเห็นและความเชื่อมากที่สุด

เห็นด้วย หมายถึง ชาวนาคิดว่าข้อความนั้นตรงกับความรู้สึก ความคิดเห็นและความเชื่อ

ไม่แน่ใจ หมายถึง ชาวนาไม่แน่ใจว่าข้อความนั้นตรงกับความรู้สึก ความคิดเห็นและความเชื่อ

ไม่เห็นด้วย หมายถึง ชาวนาคิดว่าข้อความนั้นขัดแย้งกับความรู้สึก ความคิดเห็น และความเชื่อ

ไม่เห็นด้วยอย่างยิ่ง หมายถึง ชาวนาคิดว่าข้อความนั้น ขัดแย้งอย่างยิ่ง กับความรู้สึก ความคิดเห็นและความเชื่อ

5.1 ทัศนคติต่อการใช้สารเคมีกำจัดศัตรูพืช

ข้อความ	เห็นด้วยอย่างยิ่ง	เห็นด้วย	ไม่แน่ใจ	ไม่เห็นด้วย	ไม่เห็นด้วยอย่างยิ่ง
1. ถึงแม้ว่าร่างกายของท่านจะแข็งแรง แต่ถ้าท่านได้รับสารพิษจากสารเคมีกำจัดศัตรูพืชก็อาจจะมีโอกาสแพ้พิษสารเคมีได้					
2. การใช้มือเปล่าผสมสารเคมี ไม่ใช่สาเหตุของการแพ้พิษจากสารเคมี					
3. บุคคลที่เคยแพ้พิษจากสารเคมีกำจัดศัตรูพืช จะมีภูมิต้านทานและจะไม่มีอาการเกิดขึ้นอีก					
4. หลังจากการฉีดพ่นสารเคมีแล้ว ถ้ากินอาหารโดยไม่ล้างมือ อาจทำให้เกิดอาการแพ้สารเคมีได้					
5. ถึงแม้ว่าท่านจะไม่ได้อาบน้ำ เปลี่ยนเสื้อผ้าหลังจากการฉีดพ่นสารเคมีก็ตาม จะไม่ส่งผลให้ท่านมีอาการจากการแพ้สารเคมี					
6. การใช้สารเคมีเพียงชนิดเดียวจะปลอดภัยมากกว่าใช้หลายชนิดรวมกัน					
7. ท่านสามารถกินอาหารหรือดื่มน้ำได้อย่างปลอดภัย ในพื้นที่ที่มีการฉีดพ่นสารเคมี					
8. ถ้าสุขภาพของท่านแข็งแรง ท่านสามารถสูบบุหรี่ในขณะฉีดพ่นสารเคมีได้					
9. การพ่นสารเคมีเหนือลม จะมีโอกาสเกิดอาการแพ้พิษจากสารเคมีได้น้อยกว่าใต้ลม					
10. ภาชนะบรรจุสารเคมีสามารถนำไปใช้ได้หลังจากล้างทำความสะอาดแล้ว					

5.2 ทัศนคติต่ออันตรายจากการใช้สารเคมีกำจัดศัตรูพืช

ข้อความ	เห็นด้วยอย่างยิ่ง	เห็นด้วย	ไม่แน่ใจ	ไม่เห็นด้วย	ไม่เห็นด้วยอย่างยิ่ง
1. สารเคมีที่มีความเข้มข้นสูง สามารถส่งผลให้เกษตรกรเป็นอันตรายและเสียชีวิตได้					
2. อันตรายจากการใช้สารเคมี ก่อให้เกิดอันตรายที่ ไม่มีวิธีการป้องกันหรือรักษาได้					
3. ถ้าท่านพ่นสารเคมีหรือสัมผัสสารเคมีเป็นประจำ จะส่งผลให้กล้ามเนื้อของท่านอ่อนเปลี้ยชั่วคราวได้					
4. หลังจากการฉีดพ่นสารเคมีแล้ว ถ้ากินอาหารโดยไม่ล้างมือ อาจทำให้เกิดอาการแพ้สารเคมีได้					
5. ขั้นตอนแรก ในกรณีที่สารเคมีหกใส่ร่างกาย คือรีบไปโรงพยาบาลทันที					
6. บุคคลที่มีอาการแพ้พิษสารเคมี อาจส่งผลให้โรคอื่นที่เป็นอยู่มีอาการแทรกซ้อนได้					
7. การใช้สารเคมีเป็นเวลานาน จะไม่ส่งผลอันตรายต่อร่างกายเนื่องจากร่างกายสามารถขับและทำลายสารพิษได้					
8. สารเคมี สามารถเป็นสาเหตุหนึ่งที่ทำให้เกิดโรคมะเร็งได้					
9. การพ่นสารเคมีเป็นเวลาหลายปี จะช่วยให้ร่างกายทนทานและไม่เป็นอันตรายในระยะยาว					
10. สารเคมีทุกชนิด มีความรุนแรงและอันตรายต่อร่างกายไม่เท่ากัน					

5.3. ทัศนคติต่อประโยชน์จากการใช้อุปกรณ์ป้องกันจากสารเคมีกำจัดศัตรูพืช

ข้อความ	เห็นด้วยอย่างยิ่ง	เห็นด้วย	ไม่แน่ใจ	ไม่เห็นด้วย	ไม่เห็นด้วยอย่างยิ่ง
1. ถ้าสวมใส่เฉพาะเสื้อแขนยาวและกางเกงขายาวในขณะฉีดพ่นสารเคมี ทำให้สะดวกและไม่อึดอัด แต่จะมีความเสี่ยงจากการแพ้พิษจากสารเคมีได้					
2. การสูบบุหรี่ในการพ่นสารเคมี จะก่อให้เกิดโทษต่อร่างกายอย่างมาก แต่หลังจากที่หยุดการฉีดพ่นสารเคมี ท่านสามารถสูบบุหรี่ได้					
3. การใส่หน้ากาก กรองอากาศ ในขณะฉีดพ่นสารเคมี ทำให้หายใจไม่สะดวกและรู้สึกร้อน แต่สามารถมั่นใจในความปลอดภัยได้					
4. การใส่ถุงมือยาง ในขณะฉีดพ่นสารเคมี มีความจำเป็น					
5. ถึงแม้การซื้ออุปกรณ์ป้องกันอันตรายจากสารเคมีจะมีราคาแพง แต่ก็คุ้มค่า					
6. การสวมใส่ชุดป้องกันอันตรายแบบครบชุด เป็นสิ่งที่ควรทำทุกครั้งที่มีการฉีดพ่นสารเคมี					
7. การใส่รองเท้าบูทอาจส่งผลให้ทำงานช้าลง ไม่สะดวกแต่สามารถป้องกันอันตรายจากสารเคมีได้					
8. การอาบน้ำทันทีหลังการฉีดพ่นสารเคมี ทำให้ลดการเกิดอาการจากการแพ้สารเคมีได้					
9. การแยกเสื้อผ้าที่ใช้แล้วจากการพ่นสารเคมี ออกจากเสื้อผ้าอื่น จะส่งผลทำให้ผู้อื่นปลอดภัย					
10. การใช้ปากเป่าเมื่อปลายท่อพ่นสารเคมีอุดตัน อาจเกิดอันตรายแต่เป็นวิธีการแก้ปัญหาที่สะดวกและรวดเร็ว					

ส่วนที่ 6 ข้อมูลพฤติกรรมการใช้สารเคมีกำจัดศัตรูพืช

ข้อแนะนำ: กรุณากาเครื่องหมาย (/) ในช่องว่างที่ตรงกับคำตอบ ตามข้อความข้างล่างนี้

สม่ำเสมอหรือบ่อยครั้ง หมายถึงในการใช้สารเคมี 10 ครั้งท่านได้ปฏิบัติ 7 –10 ครั้งในการป้องกันตนเอง

บางครั้ง หมายถึง ในการใช้สารเคมี 10 ครั้ง ท่านได้ปฏิบัติ 4 – 6 ครั้งในการป้องกันตนเอง

นาน ๆ ครั้ง หมายถึง ในการใช้สารเคมี 10 ครั้ง ท่านได้ปฏิบัติ 1 – 3 ครั้งในการป้องกันตนเอง

ไม่เคยปฏิบัติ หมายถึง ในการใช้สารเคมี 10 ครั้ง ท่านไม่เคยปฏิบัติในการป้องกันตนเอง

6.1 ขณะใช้สารเคมี

6.1.1ขณะผสมสารเคมี

ข้อ	กิจกรรม	สม่ำเสมอหรือบ่อยครั้ง	บางครั้ง	นานๆ ครั้ง	ไม่เคยปฏิบัติ
1.	สวมถุงมือพลาสติก/ถุงมือยาง/ถุงมือป้องกันสารเคมีขณะผสม				
2.	ปิดปาก จมูกด้วยผ้าหรือหน้ากากป้องกันสารเคมีขณะผสม				
3.	ผสมสารเคมีตามที่ระบุไว้ในฉลาก				
4.	ใช้ไม้หรือภาชนะกวนหรือคนในการผสม(ไม่ใช้มือเปล่า)				
5.	ล้างมือให้สะอาดทันทีหลังการผสม				

6.1.2 ขณะการฉีดพ่น

ข้อ	กิจกรรม	สม่ำเสมอหรือบ่อยครั้ง	บางครั้ง	นานๆ ครั้ง	ไม่เคยปฏิบัติ
6.	สวมหมวกป้องกันระหว่างฉีดพ่น				
7.	สวมหน้ากากป้องกันจมูกและปาก				
8.	สวมแว่นตาหรืออุปกรณ์ป้องกันสารเคมีสัมผัสตา				
9.	สวมรองเท้าบูท				
10	สวมถุงมือยางหรือพลาสติก				
11.	สวมเสื้อแขนยาว กางเกงขายาว				
12.	สวมชุดคลุมป้องกันสารเคมี				
13.	สูบบุหรี่/เคี้ยวหมากฝรั่ง				
14.	ดื่มน้ำหรือรับประทานอาหารขณะฉีดพ่น				
15.	ฉีดพ่นอยู่เหนือลม				
16.	ฉีดพ่นโดยการถอยหลัง				
17.	ฉีดพ่นในช่วงเวลาที่มีลมน้อยและมีแสงแดดอ่อน				

6.2 หลังการใช้สารเคมี

ข้อ	กิจกรรม	สม่ำเสมอหรือบ่อยครั้ง	บางครั้ง	นานๆ ครั้ง	ไม่เคยปฏิบัติ
18.	ล้างมือด้วยสบู่หรือผงซักฟอกทันทีภายหลังการใช้				
19.	เปลี่ยนเสื้อผ้าทันทีเมื่อถึงบ้าน				
20.	อาบน้ำทันทีที่ถึงบ้าน				
21	ในการซักผ้า แยกเสื้อผ้าที่ใช้สารเคมีออกจากเสื้อผ้าที่ใส่ปกติ				
22.	ทำความสะอาดเครื่องมือ เครื่องใช้ ในการป้องกันตนเอง				
23.	ล้างภาชนะที่ใช้ห่างจากแหล่งน้ำที่ใช้ประโยชน์ เช่น แหล่งน้ำดื่ม น้ำใช้				

ส่วนที่ 7 ข้อมูลการเจ็บป่วยจากการใช้สารเคมีกำจัดศัตรูพืช

ท่านเคยมีอาการเจ็บป่วยที่เกี่ยวข้องกับการใช้ โดยอาการเหล่านี้เกิดขึ้นระหว่างการใช้หรือภายหลัง 24 ชั่วโมงหลังการใช้สารเคมีกำจัดศัตรูพืช

คำอธิบาย ***เพื่อให้แน่ใจว่าอาการ เกิดจากการใช้สารเคมีกำจัดศัตรูพืชทั้งระหว่างและภายหลังการใช้ 24 ชั่วโมง ให้พิจารณาดังนี้***

- ***ถ้ามีอาการเหล่านี้ก่อนที่จะทำการใช้ แล้วพบว่ามีอาการระหว่างการใช้และหรือ ภายหลังการใช้ 24 ชั่วโมงถือว่า ไม่มีอาการจากการใช้ ให้กาเครื่องหมาย ／ในช่องไม่ใช่***
- ***ถ้ามีไม่อาการเหล่านี้ก่อนที่จะทำการใช้สาร แล้วพบว่ามีอาการระหว่างการใช้และหรือ ภายหลังการใช้ 24 ชั่วโมงถือว่า มีอาการ ให้กาเครื่องหมาย ／ในช่องใช่***

อาการ	**ก.) สัปดาห์ที่แล้ว**		**ข.) 1 เดือนที่ผ่านมา**	
	ใช่	**ไม่ใช่**	**ใช่**	**ไม่ใช่**
ระบบประสาท				
1. เวียนศีรษะ มึนงง				
2. ปวดศีรษะ				
3. หนังตากระตุก				
4. ตาพร่ามัว				
5. นอนไม่หลับ				
6. เดินโซเซ				
7. เป็นลม				
8. ใจสั่น				
9. อ่อนเพลีย				
10. เหงื่อออกมาก				
11. กล้ามเนื้ออ่อนแรง				
12. มือสั่น				
13. กล้ามเนื้อเป็น ตะคริว				
14. น้ำลายไหล				
15. อาการชา				

อาการ	**ก.) สัปดาห์ที่แล้ว**		**ข.) 1 เดือน ที่ผ่านมา**	
	ใช่	**ไม่ใช่**	**ใช่**	**ไม่ใช่**
ระบบทางเดินหายใจ				
16. แสบจมูก				
17. เลือดกำเดาไหล				
18. น้ำมูกไหล				
19. คอแห้ง				
20. เจ็บคอ				
21. ไอ				
22. แน่นหน้าอก				
23. หายใจ มีเสียงวี๊ด				
ระบบทางเดินอาหาร				
24. คลื่นไส้				
25. ท้องเสีย				
26. ปวดเกร็งท้อง				
ตา				
27. ปวดแสบ ปวดร้อนตา คันตา				
28. ตาแดง				
29. น้ำตาไหล				
ผิวหนัง				
30. ผื่นและ คันผิวหนัง				
31. คันผิวหนัง				

ส่วนที่ 8 ข้อมูลการตรวจวัดระดับโคลีนเอสเทอเรสในเลือด

ระดับโครีน เอสเทอเรส	ก). ครั้งที่ 1	ข) ครั้งที่ 2	ค.) ครั้งที่ 3
	วดป..........................	วดป………………..	วดป……………..
ไม่ปลอดภัย			
มีความเสี่ย			
ปลอดภัย			
ปกติ			

APPENDIX C
REACTIVE PAPER FINGER BLOOD TEST

WHAT IS CHOLINESTERASE?

Cholinesterase (ko-li-nes-ter-ace) is one of many important enzymes needed for the proper functioning of the nervous systems of humans, other vertebrates, and insects. Certain chemical classes of pesticides, such as organophosphates (OPs) and carbamates (CMs) work against undesirable bugs by interfering with, or 'inhibiting' cholinesterase. While the effects of cholinesterase inhibiting products are intended for insect pests, these chemicals can also be poisonous, or toxic, to humans in some situations. Human exposure to cholinesterase inhibiting chemicals can result from inhalation, ingestion, or eye or skin contact during the manufacture, mixing, or applications of these pesticides.

HOW DOES IT WORK?

Electrical switching centers, called 'synapses' are found throughout the nervous systems of humans, other vertebrates, and insects. Muscles, glands, and nerve fibers called 'neurons' are stimulated or inhibited by the constant firing of signals across these synapses. Stimulating signals are usually carried by a chemical called 'acetylcholine' (a-see-till-ko-leen). Stimulating signals are discontinued by a specific type of cholinesterase enzyme, acetylcholinesterase, which breaks down the acetylcholine. These important chemical reactions are usually going on all the time at a very fast rate, with acetylcholine causing stimulation and acetylcholinesterase ending the signal. If cholinesterase-affecting insecticides are present in the synapses, however, this situation is thrown out of balance. The presence of cholinesterase inhibiting chemicals prevents the breakdown of acetylcholine. Acetylcholine can then build up, causing a "jam" in the nervous system. Thus, when a person receives to great an exposure to cholinesterase inhibiting compounds, the body is unable to break down the acetylcholine.

Let us look at a typical synapse in the body's nervous system, in which a muscle is being directed by a nerve to move. An electrical signal, or nerve impulse, is conducted by acetylcholine across the junction between the nerve and the muscle (the synapse) stimulating the muscle to move. Normally, after the appropriate response is accomplished, cholinesterase is released which breaks down the acetylcholine terminating the stimulation of the muscle. The enzyme acetylcholine accomplishes this by chemically breaking the compound into other compounds and removing them from the nerve junction. If acetyl cholinesterase is unable to breakdown or remove acetylcholine, the muscle can continue to move uncontrollably.

Electrical impulses can fire away continuously unless the number of messages being sent through the synapse is limited by the action of cholinesterase. Repeated and unchecked firing of electrical signals can cause uncontrolled, rapid twitching of some muscles, paralyzed breathing, convulsions, and in extreme cases, death. This is summarized below.

Exposure to:

- carbamates
- organophosphates
- chlorinated derivatives of nicotine

May result in:

- build-up of acetylcholine
- cholinesterase inhibition
- constant firing of electrical messages
- potential symptoms of: twitching, trembling, paralyzed breathing, convulsions, and in extreme cases, death.

WHICH PESTICIDES CAN INHIBIT CHOLINESTERASE?

Any pesticide that can bind, or inhibit, cholinesterase, making it unable to breakdown acetylcholine, is called a "cholinesterase inhibitor," or "anticholinesterase agent." The two main classes of cholinesterase inhibiting pesticides are the organophosphates (OPs) and the carbamates (CMs). Some newer chemicals, such as the chlorinated derivatives of nicotine can also affect the cholinesterase enzyme. Organophosphate insecticides include some of the most toxic pesticides. They can enter the human body through skin absorption, inhalation and ingestion. They can affect cholinesterase activity in both red blood cells and in blood plasma, and can act directly, or in combination with other enzymes, on cholinesterase in the body. The following list includes some of the most commonly used OPs:

- acephate (Orthene)
- Aspon
- azinphos-methyl (Guthion)
- carbofuran (Furadan, F formulation)
- fenitrothion(Sumithion)fensulfothion (Dasanit)fenthion (Baytex, Tiguvon)
- fonofos (Dyfonate)
- isofenfos (Oftanol, Amaze)
- malathion (Cythion)

- carbophenothion (Trithion)
- chlorfenvinphos (Birlane)
- chlorpyrifos (Dursban, Lorsban)
- coumaphos (Co-Ral)
- crotoxyphos (Ciodrin, Ciovap)
- crufomate (Ruelene)
- demeton (Systox)
- diazinon (Spectracide)
- dichlorvos (DDVP, Vapona)
- dicrotophos (Bidrin)
- dimethoate (Cygon, De-Fend)
- dioxathion (Delnav)
- disulfoton (Di-Syston)
- EPN
- ethion
- ethoprop (Mocap)
- famphur
- fenamiphos (Nemacur)
- methamidophos (Monitor)
- methidathion (Supracide)
- methyl parathio
- mevinphos (Phosdrin)
- monocrotophos
- naled (Dibrom)
- oxydemeton-methyl(Meta systox-R)
- parathion (Niran, Phoskil)
- phorate (Thimet)
- phosalone (Zolonc)
- phosmet (Irnidan, Prolate)
- phosphamidon (Dimecron)
- temephos (Abate)
- TEPP
- terbufos (Counter)
- tetrachlorvinphos (Rabon, Ravap)
- trichlorfon (Dylox, Neguvon)

Carbamates, like organophosphates, vary widely in toxicity and work by inhibiting plasma cholinesterase. Some examples of carbamates are listed below:

- aldicarb (Temik)
- bendiocarb (Ficam)
- bufencarb
- carbaryl (Sevin)
- carbofuran(Furadan)
- formetanate (Carzol)
- methiocarb (Mesurol)
- methomyl (Lannate, Nudrin)
- oxamyl (Vydate)
- pinmicarb (Pirimor)
- propoxur (Baygon)

WHAT HAPPENS AS A RESULT OF OVEREXPOSURE TO CHOLINESTERASE INHIBITING PESTICIDES?

Overexposure to organophosphate and carbamate insecticides can result in cholinesterase inhibition. These pesticides combine with acetylcholinesterase at nerve endings in the brain and nervous system, and with other types of cholinesterase found in the blood. This allows acetylcholine to build up, while protective levels of the cholinesterase enzyme decrease. The more cholinesterase levels decrease, the more likely symptoms of poisoning from cholinesterase inhibiting pesticides are to show. Signs and symptoms of cholinesterase inhibition from exposure to CMs or OPs include the following:

1. In mild cases (within 4 - 24 hours of contact): tiredness, weakness, dizziness, nausea and blurred vision;
2. In moderate cases (within 4 - 24 hours of contact): headache, sweating, tearing, drooling, vomiting, tunnel vision, and twitching;
3. In severe cases (after continued daily absorption): abdominal cramps, urinating, diarrhea, muscular tremors, staggering gait, pinpoint pupils, hypotension (abnormally low blood pressure), slow heartbeat, breathing difficulty, and possibly death, if not promptly treated by a physician.

Unfortunately, some of the above symptoms can be confused with influenza (flu), heat prostration, alcohol intoxication, exhaustion, hypoglycemia (low blood sugar), asthma, gastroenteritis, pneumonia, and brain hemorrhage. This can cause problems if the symptoms of lowered cholinesterase levels are either ignored or misdiagnosed as something more or less harmful than they really are.

The types and severity of cholinesterase inhibition symptoms depend on:

(a) The toxicity of the pesticide.

(b) The amount of pesticide involved in the exposure.

(c) The route of exposure.

(d) The duration of exposure.

Although the signs of cholinesterase inhibition are similar for both carbamate and organophosphate poisoning, blood cholinesterase returns to safe levels much more quickly after exposure to CMs than after OP exposure. Depending on the degree of exposure, cholinesterase levels may return to pre-exposure levels after a period ranging from several hours to several days for carbamate exposure, and from a few days to several weeks for organophosphates.

When symptoms of decreased cholinesterase levels first appear, it is impossible to tell whether a poisoning will be mild or severe. In many instances, when the skin is contaminated, symptoms can quickly go from mild to severe even though the area is washed. Certain chemicals can continue to be absorbed through the skin in spite of cleaning efforts.

If someone experiences any of these symptoms, especially a combination of four or more of these symptoms during pesticide handling or through other sources of exposure, they should immediately remove themselves from possible further exposure. Work should not be started again until first aid or medical attention is given and the work area has been decontaminated. Work practices, possible sources of exposure, and protective precautions should also be carefully examined.

The victim of poisoning should be transported to the nearest hospital or poison center at the first sign(s) of poisoning. Atropine and pralidoxime (2-PAM, Protopam) chloride may be given by the physician for organophosphate poisoning; atropine is the only antidote needed to treat cholinesterase inhibition resulting from carbamate exposure.

WHY MONITOR CHOLINESTERASE?

Anyone exposed to cholinesterase-affected pesticides can develop lowered cholinesterase levels. The purpose of regular checking of cholinesterase levels is to alert the exposed person to any change in the level of this essential enzyme before it can cause serious illness. Ideally, a pre-exposure baseline cholinesterase value should be established for any individual before they come in regular contact with organophosphates and carbamates. Fortunately, the breakdown of cholinesterase can be reversed and cholinesterase levels will return to normal if pesticide exposure is stopped.

WHAT IS THE CHOLINESTERASE TEST?

Humans have three types of cholinesterase: red blood cell (RBC) cholinesterase, called "true cholinesterase;" plasma cholinesterase, called "pseudocholinesterase;" and brain cholinesterase. Red blood cell cholinesterase is the same enzyme that is found in the nervous system, while plasma cholinesterase is made in the liver.

When a cholinesterase blood test is taken, two types of cholinesterase can be detected. Physicians find plasma cholinesterase readings helpful for detecting the early, acute effects of organophosphate poisoning, while red blood cell readings are useful in evaluating long-term, or chronic, exposure.

The cholinesterase test is a blood test used to measure the effect of exposure to certain or cholinesterase-affected insecticides. Both plasma (or serum) and red blood cell (RBC) cholinesterase should be tested. These two tests have different meanings and the combined report is needed by the physician for a complete understanding of the individual's particular cholinesterase situation. Laboratory methods for cholinesterase testing differ greatly, and results obtained by one method cannot be easily compared with results obtained by another. Sometimes there is also considerable variation in test results between laboratories using the same testing method. Whenever possible, cholinesterase monitoring for an individual should be performed in the same laboratory, using a consistent testing method.

The approved methods are: Michel, microMichel, pH stat, Ellman, micro-Ellman, and certain variations of these. Micro methods have the advantage of not necessitating venipuncture, the drawing of blood from a vein by puncturing the vein with a needle attached to a collecting tube. The Ellman technique is considered better for detecting cholinesterase inhibition caused by carbamates. Many of the various "kit" methods in use are not satisfactory, particularly those which can be used only for plasma (or serum) determinations.

WHO NEEDS TO BE TESTED?

The following people should be concerned with having their cholinesterase levels checked on a regular basis: (a) anyone that mixes, loads, applies, or expects to handle or come in contact with highly or moderately toxic organophosphate and/or carbamate pesticides (this includes anyone servicing equipment used in the process); (b) anyone that is in contact with these chemicals for more than 30 hours at a time in one 30-day period.

WHEN SHOULD SOMEONE BE TESTED AND HOW OFTEN?

Every person has his/her own individual 'normal' range of baseline cholinesterase values; cholinesterase levels vary greatly within an individual, between individuals, between test laboratories, and between test methods. The extent of potential pesticide poisoning can be better understood if cholinesterase tests taken after exposure to the cholinesterase inhibiting pesticides can be compared to the individual's baseline, pre-exposure measurement. Workers that receive routine exposure to organophosphate or carbamate pesticides should be offered an initial pre-employment check of their blood cholinesterase levels to establish "baseline values" prior to any exposure to these agrochemicals. If no pre-exposure value was obtained, however, the earliest cholinesterase value recorded can be used for later comparison. Excessive exposure to OPs and CMs depresses the cholinesterase so markedly that a diagnosis can also be made without previous baseline testing. If an individual's cholinesterase levels drop 30 percent below the original baseline level, immediate retesting should be done.

While there is no set formula for deciding the frequency of cholinesterase testing, in general, the initial baseline test should be followed by subsequent cholinesterase testing on a regular (usually monthly) basis. This testing should be done weekly during the active season, however, when workers are employed full-time and regularly using OPs and CMs labelled "DANGER." The test should be repeated any time a worker becomes sick while working with OPs, or within 12 hours of his/her last exposure.

Several factors should be considered in deciding how often someone should have his/her cholinesterase levels tested:

a) The extent and seriousness of the possible exposure. This will vary with the toxicity of the pesticides being used and how often they are handled.

b) The type of work being done and the equipment being used may involve different risks of exposure.

c) Work practices have an important effect on worker safety. Some good practices include: the proper use of protective clothing and equipment; showering after each job; avoidance of drinking, eating and smoking in pesticide contaminated areas; prompt and effective decontamination in the event of spills.

d) The past safety record of a company and the work history and experience of an individual.

e) The physician's experience and familiarity with a specific work force may be an additional factor.

HOW DOES SOMEONE GET TESTED?

Since individual states vary in their cholinesterase monitoring programs, people that want to get their cholinesterase levels checked should consult with either their family or company physician for the specific requirements and procedures for cholinesterase testing in their particular state. After the blood is sampled and tested, test results are sent to the individual and his/her physician for interpretation.

Baseline blood samples should be taken at a time when the worker has not been exposed to organophosphate and carbamate pesticides for at least 30 days. Establishing a stable baseline requires a minimum of two pre-exposure tests taken at least 3 days but not more than 14 days apart. If these two tests differ by as much as 20 percent, a third sample should be taken and the two closest values averaged and considered the true baseline.

WHAT ARE THE LIMITS OF CHOLINESTERASE TESTING?

While cholinesterase testing is extremely valuable, it does have its limits, for the following reasons:

(a) Not all hospitals are set up to complete the test within one facility, causing delays in diagnosis;

(b) The wide statistical error of the test makes it difficult to accurately detect very slight poisoning from cholinesterase inhibiting pesticides;

(c) The blood test is more effective in detecting cholinesterase depression from OP exposure than it is in detecting cholinesterase inhibition from carbamate exposure.

While carbamates (CMs) cause a depression in cholinesterase levels, the enzyme levels may return to baseline levels within hours of exposure, perhaps before test results are returned. When the effects of over-exposure to CMs are being checked, blood must be drawn during actual exposure or not more than 4 hours thereafter. If the drawing of blood and the actual completion of the laboratory test is delayed for more than 4 hours, reactivation of the enzyme will have taken place in the blood. This situation makes it hard for the physician to know the extent to which cholinesterase was inhibited, and to fully assess the seriousness of any safety problems which might exist in the work environment.

HOW ARE THE TESTS INTERPRETED?

The interpretation of cholinesterase test results should be done by a physician. A 15 to 25 percent depression in cholinesterase means that slight poisoning has taken place. A 25 to 35 percent drop signals moderate poisoning, and a 35 to 50 percent decline in the cholinesterase readings indicates severe poisoning.

A reported change in an individual's cholinesterase level may result from something other than a pesticide exposure, or it may be the result of laboratory error, but this should never be assumed to be the case. If the report shows a worker's cholinesterase level has dropped 20 percent below his/her baseline in either plasma or RBC, he/she should be retested immediately. If the second test repeats the same low values, faulty work practices should be carefully looked for and steps should be taken to correct them.

A 30 percent drop below the individual's baseline of RBC cholinesterase or plasma cholinesterase means that the individual should be removed from all exposure to organophosphates and carbamates, with the individual not being allowed to return until both levels return to the pre-exposure baseline range. Removal from exposure means avoidance of areas where the materials are handled or mixed and avoidance of any contact with open containers or with equipment that is used for mixing, dusting or spraying organophosphates or carbamates. A worker removed from exposure to cholinesterase inhibitors may be employed at other types of work.

WHERE CAN ONE GET TESTED AND WHAT IS THE COST OF THE TEST?

Because of the lack of approval of standardized test methods and laboratories in the U.S., a list of approved laboratories is not available. However, consult with your physician or local community hospital (testing laboratory) and the State Department of Health for guidance and recommendation of a good laboratory. Keep in mind that a single test method at one test laboratory should be used in your monitoring program.

1986 estimates on the cost of individual cholinesterase tests range from \$7.00 to \$60.00, with the average test costing approximately \$35.00. The quality of tests will improve and prices will be lowered if and when testing methods are standardized and automated.

WHAT IS THE CURRENT STATUS OF CHOLINESTERASE SURVEILLANCE PROGRAMS?

Current EPA worker protection standards (put into place in 1974) are incomplete, and more comprehensive rules are being proposed which would be put into effect in the Spring of 1988.The standards address reentry intervals, notification, decontamination facilities, training of workers, and emergency medical care for workers. Additional provisions are also specified on protective equipment, change facilities, medical monitoring, annual physical examinations, and maintaining contact during pesticide handling. These regulations are likely to require commercial pesticide applicators to have cholinesterase blood tests to establish individual baseline readings. Applicators would then be required to have another test for every 3 or more consecutive days of exposure to organophosphates which fall in toxicity category I ("highly toxic") or category II ("moderately toxic") or when exposed six or more days in a 21-day period. Four states currently have some type of cholinesterase testing requirement in place: California, Ohio, Arizona, and Colorado.

REACTIVE PAPER

picture of serum cholinesterase screening test with reactive paper set

$$\text{Acetylcholine} \xrightarrow[\text{Hydrolyse}]{\text{Cholinesterasee Enzyme}} \text{Acetic acid} + \text{Choline}$$

Acetic acid chances the colour of Bromthymol Blue Indicator on the tested paper that indicates the cholinesterase activity.

The component of reactive paper

- Cellulose paper
- Bromthymol blue
- Acetylcholine salt
- Non-reactive ingredients

Standard color preparing for interpret the result

The standard color adapted from Calibration Curve [Bigg's method] that to be level with 10, 30, 130, 150 of cholinesterase activity level. The rising color became a standard color that copy the changed of color of bromthymol blue on paper [Standard color comparable paper].

The efficiency study of reactive paper

- The suitable time for interpret the result

On 25 $\pm$ 1 centigrade degree found that in 7 minutes the level of cholinesterase that tested by reactive paper significant had no different from Bigg's method [99%CI]. So the suitable time for reactive paper is not over than 7 minutes.

- **Laboratory test**

Confirming Analysis Bigg's method

Screening Test with reactive paper	Positive	Negative
Positive	True Positive (35)	False Positive (2)
Negative	False Negative (8)	True Negative (44)

- **Field test**

Confirming Analysis Bigg's method

Screening Test with reactive paper	Positive	Negative
Positive	True Positive (94)	False Positive (10)
Negative	False Negative (28)	True Negative (91)

Sensitivity of process $= \dfrac{\text{True Positive}}{\text{True Positive + False Negative}}$

1. laboratory $= \dfrac{35}{35 + 8} =$ 89.89 %

2. field $= \dfrac{94}{94 + 28} =$ 77.04 %

Sspecificity of process = $\frac{\text{True Negative}}{\text{True Negative + False Positive}}$

1. laboratory = $\frac{44}{44 + 2}$ = 95.65 %

2. field = $\frac{91}{91 + 10}$ = 90.01 %

Positive Predicted Value of process = $\frac{\text{True Positive}}{\text{True Positive + False Positive}}$

1. laboratory = $\frac{35}{35 + 2}$ = 94.59 %

2. field = $\frac{94}{94 + 10}$ = 90.38 %

The comparable of quantity tested of enzyme cholinesterase between reactive paper and Bigg's method in laboratory tested with Pair t-test found that it significantly not different [$P<0.01$].

The procedure for AchE test

In the field, finger blood samples from farmers were collected using capillary tubes at the end of shift. The capillary tube was left at room temperature until there was separation of serum and red blood cells. The serum was transferred onto reactive paper and the whole area of the paper got soaked. The samples were left for 7 minutes and the result was read by comparing the developed color with the standard color to determine the levels of cholinesterase. The scale of results is divided into 4 levels; when the reactive paper does not change the color, it indicates normal level of cholienesterase enzyme (≥100 units/ml). If the color of the paper has changed into yellow; it indicates safe level of cholinesterase enzyme (87.5 – 99.9 units/ml). If the color has changed into green, it indicates risky level of cholinesterase enzyme (75 – 87.4 units/ml). If the color has changed into green-blue, it indicates unsafe level of cholinesterase enzyme (<75 units/ml). The reactive paper is not specific to chlorpyrifos; it is designed for organophosphate pesticide.

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