The Potential Risk and Occupational Exposure of Pesticides Among Rice Farmers in Delta Ayeyarwaddy Division, Myanmar

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A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Hazardous Substance and Environmental Management
Inter-Department of Environmental Management
GRADUATE SCHOOL
Chulalongkorn University
Academic Year 2022

การประเมินความเสี่ยงสุขภาพจากการได้รับสัมผัสสารกำจัดศัตรูพืชจากการประกอบอาชีพเกษตรกรนาข้าว เขตสามเหลี่ยมปากแม่น้ำอิระวดี ประเทศพม่า

น.ส.โม ทู ขิ่น

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
สาขาวิชาการจัดการสารอันตรายและสิ่งแวดล้อม สหสาขาวิชาการจัดการสิ่งแวดล้อม
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2565

Thesis Title	The Potential Risk and Occupational Exposure of Pesticides Among Rice Farmers in Delta Ayeyarwaddy Division, Myanmar
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Field of Study	Hazardous Substance and Environmental Management
Thesis Advisor	Associate Professor WATTASIT SIRIWONG, Ph.D.
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โม ทู ขิ่น : การประเมินความเสี่ยงสุขภาพจากการได้รับสัมผัสสารกำจัดศัตรูพืชจากการประกอบอาชีพเกษตรกรนาข้าวเขตสามเหลี่ยมปากแม่น้ำอิระวดี ประเทศพม่า. (The Potential Risk and Occupational Exposure of Pesticides Among Rice Farmers in Delta Ayeyarwaddy Division, Myanmar) อ.ที่ปรึกษาหลัก : วัฒน์สิทธิ์ ศิริวงศ์, อ.ที่ปรึกษาร่วม : Mark G. Robson

การศึกษานี้มีวัตถุประสงค์เพื่อประเมินความเสี่ยงที่อาจเกิดขึ้นและการสัมผัสสารกำจัดศัตรูพืชจากการประกอบอาชีพในชาวนาเขตเดลต้าอิระวดี ประเทศเมียนมาร์ ดำเนินการศึกษาแบบภาคตัดขวางกับชาวนา 454 รายตั้งแต่เดือนมีนาคมถึงเมษายน 2565 การรวบรวมข้อมูลดำเนินการผ่านการสัมภาษณ์แบบตัวต่อตัวที่ใช้กับแบบสอบถามแบบกึ่งโครงสร้าง ผลการศึกษาพบว่าอายุเฉลี่ยของเกษตรกรคือ 44.36 ปี (ช่วงอายุคือ 16 และ 74 ปี) น้ำหนักเฉลี่ยของชาวนา (± ส่วนเบี่ยงเบนมาตรฐาน) เท่ากับ 56.86 (± 7.30) กก. ผลการศึกษาพบว่า ในการศึกษาครั้งนี้ มากกว่า 2 ใน 3 ของเกษตรกร (ร้อยละ 77) มีระดับความรู้ ด้านความตระหนักต่อสิ่งแวดล้อม การสัมผัส และ พิษจากสารกำจัดศัตรูพืชอยู่ในระดับปานกลาง และ เกษตรกรส่วนใหญ่ ร้อยละ 94 มีระดับการปฏิบัติตนที่เกี่ยวข้องกับการใช้สารกำจัดศัตรูพืช การจัดการ การจัดเก็บ และ สุขอนามัยอยู่ในระดับปานกลาง นอกจากนี้ ร้อยละ 87 ของผู้ตอบแบบสอบถาม (ชาวนาในอิระวดี) มีการใช้สารกำจัดแมลง ร้อยละ 73 ใช้สารกำจัดวัชพืช และ ร้อยละ 29 ใช้สารกำจัดเชื้อรา สำหรับการประเมินความเสี่ยงด้านสุขภาพเกี่ยวกับการสัมผัสสารกำจัดศัตรูพืชโดยการสูดดมในระหว่างการผสมและการฉีดพ่นสารกำจัดศัตรูพืชเหล่านี้ พบว่ามีการใช้สารกำจัดศัตรูพืชในปริมาณสูงในกลุ่มออร์กาโนฟอสเฟต (อะซีเฟต คลอร์ไพริฟอส และไดเมโทเอต กลุ่มไพรีทรอยด์ (แลมบ์ดา-ไซฮาโลทรินและไซเปอร์เมทริน) และกลุ่มคาร์บอเนต (คาร์โบฟูรานและคาร์แทปไฮโดรคลอไรด์) และปริมาณการได้รับสัมผัสจากการประกอบอาชีพของชาวนาในชุมชนนี้ พบว่าค่าเฉลี่ยปริมาณการรับสัมผัสต่อวัน (Average Daily Dose, ADD) ของ อะซิเฟต คลอร์ไพริฟอส และไดเมโทเอตของกลุ่มออร์กาโนฟอสเฟตเท่ากับ 8× 10-3 มก./กก. วัน 1.53 × 10-3 มก. /กก.วัน และ 7.91 × 10-3 มก./กก.-วัน,กลุ่มไพรีทรอยด์ของไซเปอร์เมทริน 1.91 × 10-3 มก./กก.-วัน และแลมบ์ดา-ไซฮาโลทริน 1.26× 10-4 มก./กก.-วัน และกลุ่มคาร์บอเนตของคาร์โบฟูราน และคาร์แทปไฮโดรคลอไรด์ของเกษตรกรข้าว 2.27× 10-3 มก./กก.-วัน และ 9.6×10-4 มก./กก.-วัน ตามลำดับ ในการระบุลักษณะความเสี่ยงของสารที่ไม่ก่อให้เกิดมะเร็ง โดยใช้ค่าดัชนีความเป็นอันตราย(Hazard Quotient, HQ) สำหรับกลุ่มออร์กาโนฟอสเฟตแบบเฉียบพลันและแบบกึ่งเรื้อรังของคลอร์ไพริฟอส HQ เท่ากับ 5.1 เท่า ในขณะที่กลุ่มที่ได้รับสัมผัสเรื้อรัง HQ เท่ากับ 23.93 ซึ่งเกินระดับที่ยอมรับได้ (HQ ≤ 1) สรุปการศึกษานี้ เกษตรกรผู้ปลูกข้าวเขตสามเหลี่ยมปากแม่น้ำอิระวดี ในประเทศเมียนมาร์ มีโอกาสได้รับสัมผัสทางการหายใจสูง อาจได้รับคลอร์ไพริฟอสของกลุ่มออร์กาโนฟอสเฟตในการใช้สารกำจัดศัตรูพืช ผลกระทบต่อสุขภาพจากการสัมผัสสารกำจัดศัตรูพืช และเกษตรกรมีอาการเฉียบพลัน คือ อาการวิงเวียนศีรษะ 239 (53%) ในทำนองเดียวกัน ร้อยละ 31.8% มีอาการวิงเวียนศีรษะเป็นอาการกึ่งเรื้อรังหลังการใช้สารกำจัดศัตรูพืชภายใน 1 เดือน รวมทั้ง อาการปวดศรีษะร้อยละ 9 และความรู้สึกสั่นร้อยละ 9 ซึ่งเป็นอาการพบบ่อย

สาขาวิชา	การจัดการสารอันตรายและสิ่งแวดล้อม	ลายมือชื่อนิสิต ....
ปีการศึกษา	2565	ลายมือชื่อ อ.ที่ปรึกษาหลัก ....
		ลายมือชื่อ อ.ที่ปรึกษาร่วม ....

6388047320 : MAJOR HAZARDOUS SUBSTANCE AND ENVIRONMENTAL MANAGEMENT
KEYWORD:

Moe Thu Khin : The Potential Risk and Occupational Exposure of Pesticides Among Rice Farmers in Delta Ayeyarwaddy Division, Myanmar . Advisor: Assoc. Prof. WATTASIT SIRIWONG, Ph.D. Co-advisor: Prof. Dr. Mark G. Robson

This study aims to assess the potential risk and occupational exposure of pesticides among rice farmers in the Delta Ayeyarwady Region, Myanmar. A cross-sectional study was carried out with 454 rice farmers from March-April 2022. Data collection was done through face-to-face interviews used with a semi-structured questionnaire. The study showed that the mean age of farmers was 44.36 years old while the range was 16 and 74 years old. Rice farmers' average weight (± standard deviation) was 56.86 (± 7.30) kg. In this study, over two-thirds of the rice farmers (77 %) had a moderate level of knowledge regarding environmental awareness related to pesticides, exposure, and toxicity of pesticides. Likewise, almost rice farmers in the participants (94 %) had a moderate practice level regarding pesticide handling, management, storage, and hygiene. Regarding potential of risk assessment, in the cross-sectional study of rice farmers in Ayeyarwady, (87%) of the respondents applied insecticides while 73 % and 29% were herbicides and fungicides users, accordingly. For determination of health risk assessment, inhaling a large amount of organophosphate group (acephate, chlorpyrifos, and dimethoate, pyrethroids group (Lambda-Cyhalothrin and cypermethrin) and carbonate group (carbofuran and cartap hydrochloride) during loading, mixing, and spraying of these pesticides without proper respirators. To evaluate the potential occupational exposure of rice farmers in this community, the mean average daily dose (ADD) of acephate, chlorpyrifos, and dimethoate of the organophosphate group was 8× 10-3 mg/kg-day, 1.53 × 10-3 mg/kg-day and 7.91 × 10-3 mg/kg-day, pyrethroid group of cypermethrin 1.91 × 10-3 mg/kg-day and lambda-cyhalothrin 1.26× 10-4 mg/kg-day, and carbonate group of carbofuran and cartap Hydrochloride of rice farmers at 2.27× 10-3 mg/kg-day and 9.6×10-4 mg/kg-day, respectively. To characterize non-cancer risk, a hazard quotient (HQ) was applied. The HQ for the organophosphate group of chlorpyrifos acute and sub-chronic exposures was 5.1 times while 23.93 times was chronic exposure exceeded the acceptable level (greater than 1) in both short-term and long-term. In conclusion, there has a higher potential of inhalation exposure for rice farmers in Ayeyarwady, Delta Region in Myanmar might be exposed to chlorpyrifos of organophosphate group in pesticide application. Regarding, health adverse effects related to pesticide exposure, most of the rice farmers in the study areas suffered acute symptoms was dizziness accounted for 239 (53%). Likewise, (31.8%) of rice farmers suffered from dizziness as a sub-chronic symptom within one month after application of the pesticide. In addition, subjective signs, and symptoms related to pesticide exposure (14%) of the participants often suffered headaches, and (9%) feeling nervous were the most occurrence symptoms.

Field of Study:	Hazardous Substance and Environmental Management	Student's Signature ....
Academic Year:	2022	Advisor's Signature ....
		Co-advisor's Signature ....

ACKNOWLEDGEMENTS

I would like to express my deep appreciation and gratitude to my advisor, Assoc. Prof. Dr. Wattasit Siriwong, for his invaluable advice, guidance, and encouragement. With my respect and heartfelt appreciation, I would like to display to Professor Dr. Mark Gregory Ronson, my thesis co-advisor for his kindly support, helpful suggestions, and encouragement. From my deep heart, I would like to express my thankfulness to my thesis chairman Assoc. Prof. Dr. Ekawan Luepromchai for her continuous support and useful comments. Besides, I am very thankful and would like to show appreciation for valuable comments and discussions with my thesis committees, Asst. Prof Dr. Pendee Chanpiwat, Asst. Prof Dr. Suthirat Kiitpongvises. I would like to greatly thank Asst. Prof Dr. Saowanee Norkew, my external examiner for her comments and suggestions.

I would like to express my sincere thanks to all my teachers and staff at International Postgraduate Program in Hazardous Substances and Environmental Management (IP-HSM), Chulalongkorn University who have given me support and guidance throughout my study. This study is supported by ASEAN and NON- ASEAN countries, Chulalongkorn University, Thailand for the financial support throughout the study period of my Master's degree.

I am indebted to all rice farmers and other participants who are willing to participate in this study. My appreciation is offered to the officers of the Department of Agriculture and the Administrative Office, Ayeyarwady Region, Myanmar for allowing me to carry out this study. The gratitude thanks have to continue to the officers of the Plant Protection Division, Department of Agriculture, Ministry of Agriculture, Livestock and Irrigation providing secondary data and their kindness extended to me during my study.

My sincere thanks to the Ethics Committee of the Institutional Review Board of the Defence Services Medical Research Center, Republic of the Union of Myanmar for allowing me to carry out this study on rice farmers in Ayeyarwady, Delta Region, Myanmar. The gratitude to continue to thank Major. Nyan Linn, joint secretary, DSMRC IRB for kindness helpful, and thoughtful suggestions. This study will not be completed unless I have good teamwork. I would like to express my appreciation to Ms. Hnin Yu Wai and Ms. Htar Htar Oo and the enumerators for helping me during my data collection.

I also would like to thank my senior Dr. Nyan Lin from the College of Public Health Science, the same batch of friends of IP-HSM in the Myanmar and Vietnam communities, one of my friends in Food Science at Chulalongkorn University, and a special friend from Myanmar for sharing information, happiness, and mental support throughout my study.

Finally, for their love, support, and encouragement, my deepest thanks to my parents.

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CHAPTER I

INTRODUCTION

1.1. Background and Rationale

Climate-Smart Agriculture is promoted to use chemical pesticides around the world to proper access knowledge on how to use the pesticide to free from the threat of human health, the risk of pesticide exposure cases is remaining. In 2020, almost all low and middle-income countries (LMICs) were attached by the economic downturn (Sarkar et al. 2021). The use of pesticides in developing countries and their impact on health and the right to food, European Union. LMICs often lack pesticide use regulations or implementation thereof and have limited resources available to deal with the environmental and health consequences of pesticide use such as access to a functioning health system or monitoring of water quality in open water bodies (Fuhrimann et al. 2019). Pesticides are agrochemicals used in agricultural lands, public health programs, and urban green areas to protect plants and humans from various diseases. However, due to their known ability to cause many negative health and environmental effects, their side effects can be an important environmental health risk factor. The urgent need for a more sustainable and ecological approach has produced many innovative ideas, among them agriculture reforms and food production implementing sustainable practice evolving to food sovereignty (Nicolopoulou-Stamati et al. 2016)

Agriculture is one of the human work activities connected with very high risk. Evidence across the world shows that there are multiple links between the practices and products of agriculture and environmental health risks. Agricultural workers are inevitably exposed to pesticides during the preparation and application of the spray solution to increase their crops yields. The World Health Organization (WHO) has reported that approximately 20% of pesticides are used in developing countries and this rate is increasing. Pesticides play a significant role in food production. They protect or increase yields and the number of times per year a crop can be grown on the same land. This is particularly important in countries that face food shortages. The toxicity of a pesticide depends on its function and other factors. For example, insecticides tend to be more toxic to humans than herbicides. The same chemical can have different effects at different doses. It can also depend on the route by which the exposure occurs (such as swallowing, inhaling, or direct contact with the skin) (WHO,2018). Exposure to pesticide means any contact between a living organism and one or more pesticides. Mainly exposure to a particular pesticide may occur through multiple exposure routes such as oral, dermal, and inhalation depending on the type and use of the pesticide. Exposure to organophosphates and carbamates resulted on anti-cholinesterase chemicals, and intoxication emanates through the inhibition of acetylcholinesterase, resulting in an accumulation of acetylcholine at the synaptic junction following subsequent activation of cholinergic receptors which leads to respiratory damage and eventual death (Mitra et al. 2021)

The most occurrence exposure to pesticides is inhalation when spraying the crops. Among many pesticide poisoning incidents, the number of people poisoned by pesticides due to skin absorption accounted for more than 90% of incidents of poisoning (Eddleston et al. 2002). All pesticides are potentially toxic and hazardous to human beings. Pesticide poisoning is one of the agricultural hazards in our world. Longer-term effects are harder to attribute directly to pesticide use but may include cancer. There are also health impacts from the consumption of food with residues over regulatory limits (Joko, Dewanti, and Dangiran 2020). A major factor of pesticide contamination or poisoning in developing countries is the unsafe use or misuse of pesticides. Studies have found excessive use of pesticides, frequent mixing of pesticides, use of substandard equipment, poor personal protection, unsafe storage and disposal of containers and lack of knowledge on appropriate pesticide management. All the farmers routinely mix between four and six pesticides in one spray producing a " chemical cocktail" (Hashmi and Khan 2011). Tea drinking is one of the important oral pathways for human exposure to organophosphorus pesticides (Manikandan et al. 2009).

Agriculture is vital to most ASEAN economies and provides livelihoods to a large segment of the population. In other words, agriculture has played and continues to play an important role in the ASEAN region. (Ahmed et al. 2020). In Myanmar, the agriculture sector contributes 38 per cent of GDP, accounts for 20 to 30 per cent of total export earnings and employs more than 70 per cent of the workforce. Rice is the country's primary white rice is the major staple, followed by vegetables and animal source food in inadequate quantities (Anitha et al. 2020). Food safety and environmental conservation are the top priority for Myanmar and a significant challenge for most of the developing countries as it can affect not only public health and social well-being but also the ecosystem, the natural system existing living, non-living substances and plants incompatibility and the natural environment which have been pollination. Myanmar ranked 77th for food quality and safety among 113 countries globally, according to the Economist Intelligence Unit’s Global Food Security Index 2019. Myanmar Farmers often have a very strong desire to " kill" insects in rice fields and since insecticides are convenient tools, they continued to believe that insecticides are the only way and ignore predators and parasitoids which cause most of the pest mortality. This belief tends to encourage farmers to misuse pesticides and they become susceptible to pesticide salesmen promoting " new and more powerful insecticide they sell each season (Escalada, Aung, and Heong 2020).

Very few have been reported about the health hazards on humans, as well as the health impact on the wildlife and the possible environmental pollution from the use of pesticides in Myanmar. Chronic exposure related to Organophosphate Pesticides dose may reduce potential male reproductivity in Myanmar (Lwin et al. 2018). Medical points of studies in Myanmar have been proved that there has an impact of chronic low doses of pesticide poisoning exposure on respiratory health (Lwin 2017)., as well as OP pesticides, had harmful effects on the cardiovascular system (Thandar, Naing, and Sein 2021). Even though the medical research, there have still a limited number of studies on the relationship between the livelihood of farmworkers and environmental awareness, knowledge, and skills for safe use of pesticides in Myanmar.

1.2 Research Questions

1. How much amount of pesticide on rice production shares the hazardous substance associated with the farmers’ technical and environmental awareness?
2. Is there any potential risk of occupational pesticide exposure on health adverse effects among selected farmers in Myanmar?
3. Are there selected farmers who have well-trained on the use of pesticide practices and ergonomically designed equipment, tools when handling the pesticide?

1.3 Research Gap

There are few studies about occupational exposure via inhalation route assessment in Myanmar.

1.4 Research Objectives

1.4.1. General Objective

To assess the potential risk and occupational exposure of pesticides via inhalation route among rice farmers in Delta Ayeyarwady Region, Myanmar

1.4.2. Specific Objectives

1. To assess potential risks, occupational exposure, health adverse effects (subjective sign and symptom) of pesticides among rice farmers in Delta Ayeyarwady Division, Myanmar
2. To describe the level of knowledge and practice of pesticide used by rice farmer in Delta Ayeyarwady Division, Myanmar.
3. To provide risk communication and management regarding pesticide exposure of rice farmer in Delta Ayeyarwady Division, Myanmar.

1.5. Research Hypothesis

H_o = There is a non-cancer or cancer risk due to the pesticide exposure via inhalation route on the selected farmers in the Ayeyarwady, Delta Region, Myanmar.

H_1 = There is not non-cancer or cancer risk due to the pesticide exposure via inhalation route on the selected farmers in the Ayeyarwady, Delta Region, Myanmar.

1.6. Conceptual Framework

Dependent variables

Socio – demographic information

- Gender, age, Body weight, Height, Education level,
- Working years
- Cultivated farm size (acres), types of grown rice
- Time of exposure

Personal Behavior

- purchasing behavior toward pesticides after listening to the advice of others
- betel chewing behavior
- smoking behavior,
- drinking (water/alcohol) during pesticide application
- lunch near the farm (before/after pesticide

Level of knowledge

- environmental knowledge related to pesticides
- knowledge of exposure-related wearing of personal protective equipment (PPE)
- pesticide toxicity to humans

Level of Practices

- use of registered pesticides
- use of personal protective equipment (PPE)
- practices of pesticide handling, spraying, mixing, storage, and disposing
- hygiene practices after application

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Independent variables

Potential occupational human health risk

- cancer risk, non-cancer risk
- Acute and sub chronic symptoms
- Subjective signs and symptoms

1.7 Operational Definitions

Gender: the condition of being either male or female physical characteristic.

Age: the number of years that farmer has permanently lived in the study area since birth or a long period.

Body Weight: farmer's own weight at the time of investigation

Height: the distance of the tall of farmers

Education level: the level of education such as no education, primary education, secondary education, monastery education and graduate level that the farmers already achieved

Farmer: The farmers who are rice growing mainly in their production in the selected areas

Behavior: the way that a farmer behaves in a particular situation or under particular conditions related to pesticide application.

Level of Knowledge: the state of farmers' understanding of or information regarding pesticide exposure in their rice production

Level of Practice: the action of a farmer that is usually or regularly done when the time of pesticide usage.

Pesticide: means any substance, or mixture of substances of chemical or biological ingredients intended for repelling, destroying, or controlling any pest, or regulating plant growth.

Risk is the probability and severity of an adverse health or environmental effect occurring as a function of a hazard and the likelihood and the extent of exposure to a pesticide.

Pesticide Exposure: occurs in four ways that include oral, dermal, inhalation and ocular route when a farmer can be contacted pesticide into the body.

Human Health Risk: is a chance or probability of developing a disease that farmers will be toxic or harmed and adverse health effects if exposed to the pesticide application.

Health Risk Assessment: the process to estimate the nature and probability of adverse health effects in farmers who may be exposed to pesticides in rice farming.

Hazard Identification: the process of determining whether exposure to a stressor can cause an increase in the incidence of specific adverse health effects (e.g., cancer, birth defects).

Exposure assessment: the process of measuring or estimating the magnitude, frequency, and duration of human exposure to an agent in the environment or estimating future exposures for an agent that has not yet been released.

Occupational health: is an area of work in public health to promote and maintain the highest degree of physical, mental, and social well-being of workers in all occupations.

Chronic exposure: any harmful effects that occur from small doses repeated over a period of time from pesticide exposure.

Acute exposure: describes the human health effects from a one-time exposure to pesticides and effects are illness or injuries that may appear immediately after exposure (usually within 24 hours).

1.8. Scope of the Study

1.8.1 Study areas

The study of targeted areas is Ayeyarwady, Delta region by collecting primary data from rice farmers using a questionnaire. The region lies between approximately latitude 15° 40' and 18° 30' north and between longitude 94° 15' and 96° 15' east. It has an area of 35,140 square kilometers (13,566 sq. mi). The Delta is renowned for its highly valued traditional quality rice namely " Pawsan Hmway", " Pawsan Baygyar" and " Pharpon Pawsan" rice varieties that comprise about 20% of the delta region. Pyapon District is a district famous for rice production of the Ayeyarwady Division in southwestern Myanmar. It consists of 4 cities such as Pyapon, Bogalay, Kyaiklat and Dedaye.

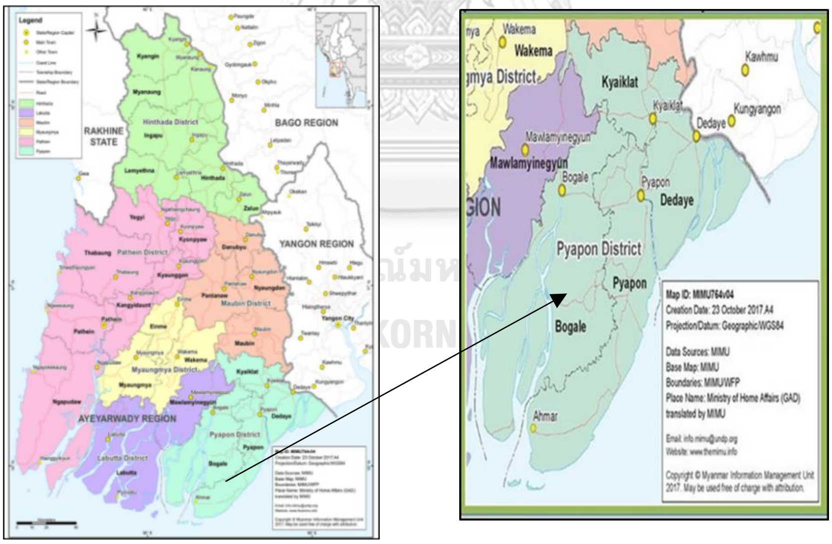

Figure 1 Map of study area of Pyapon District, Ayeyarwady Division (MIMU,2017)

1.8.2. Participants in This Research

The rice-based main growing three townships were Bogalae, Pyapon and Kyaiklat townships for the targeted sample size (383). The targeted participants were rice farmers who had the experiences of pesticide application and had access to internet connection during data collection.

CHAPTER II

LITERATURE REVIEW

2.1. Environmental education and awareness of the farmers

According to Collins English Dictionary, environment means the 'external conditions or surroundings, especially those in which people live or work' or 'external surroundings in which a plant or animal lives, which tend to influence its development and behavior. Environmental awareness associated with parental background and family environment. Other factors relate to individual characteristics such as self-concept, locus of control, and achievement motivation. On the other hand, awareness means 'the state or condition of being aware, having knowledge and consciousness. Consequently, environmental awareness could be defined as a state of being aware, having knowledge about, and being conscious of the external surroundings in which people live and work, and which tend to influence people's development and behavior (Eevi Kokkinen, 2013).

Figure 2 The three elements of environmental awareness. (Partanen-Hertell et al. 1999)

(Li and He 2021) observed that by collecting socioeconomic characteristics and the behaviors associated with farmers pesticide use to identify the related factors affecting the use of pesticides. The author found that the land size and household's farming days had significant relationships with rice planting method and pesticide use, and the rice planting method has a significant relationship with pesticide overuse. These findings of the variables were relevant that the level of knowledge of safety practices regarding pesticide exposure and environmental awareness.

The awareness level of retailers regarding the dispensing pattern of pesticides directly influences the pesticide use by farmers or end-users, as the farmers depend on the retailers for advice on the choice and use of pesticides (Miglani, Upadhyay et al. 2019). On the other hand,(Oludoye, Robson et al. 2021) studied pesticide safety, decision-making does not depend only on information sources but also on farmers' trust in the information providers. The cocoa farmers in Nigeria did not have trust, especially in retailers' information like as in a study among farmers in China (Li, Ren et al. 2020). Likewise, (Yilmaz 2015) also analyzed Turkey's farmer's influence on the decisions process on pesticide application time by farmers revealed positively significant associations between farmers' age, experience, farm size and the user information source, their opinions on the environmental and human health harm of pesticides.(Escalada, Aung et al. 2020) reported that "Farmers' pesticides use decisions are often not based on the economic rationale in Myanmar. They are usually overreaction behavioral responses to pests in general or they follow a calendar schedule". Therefore, farmers' awareness of pesticides should correlate with their educational status. Hence, these reports provide the empirical research knowledge for socioeconomic and awareness of pesticide usage on farmers in Myanmar.

2.2. Toxicity of pesticide

Pesticides cannot be categorized as "safe" or "dangerous" to humans merely because they are classified as substances that kill pests. Each active ingredient (AI) has its own unique chemical structure and toxicological characteristics. Pesticides with very similar chemical structures in many instances produce dramatically different effects. Toxicity is usually divided into two types, acute or chronic, based on the number of exposures to poison and the time it takes for toxic symptoms to develop. Acute toxicity is due to short-term exposure and happens within a relatively short period of time, whereas chronic exposure is due to repeated or long-term exposure and happens over a longer period (Nesheim 1993).

Table 1 Types of toxicity

Type	Number of Exposures	Time for symptoms to develop
Acute	usually, 1	Immediate (minutes to hours)
Chronic	more than a few	one week to years

The toxicity of a pesticide is determined by quantifying the response of laboratory animals to a series of increasing doses. This relationship between administered dose and animal response is graphically depicted as the dose-response curve. The graph includes the measured response (e.g., the number or per cent of animals affected, or the severity of the response) on the vertical axis and increasing doses of the test chemical on the horizontal axis. For a measured response such as death, the percentage of animals that die increases proportionally as the dose increases. A common measure used to define toxicity when about one-half of the animals die at a certain dose is the LD50—the lethal dose for 50 per cent of the animals tested. More than 50 per cent of the animals die at doses higher than the LD50, while fewer or no animals die at lower doses. Thus, the higher the LD50 dose, the less acutely toxic the pesticide. (Whitford. F, et al., Purdue University Cooperative Extension Service). Animal studies are often used to delineate both the lower and upper limits of a chemical's potency. Typical measures are based on dose-response relationships for an endpoint on the response of animals.

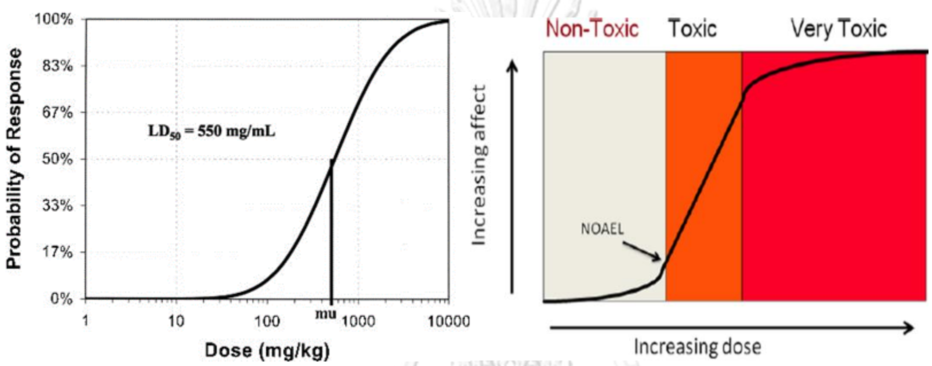

Figure 3 The response of laboratory animals to a series of increasing doses

2.3. Scenario research related to the potential risk and occupational exposure of pesticides research among rice farmers of a Village Located in Northern Peninsular in Malaysia

(Ahmad, Salehabadi et al. 2020) analyzed the potential risks and occupational exposure of pesticides among rice farmers in Malaysia by collecting field data from the farmers in the villages located in the Northern Peninsular of Malaysia. In that research, a questionnaire containing 40 questions was designed to obtain the farmer's socio-demographic data such as pesticide types, average age, sex, and similar activities (like frequency of spraying in one rice farming season). In the Northern Peninsular of Malaysia, four different pesticides used by rice farmers include buprofezin, chlorpyrifos, difenoconazole, and lambda cyhalothrin and he focused-on studying risk assessment to calculate the risk rating (RR). The right trend of exposure rate (ER), the farmer's categories were ranked into two levels, 3 and 4, with respect to hazard rating (HR) and frequency rating (FR), and in terms of magnitude rating (MR), they were assorted into 3 to 5 levels. In that kind of questionnaire research, it can be deduced that rice farmers are a high-risk group in relation to harmful exposure of pesticides under categories 3 to 5. And finally, the author pointed out that the farmers exposed to a wide variety of different carcinogens, several risk minimization strategies (as recommended) were urgently required, in order to reduce the impact of exposure.

Likewise, the study of potential risk and occupational exposure of pesticides in Malaysia as a similar study can analyze the potential risk and occupational exposure of rice farmers in Myanmar by using a questionnaire survey.

2.4. Pest management in rice and vegetable farmers on their practices, beliefs and pesticide usage in Myanmar

(Escalada, Aung et al. 2020) conducted a based line survey on pest management of rice and vegetable farmers on their practices, beliefs and pesticide use among 474 rice farmers and vegetable growers in Nay Pyi Taw, Shan State and Yangon regions in Myanmar Regarding rice production, farmers cultivated average rice areas ranging from 1.54 ha to 3.62 ha and reported yields ranging from 1.12 to 4.32 t/ha for both the summer and monsoon crops in 2018-2019. The mean number of all pesticide sprays per farmer/season was 2.2; while the lowest number of sprays was zero and the highest 8. Insecticide use had remained low with an average of 0.54 sprays/season compared to that from a 2012 survey (unpublished data) when the average was 0.62. Insecticides were first applied about 18 days after planting, with rice farmers groups withholding their first insecticide spray until about 21 days after planting and the rice and vegetable growers at 15 days after planting. In rice cultivation, insecticides were primarily applied about 18 days after planting at the seeding stage, while rice farmers groups withheld their first insecticide spray until about 21 days in the vegetative stage. At seedling and tillering stages, weeds were their main spray target pest, at booting, stem borers of insect, and at heading, rice ear bugs. Imidacloprid was applied at the seedling stage meanwhile cypermethrin at tillering, booting and heading stages. In this report, the significant fact of insecticide misuse had found to be extremely high (90.7%). High use of secondary pest inducing insecticides such as cypermethrin, emamectin, chlorpyrifos and imidacloprid of pesticide resistance on the brown planthopper outbreaks and a threat to future rice production as well as human health and environmental damages and risks in Myanmar.

2.5. Risk Assessment

Risk assessment may be defined as the identification of potential adverse effects to humans or ecosystems resulting from exposure to environmental hazards. The risk involved (probable injury, disease, functional deficits, or death) may be expressed in quantitative terms or in quantitative terms (U.S. EPA/600/M-91/034/1992). The process for human health risk assessment often involves the following steps:

1) hazard identification · determination of whether a pollutant adversely affects human health

2) dose-response assessment – determination of the relationship between the level of exposure and the probability of occurrence of adverse effects.

3) exposure assessment - determination of the extent of exposure

4) risk characterization- description of the nature and often the magnitude of risk, including the accompanying uncertainty.

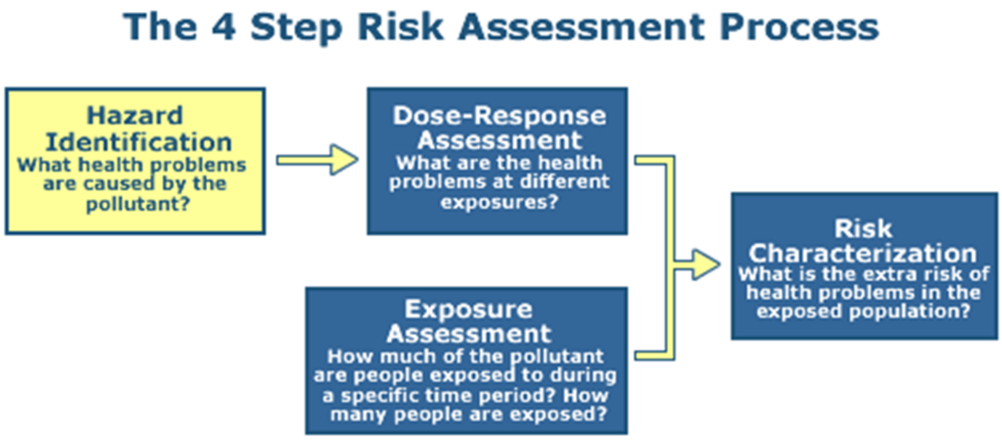

Figure 4 The process of risk assessment process

https://www.epa.gov/sites/default/files/2015-04/4step-live-1.gif

2.5.1 Step (1): Hazard Identification

The objective of Step (1) is to identify the types of adverse health effects that can be caused by exposure to some agent in question and to characterize the quality and weight of evidence supporting this identification. Hazard Identification is the process of determining whether exposure to a stressor can cause an increase in the incidence of specific adverse health effects (e.g., cancer, birth defects). It is also whether the adverse health effect is likely to occur in humans. In the case of chemical stressors, the process examines the available scientific data for a given chemical (or group of chemicals) and develops a weight of evidence to characterize the link between the negative effects and the chemical agent.

2.5.2. Step (2): Dose-Response Assessment

A dose-response relationship describes how the likelihood and severity of adverse health effects (the responses) are related to the amount and condition of exposure to an agent (the dose provided). The "dose-response" relationship, the same principles generally apply for studies where the exposure is to a concentration of the agent (e.g., airborne concentrations applied in inhalation exposure studies), and the resulting information is referred to as the "concentration-response" relationship. The term "exposure-response" relationship may be used to describe either a dose-response or a concentration-response, or other specific exposure conditions. The shape of the dose-response relationship depends on the agent, the kind of response (tumors, incidence of disease, death, etc.), and the experimental subject (human, animal) in question. For example, there may be one relationship for a response such as 'weight loss and a different relationship for another response such as 'death'. Since it is impractical to study all possible relationships for all possible responses, toxicity research typically focuses on testing for a limited number of adverse effects.

2.5.3. Step (3): Exposure Assessment

Exposure assessment is the process of measuring or estimating the magnitude, frequency, and duration of human exposure to an agent in the environment or estimating future exposures for an agent that has not yet been released. An exposure assessment includes some discussion of the size, nature, and types of human populations exposed to the agent, as well as discussion of the uncertainties in the above information. Exposure can be measured directly, but more commonly is estimated indirectly through consideration of measured concentrations in the environment, consideration of models of chemical transport and fate in the environment and estimates of human intake over time. The three major exposure routes to humans are inhalation, ingestion, and dermal contact. There are a few different ways to measure dose (U.S. EPA, 1992 Guidelines):

- **Applied dose** is the amount of contaminant at the absorption barrier (e.g., respiratory tract) that can be absorbed by the body.
- **Internal dose** is the amount of contaminant that gets past the exchange boundary (lung) and into the blood, or the amount of the contaminant that can interact with organs and tissues to cause biological effects.
- **Biologically effective dose** is the amount of contaminant that interacts with the internal target tissue or organ.

Potential dose is the amount of contaminant inhaled (i.e., amount that gets in the mouth or nose), not all of which is actually absorbed.

2.5.4. Inhalation of pesticide (vapor phase) exposure

Exposure occurs via the inhalation route when an individual breathes a chemical. The chemical can directly affect the respiratory tract (point-of-entry effect) or enter the bloodstream through respiratory tract tissues, potentially affecting other systems of the body (target organ effect). A simplifying assumption is that inhalation exposure equals dose for gases, aerosols and fine (“respirable”) particles less than 2.5 micro average meters (μm). The potential dose of a contaminant is the product of the contaminant concentration, inhalation rate, exposure time, exposure frequency, and exposure duration divided by the product of averaging time and body weight. (U.S. EPA 1994b; U.S. EPA 2009f)

2.5.5. Pesticide Inhalation Handler Exposure Assessment

This inhalation assessment provides a standard method for completing handler exposure assessment for adults treating an outdoor space for pesticide spray from Standard Operating Procedures for Residential Pesticide Exposure Assessment of U. S Environmental Protection Agency (USEPA 2012). The method should be applied for estimating potential doses that insect repellents sprayers may obtain during aerosol applications from inhalation and dermal contact when chemical-specific data are unavailable.

$$E = UE * AR \qquad (2.1)$$

where: E = exposure (mg/day); UE = unit exposure (mg/lb. ai); and AR = application rate (lb. ai/day).

The application rate can be calculated as follows:

$$AR = A\ product * A.I. * CF1 * N \qquad (2.2)$$

where:

AR = application rate per day (lb. ai/ day);

A product = amount of product in 1 can (oz or g/can);

A.I. = percent active ingredient in product (% ai);

CF1 = weight conversion factor (1 lb./16 oz or 1 lb./454 g); and

N = number of cans used in one application (cans/day).

Alternatively, if the aerosol can contents are expressed as a volume in milliliters, the application rate for use in the exposure assessment can be calculated as follows:

2.5.6. Step (4): Risk Characterization

Risk characterization is the combination of hazard identification, dose-response information, and exposure information. It is an integral component of the risk assessment process for both ecological and health risks, i.e., it is the final, integrative step of risk assessment (U.S. EPA/600/M-91/034/1992). The hazard of a product is Pilot pretest survey on the rice farmers in Ayeyarwady in targeted areas.

2.5.6.1. Quantitative Estimation of Cancer Risk: For carcinogenic chemicals, risk estimates represent the incremental probability that an individual will develop cancer over a lifetime as a result of a specific exposure to a carcinogenic chemical. These risks are calculated as follows: These risks are calculated as follows:

Cancer Risk = LADD × CSF (2.5)

where: LADD = Lifetime average daily dose (mg/kg-day), CSF = Cancer slope factor (mg/kg-day)-1

Within a specific exposure pathway, receptors may be exposed to more than one COPC. The total risk associated with exposure to all COPCs through a single exposure pathway is estimated as follows

Cancer Risk T = $\boldsymbol{\Sigma_i}$ Cancer Risk I (2.6)

where:

Cancer Risk T = Total cancer risk for a specific exposure pathway,

Cancer Risk i = Cancer risk for COPC i for a specific exposure pathway, COPCs = Chronic Overlapping Pain Conditions.

For fugitive emissions from storage and handling of hazardous, the risk associated with fugitive emissions should be added to the risks from the combustion unit for each receptor at each exposure scenario location. For example, if a facility operates both an incinerator and a boiler that burn hazardous waste, then the risks from both types of units should be summed across all the units for each receptor. The total risk posed to a receptor is the sum of total risks from each individual exposure pathway expressed as follow

$$\text{Total Cancer Risk T} = \sum \text{Cancer Risk T} \quad (2.7)$$

where: Total Cancer Risk = Total cancer risk from multiple exposure pathways, Cancer Risk T = Total cancer risk for a specific exposure pathway

2.5.6.2. Quantitative Estimation of Non- cancer Risk: Standard risk assessment models assume that noncarcinogenic effects, exhibit a threshold; that is, there is a level of exposure below which no adverse effects will be observed (U.S.EPA/540/4-89-002). The potential for noncarcinogenic health effects resulting from exposure to a chemical is generally assessed by (1) comparing an exposure estimate to an RfD for oral exposures, and (2) comparing an estimated chemical-specific air concentration to the RfC for direct inhalation exposures. An RfD is a daily oral intake rate that is estimated to pose no appreciable risk of adverse health effects, even to sensitive populations, over a specific exposure duration. Similarly, an RfC is an average daily concentration of a chemical in air, the exposure to which over a specific exposure duration poses no appreciable risk of adverse health effects, even to sensitive populations.

The U.S. Environmental Protection Agency (EPA) recommended the updated inhalation exposure methodology that risk assessors can use the concentration of the contaminant in air (Cair) as the exposure metric (e.g., mg/m^3) instead of the intake of a contaminant in air based on inhalation rate and body weight (dose, e.g., mg/kg-day). Average Daily Dose (ADD) is generally expressed as mass of contaminant per unit of body weight over time (e.g., mg/kg-day).

$$\text{Hazard quotient: HQ} = \frac{\boldsymbol{Average\ Daily\ Dose(mg/kg-day)}}{\boldsymbol{Acceptable\ Daily\ Intake(mg/kg-day)}} \quad (2.8)$$

$$= \frac{\boldsymbol{ADD}}{\boldsymbol{RFD}}$$

where: ADD= average daily dose; RfD = Reference dose (mg/kg-day) **(2.9)**

$$\text{ADD} = \text{Cair} \times \text{InhR} \times \text{ET} \times \text{EF} \times \text{ED/BW} \times \text{AT}$$

where:

ADD = Average daily dose (mg/kg-day), Cair = Concentration of contaminant in air (mg/m3), InhR = Inhalation rate (m3/hour), ET = Exposure time (hours/day), EF = Exposure frequency (days/year),, ED = Exposure duration (years), BW = Body weight (kg), AT = Averaging time (days)

As with carcinogenic chemicals in a specific exposure pathway, a receptor may be exposed to multiple chemicals associated with noncarcinogenic health effects. The total noncarcinogenic hazard attributable to exposure to all chemicals of potential concern (COPCs) through a single exposure pathway is known as a hazard index (HI).

$$\mathbf{HI = \Sigma\ i\ HQ\ I} \qquad \mathbf{(2.10)}$$

where: HI = Total hazard for a specific exposure pathway, HQ i = Hazard quotient for COPC i

For the purposes of the risk assessment, it is reasonable to estimate a receptor's total hazard as the sum of the HIs for each of the exposure pathways. Specifically, a receptor's total hazard is the sum of hazards from each individual exposure pathway, expressed as follows:

$$\mathbf{Total\ HI = \Sigma\ HI.} \qquad \mathbf{(2.11)}$$

where: Total HI = Total hazard from multiple exposure pathways, HI = Total hazard for a specific exposure pathway.

2.6. Impact of Pesticide use on Human Health

At the global level, total pesticides use in agriculture remained stable in 2019, at 4.2 million tons (Mt) of active ingredients. The worldwide application of pesticides per area of cropland was 2.7 kg/ha. Total pesticides trade reached approximately 5.6 Mt of formulated products in 2019, with a value of USD 35.5 billion. The global application of pesticides increased across these two periods for herbicides, fungicides and bactericides, and insecticides, with increases in the share of herbicides (from 40 to 53 percent of total pesticides) and reductions in the shares of fungicides (from 25 to 22 percent) and insecticides (from 23 to 17 percent). In 2019, Asia had the highest levels of pesticides exports (2.5 Mt at a value of USD 12.5 billion) and used the most pesticides in the agricultural sector (2.2 Mt), both in terms of totals and per ha of cropland (3.7 kg/ha) (FAO, 2021). Of this, about 75% is located in low- and middle-income countries. (Pimentel 1995) predicted that the amount of pesticide applied, only 0.1% to 0.3% comes into contact with the target pests directly or indirectly. Thus, 99.7 to 99.9% of the applied pesticide is dispersed into the environment and reaches non-target organisms, including humans. Hazardous and persistent pesticides - carbofuran, DDT, dichlorvos, endosulfan, monocrotophos, profenofos, etc. are often currently used for control of disease-transmitting vectors in low- and middle-income countries (Weiss, Leuzinger et al. 2016)

The most hazardous organophosphates are Azinphosmethyl, chlorpyrifos, diazinon, dichlorvos, dimethoate, ethephon, malathion, methamidophos, naled, and oxydemeton-methyl. The carbamates aldicarb, aldoxycarb, aminocarb, bendiocarb, carbofuran, dimetan, dimetilan, dioxacarb, methiocarb, methomyl, oxamyl, and propoxur are very toxic. Bufencarb, carbosulfan, pirimicarb, promecarb, thiodicarb, and trimethacarb are moderately toxic carbamates (Morais, Dias et al. 2012). There is evidence of the negative effect of organochlorides on endocrine activity;(Kojima, Katsura et al. 2004, Lemaire, Terouanne et al. 2004), their carcinogenic potential (Ibarluzea, Fernandez et al. 2004), and their potential to promote neuropsychiatric impairment and diseases such as Parkinson’s Disease (Fleming, Mann et al. 1994).

In a prospective cohort study in the LMIC/Lati American/Brazilian, (Medeiros, Reddy et al. 2020) found an increased all-cause mortality rate in Parkinson's Disease patients with occupational exposure to pesticides. Moreover, organophosphates (OP) pesticide exposure causes damaging effects on the immune system and secretes inflammatory mediators such as cytokines, chemokines, reactive oxygen species (ROS) and reactive nitrogen species (RNS) (Zaw, Phyu et al. 2020). In Cambodia,(Jensen, Konradsen et al. 2011) found that evidence symptoms of occupational pesticide poisoning were common among farmers and were related to the number of hours spraying Organophosphates and carbamates (OPs/CMs) with highly toxic pesticides.

(Siriwat, Nganchamung et al. 2021) found a significant association between work-related factors, scores of practices regarding exposure, blood ChE level, and health symptoms from exposure to pesticide residues among greengrocers. (Lwin et al. 2017) studied chronic exposure related to OP dose may reduce potential male reproductivity in Myanmar. Likewise, impacts of chronic low dose OP exposure on respiratory health and function decline, OP exposure have a significant negative correlation between the oxidative street and the development of insulin resistance (Phyu, Hlain et al. 2020) and chronic low- level exposure to OP pesticides has harmful effects on the cardiovascular systems (Thandar, Naing et al. 2021)

CHAPTER III

RESEARCH METHODS

3.1 Study Design

This study aims at exploring the potential risk and occupational exposure of pesticides among rice farmers in Delta Ayeyarwady Region, Myanmar. The research design was a "cross-sectional study" as shown in Figure 5. A cross-sectional study was carried out with 454 rice farmers from March-April 2022. Data collection was done through household face-to-face interviews were used with a semi-structured questionnaire. This study was approved by Institutional Review Board, Defence Services Medical Research Center, Directorate of Medical Services, Ministry of Defence, Republic of the Union of Myanmar with the certified code No IRB/2022/A-01. All participants agreed to contribute to this study.

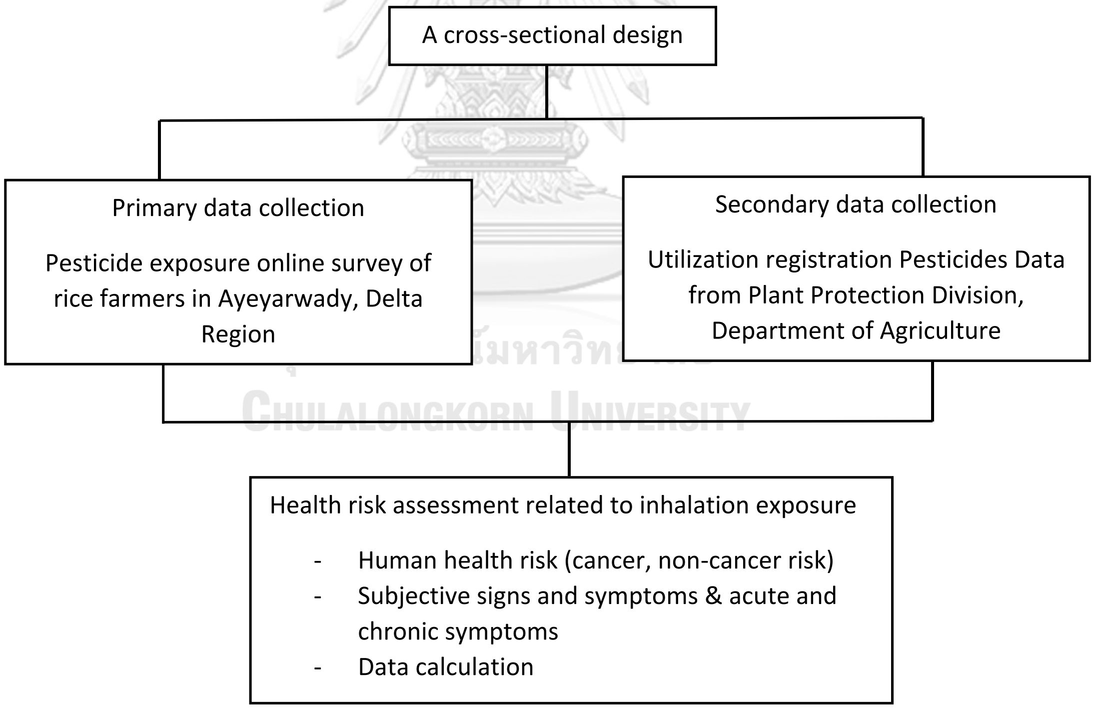

Figure 5 Flow Chart of study design of this study

3. 2 Study area and sampling sites

Myanmar’s fertile Ayeyarwady Delta is actually the rice bowl of Myanmar and paddy rice is traditionally an important source of income for farmers and agricultural laborers. The region lies between approximately latitude 15° 40' and 18° 30' north and between longitude 94° 15' and 96° 15' east. It has an area of 35,140 square kilometers (13,566 sq mi). Pyapon District is a district famous for rice production in the Ayeyarwady Region in southwestern Myanmar. Pyapon District in the rice-based main growing Bogalae, Kyaiklat and Pyapon townships were selected with 454 rice farmers to be study areas (Figure 6). The 454 participants of this study were randomly selected both males and females who were experienced in pesticides applied in rice production and permanently lived since birth or a long period in the study areas

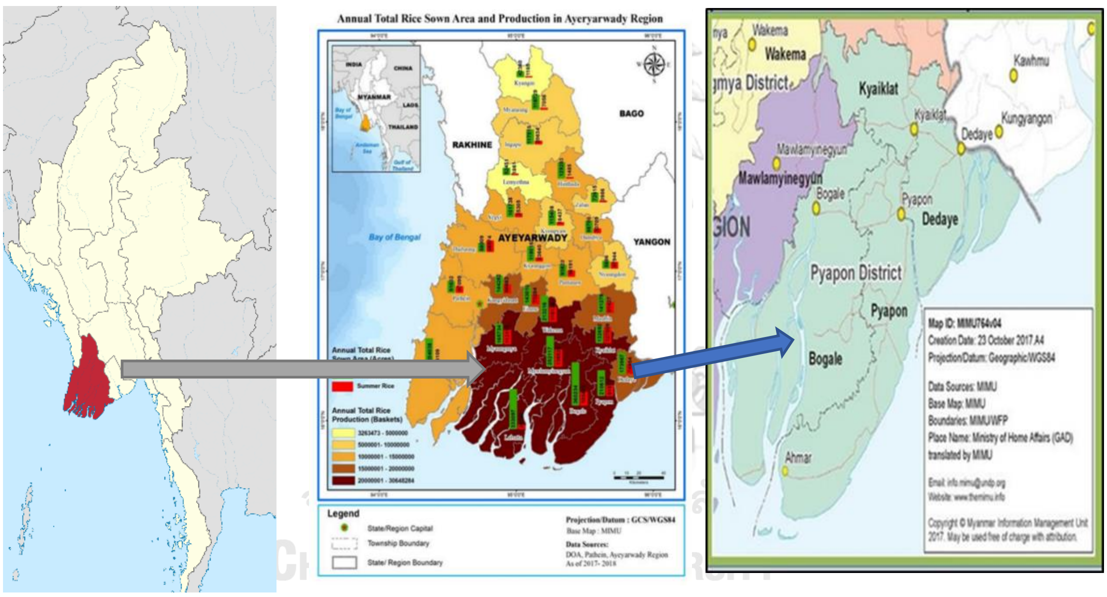

Figure 6 Location of the study area of Pyapon District, Ayeyarwady Division (MIMU,2017)

3.3. Sampling technique: Purposive sampling for Rice-based main growing Bogalae, Kyaitlat and Pyapon townships, Ayeyarwady delta region

The rice-based main growing two townships selected Bogalae, Pyapon and Kyaitlat townships for the targeted sample size (383). The sample size for this study was calculated based on Andrew Fisher’s formula for the sample size estimation. Z is a standard normal deviation while a confidence interval of 95% (α 0.05, margin of error) was considered giving a corresponding confidence level score of 1.96. This can be expressed as z is the z score, d is the margin of error at 0.05, N is the population size, and $\hat{p}$ is the population proportion perform preventive behavior of pesticide use in good level from the previous study = 0.517 (Myo, 2015).

The targeted population from the agriculture, forestry, and fishery sector of the labor force in Bogalae, Kyaiklat and Pyapon townships, Ayeyarwady, Delta Region, Myanmar was (82074) population (DOP,2019).

$$\boldsymbol{n = \frac{z^2\alpha/2 \times p(1-\hat{p})}{d^2}}$$

$$n = \frac{1.96^2 x\ 0.517\ (1-0.517)}{0.05^2}$$

n = 383

Table 2 The proposed Sample size table (Bogalae, Kyaiklat and Pyapon townships)

Farmers in the study areas	82074		
Confidence Level	90	95	99
Ideal Sample Size	182	**383**	442
Margin of Error	5%		
Response Distribution	50		

(Source:2019 inter- censual Survey, Department of Population, Ministry of Labor, Immigration and Population)

As a result, a sample of 383 participants was randomly selected from the farmers in the study areas. However, in this study, 12% was added into the study sample in order to avoid of subject dropout. Therefore, the sample size was (454) rice farmers. The participants randomly were selected according to the following criteria.

<u>Inclusion criteria</u>

- The farmers who were rice growing mainly in their production
- the farmers who were experienced in pesticide applied in rice production and permanently lived in the growing Bogalae, Kyaiklat and Pyapon townships, Delta Ayeyarwady Region, Myanmar since birth or a long period.
- Age >16 years old.
- No migration or change of residence.

<u>Exclusion criteria</u>

- Rice farmers who were not inclusion criteria
- Rice farmers who did not have the willingness to participate

3.4 Data collection

3.4.1 Primary data

Primary data were collected on household face-to-face interviews with the enumerator of each representative farmers who were growing rice by using semi- structured questionnaires which were built by the Kobo toolbox software. The researcher trained the enumerators well-prepared for the survey team before the actual data collection with the corporation of the agricultural officers and the related field expertise. The researcher took the responsibility of the tasks of carefully explaining details of the facts and main points of the questionnaires and actively illustrating the training tools and materials (PowerPoint, handouts, worksheets, and other sample equipment) for the questioners.

Figure 7 Face to face interviews between enumerators and Rice farmers of Delta, Ayeyarwady, Region from March to April 2022

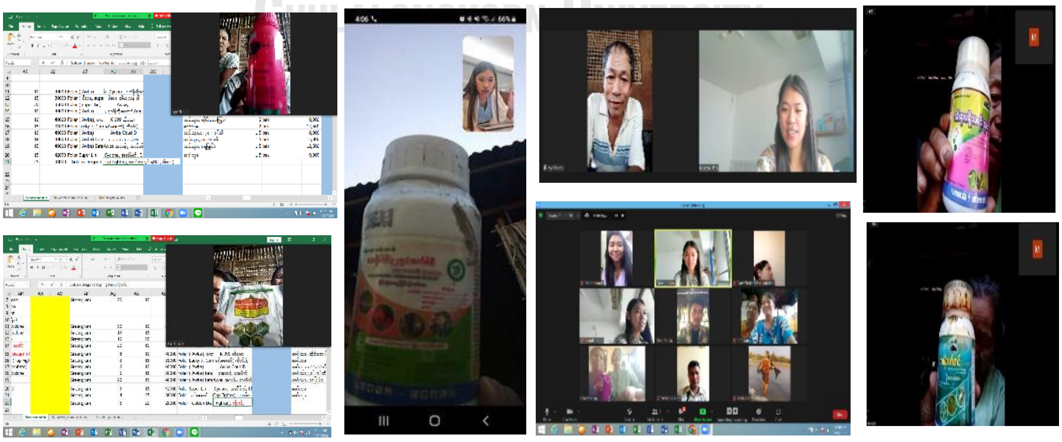

Figure 8 Face-to-face interviews and double-checking between researcher and Rice farmers of Delta, Ayeyarwady, Region from March to Aril 2022

In this study, the enumerators who were familiar with the rice-growing activities and practices of the study area, and skillfully contact the local agricultural officers, staff, civil society organizations (CSOs) and households are being assigned to interview for the research. In the figure (7) was illustrated data collection by face-to-face interviewing between enumerators and rice farmers. In this study, there were (10) enumerators contributed and each of enumerator of this study had already experienced the data collection and attended the training course attentively about the surveying and got the responsibility of the concept of the various questionnaires and reviewing each completed questionnaire for accuracy. and Figure (8) was described the researcher randomly double-checked the online survey of the interviewee's rice farmers who were participants in the study. The enumerators had the following criteria.

- An enumerator who is familiar with the rice-growing activities and practices of the study area
- An enumerator is a person who had an agricultural background with a diploma degree and /or is already graduated.
- A questioner is a person who can skillfully contact to the local agricultural officers, staff, civil society organizations (CSOs) and households are being assigned to interview for the research.
- An interviewer of this study has already experienced the data collection and/or attended the training course attentively about the surveying.
- An enumerator might have got the responsibility of the concept of the various questionnaires and reviewing each completed questionnaire for accuracy.
- An interviewer must submit a completed questionnaire form to the researcher as well as keep all information received confidential.

The interview questionnaire study consisted of three parts: Part (1) Socio-demographic characteristics (age, gender, education, body weight, and working farming experiences); cropping pattern, sown areas, and environmental condition; Part (2) Environmental awareness of pesticides exposure and practices regarding pesticide handling, management, storage, and hygiene practice after application Part (3) Health symptoms of pesticide. The structure of the questionnaire was designed based on questions which were established by Thant Zaw Lwin (2017).

3.4.2 Secondary data

Pesticide registration Data were collected from the Plant Protection Department and Department of Agriculture, Ministry of Agriculture, Livestock, and Irrigation. To get the most understanding of the existing situation of rice cultivation, secondary data were gathered from published or unpublished information about rice in particular and the study area in general. The rice cropping pattern and rice cultivation information were collected from Pyapon District, Agricultural Office, Ayeyarwady Division Agricultural Office, Ministry of Agriculture, Livestock, and Irrigation.

3.5 Pre-Test

A pilot survey was conducted on the 27 participants of this study rice farmers who were applying pesticides and permanently living in the selected villages in the Ayeyarwady Division, Myanmar. Before the main data collection, semi-structured questionnaires were prepared in English Language and translated into Myanmar language. The researcher contacted Plant Protection Division, and the Department of Agriculture and then discussed the requirements for the survey design. For the implementation of the data collection, the researcher contacted and got advice from agricultural experts from a reliable field including government officers, non-government organizations, pesticide sale workers and public health staff. And the training was given to the enumerators to perform well in interviews for the main data collection. In this training, the objective of this study was explained by the investigators and survey collection approaches were rehearsed with each other. From this training, they came to understand and become familiar with the procedure of data collection. In this pretest survey, sample data of pesticide application for reliability and validity was prior completed with 27 rice farmers in the nearest and similar characteristics to the sample. Cronbach's coefficient alpha of questionnaire in knowledge regarding used and exposure, safety behavior of pesticide applications, and practice action on handling, mixing, spraying, and storage on pesticide application questionnaires were 0.667, 0.690, and 0.684 respectively.

3.6 Data analysis

In this study, the data were analyzed using descriptive statistics. The socio-demographic data of the study area and the respondents and their practices were expressed in terms of charts, graphs, frequencies, percentages, mean and medium to overcome the three objectives.

Kolmogorov- Smirnov and Shapiro-Wilk Test were used to check the normality distribution and data procured a skewed distribution. Pesticide exposure and risk assessment were analyzed by the description of the inhalation exposure pathway for the pesticide, the risk identification and calculations average daily dose (ADD), unit exposure (UE), and hazardous quotient (HQ) with scoping. All the data were analyzed by Statistical Package for the Social Science Program (SPSS) license for windows (version 25.0).

3.7 Farmer's behavior related to pesticide exposure

The distribution of respondents expressed the extent of their behavior while dealing with daily farming lifestyles of the pesticide exposure by asking a set of questionnaires concerning their opinion on the use of pesticides 5 questions. Farmers' behavior related to pesticide exposure included purchasing behavior toward pesticides after listening to the advice of others and doing activities (eating, smoking, betel chewing, and drinking) during pesticide application.

Asking Questions

1. Who would you listen to when you decide to purchase pesticides?
2. Which behaviors did you do during the application of pesticides?
3. Where do you have lunch after spraying?
4. What behaviors do you usually avoid in the interval after the first spray and the second spray?
5. Do you smoke in the farm or after having lunch?

Level of knowledge and practice of pesticide

Phrase (1) Level of knowledge regarding environmental awareness related to pesticides, exposure, and toxicity of pesticides

The level of farmer's knowledge was calculated as index scores of general knowledges by using a set of questionnaires concerning the opinion on the environmental awareness, exposure, and toxicity of pesticides 6 questions. The level of agreement on each given statement was scored according to the orientation of the statement. A correct answer will give a 1 score and 0 score for wrong or unsure answer (Lwin 2017). Questions were chosen with more than one answer depending on the participants' choice. The overall knowledge score was assessed using the sum of each outcome and the scores were classified into 3 levels based on Bloom's cut-off point, consisting low level (<60%), moderate level (60-79%), and good level (≥80%).

- High level : 5– 6 (≥80%)
- Moderate level : 3 – 4 (60-79%)
- Low level : 0 – 2 (less than 60%)

Asking Questions

1. Do you hear about environmental pollution?

2. Do you know pesticides can damage the environment (air, soil, water)?
3. Do you know why some pesticides are currently banned in the Department of agriculture for usage?
4. While spraying pesticides, have you known to wear personal protective equipment (PPE)?
5. While mixing and loading pesticides, have you known to wear personal protective equipment (PPE)?
6. Can pesticides cause toxicity to humans?

Phrase (2) Level of practice regarding pesticide handling, management, storage, and hygiene practice after application

Regarding pesticide handling, management, storage, and hygiene practices of farmers were included in 15 questions. The practices about using pesticides, proper use of personal protective equipment (PPE), and safe work procedures when handling and disposal method of pesticides.

Asking Questions

1. Do you use registered fertilizer/ pesticides in agriculture?
2. Where do you store pesticide?
3. Do you read, follow, and spray pesticide according to instruction or label?
4. Have you replaced the pesticides containers as a portion of food or domestic water container?
5. Do you keep pesticides with food and water? (Keep near food)
6. In general, how do you mix pesticide?
7. Which personal protective equipment (PPE) do you usually use when you mix pesticide?
8. What kind of outfit do you wear when you apply pesticide?
9. Have you often spilled pesticide when you mix and spray pesticide?
10. If you spill some pesticide on your clothes and body, when do you change clothes and clean your body?
11. After you mix and spray pesticide, how do you clean your body?
12. Which products do you use to clean body after touching and mixing pesticide?
13. What do you do with the clothes you wearing after you used pesticide?
14. How often do you clean your clothes after those clothes contact with pesticide?
15. What is the method in disposing pesticide container?

For the scoring method, level of practices on each given statement was scored according to the orientation of the statement. A correct answer will give a 1 score and 0 score for wrong or unsure answer (Lwin 2017). Questions were chosen with more than one answer depending on the participants' choice. The overall knowledge score was assessed using the sum of each outcome and the scores were classified into 3 levels based on Bloom's cut-off point, consisting low level (<60%), moderate level (60-79%), and good level (≥80%).

Good practice : 11 – 15 (≥80%)

Fair Practice : 5 – 10 (60-79%)

Poor practice : 0 – 5 (less than 60%)

3.9 Risk Assessment of inhalation pesticide exposure

Regarding health, risk estimation was done based on an integration of Outdoor Residential Misting Systems (ORMSs) analysis data and information from the questionnaire-based exposure survey. (ORMSs) handler exposure estimation of dosage and risk assessment was used to estimate farmers exposed to pesticide dose by inhalation exposure pathway. Handler exposure was estimated in the absence of chemical-specific exposure monitoring data and Standard Operating Procedures for Residential Pesticide Exposure Assessment (2012) were obtained from US EPA. Moreover, the individual exposure (mg/kg. Day) was calculated for the respondents.

3.9.1. Risk estimation by Standard Operating Procedures (SOP) for Residential Pesticide Exposure Assessment (USEPA, 2012)

This approach is used to estimate farmers exposed to pesticide dose by inhalation exposure pathway. To assess the inhalation pathway, Standard Operating Procedures (SOP) for Residential Pesticide Exposure Assessment (2012) were obtained from the United State of environmental protection agency (US EPA). According to the SOP residential pesticide assessment has the following criteria. Handler exposure refers to an exposure scenario in which an adult is exposed during mixing, loading, and applying a pesticide. Residential handler exposure assessments estimate dermal and inhalation exposures for individuals using pesticides in and around their homes. Some key assumptions for residential handler assessments include:

- Residential handlers are assumed to be wearing shorts and short-sleeve shirts, shoes, and socks. This assumption differs from occupational handler assessments which assume handlers are wearing at least long pants, long-sleeved shirts, shoes, and socks.

- Personal protective equipment (PPE) is not considered a mitigation option for residential handlers because users are not trained, and compliance would not be expected.
- Pesticides are assumed to be applied only by adults. The assessment methods account for children 16 years and older who may also perform applications, thus for the purposes of this document 16-year-olds may be grouped with adults.
- All applicable application methods should be assessed unless prohibited by the product label.

3.9.2. Average daily Dose Calculation

E = UE * AR eq. 3.1

where:

E = exposure (mg/day).

UE = unit exposure (mg/lb. ai); and

AR = application rate (lb. ai/day).

AR = AR label* AI * CF *VnC * DH$_2$O *eq.3.2*

AR = Application rate (lb. ai/ day)

AR of product in label = (application rate in label of ounces)

AI = Percent ai in product (%)

VnC= Volume of nozzles can (Application rates are typically given in ounces of solution per 1000 ft3)

CF= Volume unit Conservation factor (1 gallon/128 ounces)

DH2O = water density (lb./gal)

AR= AR of product in label * AI* (1 gallon/128 ounces) * 1000 ft3/nozzle * 8.34 lbs./gallon

eq 3.3

Average daily Inhalation doses (ADD) normalized to body weight are calculated as:

ADD = Cair x InhR x ET x EF x ED/BW x AT *eq 3.4*

where:

ADD = Average daily dose (mg/kg-day)

Cair = Concentration of contaminant in air (mg/m3)

InhR = Inhalation rate (m3/hour)

ET = Exposure time (hours/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time (days)

3.9.3. Health risk assessment

Health risk estimation was done based on integrating Outdoor Residential Misting Systems (ORMSs) analysis data and information from the questionnaire-based exposure survey. Regarding, individual pesticide exposure (mg/kg. Day) was calculated using 95% confidence interval (C.I) for the mean of OPPs (acephate, chlorpyrifos and dimethoate), pyrethroid group of Lambda-Cyhalothrin and cypermethrin and carbonate group of carbofuran and cartap hydrochloride. Furthermore, the mean of pesticides of OPPs (acephate, chlorpyrifos and dimethoate), lambda-cyhalothrin and cypermethrin, carbofuran and cartap hydrochloride based on the statistical calculation among rice farmers of based on average daily inhalation dose and hazardous quotient were calculated as mean. All the data were analyzed by Statistical Package for the Social Science Program (SPSS) license for Windows (version 25.0).

3.9.4. Non- carcinogenic Hazardous quotient

Risk characterization is the final step of accessing human health risks from pesticide exposure. The potential risk of non-carcinogenic health effects from exposure. Non-cancer risk is defined as the ratio (hazard quotient; HQ) of the estimated intake to the reference dose (RfD). The following equation can be calculated as Hazard quotient (HQ).

$$HQ = Exposure / RfD \qquad \text{eq (3.5)}$$

where,

HQ = Hazard quotient (unitless)

RfD = Reference dose (mg/kg-day)

3.10 Health associated with pesticide exposure assessment questionnaire

Regarding health associated with pesticide exposure was included in three sections (1) acute symptoms within 24 hours, (2) Sub chronic symptoms (for one month), and (3) subjective signs and symptoms related to pesticide exposure. For the scoring method, each symptom suffered by the respondent was given a (1) score. All individual participants were summed up for a total score and frequency and percentage were calculated. Acute toxicity for inhalation exposure of 4 hours is classified according to the Globally Harmonized System for the Classification and Labelling of Chemicals (GHS) of the international labor organization (ILO/Safework) which is described in table (3).

3.11. Ethical Consideration

This study was approved by Institutional Review Board, Defence Services Medical Research Center, Directorate of Medical Services, Ministry of Defence, Republic of the Union of Myanmar with the certified code No IRB/2022/A-01. All participants agreed to contribute to this study.

Table 3 Classification and Labelling of Acute Toxicity from (ILO/Safework)

	Criteria	Hazard Communication Element	
		Signal Word	Danger
Category 1	- LC50 # 100 ppm (gas) - LC50 # 0.5 (mg/l) (vapor) - LC50 # 0.05 (mg/l) (dust, mist)	Symbol	Symbol Skull and Crossbones
		Hazard Statement	Fatal if inhaled (gas, vapor, dust, mist)
Category 2	- LC50 between 100 and less than 500 ppm (gas) - LC50 between 0.5 and less than2.0 (mg/l) (vapor) - LC50 between 0.05 and less than 0.5 (mg/l) (dust, mist)	Symbol	Skull and Crossbones
		Hazard Statement	Fatal if inhaled (gas, vapors, dust, mist)
Category 3	- LC50 between 500 and less than 2500 ppm (gas) - LC50 between 2.0 and less than 10.0 (mg/l) (vapor) - LC50 between 0.5 and less than 1.0 (mg/l) (dust, mist)	Symbol	Skull and Crossbones
		Hazard Statement	Toxic if inhaled (gas, vapor, dust, mist)
Category 4	- LC50 between 2500 and less than 5000 ppm (gas) - LC50 between 10.0 and less than 20.0 (mg/l) (vapour) - LC50 between 1.0 and less than 5.0 (mg/l) (dust, mist)	Symbol	Exclamation Mark
		Hazard Statement	Harmful if inhaled (gas, vapor, dust, mist)
Category 5	- LD50 between 2000 and 5000 (oral)	Symbol	No symbol
		Hazard Statement	May be harmful if inhaled (gas, vapour, dust, mist)

CHAPTER (IV)

RESULT

4.1. General information of pesticide exposure

This study was a cross – sectional design that collected information on the pesticide exposure. This study area is located Bogalae district, Ayeyarwady, Delta region in Myanmar. The study population was focused on individuals living in rice production communities. Samples from the pesticide exposure questionnaire were obtained from (454) persons with their general information.

In this research, there were 454 participants that consisted of 431 persons (95%) male and 23 persons (5%) female. Table (4) illustrates socio- ddemographic characteristics of participants in the study areas. The result showed that the mean age of farmers was 44.36 years old while the range was 16 and 74 years old. The largest sample 60% or 272 persons were in the age range of (35 – 54) years old. The rest of the two equal sample groups were (90) persons who ranged from (16 – 34) years old and 92 persons who ranged from (55 – 74) years, respectively. Rice farmer's average weight (± SD) and height (± SD) were 56.86 (± 7.30) kilograms and 165.12 (± 8.32) centimeters, respectively. Regarding educational background, 41% of the participants graduated from high school and 28% graduated from primary school.

Table 4 Demographic characteristics of Participants (n= 454)

Characteristics of respondents	Frequency	Percentages (%)
Age		
• Mean ± SD	44.36 ± 11.14	
• Range	16 -74	
Age in years		
• 16 – 34	90	20
• 35 – 54	272	60
• 55 – 74	92	20
Sex		
• Male	431	95
• Female	23	5

Characteristics of respondents	Frequency	Percentages (%)
Body weight (Kg)		
• Mean ± SD	56.86 ± 7.30	
• Range	95.25 - 137.19	
Height(cm)		
• Mean ± SD	165.12 ± 8.32	
• Range	124.97 - 188.98	
Education Status		
• Primary School	127	28
• Secondary	53	12
• High School	188	41
• Graduate	27	6
• Monastery education	57	13
• Illiterate	2	0.4

The majority of participants had an average farming experience of 22 years with a range of (1 – 52) years. For the farming size, most of them (90%) farm the average land owned 9.28 acres while the farmers (10%) the land rented 2.34 acres for the rice production. Almost all the participants presented as rice farmers (83.3%) who grew rice during the monsoon and summer seasons. Each farmer grew rice (92%) in average 8.39 acres during the monsoon season. Likewise, summer rice (91%) and had been grown (6.56 acres) respectively and described in table (5).

Regarding the environmental situation and water usage most respondents of rice farmers answered about there might have been birds and insects (refer to as predators and beneficial insects) existing, but they did not see much of them in their surrounding paddy fields in recent years. Among the study participants, 400 participants (88.13%) used stream or river water resources in their agricultural activities. Likewise, 268 participants representing (59%) of farmers used stream or river water resources as their domestic water supply for their household. Meanwhile, 353 participants (77.8%) applied streams or rivers as water source for mixing water with pesticides which is the same as in their agricultural activities. Additionally, there were 95% of participants who mixed pesticide in places located more than 50 feet far away from their house.

Table 5 Cropping pattern of the participants (n= 454)

Cropping Pattern	Frequency	Percentages (%)
Farming experience (years)		
• Mean	22	
• Range	1- 52	
Cultivated farm size (acres)		
• Own (Mean ± SD)	9.28 (± 10.78)	90
• Rent (Mean ± SD)	2.34 (± 4.47)	10
Time of Exposure		
• Spraying day per season (days)	1.52 (± 3.0)	
• Spraying hour per day (hours)	4.5231 (±8.0)	
Size of Rice farm		
• Average sown area (acres)	378	83
• Both Monsoon and Summer Rice	9.28	
Monsoon Rice		
• Average sown area (acres)	8.4	
• Grown monsoon rice	419	92
Summer Rice		
• Average sown area (acres)	6.6	
• Grown summer rice	413	91

4.2. Farmer’s behavior related to pesticide exposure

Farmers' behavior related to pesticide exposure included purchasing behavior toward pesticides after listening to the advice of others and doing activities (eating, smoking, betel chewing, and drinking) during pesticide application. Frequency and percentage of behavior related to pesticide exposure in 454 participants was illustrated in Table 6.

Table 6 Frequency and percentage of farmer’s behaviour related to pesticide exposure, (n=454)

No.	Behavior’s Items	Correct Answer	
		Yes	No
1	I did none of these activities (eating, smoking, drinking, betel chewing) during pesticide application.	99 (22%)	355 (78%)
2	I have a behavior of eating at home during break time of pesticide application or finish work.	434 (96%)	20 (4%)
3	I have avoided those kinds of habitats in all behavior (eating, smoking, drinking (water/alcohol), Betel Chewing) in the interval after the first and the second spraying.	300 (66%)	154 (34%)
4	I didn't smoke in the farm or after having lunch.	406 (89%)	48 (11%)
5	Listening from one of them (Neighborhood, Shopkeeper’s advice, Advertisement, Agricultural officer, and Sales representative) when I decide to purchase pesticide.	446 (98%)	8 (2%)

Farmers had more than one impression and often widely listen to other suggestions when purchasing pesticides. The high item of correct answer (98%) was the question no. 5: “I have a listening behavior from advising to others when I decided to purchase pesticide”. Over half of the people listen to shopkeepers' advice when purchasing pesticides. Similarity, one of the highest items of correct answer (96%) were no. 2: “I have a behavior of eating at home during break time of pesticide application or finish work”. On the other hand, the lowest item of a correct answer (22%) was the question no 1: " I did none of these activities (eating, smoking, drinking, betel chewing during pesticide application.” Figure 9 illustrates the respondent's behavior regarding information accessibility to determine purchasing pesticides.

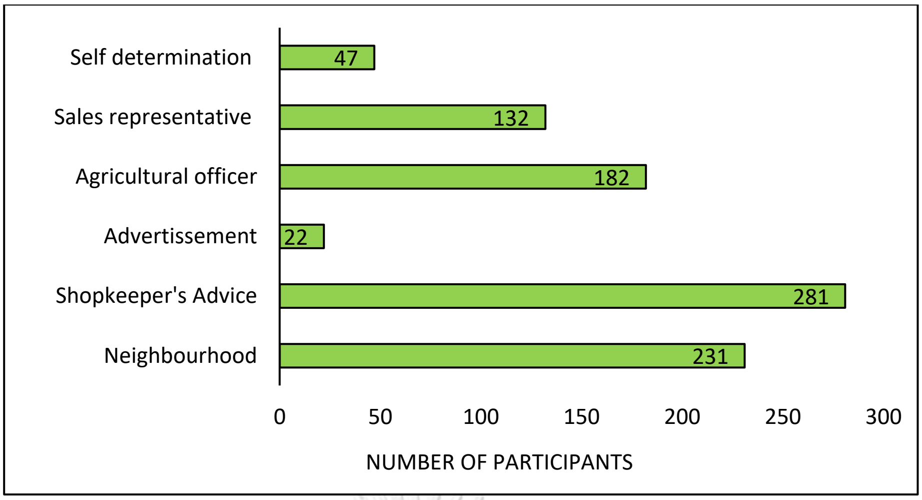

Figure 9 Information accessibility to determine purchasing pesticides (n=454)

Regarding participants' behavior doing activities (eating, smoking, betel chewing, and drinking (water/alcohol) related to pesticide exposure, 66% of the respondents avoided these activities during pesticide application. In comparison, 16% of the respondents did not avoid these activities (eating, smoking, betel chewing, and drinking) during pesticide application. Among these non-avoided participants, (20%) the respondents had to betel chewing activities which is the most occurrence activity. Furthermore, the rest of the non-avoided participants had drinking (water/alcohol) (4%), smoking (2%) and eating (1%), respectively. Figure 10 describes participants' behavior doing activities (eating, smoking, betel chewing, and drinking) related to pesticide exposure during pesticide spraying. Table 7 was shown the frequency and percentage of participants' inhabitant activities in the interval after the first and the second spraying near the field. Most of the participants (66%) avoided eating, smoking, drinking, and Betel Chewing activities. On the contrary, (16%) of the respondents did not avoid all activities. In addition, (18%) of the respondents did more than one activity (Eating, smoking, drinking, and Betel Chewing) near the field.

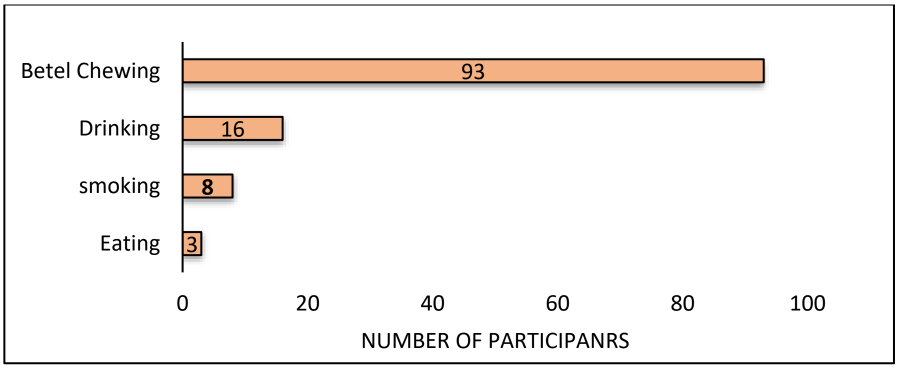

Figure 10 Farmer's behaviour during pesticide spraying (n=454)

Table 7 Participant's inhabitant activities in the interval after the first and the second spraying near the field (n=454)

Activities	Frequency	Percentage (%)
All avoid (Eating, smoking, drinking, Betel Chewing)	300	66
Do more than one activity (Eating, smoking, drinking, Betel Chewing)	81	18
No avoid (Eating, smoking, drinking, Betel Chewing)	73	16

For the smoking behavior at work on the farm or after lunch in the field, 89% of the participants were non- smoking and describes in table 8. The researcher observed that out of 48 participants (11%) had smoking behavior of mostly (1%) often (7%) and only occasionally (3%), respectively. Table 9 describes participants' smoking behavior at work on the farm or after lunch in the farm.

Table 8 Participants' smoking behaviour at the work (n=454)

Title	Participants	Percentage (%)
Non-smoker	406	89
Smoker	48	11

Table 9 Participants' smoking practice at work on the farm or after lunch in the field (n=454)

Smoking frequency	Participants	Percentage (%)
often	33	7
Mostly	3	1
Only occasionally	12	3

4.3: Result of the level of knowledge and practice of pesticide

4.3.1 Level of knowledge regarding environmental awareness related to pesticides, exposure, and toxicity of pesticides

According to Table (10), almost of rice farmers (98.67%) knew about the pesticide toxicity to humans (means that most farmers knew about pesticides are dangerous when the body only touch and swallow to the pesticides). Likewise, over (90%) of rice farmers have already known about pesticides can damage to the environment (air, soil, water). And over (90%) rice farmers answered about "while spraying pesticides, I already known wearing fully personal protective equipment (PPE) can prevent pesticide exposure. On the other hand, only rice farmers (13.21%) knew to wear fully personal protective equipment (PPE) while mixing and loading pesticides. Furthermore, 44.71% of respondents disagreed with the statement " I already know why some pesticides are currently banned in the Plant Protection Division, Department of Agriculture ".

Table 10 Frequency and percentage of level of knowledge regarding environmental awareness related to pesticides, exposure, and toxicity of pesticides (n=454)

Knowledge items	Correct Answer	
	Frequency	Percentage (%)
1. I have already heard about environmental pollution.	390	85.9
2. I have already known about pesticides can damage to the environment (air, soil, water)	433	95.4
3. I already known why some pesticides are currently banned in the Department of agriculture for usage.	203	44.71
4. While spraying pesticides, I already known wearing fully personal protective equipment (PPE) can prevent pesticide exposure.	425	93.61
5. While mixing and loading pesticides, I already known wearing fully personal protective equipment (PPE) can prevent pesticide exposure.	60	13.21
6. Pesticides cause toxicity to humans.	448	98.67

Table 11 illustrates rice farmers' knowledge of pesticides. Score were classified into (0- 2) as low levels, (3- 4) as moderate levels and (5 -6) as high levels. As a result, the distribution of the knowledge of the participants showed that 11 % of the subjects had "Low level of knowledge", and 77 % of them had "Moderate level of knowledge" while 12% of the respondents had " High level of knowledge".

Table 11 Level of knowledge regarding environmental awareness related to pesticides, exposure, and toxicity of pesticides of the rice farmers in Myanmar (n=454)

Level of knowledge	Frequency	Percentage
Low (0- 2)	50	11
Moderate (3- 4)	348	77
High (5 - 6)	56	12

4.3.2 Level of practice regarding pesticide handling, management, storage, and hygiene practice after application

Frequency and percentage of level of practices regarding pesticide handling, management, storage, and hygiene after application in 454 participants was illustrated in Table 12. The high items of correct answer (98%) were the question no. 2: "Storing pesticides in separate room (separate/ high place/ locked box), keeping out of children, animals, keeping out of food and water) "and question no 12: "After finishing work, immediately washing clothes that are in contact with the pesticide". Regarding Question no 12, the correct answer was (98%) compared to the wrong answer was (2%) still described an important answer as" Keep it and wear it again on the next day". In contrast, the lowest item of a correct answer (3%) was the question no 13: "Incinerating method is the best for disposing of pesticide containers". Likewise, the question no 11: After using the pesticide, changing new clothes immediately at the field was also one of the lowest items of the correct answer (7%).

Table 12 Frequency and percentage of practices regarding pesticide handling, storage, and hygiene (n=454)

No	Practice Items	Correct Answer	
		Frequency	Percentage (%)
1	I use registered pesticides	401	88
2	Storing pesticides in separate room (separate/ high place/ locked box), keeping out of children, animals, keeping out of food and water)	445	98
3	In general, when mixing pesticide, I follow the bottle instruction label	390	86
4.	I have not replaced the pesticides containers as a portion of food or domestic water container	449	99
5.	I did not keep pesticides with food and water. (don't keep near the food)	451	99
6	When mixing pesticide, I wear rubber gloves, and using stirring stick	72	16
7	When spraying pesticide, I wear fully personal protective equipment	145	32
8	When spraying pesticide, I wear with long sleeved shirt and long pants	88	19
9	I have not spilled pesticide when mixing and spraying of these pesticides.	311	69
10	If the participants spill some pesticide on their clothes and body, changing cloths and clean body immediately	139	31
11	After the participants mix and spray pesticides, washing hands and arms immediately and taking a bath after finish work	428	94

No	Practice Items	Correct Answer	
		Frequency	Percentage (%)
12	After touching and mixing pesticide, using to clean the body with water and soup.	418	92
13	After using the pesticide, changing new clothes immediately at the field	33	7
14	After finishing work, washing immediately clothes that are in contact with the pesticide.	445	98
15	Incinerating method is the best for disposing pesticide containers	14	3

Table (13) and (14) describe frequency and percentage of personal protective equipment (PPE) usage during pesticide application in rice farmers. Among the (90%) used personal protective equipment (PPE). The users of PPE in (409), 364 participants (80%) used upper body covering (fabric gloves, face mask, long-sleeve shirts) as described in table 12. By comparison, (10%) of the respondents have never been used PPE was a noteworthy result. Regarding face mark wearing, most of the respondents widely used fabric masks (60%) when they mixed or sprayed pesticides. Similarly, 57 % of the respondents applied ordinary face masks (surgical masks). Whereas (28%) and (20%) of all the rice farmers applied fabric gloves and rubber boots, respectively. Rice farmers of hardly any used PPE are goggles or glasses (2%) and plastic covering (1%), correspondingly.

Figure 10 Poor practices of using PPE (without wearing masks and gloves) during loading and mixing of pesticide (photo by participant of enumerators)

Table 13 Use of personal protective equipment (PPE) usage during pesticide spraying in rice farmers (n=454)

Use of PPE	Frequency	Percentage (%)
No use of PPE	45	10
Use of PPE	409	90

Table 14Frequency and percentage of personal protective equipment (PPE) usage during pesticide spraying in rice farmers (n=409)

Use of PPE	Frequency	Percentage (%)
Goggle or glasses	10	2
Fabric gloves	125	28
Normal face mask	259	57
Rubber boots	91	20
Apron	10	2
Fabric mask	272	60
Plastic covering	4	1
Clothes coverall (upper potion)	364	80

The level of practices pesticide regarding handling, management, storage and hygiene after application of farmers were included in 15 questions. For the scoring method, a correct answer gave 1 score and 0 scores for the wrong answer. The level of practices regarding pesticide handling, storage and hygiene practices of rice farmers were shown in Table 15. As a result, (5%) of rice farmers had a poor level of practice. On the contrary, (94 %) of rice farmers had moderate practices level and (1%) high practices, correspondingly. Figure (10) describes the poor practices of using PPE (without wearing masks and gloves) in rice farmers during loading and mixing of pesticides in the study areas.

Table 15 Level of practices regarding pesticides handling, storage and hygiene after application of farmers (n= 454)

Level of Practice	Frequency	Percentage (%)
Poor practice (0 – 5)	23	5
Moderate (6-10)	428	94
High (11- 15)	3	1

4.4. Result of the potential risk and occupational exposure of pesticides

4.4.1: Hazard identification by inhalation route of pesticide usage of participants for the cross-sectional study

Regarding hazard identification by inhalation route of pesticides that are classified as carcinogenic or non-carcinogenic according to the United State Environmental Protection Agency (USEPA) which were used by rice farmers in the paddy fields in Pyapon District, Ayeyarwady Region, Myanmar. In the cross-sectional study of rice farmers in Ayeyarwady, (84%) of the respondents applied insecticides while 73 % and 29% were herbicides and fungicides users, accordingly. Pesticides of respondents are grouped as insecticide, herbicide, and fungicide according to the Pesticide Registration Data from the Plant Protection Department and Department of Agriculture, Ministry of Agriculture, Livestock, and Irrigation, Myanmar. The pesticides used by the farmers in a cross-sectional study in the Ayeyarwady region are presented in table (16).

Insecticide rice farmers used pesticide groups are carbonates, organophosphates, pyrethroids and other agrochemicals, respectively. Among them, most of the farmers who applied pesticides were organophosphate groups of Chlorpyrifos (29.07%) is the most and acephate (19.16%) was the second-largest group. Pyrethroids was the third largest user of insecticide was Lambda-cyhalothrin (14.66%), accordingly. Regarding herbicides application, aryloxyphenoxypropionate, bipyridinium, glyphosate, sulfonylurea and Phenoxycarb ethyl groups were commonly used by the farmers. Including these herbicides, Bensulfuron-methyl was almost half of the participants widely applied. Regarding fungicides groups, (29%) of the respondents applied acetamide, antibiotic, avermectin, botanical pesticides, Reductase, Triazole Strobilurins and Dithiocarbonate, respectively. Among them, most of the respondents who applied fungicides was Tricyclazole (5.51%). All these pesticides were classified by non-carcinogenic effects for inhalation exposure according to the United State Environmental Protection Agency (USEPA) which were used by rice farmers in the paddy fields in Pyapon District, Ayeyarwady Region, Myanmar.

Table 16Hazard identification (carcinogenic or non-carcinogenic) by inhalation route of pesticides used by rice farmers in paddy field in Pyapon District, Ayeyarwady Region, Myanmar (n=454)

NO	Chemical type	Active ingredient	Main Use (Mode of action)	Risk identification (Inhalation route)	Participants (n)	Participants' usage (%)
1	Organophosphates	Acephate	Insecticide	Non-carcinogenic	86	18.94
2	Organophosphates	Chlorpyrifos	Insecticide	Non-carcinogenic	132	29.07
3	Organophosphates	Dimethoate	Insecticide	Non-carcinogenic	5	1.10
4	Organophosphates	Profenofos	Insecticide	Non-carcinogenic	2	0.44
5	Carbonates	Carbofuran	Insecticide	Non-carcinogenic	44	9.69
6	Carbonates	Carbosulfan	Insecticide	Non-carcinogenic	6	1.32
7	Carbonates	Cartap Hydrochloride	Insecticide	Non-carcinogenic	13	2.86
8	Carbonates	Fenobucarb	Insecticide	Non-carcinogenic	10	2.20
9	Pyrethroids	Beta-cypermethrin	Insecticide	Non-carcinogenic	4	0.88
10	Pyrethroids	Cypermethrin	Insecticide	Non-carcinogenic	11	2.42
11	Pyrethroids	Lambda-cyhalothrin	Insecticide	Non-carcinogenic	62	13.66
12	Avermectin, milbemycin	Emamectin Benzoate	Insecticide	Non-carcinogenic	4	0.88
13	Neonicotinoid	Imidacloprid	Insecticide	Non-carcinogenic	2	0.44
14	phenylpyrazole	Fipronil	Insecticide	Non-carcinogenic	8	1.76
15	Oxadiazine	Indoxacarb	Insecticide	Non-carcinogenic	2	0.44
16	Thiadiazole	Buprofezin	Insecticide	Non-carcinogenic	1	0.22
17	Bipyridinium	Paraquat dichloride	Herbicide	Non-carcinogenic	9	1.98
18	Phenoxy carboxylic acid	2,4-Dichlorophenoxyacetic acid	Herbicide	Non-carcinogenic	79	17.40
19	Aryloxyphenoxypropionate	Quizalofop-P-ethyl	Herbicide	Non-carcinogenic	36	7.93

NO	Chemical type	Active ingredient	Main Use (Mode of action)	Risk identification (Inhalation route)	Participants (n)	Participants' usage (%)
20	Neonicotinoid	Thiamethoxam	Herbicide	Non-carcinogenic	5	1.10
21	Phosphonic Acid	Glyphosate	Herbicide	Non-carcinogenic	74	16.30
21	Chloroacetamide	Metolachlor	Herbicide	Non-carcinogenic	7	1.54
23	Sulfonylurea	Bensulfuron-methyl	Herbicide	Non-carcinogenic	83	18.28
24	Sulfonylurea	Pyrazosulfuron-ethyl	Herbicide	Non-carcinogenic	8	1.76
25	Diphenyl ether	Oxyfluorfen	Herbicide	Non-carcinogenic	10	2.20
26	Avermectin	Abamectin	Herbicide	Non-carcinogenic	2	0.44
27	Acetamide	Cymoxanil	Herbicide	Non-carcinogenic	5	1.10
28	Triazole	Difenoconazole	Fungicide	Non-carcinogenic	13	2.86
29	dithiolane	Isoprenaline	Fungicide	Non-carcinogenic	3	0.66
30	Reductase	Tricyclazole	Fungicide	Non-carcinogenic	25	5.51
31	Aminoglycoside Antibiotic	Kasugamycin	Fungicide	Non-carcinogenic	12	2.64
32	Dithiocarbonate	Mancozeb	Fungicide	Non-carcinogenic	9	1.98

4.4.2 Dose-Response Assessment

After identifying the potential hazard of pesticides, dose-response assessment is the second step of risk assessment. The U.S National Academic Press report in 1994 described that dose-response assessment entails a further evaluation of the conditions under which the toxic properties of a chemical might be manifested in exposed people, with particular emphasis on the quantitative relation between the dose and the toxic response.

4.4.2.1. Toxicity assessment

Noncancer toxicity refers to adverse health effects other than cancer and gene mutations. Noncancer risk is defined as the ratio (hazard quotient; HQ) of the estimated intake to the reference dose (RfD). The report of Heath Effects Assessment Summary Tabel (HEAST) of US

EPA in 1995, RfC or RfD is a provisional estimate (with uncertainty spanning perhaps an order of magnitude) of the daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a portion of the lifetime, in the case of a subchronic (RfC) or RfD, or during a lifetime, in the case of (RfC) or (RfD). The RfD is the dose at or below which adverse noncancer health effects are not estimated to occur. Noncancer risks from exposures to pesticides with no systemic (portal-of-entry) effects (e.g., respiratory irritation) were assessed by eliminating inhalation rate (IR) and conversion factor (0.001 m3/L air); in other words, the effect is dependent on-air concentration. The resulting exposure estimate in milligrams per cubic meter is divided by the reference value in milligrams per cubic meter (lee et all., 2002).

In this study, the most used organophosphate pesticides (29.07%) were chlorpyrifos and acephate (18.94%) of participants in rice farmers. In the pyrethroid group, Lambda-cyhalothrin was the third most applied insecticide among the respondents (13.66 %) and (2.42%) of respondents of rice farmers was used Cypermethrin. In addition, carbofuran and Cartap Hydrochloride were which were applied by the respondents (9.69 %) and (2.86%) in the study areas. For the determination of toxicity assessment, the organophosphate pesticides (including acephate chlorpyrifos and dimethoate), pyrethroids groups of cypermethrin and lambda-cyhalothrin, and carbonate groups of carbofuran and cartap hydrochloride which were applied by the respondents during loading, mixing, and spraying of these pesticides without proper the respirators.

Toxicity assessment of non-cancer of pesticide exposure RfD values of OPPs (acephate chlorpyrifos and dimethoate), pyrethroids groups of cypermethrin and lambda-cyhalothrin, and carbonate groups of carbofuran and cartap hydrochloride which were illustrated in the table (17). The RfD used with inhalation doses under chronic exposures to estimate the potential of a systemic toxic effect. The inhalation chronic RfD is derived from an inhalation chronic reference concentration (RfC). All RfD values of these pesticides are based on inhalation studies, unless noted, as oral (o) or oral-to-inhalation (o⟶i) route extrapolation administered doses, with no adjustment for absorption by the U.S EPA.

Regarding organophosphate group, acephate has low acute dermal and inhalation toxicity which was Toxicity Category IV (Very Low Toxicity). For oral route, acephate was classified under Category III (Slightly toxic and slightly irritating) while acute RfD was 0.005 (mg/kg/day); and chronic RfD was 0.0012 (mg/kg/day) which reported by the Interim Reregistration Eligibility Decision (IRED) from the US EPA (US. EPA, 2006). For dimethoate was classified acute oral toxicity Category II (moderately toxic) and acute dermal III (Slightly toxic and slightly irritating) by the US EPA. Oral RfD values with acute and chronic of dimethoate were 0.013 (mg/kg/day) and 0.0022 (mg/kg/day) which recommended by the Interim Reregistration Eligibility Decision (IRED) from the US EPA (US. EPA, 2008). On the other hand, chlorpyrifos is moderately toxic following acute oral, dermal and inhalation exposures, and is classified in toxicity category II (moderately toxic). RfD values with acute and chronic of chlorpyrifos were 0.001 mg/kg/day and 0.0003 mg/kg/day which recommended by the Interim Reregistration Eligibility Decision (IRED) from the US EPA (US. EPA, 2006).

For the pyrethroid group, the US EPA recognized that cypermethrin has moderate acute toxicity via the dermal and inhalation routes (Category III & IV) and is not a skin sensitizer. It is more toxic via the oral route (Category II). For the oral route of RfD values with acute and chronic cypermethrin were 0.1 mg/kg/day and 0.06 mg/kg/day which was recommended by the Reregistration Eligibility Decision (IRED) from the US EPA (US. EPA, 2006). Lambda-cyhalothrin is moderately acutely toxic via oral, dermal, and inhalation routes (Category II). The special docket of the Office of Prevention, Pesticides and Toxic Substances, US EPA reported acute dietary RfD value (General Population, including Infants and Children) was 0.005 mg/kg/day and chronic Rfd was 0.001 mg/kg/day (US. EPA,2007). In the carbonate group of carbofuran for acute and chronic RfD value was 0.00006 mg/kg/day from (IRED) the agency US EPA (US EPA, 2006), and acute (RfD) 0.5 mg/kg/day and chronic RfD was 0.14 mg/kg/day of cartap hydrochloride was reported from Office of Prevention, Pesticides and Toxic Substances, US EPA. (US EPA, 1999). RfDs are listed in Table (13) by exposure duration (acute, sub chronic, or chronic) and corresponding target organ/toxicity.

Table 17 Toxicity assessment of reference values for non-cancer risk of OPPs (acephate, chlorpyrifos and dimethoate), pyrethroids groups of cypermethrin and lambda-cyhalothrin, and carbonate groups of carbofuran and cartap hydrochloride (n=353)

Pesticides	**FQPA factor**	**Acute RfD (mg/kg/ 24hr)**	**Target toxicity**	**Sub chronic RfD (mg/kg/ day)**	**Target toxicity**	**Chronic RfD (mg/kg/day)**	**Target toxicity**
Organophosphate group (OPPs)							
Acephate	1x	0.005(o)	Brain and plasma cholinesterase inhibition	0.0012	Brain and plasma cholinesterase inhibition	0.0012(o)	Brain cholinesterase inhibition
Dimethoate	1x	0.013(o)	Brain cholinesterase inhibition	0.013	Brain ChE inhibition	0.0022(o)	Brain cholinesterase inhibition
Chlorpyrifos	10×	0.001	Plasma and RBC cholinesterase inhibition	0.001	Plasma and RBC cholinesterase inhibition	0.0003 (o⟶i)	Plasma and RBC cholinesterase inhibition
Pyrethroids groups (PYs)							
Cypermethrin	1x	0.1 (o)	Acute neurotoxicity	0.1 (o)	neurotoxicity	0.06 (o)	neurotoxicity
Lambda-cyhalothrin	10x	0.005 (o)	neurotoxicity	0.005 (o)	neurotoxicity	0.001 (o)	neurotoxicity
Carbonate groups (CAs)							
Carbofuran	5X	0.00006	cholinesterase inhibition	0.00006	cholinesterase inhibition	0.00006	cholinesterase inhibition
Cartap Hydrochloride	1x	0.5	acute neurotoxicity	0.5	neurotoxicity	0.14	reproductive toxicity

4.4.3. Exposure assessment

The inhalation exposure was estimated from the airborne aerosols released by sprayer nozzles of the well-mixed box (WMB) by using the calculation algorithm to estimate the dose from inhalation which is provided by USEPA. The average daily inhalation dose (ADD) normalized to body weight is calculated as:

$$ADD = Cair \times InhR \times ET \times EF \times ED/BW \times AT \qquad \text{eq (4.1)}$$

where:

ADD = Average daily dose (mg/kg-day)

Cair = Concentration of contaminant in air (mg/m3)

InhR = Inhalation rate (m3/hour)

(0.64 m3/hour for adult recommended by US EPA)

ET = Exposure time (hours/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time (days)

4.4.3.1 Predict exposure modeling by handler exposure assessment

Health risk estimation was performed based on integrating Outdoor Residential Misting Systems (ORMSs) analytical data and information from the questionnaire-based exposure survey. The pesticide exposure assessment spreadsheets are a standard method provided for completing post-application inhalation exposure assessments for adults after a pesticide applying in an outdoor space (USEPA,2012). The air concentration can be calculated using the inhalation handler exposure algorithm formula in USEPA. The derivation data of the ambient concentration in air (mg/m3) was estimated amount of active ingredient handled in a day in the study area. Handler exposure can be estimated in the absence of chemical-specific exposure monitoring data with the following information:

- Application site (e.g., lawns, gardens, kitchen baseboards, etc.).
- Formulation type (e.g., liquid, granule, etc.).
- Application equipment (e.g., aerosol can, sprinkler can, backpack sprayer, etc.); and

- Application rate (e.g., lb. ai/ft2, lb. ai/gal).

$$E = UE * AR$$ eq (4.2)

where:

- E = exposure (mg/day).
- UE = unit exposure (mg/lb. ai); and
- AR = application rate (lb. ai/day).

$$AR = AR\ label * AI * CF * VnC * DH2O$$ eq (4.3)

- AR = Application rate (lb. ai/ day)
- AR of product in label = (application rate in label of ounces)
- AI = Percent ai in product (%)
- VnC= Volume of nozzles can (Application rates are typically given in ounces of solution per 1000 ft^3)
- CF= Volume unit Conservation factor (1 gallon/128 ounces) • DH2O = water density (lb./gal).

$$AR = AI * (1\ gallon/128\ ounces) * AR\ of\ product\ in\ label * 1000\ ft3/nozzle * 8.34\ lbs./gallon$$

The determination of estimated inhalation exposure (mg/day) in the absence of chemical-specific exposure monitoring data was used by multiplying the formulation-application method-specific unit exposure by an estimate of the amount of active ingredient handled in a day. Unit conversion factors (points estimate) by multiplying the formulation-application method-specific unit exposure and input parameters. Table 18 illustrates the recommended post-application inhalation exposure factors point estimates of outdoor Residential misting systems from USEPA, 2012.

The following equation was used

$$UE = \frac{IR * C0 * V}{Q}\ (\mathrm{Int}\ (\mathrm{ER.PR}) + (\frac{1 - \mathrm{R\ fra(ET.PR)}}{(1-\mathrm{R})})$$ eq (4.4)

where:

- UE = exposure (mg/day);
- IR = inhalation rate (m^3/hr);

- C_0 = initial air concentration (mg/m^3);
- V = volume of treated space (m^3);
- Q = airflow (m^3/hr.).
- ET PR = pulse rate (spray events/hr);
- frac (ET·PR) = fraction portion of the product of the exposure time (ET) and the pulse rate (PR);
- int (ET·PR) = integer (i.e., whole number) portion of the product of the exposure time (ET) and the pulse rate (PR).
- R= $e^{-(\frac{Q}{V})TBA}$
- TBA = time between application events (1/PR). = exposure time (hours/day);

The initial air concentration can be calculated using the following formula:

$$C_0 = AR * CF_1 * CF_2$$ eq (4.5)

where:

C_0 = initial air concentration (mg/m3);

AR = application rate per spray event (lbs ai/ft3);

CF_1 = weight unit conversion factor (454,000 mg/lb.); and

CF_2 = volume unit conversion factor (35.3 ft3/ 1.0 m3).

The airflow in the field is determined as follows:

$$Q = AV * CF_1 * CF_2 * A_{cross\text{-}section}$$ eq (4.6)

where:

- Q = airflow through treated space (m3/hr);
- AV = air velocity (m/s);
- CF_1 = time unit conversion factor (60 seconds/1 minute);
- CF_2 = time unit conversion factor (60 minutes/ hour); and
- $A_{cross\text{-}section}$ = cross-section of outdoor space treated (m2).

Table 18 Recommended Post-application Inhalation Exposure Factors by Outdoor Residential Misting Systems (ORMS) in Point Estimates from USEPA, 2012

Algorithm Notation	**Exposure Factor (units)**	**Point Estimate(s)**
AR	Application rate per spray event (lb. ai/1000 ft3)	Product-specific
PR	Pulse Rate (sprays/hr.)	1
DH_2O	Water density (lb./gal)	8.34
V_{NC}	Nozzle coverage volume (ft3)	1,000 ft3 per nozzle
V	Volume of treated space (m3)	90.6
Q	Airflow (m3/hr.)	5,400
AV	Air velocity (m/s)	0.1
C_0	Initial air concentration (mg/m3)	Calculated; concentration at time "0"
$A_{cross\text{-}section}$	Cross sectional area of area treated (m^2)	15 m^2
IR	Inhalation rate (m3/hour) Adult	0.64

The calculation of average daily inhalation dose (ADD) is shown in the following sample calculation. The sample calculation of the scenario is that inhalation exposure occurs with a specific exposure time from the airborne pesticides released by handler nozzles.

4.4.3.2: Sample scenario calculation of the pesticide inhalation handler exposure assessment in targeted areas; Insecticide for acephate (OP) exposure assessment

Brand name: Armo Vital 75% SP (Water soluble powder)

Group: acephate, Organophosphate group

Active Ingredient (AI): 75% Soluble Power

AI= 75%= 0.75

CF1= 1 gallon/128 ounces

AR of product in label by farmer applied rate (oz) = Amount of product in one package × (no. of package) / (no. of can × 4-gallon)

AR of product in label by farmer applied rate= 0.7 oz/1000 ft3

BW (body weight) = 135 lb. = 61.23 kg

AR= AI* (1 gallon/128 ounces) * AR of product in label * 1000 ft3/nozzle * 8.34 lbs./gallon

= 3.30342*10-8 (lb. ai/ft3)

C_0 = AR * CF1* CF2

= 3.30342*10-8 (lb. ai/ft3) *454000 (mg/lb.) * 35.3(ft3/m3)

= 0.529412997 (mg/m3)

ADD = Cair x InhR x ET x EF x ED/BW x AT

ADD = 0.529412997 (mg/m3) × 0.64 (m3/hr) × 3(hrs/day) × 48 (days/year) × 46 (years) / (54.43kg ×402960 days)

ADD = 1.023279×10^{-4} mg/kg-day

The scenario-specific input parameters from the survey interview (Exposure time (ET), Exposure frequency (EF), Exposure duration (ED), Body weight (BW), Average time (AT) values of widely used pesticides of acephate, chlorpyrifos, and dimethoate (OPPs), lambda-cyhalothrin and cypermethrin of pyrethroid groups and carbonate group of carbofuran and cartap hydrochloride for post-application inhalation exposure assessments are calculated and described in Tables (19), (20), (21),(22), (23), (24) and (25) respectively.

Table 19 Age, body weight, exposure time and average time of the respondents of Acephate (n= 86)

Factor	Range	Mean (±SD)
Age(years)	16 - 72	45 (±1.29)
Exposure time (ET) (hours/day)	1 - 6	4 (±0.23)
Exposure frequency (EF) (days/year)	24 - 48	38 (±5.87)
Exposure duration (ED) (years)	10 - 46	21(±7.31)
Body Weight (kg)	37 - 82	55 (±0.99)
Averaging time (AT) (days)	87600- 402960	185712 (±64037.9)

Table 20 Age, body weight, exposure time and average time of the respondents of Chlorpyrifos (n= 132)

Factor	Range	Mean (±SD)
Age(years)	28 - 72	48.58 (±0.88)
Exposure time (ET) (hours/day)	5 - 11	7.6 (±1.0295)
Exposure frequency (EF) (days/year)	26 - 72	33.6(±5.88)
Exposure duration (ED) (years)	18 - 39	29 (±3.75)
Body Weight (kg)	41- 77	57 (±0.57)
Average time (AT) (days)	175200 - 341640	254040 (±32893.7)

Table 21 Age, body weight, exposure time and average time of the respondents of Dimethoate (n= 5)

Factor	Range	Mean (±SD)
Age(years)	40 - 65	53 (±4.57)
Exposure time (ET) (hours/day)	1 - 8	5.8 (±0.73)
Exposure frequency (EF) (days/year)	34 - 76	52.8 (±11.75)
Exposure duration (ED) (years)	3 – 30	20.2 (±4.59)
Body Weight (kg)	50 - 59	54 (±2.02)
Average time (AT)(day)	26280 - 262800	176952 (±40276.9)

Table 22 Age, body weight, exposure time and average time of the respondents of Lambda cyhalothrin (n= 62)

Factor	Range	Mean (±SD)
Age(years)	19 - 65	42 (±1.36)
Exposure time (ET) (hours/day)	1 - 6	5 (±0.36)
Exposure frequency (EF) (days/year)	24 - 96	67.2 (±11.75)
Exposure duration (ED) (years)	11 - 40	20.4 (±5.5)
Body Weight (kg)	45 - 95	59 (±1.15)
Average time (AT) (days)	96360 - 350400	178704 (±48187.9)

Table 23 Age, body weight, exposure time and average time of the respondents of Cypermethrin (n= 11)

Factor	Range	Mean (±SD)
Age(years)	31 - 45	40 (±2.60)
Exposure time (ET) (hours/day)	1 - 7	5 (±0.36)
Exposure frequency (EF) (days/year)	24 - 72	48 (±7.58)
Exposure duration (ED) (years)	11 - 40	20.4 (±5.50)
Body Weight (kg)	54 - 59	57 (±1.02)
Average time (AT) (days)	96360 - 350400	178704 (±48187.96)

Table 24 Age, body weight, exposure time and average time of the respondents of Carbofuran (n= 44)

Factor	Range	Mean (±SD)
Age (years)	28 - 72	50 (±1.66)
Exposure frequency (EF) (days/year)	32 - 75	38.4(±9.6)
Exposure duration (ED) (years)	20 - 35	27.6(±2.50)
Exposure time (ET)	1 - 7	4 (±0.87)
Body Weight (kg)	45 - 86	57 (±1.30)
Average time AT (days)	175200 - 306600	241776 (±21917.5)

Table 25 Age, body weight, exposure time and average time of the respondents of Cartap Hydrochloride (n= 13)

Factor	Range	Mean (±SD)
Age(years)	38 - 61	46 (±4.13)
Exposure time (ET) (hrs/day)	1 - 6	4.6 (±0.4)
Exposure frequency (EF) (days/year)	24 - 72	48(±7.60)
Exposure duration (ED) (years)	10 - 29	21(±3.62)
Body Weight (kg)	48 - 64	55 (±3.09)
Average time per season AT (day)	87600 - 254040	183960 (±31705.8)

Average daily dose (ADD) was calculated by using equation (4.1). The mean average daily dose (ADD) of acephate, chlorpyrifos, and dimethoate of the organophosphate group was 8× 10-3 mg/kg-day,1.53 × 10-3 mg/kg-day and 7.91 × 10-3 mg/kg-day, Pyrethroid group of cypermethrin 1.91 × 10-3 mg/kg-day and lambda-cyhalothrin 1.26× 10-4 mg/kg-day, and carbonate group of Carbofuran and Cartap Hydrochloride of rice farmers at 2.27× 10-3 mg/kg-day and 9.6×10-4 mg/kg-day, which were shown in table (26), respectively.

Table 26 Average daily dose (ADD) and initial air concentration (Cair) of organophosphate groups, pyrethroid group and carbonate for rice farmers in Ayeyarwady, Delta Region, Myanmar in rice production (n=454)

Pesticides	Initial air concentration (Cair) (mg/m3)	Average daily dose (ADD) (mg/kg/day)
Organophosphate groups (OPPs)		
Acephate		
Mean	0.46	0.00008
Max	13.24	0.000133
Chlorpyrifos		
Mean	2.46	0.001530
Max	11.14	0.007180
Dimethoate		
Mean	1.97	0.000791
Max	8.83	0.0041997
Pyrethriod group (PYs)		
Cypermethrin		
Mean	2.65	0.0019089
Max	5.88	0.003674
Lambda-Cyhalothrin		
Mean	2.206	0.0001263
Max	4.41	0.0008124
Carbonate Group (CAs)		
Carbofuran		
Mean	6.48	0.00227
Max	13.81	0.0054
Cartap Hydrochloride		
Mean	4.3	0.00096
Max	14.57	0.0019

4.4.4: Risk Characterization for inhalation exposure

4.4.4.1 Non- carcinogenic Hazardous quotient

Risk characterization is the final step of accessing human health risks from pesticide exposure. The potential risk of non-carcinogenic health effects from exposure. Non-cancer risk is defined as the ratio (hazard quotient; HQ) of the estimated intake to the reference dose (RfD). The following equation can be calculated as Hazard quotient (HQ).

$$HQ = Exposure / RfD \qquad \text{eq (4.4)}$$

HQ > 1 (adverse non-carcinogenic effect concern)

HQ ≤ 1 acceptable level (no concern)

where,

HQ = Hazard quotient (unitless)

RfD = Reference dose (mg/kg-day)

In this study, ADDs in the previous steps were used in terms of "exposure". Regarding risk characterization, the organophosphate group for accessing human health risks from the inhalation pathway of pesticide exposure. In organophosphate group, acephate and dimethoate are systemic insecticides (U.S. EPA, 2006). On the other hand, Chlorpyrifos is moderately toxic with acute oral, dermal, and inhalation exposure (toxicity category 2) and is a reversible inhalator of cholinesterase (ChE) that is evaluated in the human when the duration of exposure. The toxicity endpoint to assess hazard include acute and chronic oral reference dose (RfDs), and short-, intermediate and long-term dermal and inhalation doses (U.S. EPA, 1999).

In this study, chlorpyrifos inhalation RfD value (acute and sub-chronic) was used at 0.001 mg/kg/day (lee et all., 2002) while chronic RfD equal to 0.0003 mg/kg/day (lee et all., 2002, jaipieam 2008). Noncancer risks are assessed for chronic (> 1 year), sub chronic (≥ 15 days), and acute exposures (typically 1–24 hr) (ATSDR, 1992). The average daily inhalation dose (ADD) and hazard quotient (HQ) of chlorpyrifos for rice farmers illustrates in table (27).

Table 27 Average Daily inhalation dose (ADD) hazard quotient (HQ) of chlorpyrifos due to air ingestion for the rice farmers in Ayeyarwady, Delta Region, Myanmar in rice production (n= 132)

Organophosphate pesticide (OPP)	ADD (mg/kg/day)	Inhalation RFDs chronic (mg/kg/day)	Inhalation RFDs acute and sub-chronic (mg/kg/day)	HQ chronic (ADD/RFD)	HQ acute and sub chronic (ADD/RFD)
Chlorpyrifos		0.0003	0.001		
Mean	0.001530			5.1	1.53
Max	0.007180			23.93	7.18
95% CI				4.23 - 5.96	1.23 - 1.79

The result indicated that the mean ADD of chlorpyrifos was above the mentioned RFDs value or HQ greater than 1, suggesting that the rice farmers of the study might be concerned with adverse non-carcinogenic risk. Hazard quotient (HQ) for the organophosphate group of chlorpyrifos acute and sub-chronic exposures was 5.1 while chronic was 23.93 (both short-term and long-term) chlorpyrifos exposure exceeded 1, which were over the acceptable level. The finding indicated that the users of chlorpyrifos in respondent rice farmers were at high risk of breathing air during farm activities of mixing, loading, and spraying their working conditions.

4.5. Result of occupational pesticide exposure on the health adverse effects for the rice farmers in Ayeyarwady, Delta Region, Myanmar in rice production (n=454)

4.5.1. General health information (acute and sub-chronic symptoms) related with pesticide exposure in last season of rice production (growing season: late October 2021 to mid-February 2022)

Regarding information about pesticide exposure (acute symptoms) in the late October 2021 to mid-February 2022 of rice production, the questionnaires classified about 5 categories of answers for each symptom (never, almost never, during pesticide exposure, shortly after pesticide application and suffered when applied after pesticide and so stopped that pesticide) and reorganized as not suffer symptoms (never and almost never) and suffer symptoms (during pesticide, shortly after pesticide application and suffered when applied after pesticide and so stopped that pesticide). Most of the rice farmers in the study areas suffered dizziness accounted 239 (53%) and the headage was the second most suffered symptom calculated at 171 (38%). On the contrary, there had been a few symptoms only (1%) were numbness or pins and needles in the participant's hands and feet and chest tightness. All these signs and symptoms represent acute symptoms that suffer within 24 hours after the application of the pesticides and illustrates in Table (28).

Table 28 General health information (acute symptoms) related with pesticide exposure in last season of rice production(n=454)

Sign and Symptoms	Not Suffer Symptom	Suffered Symptoms	Duration (%)		
			During pesticide exposure	Shortly after pesticide Application	Suffered when applied after pesticide and so stopped that pesticide
Headage	283 (62%)	171 (38%)	126(28%)	45(10%)	-
Nausea/ Vomiting	402(89%)	52(11%)	39(9%)	13(3%)	-
Abdomen cramp	437(96%)	17(4%)	15(3%)	2(0.4%)	-
Blurred vision	409(90%)	45(10%)	27 (6%)	18(4%)	-
Numbness or pins and	450(99%)	4(1%)	-	4(1%)	-

Sign and Symptoms	Not Suffer Symptom	Suffered Symptoms	Duration (%)		
			During pesticide exposure	Shortly after pesticide Application	Suffered when applied after pesticide and so stopped that pesticide
needles in participant's hands and feet					
Dizziness	215(47%)	239(53%)	- 169(37%)	70(15%)	-
Arms and legs weakness	425(94%)	29(6%)	8(2%)	21(5%)	-
Involuntary twitches or jerks in participant's arms or legs	452(99.56%)	2(0.4 %)	-	2(0.4%)	-
Skin Tearing	378(83%)	76(17%)	-	30(7%)	- 46(10%)
Chest tightness	418(92%)	6(1%)	-	6(1%)	-
Difficult breathing	429(94%)	25(6%)	16(4%)	5(1%)	4(1%)

Regarding acute toxicity, pesticides of organophosphate group (including acephate chlorpyrifos and dimethoate), pyrethroids groups of cypermethrin and lambda-cyhalothrin, and carbonate groups of carbofuran and cartap hydrochloride were classified into one of five toxicity categories based on acute toxicity by the inhalation route according to the Globally Harmonized System for the Classification and Labelling of Chemicals (GHS) of the International labor organization (ILO/Safework) which is described in table (29).

Table 29 Classification and Labelling of Acute Toxicity from (ILO/Safework)

	Criteria	Hazard Communication Element	
		Signal Word	Danger
Category 1	- LC50 # 100 ppm (gas) - LC50 # 0.5 (mg/l) (vapor) - LC50 # 0.05 (mg/l) (dust, mist)	Symbol	Symbol Skull and Crossbones
		Hazard Statement	Fatal if inhaled (gas, vapor, dust, mist)
Category 2	- LC50 between 100 and less than 500 ppm (gas) - LC50 between 0.5 and less than2.0 (mg/l) (vapor) - LC50 between 0.05 and less than 0.5 (mg/l) (dust, mist)	Symbol	Skull and Crossbones
		Hazard Statement	Fatal if inhaled (gas, vapors, dust, mist)
Category 3	- LC50 between 500 and less than 2500 ppm (gas) - LC50 between 2.0 and less than 10.0 (mg/l) (vapor) - LC50 between 0.5 and less than 1.0 (mg/l) (dust, mist)	Symbol	Skull and Crossbones
		Hazard Statement	Toxic if inhaled (gas, vapor, dust, mist)
Category 4	- LC50 between 2500 and less than 5000 ppm (gas) - LC50 between 10.0 and less than 20.0 (mg/l) (vapour) - LC50 between 1.0 and less than 5.0 (mg/l) (dust, mist)	Symbol	Exclamation Mark
		Hazard Statement	Harmful if inhaled (gas, vapor, dust, mist)
Category 5	- LD50 between 2000 and 5000 (oral)	Symbol	No symbol
		Hazard Statement	May be harmful if inhaled (gas, vapour, dust, mist)

For the evaluation of acute toxicity by the inhalation routes of the organophate group (including acephate chlorpyrifos and dimethoate), pyrethroids groups of cypermethrin and lambda-cyhalothrin, and carbonate groups of carbofuran and cartap hydrochloride by using Globally Harmonized System for the Classification and Labelling of Chemicals (GHS) from (ILO/Safework), The determination of acute toxicity categories by organophate group, pyrethroids group, and carbonate groups of carbofuran were applied by rice farmers (n= 353) in the study areas described in the table (30). As a result, (51%) of the respondents of rice farmers had category (5) which was the most occurrence of acute toxicity by the inhalation routes the distribution of the category (3) and (4) were 30 % and 19%, respectively.

Table 30 Acute toxicity categories (only organophosphate, pyrethroids and carbonate group) rice farmers in the paddy fields in Pyapon District, Ayeyarwady Region, Myanmar (n=353)

Acute toxicity categories	Hazard Statement	Participants (n)	Participants' usage (%)
Category 1	Fatal if inhaled (gas, vapor, dust, mist)	0	0
Category 2	Fatal if inhaled (gas, vapour, dust, mist)	0	0
Category 3	Toxic if inhaled (gas, vapour, dust, mist)	105	30
Category 4	Harmful if inhaled (gas, vapour, dust, mist)	67	19
Category 5	May be harmful if inhaled (Gas, vapour, dust, mist)	181	51

For sub-chronic inhalation symptoms, the respondents of rice farmers (31.8%) mostly suffered from Dizziness within one month after application of the pesticide. The second mostly suffered symptoms within one month ago were headache (16.8%) and excessive sweating (16.6%), respectively. Figure (9) describes farmers suffering symptoms within one month ago after the application of the pesticides.

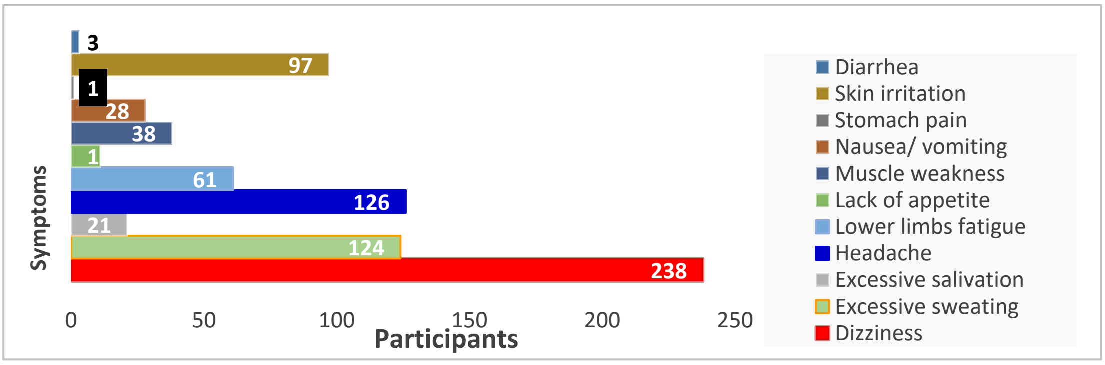

Figure 11 Sub-chronic Inhalation signs and symptoms after application of the pesticide spraying (n=454)

4.4.2. General health information (subjective signs and symptoms) related with pesticide exposure in last season of rice production (growing season: late October 2021 to mid-February 2022)

Regarding information about pesticide exposure (subjective signs and symptoms) in the late October 2021 to mid-February 2022 of rice production, even though most of the participants did not suffer from the somatic symptoms and did not have depressive/ anxious thoughts, a few participants suffered from these symptoms and had depressive/ anxious thoughts. Of the suffered respondents, (14%) of the participants had often suffered headaches and (9%) of feeling nervous were the most occurrence symptoms. Table 31 was shown the frequency and percentage of participants' health information of somatic symptoms and table 32 was illustrated depressive/ anxious thoughts from the questionnaire.

Table 31 Self-response health information (somatic symptoms) related to pesticide exposure from late October to mid-February of rice production (n=454)

Somatic signs and symptoms	No Symptom (%)	Had Symptoms (%)
Often have headaches	391(86%)	63 (14%)
Poor sleep	446(98%)	31 (7%)
Uncomfortable stomach feelings	438(96%)	16 (4%)
Poor digestion	423(93%)	17 (4%)
Poor appetite	438(96%)	8 (2%)
Hands shake	437(96%)	16 (4%)

Table 32 Self-response health information (Depressive/anxious thoughts) related to pesticide exposure from late October to mid-February of rice production (n=454)

Depressive/anxious thoughts	No Symptom (%)	Had Symptoms (%)
Feeling nervous	415(91%)	39 (9%)
Feeling unhappy	438(96%)	16 (4%)
Tense or worried	436(96%)	18 (4%)
Easily frightened	451(99%)	3 (1%)

CHAPTER (V)

DISCUSSION

Agricultural workers are inevitably exposed to pesticides during the preparation and application of the spray solution. Pesticide contamination may cause potential adverse health effects and environmental impacts. Myanmar farmers often have a strongly desirable to kill pests in rice fields since pesticides are becoming a convenient tool. This study investigated pesticide exposure through inhalation of rice farmers in Ayeyarwady, Delta Region, Myanmar. A cross-sectional study was carried out with 454 rice farmers from March-April 2022.

5.1 Background and general information on pesticide usage and exposure among rice farmers in Ayeyarwady, Delta Region, Myanmar

The cross-sectional study was done in Bogalae, Pyapon and Kyaitlat townships, Pyanpon District, Ayeyarwady, Delta Region, Myanmar. All the respondents have represented rice farmers who are growing rice as their traditional careers. In this study, over two-thirds of the respondents were male and thus male population were greater than females in rice production. This result is similar to Myo Min, 2006, Khin Maung Nyunt, 2015 and Thant Zaw Lwin, 2017 studies. Myanmar agricultural workers were typically done by males. Over half of the respondents were in 35 to 54 years of general productive age. This finding was comparable to Lwin et al, (2017) indicated that (40.8%) of the respondents were between the age group of 38 to 47 years.

Primary education was the dominant group of the population in this research. Two-thirds of the respondents in this study (41%) had a primary education level while only 6% of the population represented graduated level education. This result was in obedience to Nyunt et al (2015) and Lwin et al. (2017). As a consequence, there is not much difference in the demographic characteristics of the three studies. The finding was relevant from the 2019 Inter-censual Survey, Myanmar, in which Pyanpon district had (4.6%) graduated course bachelor's degrees. The more lack of education leads, the less chance of protection and prevention of pesticide exposure.

Hence, it could be affected the knowledge and behaviors that lead to disturbance and concern about pesticide exposure protection and prevention.

Most of the respondents had an average farming experience of 22 years which means that rice farmers could probably undertake the cultivated work that farmers' occupations careered for their whole life. This finding of the research, the higher the number of farming experience, the more chance to get the risk of the pesticide exposure which was similar to the study of Lwin et al. (2017). Most of the farmers owned 9.28 acres and grew rice during the monsoon and summer seasons. Both monsoon and summer rice were cultivated by more than (90%) which were not much different in the study region.

In the Delta region, more than half of the farmers used stream or rivers for their domestic water supply for their household as same as in their agricultural activities. Almost all participants mixed pesticides places were located near the rice field more than 50 feet far away from their houses. Regarding this finding, the researcher assumes that "If the pesticide will contaminate the stream and river, the fate and transport of pesticide contaminants are a non-point source of environmental pollution". In addition, rice farmers observed beneficial insects and birds did not see much of them in their surrounding paddy fields in recent years.

5.2 Farmer's behavior related to pesticide exposure

Farmers had more than one impression and often widely listen to other suggestions when purchasing pesticides. Over half of the respondents had purchasing behavior toward pesticides after listening to the advice of the shopkeepers. For other reports, pesticide usage in the study area seems to be highly influenced by pesticide vendors who were carrying out their business right in the farming communities and are very interested in achieving large sales of their pesticides (Aung 2011). Approximately (40%) of the farmers had received advice from their local agricultural officers. 75 This finding is less than the study done by Lwin et al. (2017) who found about (78.5%) of farmers received information related to the pesticide safety measure from Myanmar agricultural services. The behavior of pesticide purchasing is also based on their experience, disease and pest in their rice field and considered the fact that is easy to buy pesticides which are described on Myanmar Language labels on containers.

In this study, nearly two-thirds of participants avoided eating, smoking, betel chewing and drinking water/alcohol during pesticide application and in the interval time after the first and the second spraying near the field. Regarding smoking habits, nearly (90) % of farmers avoid smoking when spraying pesticides. In the study done by Nwe New Oo in 1996, it is found that more than 90% of exposed farmers never smoke while pesticide handling. The two studies are not different from the participants' behavior (Oo 1996). On the contrary, (16%) of the respondents did not avoid eating, smoking, betel chewing and drinking water during handling and the interval of first and second spraying. Likewise, one-eighth of respondents had done betel chewing and smoking activities both during handling and interval of first and second spraying. This finding can be compared with the study done by Lwin et al. (2017), it was (19.2%) who avoid smoking, eating, and drinking water while spraying pesticides.

5.3 Knowledge and practices of rice farmers on pesticide application

According to the objective of this study was to describe the knowledge, and practice of the farmer related to improper use of pesticides in the Delta Ayeyarwady Region, Myanmar. In this study, the knowledge level of pesticides was explored and the average knowledge score of them ranged from 0 to 6. Most rice farmers had a moderate level of knowledge (77 %). On the other hand, the finding of the respondents showed that 11% of the subjects had still a low level of knowledge and 12 % had high knowledge.

Respondents in the study, over (80%) of rice farmers had knowledge of pesticides that can affect the environment and already know about environmental pollution. As revealed in this study, other Myanmar studies done Myo Sabai Aye in 2015 pointed out that most of the farmers had a high knowledge on the environmental impact and agriculture in the study area. (Myo, Theingi et al. 2015). The study done by Ei Mon Thida Kyaw considered more than 50% of farmers had high awareness of environmental conservation (Kyaw 2014). But the difference between this research is that it is still not studied the relationship between the knowledge and practices spread over their attitude. Although both these two authors pointed out that the answers were quite satisfactory, over two-quarters of the respondents did not know about some pesticides are currently banned from the Plant Protection Division, Department of Agriculture. Likewise, only rice farmers (13.21%) knew to wear full personal protective equipment (PPE) while mixing and loading pesticides. As linked to the study done by Thein Thein Aung who pointed out that the need for proper training and extension service of Myanmar Agriculture Service (MAS) was in a very weak situation and becomes ineffective due to the lack of budgets for extension education processes (Aung 2011).

Therefore, there are not many transformations in the knowledge sharing and training programs of the studies. The respondents of the almost rice farmers in this study already knew about pesticides are dangerous when the body only touch and swallow to the pesticides. It was compared with Myanmar studies done by Thar et al. (2012) which found that about 80% knew the adverse health effect of pesticides on humans as well as Lwin et al. (2017) studied over 82% had knowledge about acute and chronic toxicity of the pesticide.

The study informed about their practice score of them was moderate practices level. Regarding Practices questions, it rearranged the following categories by handling, management, storage, and hygiene practice after the application.

Table 33 Practice questions are categorized by handling, management, storage, and hygiene practice after the application.

Categories	Question no	Corrected answering about each of the question
Handling	Q3	In general, when mixing pesticide, I follow the bottle instruction label.
	Q4	I have not replaced the pesticides containers as a portion of food or domestic water container.
	Q6	When mixing pesticide, I wear rubber gloves, and using stirring stick.
	Q7	When spraying pesticide, I wear fully personal protective equipment.
	Q8	When spraying pesticide, I wear with long sleeved shirt and long pants.

Categories	Question no	Corrected answering about each of the question
Management	Q1	I use registered pesticide.
	Q15	Incinerating method is the best for disposing pesticide containers
Storage	Q2	Storing pesticides in separate room (separate/ high place/ locked box), keeping out of children, animals, and keeping out of food and water
	Q5	I did not keep pesticides with food and water. (don't keep near the food)
Hygiene practice after application	Q9	I have not spilled pesticide when mixing and spraying these pesticides.
	Q10	If the participants spill some pesticide on their clothes and body, changing cloths and clean their body immediately
	Q11	After the participants mix and spray pesticides, washing their hands and arms immediately and taking a bath after finish work
	Q12	After touching and mixing pesticide, using to clean the body with water and soup
	Q13	After using the pesticide, changing new clothes immediately at the field
	Q14	After finishing work, washing immediately clothes that are in contact with the pesticide.

Farmers in this study had reasonable knowledge about environmental awareness and routes of exposure, and hazards but had moderate safety practices, particularly for the disposal and use of PPE. This leads to inadequate and improper use of safety equipment and tools. According to the practices, (88 %) of the respondents used registered pesticides in the Plant Protection Division (Pp), Department of Agriculture, Myanmar. Similarly, (86%) of respondents followed the bottle instruction label with described in Myanmar language when mixing pesticides. This finding is different from Lwin et al. (2017) which was (29.5%) did not follow the bottle instruction. Regarding personal protective equipment (PPE) usage during mixing and spraying pesticides, wearing rubber gloves, fully PPE and using a stirring stick had only a few people. The 74 majority of rice farmers did not notice the risk of exposure especially in mixing pesticide solutions. But they wear proper PPE when spraying pesticides. The users of PPE in (409), 80% of each respondent wore more than one item of PPE usage was clothes coveralls which meant long-sleeved shirts or clothing covering the upper parts of the body. By comparison, (1 out of 10%) of the respondents' never used PPE was a noteworthy result. The reason why farm workers are not familiar with the use of whole-body covering (wearing rubber boots, apron, goggles or glasses, plastic covering) might be a long time working on the farm and in tropical weather circumstances.

In this study, most of the respondents widely used wearing masks, especially fabric face masks when they sprayed pesticides during the Covid-19 pandemic. This new finding is over half of respondents (60%) used wearing masks during spraying pesticides in Myanmar. This practice can properly directly prevent inhalation of the pesticide exposure. On the other hand, over 80 % of rice farmers did not wear proper personal equipment (wearing rubber gloves and using stirring stick) when mixing and loading pesticide. Even though rice farmers had low practices compared to other practices, wearing masks during pesticide spraying is one of the good practices. But there is a need for more extensive knowledge sharing about wearing masks, rubber gloves and utilizing a stirring stick especially in mixing pesticide solutions. Rice farmers already knew and applied these practices about storage areas were separate buildings, away from people, living areas, food, animal feed and animals. On the contrary, farmers did not dispose of pesticide containers appropriately. Likewise, most of the farmers did not have good practices of changing new clothes immediately at the field when spilling or leaking pesticides after utilizing them. Most of the rice farmers did not aware of the risk of exposure while spilling and disposing of the pesticides.

Hence, Farmers should get aware of the risk of spilling and disposing of pesticides and how dangerous these hazardous active ingredients of the pesticide are.

5.4 Pesticide Exposure Assessment

5.4.1. Hazard identification

Hazard identification by the inhalation route of pesticides that are classified as carcinogenic or non-carcinogenic according to the United State Environmental Protection Agency (USEPA) which were used by rice farmers in the paddy fields in Pyapon District, Ayeyarwady Region, Myanmar. In the cross-sectional study of rice farmers in Ayeyarwady, (84%) of the respondents applied insecticides while 73 % and 29% were herbicides and fungicides users, accordingly. The pesticides of respondents are grouped as insecticide, herbicide, and fungicide according to the Pesticide Registration Data from the Plant Protection Department and Department of Agriculture, Ministry of Agriculture, Livestock, and Irrigation, Myanmar. All these pesticides are classified by non-carcinogenic effects for inhalation exposure. Most of the farmers who applied insecticide were in organophosphate groups where Chlorpyrifos (29.07%) is the most and acephate (19.16%) was the second-largest group. The third largest user of pesticides (14.66 %) was the pyrethroid group (Lambda-cyhalothrin), respectively.

5.4.2. Toxicity assessment

After identifying the potential hazard of pesticides, dose-response assessment is the second step of risk assessment. Noncancer risk is defined as the ratio (hazard quotient; HQ) of the estimated intake to the reference dose (RfD). The report of Heath Effects Assessment Summary Tabel (HEAST) of US EPA in 1995, RfC or RfD is a provisional estimate (with uncertainty spanning perhaps an order of magnitude) of the daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a portion of the lifetime, in the case of a subchronic (RfC) or RfD, or during a lifetime, in the case of (RfC) or (RfD). The critical dose or concentration level is usually a No-observed-Adversed-Effect Level (NOAEL) or a lowest -observed-Adversed-Effect level (LOAEL). The RfC or RfD is derived by dividing the NOAEL or LOAEL by an uncertainty factor (UF) times a modifying factor (MF):

$$(RfC) \text{ or } (RfD) = \frac{\text{NOAEL or LOAEL}}{\text{UF} \times \text{MF}}$$

Where,

RfD = reference dose, RfC = reference concentration, NOAEL= No-observed-Adversed-Effect Level, LOAEL = lowest -observed-Adversed-Effect level, UF= an uncertainty factor**,** MF= modifying factor

The RfC derivation begins with the identification of a no-observed-adverse-effect level (NOAEL) and a lowest-observed-adverse-effect level (LOAEL), which are determined for the specified adverse effect from the exposure levels of a given individual study on the various species tested. The NOAEL is the highest level tested at which the specified adverse effect is not produced and is therefore, by definition, a subthreshold level (Klaassen,1986). The RFC methodology requires conversion by dosimetric adjustment of the NOAELs and LOAELs observed in laboratory animal experiments or in human epidemiological or occupational studies to human equivalent concentrations (HECs) for ambient exposure conditions. These conditions are currently assumed to be 24 h/day for a lifetime of 70 years. The RfC is an estimate that is derived from the NOAEL[HEC] for the critical effect by consistent application of uncertainty factors (UFs).

$$RfC = NOAEL\ [HEC] / (UF \times MF),$$

Inhalation (RfC) value reported the implementation of the interim methods were calculated using a similar in concept to those for oral (RfD)s (HEAST 1995). The inhalation chronic RfD is derived from an inhalation chronic reference concentration (RfC). The RfD is used with inhalation doses under chronic exposures to estimate the potential of a systemic toxic effect. In this study, toxicity assessment of non-cancer of pesticide exposure RfD was used for OPPs (acephate chlorpyrifos and dimethoate), pyrethroids groups of cypermethrin and lambda-cyhalothrin, and carbonate groups of carbofuran and cartap hydrochloride.

5.4.3. Exposure assessment

The inhalation exposure was estimated from the airborne aerosols released by sprayer nozzles of the well-mixed box (WMB) by using the calculation algorithm to estimate the dose from inhalation which is provided by USEPA. The average daily inhalation dose (ADD) normalized to body weight is calculated as:

$$ADD = Cair \times InhR \times ET \times EF \times ED/BW \times AT \quad \text{eq (5.3)}$$

where:

ADD = Average daily dose (mg/kg-day)Cair = Concentration of contaminant in air (mg/m3), InhR = Inhalation rate (m3/hour) (0.64 m3/hour for adult recommended by US EPA) ,ET = Exposure time (hours/day), EF = Exposure frequency (days/year), ED = Exposure duration (years), BW = Body weight (kg), AT = Averaging time (days)

Health risk estimation was performed based on integrating Outdoor Residential Misting Systems (ORMSs) analytical data and information from the questionnaire-based exposure survey. The pesticide exposure assessment spreadsheets are a standard method provided for completing post-application inhalation exposure assessments for adults after a pesticide applying in an outdoor space (USEPA,2012). The determination of estimated inhalation exposure (mg/day) in the absence of chemical-specific exposure monitoring data was used by multiplying the formulation-application method-specific unit exposure by an estimate of the amount of active ingredient handled in a day. Unit conversion factors (points estimate) by multiplying the formulation-application method-specific unit exposure and input parameters. Average daily dose (ADD) was calculated by using equation (5.3). The mean average daily dose (ADD) of acephate, chlorpyrifos, and dimethoate of the organophosphate group was 8× 10-3 mg/kg-day,1.53 × 10-3 mg/kg-day and 7.91 × 10-3 mg/kg-day, Pyrethroid group of cypermethrin 1.91 × 10-3 mg/kg-day and lambda-cyhalothrin 1.26× 10-4 mg/kg-day, and carbonate group of Carbofuran and Cartap Hydrochloride of rice farmers at 2.27× 10-3 mg/kg-day and 9.6×10-4 mg/kg-day.

5.4.4. Hazard Characterization assessment

In this study, ADDs in the previous steps were used in terms of “exposure". Regarding risk characterization, the organophosphate group for accessing human health risks from the inhalation pathway of pesticide exposure. In organophosphate group, acephate and dimethoate are systemic insecticides (U.S. EPA, 2006). The non-carcinogenic risk for organophosphate group of chlorpyrifos showed that Chlorpyrifos HQ was greater than 1, suggesting that rice farmers in the study might be concerned with adverse non-carcinogenic risk. The finding indicated that the users of chlorpyrifos in respondent rice farmers were at high risk of breathing air during farm activities of mixing, loading, and spraying their working conditions. Similarly, the study was done by Lwin et al., 2017 showed that dermal exposure to chlorpyrifos high risk for groundnut farmers in Myanmar. The two studies pointed out that the users of chlorpyrifos in respondent farmers in Myanmar might be getting non-carcinogenic risks by both inhalation and dermal route.

5.4.5 Risk commination and management of the study

Farmers should not use moderate and highly toxic pesticides which are classified by the world health organization (WHO) especially organophosphate groups of pesticides. Using alternative pest and disease management like integrated pest management (IPM) system or organic farming instead of using hazardous pesticides is highly recommended to the rice farmers in the study areas. At the community level, pesticide companies and shopkeepers must be proper advising and extending from relevant organizations, and private sectors for farmers' knowledge regarding pesticide handling, management, storage, and hygiene practices. From the point of government sector, the government should be upgraded and updated the pesticide registration process and relevant rules and regulations according to the latest international guidelines and procedures.

Farmers who have acute or sub chronic symptoms due to pesticide exposure should medically check for their health. If necessary, farmers should take consultation with doctors and the local public health officers on the occupational risk of pesticide application in rice production. The community for farmer society should be a relevant linkage between the agricultural extension officers and local public officers to help farmers access information and establish safe pesticide handling and hygiene. Likewise, there should be a proper arrangement for the emergency of acute toxicity of pesticides upon the occupational situation of pesticide handling and application. Regarding policy issue, there should have rice farmers for knowledge sharing, and training programs in collaboration with the Ministry of Health and the Ministry of Agriculture, Livestock, and Irrigation.

For the risk management of pesticide exposure, farmers must be aware of the safe use of pesticide handling, management, storage, and hygiene practices. And they must wear full personal protective equipment (PPE), especially proper safety masks and gloves when handling, mixing, loading, and spraying pesticides. Farmers should apply rules and regulations regarding pesticide application which are announced by the plant protection division (Pp), Department of

Agriculture, Ministry of Agriculture, livestock, and irrigation. There should be the relevant arrangement of easy accessibility to get safety personal protective equipment (PPE) from the markets until it reaches the local farmer's community. On the other hand, the government should have proper strategies for an update and upgrade of the communication channels for accessibility to get safety personal protective equipment (PPE) from the markets until it reaches the local farmer's community. There should be relevant training and knowledge sharing within local farmers' communities with the guidance of agricultural extension workers, public health staff, and cooperative social communities to access information and establish the pesticide handling and hygiene such as by demonstrating or providing pamphlets on the safe usage of pesticides. Likewise, there should be enforcement of relevant rules and regulations for rice farmers the reduction of pesticide exposure risk. If necessary, the inspectors should be checked without informing the pesticide stock, stores, and local shops about whether selling or buying of banned pesticides which is already been announced by Ministry of Agriculture, Livestock, and Irrigation (MOALI), Myanmar.

5.5 Health Problems related to pesticide exposure

According to the objective of this study was to assess potential risks, occupational exposure, and health adverse effects (subjective signs and symptoms) of pesticides among rice farmers in Delta Ayeyarwady Division, Myanmar. The most hazardous organophosphates are Azinphosmethyl, chlorpyrifos, diazinon, dichlorvos, dimethoate, ethephon, malathion, methamidophos, naled, and oxydemeton-methyl. Morais, Dias et al. (2012). Most of the rice farmers in the study areas suffered dizziness accounted 239 (53%) and the headage was the second most suffered acute symptom calculated at 171 (38%). As revealed in this study, other Myanmar studies done by Therin Zaw highlighted the impact of chronic low-dose OP exposure on respiratory health and that agricultural workers who are exposed to organophosphate pesticides have higher serum IL-6 levels and low respiratory functions by Zaw, Phyu et al. (2020). Lwin et al. (2017) also studied chronic exposure related to Organophosphate pesticide dose may reduce potential male reproductivity in Myanmar.

For sub chronic symptoms, almost one-third of the respondents (31.8%) mostly suffered from dizziness within one month after application of the pesticide. The second mostly suffered symptoms within one month ago were headache (16.8%) and excessive sweating (16.6%), respectively. (Thandar, Naing et al. 2021) provided a study that chronic low-level exposure to OP pesticides has harmful effects on the cardiovascular system in agricultural workers in Myanmar. Some of the participants (14%) often suffered headaches, somatic symptoms. Only (9%) felt nervous was the most occurrence symptom of depressive/anxious thoughts related to pesticide exposure from late October to mid-February in 2021 of rice production There is an evidence study by Mya Pwint Phyu that in 2020 that pointed out organophosphate pesticide exposure lowered Erythrocyte acetylcholinesterase AChE activity and increases oxidative stress and contribute to the development of insulin resistance in agricultural workers in Myanmar. (Phyu, Hlain et al. 2020).

5.6 Limitation of the study

The study of pesticide exposure analyzed only one way of pesticide exposure the inhalation system. In this study, the survey data was collected and predicted exposure modeling systems were used in data calculation. Modeling data might be different from real field conditions due to external environmental conditions

CHAPTER (VI)

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

The investigation of occupational pesticide exposure through inhalation of rice farmers working in the rice fields area at Pyapon District, Ayeyarwady, Delta Region, Myanmar can be concluded as following.

1. The participants in this study were both male and female . Most of them were male; their age was between (35 – 54) years old . Rice farmer's weight and height were in the range (38– 95) kilograms and (125 – 189) centimeters, respectively.
2. Most rice farmers in this study did not wear proper personal equipment (wearing rubber gloves and using stirring stick) and when mixing and loading pesticide. Only rice farmers (13.21%) knew to wear fully personal protective equipment (PPE) while mixing and loading pesticides. The finding of this study showed that rice farmers (77 %) had a moderate level of knowledge and (94 %) of the total participants had a moderate level of practice.
3. The Average daily dose (ADD) of acephate, chlorpyrifos, and dimethoate of the organophosphate group was 8×10^{-3} mg/kg-day, 1.53×10^{-3} mg/kg-day and 7.91×10^{-3} mg/kg-day, pyrethroid group of cypermethrin 1.91×10^{-3} mg/kg-day and lambda-cyhalothrin 1.26×10^{-4} mg/kg-day, and carbonate group of carbofuran and cartap Hydrochloride of rice farmers at 2.27×10^{-3} mg/kg-day and 9.6×10^{-4} mg/kg-day, respectively.
4. Most of the farmers who applied pesticides were organophosphate groups of Chlorpyrifos was (29.07%). It should be concluded that both acute and chronic effects of the inhalation pathway from the non-carcinogenic hazard of Chlorpyrifos.The HQ for the organophosphate group of chlorpyrifos acute and sub-chronic exposures was 5.1 times while 23.93 times was chronic exposure exceeded the acceptable level (greater than 1) in both short-term and long-term.
5. Health adverse effects related to pesticide exposure, most of the rice farmers in the study areas suffered acute symptoms was dizziness accounted for (53%) of the total participants and (31.8%) of rice farmers were suffered dizziness as sub-chronic symptom within one month after application of the pesticide. In addition, subjective signs, and symptoms related to pesticide exposure (14%) of the participants often suffered

headaches, and (9%) of the participants got feeling nervous were the most occurrence symptoms.

6.2 Contribution of This Work

This research showed the potential risk and occupational exposure to pesticides via inhalation route among rice farmers in Delta Ayeyarwady Region, Myanmar. Although there were several types of research studied about farmers exposed to inhalation routes in developed countries, but this is a prior study of inhalation exposure assessment conducted in Ayeyarwady, Delta Region, Myanmar. This study will provide information or guidance to investigate the pesticide exposure of inhalation routes among farmers in different agricultural areas in Myanmar. This information is the representation for Myanmar farmers' database to apply risk estimation. The risk information can be used to provide risk management and risk communication for rice farmers and agricultural communities at Ayeyarwady, Delta Region, Myanmar. In addition, the researcher gave some opinions to manage risk for this agricultural communities at Ayeyarwady, Delta Region, Myanmar in the previous chapter.

6.3 Recommendation

1. Farmers should not use moderate and highly toxic pesticides which are classified by the world health organization (WHO) especially organophosphate groups of pesticides. Using alternative pest and disease management like integrated pest management (IPM) systems or organic farming instead of using hazardous pesticides is highly recommended to the rice farmers in the study areas.
2. Farmers should wear fully personal protective equipment (PPE) during the mixing, loading, handling, and spraying of the application of pesticides.
3. There should have farmers for knowledge sharing, and training programs in collaboration with Ministry of Health and Sport (MOHS) and Ministry of Agriculture, Livestock, and Irrigation (MOALI) in Myanmar. Government should have proper strategies for an update and upgrade of the communication channels for accessibility to get safety personal protective equipment (PPE) from the markets until it reaches the local farmer's community.
4. Besides, enforcement (proper rules and regulations) should utilize in the existing agricultural extension network. There should have financial support and create accessibility from other private sectors including those operated by NGOs, to incorporate awareness training on the harmful effects of pesticide use and to train farmers in proper handling and management practices.

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APPENDIXS

APPENDICE A

Questionnaire (English version)

Request for willingness to participate in a survey

Greeting, I am Ms Moe Thu Khin. I am one of the master's students (candidate) in the International Program Hazardous Substance and Environmental Management (IP -HSM) at Chulalongkorn University, Thailand. Now, I am planning to do research on "The Potential Risk and Occupational Exposure of Pesticide Among Rice Farmers in Delta, Ayeyarwady Division, Myanmar". The study of targeted areas is Pyapon District, Ayeyarwady, Delta region by collecting primary data from rice farmers using a questionnaire. The answering of your responses is very useful in the development and health of your local community as well as in the Pyapon District, Ayeyarwaddy, Delta region. I won't describe each of your responses that answer regarding privacy ethics. This research will include about (400) participants and keep up like secrets regarding your response answering. The duration of the answering time is about (45) minutes per person. The participants of your answer have to cooperate their own's willingness in this research. If he questions that you don't have to be willing to answer, you can stop answering as you wish. Thank you very much for your cooperation.

1. Socio- demographic characteristics

1.1.	Township		
1.2	Village Tract		
1.3	Village		
1.4	Name		
1.5	Age	----------------year	
1.6	sex	Male	Female
1.7	weight (lb./kg),	------------------lb./kg	
1.8	height (ft/cm)	------------------ft/cm	
1.9	Education,	1) Primary 2) Secondary 3) Graduate 4) monastery education 5) None	
1.10	How many working experiences in framing?	------------------years	
1.11	Occupation	1) Farmer 2) Casual labor	

2. Land assesses, used and environmental condition

2.1	Type of assess	Own ------------- areas	Rental ------------- areas
2.2	Type of land	1) Irrigate 2) Rainfed 3) Khaing/ Khun 4) Orchard 5) sleat and burn 6) other	
2.3	Own of areas	------------- areas	
2.4	Main source of irrigation	1) Irrigate from dam 2) Stream/ river 3) lake 4) Groundwater 5) other	
2.5	Which month monsoon enters in the growing season?	--------------------------------------- (E.g., early May, lately May)	

3. **Cropping pattern and Sown areas**

3. 1	Which type of crops are you growing?	Argo - field crops (Paddy, wheat, corn, etc.) ______________	Horticultural crops (Cabbage, carrot, flowers, etc.) ______________
3.2	How many crops did you grow?	-------------------------- crops (e.g.,2 crops, 3 crops, etc.,)	
3.3	Have your field faced pests and diseases in growing crops in the previous growing season?	Yes If Yes which one you face (pest or diseases name) ______________	N0

3.4	Have you noticed surrounding paddy fields have lots of birds and insects? (Refer to predators and beneficial insects, does not represent pests)	( ) There are still a lot of places. ( ) They remain many I know there may exist. I do not see much. ( ) Not found ( ) Never seen.
Growing crop 1.		
3.1.1.	Crop 1. Name	-------------------------------------- e.g. (summer paddy)
3.1.2	Sown Acre	---areas
3.1.3	Yield(bsk/ac)	---bsk/ac
3.1.5	Brand name of fertilizer application	--------------------------------------- (e.g. Golden Dagon)
3.1.6	Brand name of pesticide application	--- (e.g. Infarno (Awba)
Pesticide application		
Pesticide (1)		
4.1.1	Unit (Type of pesticide application in a season: wettable or soluble powders, granules, dust, and other solids)	--------------------------------------- (gm/ml/ pyi/ bottle/ sack)
4.1.2	Total Application rate per one season in crop	-------------------------------------- (bottle, sacks)
4.1.3	Rate of pesticide concentration mix with water in one can	--------------------------------------(g/ml)

4.1.4	Total number of mixed can pesticide total acre	-------------------------------------(cans)
4.1.5	Total Spraying Days	---------------------------------------days
4.1.5.	Working hours	hrs. minimum hours: -- Maximum hours: ---
If (2) or (3) insecticides, herbicides and fungicides are applied by the farmers, ask similar question section (4).		
If farmers grow Growing crop 2. Ask question section (3) and 4)		

Level of knowledge and practice regarding exposure to pesticide residues

No.	Practice questionnaires	Level of agreement	Scoring
5.1.	Do you hear about environmental pollution?	Yes ( ) I have heard it seriously. ( ) I have heard. No/ Neutral ( ) I have not heard. ( ) I do not understand the meaning.	 1 1 0 0 0
5.2.	Do you know pesticide can affect to the environment (air, soil, water)?	Yes ( ) Strongly agree ( ) Agree No/Neutral ( ) Disagree ( ) Strongly disagree	 1 1 0 0 0
5.3.	Do you know why some pesticides are currently banned in the Department of agriculture for usage?	Yes ( ) I know exactly. ( ) I know. No/ Neutral ( ) I do not know. ( ) I do not understand the meaning	 1 1 0 0 0
5.4.	Can pesticides cause toxicity to humans? (how pesticide can toxic?)	Yes () I know exactly. () I know. No/Neutral () I do not know. () I do not understand the meaning	 1 1 0 0 0
5.5	While spraying	Yes	1

	pesticides, have you known to wear personal protective equipment (PPE)?	( ) I know exactly. ( ) I know. No/ Neutral ( ) I do not know. ( ) I do not understand the meaning	1 0 0 0		
5.6	While mixing and loading pesticides, have you known to wear personal protective equipment (PPE)?	Yes ( ) I know exactly. ( ) I know. No/ Neutral ( ) I do not know. ( ) I do not understand the meaning	1 1 0 0 0		
No	Tick on your handling, Storage and hygiene practice after application		Yes	No	Score
5.7	Do you use registered fertilizer/ pesticides in agriculture?		1	0	1
5.8	Where do you store pesticide?	1) Separate room (separate/high place/locked box) 2) Keep out of children, animals who do not know the hazards of pesticides. 3) Keep out of food and water source 4) None	1 1 1 0	0 0 0 0	1 1 1 0
5.9	Have you replaced the pesticide container as a portion of food or domestic water container?	1. Store very far away from food / drinking water. 2. Store away from food / drinking water. 3. Sometimes it saves. 4. I did not notice. 5. Always save.	1 1 0 0 0 0	0 0 0 0 0 0	1 1 0 0 0 0
5.10	Do you keep pesticides with food and water? (Keep near food)	1. Never used. 2. I sometimes use it. 3. I used 4. Always reuse. 5. I do not understand the meaning.	1 1 0 0 0	0 0 0 0 0	1 1 0 0 0
5.11	Do you read, follow, and spray pesticide according to instruction or label?	1. Always follow. 2. read and apply. 3. I did not read. 4. I do not understand the meaning	1 1 0 0 0	0 0 0 0 0	1 1 0 0 0
5.12	In general, how do you mix pesticide?	1. Never follow the bottle instruction label 2. Follow the bottle instruction label 3. Follow the neighborhoods 4. suggestion 5. Use more than one type of pesticide	0 1 0 0	0 0 0 0	0 1 0 0

5.13	While spraying pesticides, have you used personal protective equipment (PPE)?	1. Always follow. 2. Is used. 3. Neutral 4. I did not use. 5. I do not understand the meaning	1 1 0 0 0	0 0 0 0 0	1 1 0 0 0
5.14	How do you mix pesticide?	1) Wearing rubber gloves and using stirring stick 2) Wearing fabric gloves and using stirring stick 3) Using hand and using stirring stick 4) Using hand only	1 0 0 0	0 0 0 0	1 0 0 0
5.15	Which personal protective equipment (PPE) do you usually use when you mix pesticide?	1) None 2) Chemical glove 3) Chemical protective mask 4) Goggle or glasses 5) Dust protective mask 6) Fabric gloves 7) Normal face mask 8) Rubber boots 9) Hat 10) Apron 11) fabric 12) plastic 13) Clothes coverall	0 0 1 1 0 0 0 1 1 1 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 1 1 0 0 0 1 1 1 0 0 0
5.16	Mostly, which part of your body contact pesticide when you mix and spray pesticide?	1) None 2) Hands and arms 3) Face 4) Body 5) Legs and foots	0 1 1 1 1	0 0 0 0 0	0 1 1 1 1
5.17	What kind of outfit do you wear when you apply pesticide?	1) Short sleeved t-shirt and short pants/(longyi) 2) Long sleeved t-shirt and long pants (longyi) 3) Vest and short pants 4) Vest and long pants 5) Long sleeved shirt and short pants 6) Long sleeved shirt and long pants	0 0 0 0 1 0 0	0 0 0 0 0 0 0	0 0 0 0 1 0 0
5.18	If you spill some pesticide on your clothes and body when do you change clothes and clean your body?	1) Change clothes and clean body immediately 2) Change clothes and clean body after finish work 3) Change clothes and clean body at noon Change clothes and clean body the end of day	1 0 0 0	0 0 0 0	1 0 0 0

5.19	After you mix and spray pesticide, how do you clean your body?	1) Wash hands and arms immediately 2) Wash hands and arms before lunch 3) Take a bath immediately 4) Take a bath at noon 5) Wash hands and arms in evening 6) Take a bath after finish work	1 0 1 0 0 0	0 0 0 0 0 0	1 0 1 0 0 0
5.20	Which products do you use to clean body after touching and mixing pesticide?	1) Only water 2) Water and Soap 3) Water and Detergent 4) Water and Dishwashing	0 1 0 0	0 1 0 0	0 1 0 0
5.21	What do you do with the clothes you wear after you used pesticide?	1) Change new clothes immediately at the field 2) Change new clothes when arrive home 3) Change new clothes at the end of day 4) Change new clothes before the start of next day	1 0 0 0	0 0 0 0	1 0 0 0
5.22	How often do you clean your clothes after that clothes contact with pesticide?	1) Wash it immediately 2) Keep it and wear it again on next day 3) Keep it and wear it again whole week 4) Keep it and wear it again whole month	1 0 0 0	0 0 0 0	1 0 0 0
5.23	What is the method in disposing pesticide container?	1) Disposing on the ground 2) Keep disposing in your landfill 3) Disposing in the hole 4) Disposing in nature water source 5) Disposing in garbage 6) Incinerating	0 0 0 0 0 1	 0 0 0 0 0 0	0 0 0 0 0 0 1

6. Farmer's behavior related to pesticide exposure

No	Tick on your behavior related to pesticide exposure	Yes	No	Score

6.1	Who would you listen to when you decide to purchase pesticides?	(1) Yes, I listen from the following adviser's 1) Neighborhood 2) Shopkeeper's advice 3) Advertisement 4) Agricultural officer 5) Sales representative 6) Self-determine (2) Self-determination	1 1 1 1 1 1	0 0 0 0 0 0	1 1 1 1 1 1
6.2	Which behaviors should be avoided during the application of pesticides?	(1) Yes, I avoid the following behaviors: 1) Eating 2) Smoking 3) Drinking (2) I do not avoid	1 0	0 0	1 0
6.3	Where do you have lunch after spraying?	Where do you have lunch after spraying? 1. At home 2. Near rice field (Choose a habit of eating lunch near the field) 1) Mostly 2) Sometime 3) Often	1 0	0 0	1 0
6.4	Do you smoke in the farm or after having lunch?	1. I do not smoke. 2. I smoke 1) Mostly 2) Only occasionally 3) Often	1 0 0	0 0 0	1 0 0
6.5	What is the water source for agriculture?	1) Artesian well or deep well 2) Irrigation cannel 3) Stream/ river 4) Lake 5) Other			
6.6	Normally, what kind of drinking water do you usually drink?	1) Buy commercial water 2) Artesian well or deep well 3) Irrigation cannel 4) Stream/ river 5) Lake 6) rainwater 7) Other			

6.7	What is the water source for agriculture?	1) Artesian well or deep well 2) Irrigation cannel 3) Stream/ river 4) Lake 5) Other
6.8	What is the water source for domestic used?	1) Artesian well or deep well 2) Irrigation cannel 3) Stream/ river 4) Lake 5) Rainwater 6) Other
6.9	Whether the water source used for consuming is the same source for mixing pesticides	1) Same as drinking water source 2) Same as agriculture water source 3) Same as domestic water source 4) None of above
6.10	How far domestic water source from the pesticide mix area?	5) less than 10 ft 6) Between 11 ft-20ft 7) Between 21ft-50ft 8) More than 50ft

7. Health associated with Pesticide exposure assessment questionnaire

Do you know about pesticide effects on the body?	**1. I know exactly.** **2. I know.** **3. Neutral** **4. I do not know.** **5. I do not understand the meaning**

1: In last crop, do you have any signs or symptoms after inhale or touch pesticide follow this table (Acute Symptoms)						
No	**Signs and Symptoms**	**Never (1)**	**Almost Never (2)**	**During pesticide exposure (3)**	**Shortly after pesticide Application (4)**	**Suffered when applied after pesticide and so stopped that pesticide (5)**
1.	Headache					
2.	Nausea/Vomiting					
3.	Abdomen cramp					
4.	Blurred vision					

5.	Skin Tearing					
6.	Dizziness					
7.	Numbness or pins and needles in your hands and feet					
8.	Arms and legs weakness					
9.	Involuntary twitches or jerks in your arms or legs					
10.	Chest tightness					
11.	Difficult breathing					
2. Mental disorder of pesticide exposure						
8.2.1.	How did you suffer after application of pesticide spraying? (please arrange the highest to the lowest)	1) Dizziness 2) Excessive sweating 3) Excessive salivation 4) Headache 5) Lower limbs fatigue 6) Lack of appetite 7) Muscle weakness 8) Nausea/ vomiting 9) Stomach pain Skin irritation				
8.2.2.	Have you often felt those kinds of Depressive/Anxious signs? (please arrange the highest to the lowest)	1) Feel nervous, 2) tense or worried 3) Easily frightened 4) Feel unhappy 5) Cry more than usual				
8.2.3.	Have you often felt those kinds of Somatic symptoms? (please arrange the highest to the lowest)	1) Often have headaches 2) Poor sleep 3) Uncomfortable stomach feelings 4) Poor digestion 5) Poor appetite 6) Hands shake				
8.2.4.	Have you often felt those kinds of Reduced vital energy? (please arrange the highest to the lowest)	1) Feeling easily tired 2) Difficulty in making decisions 3) Difficulty in enjoying daily				

		activities 4) Daily work suffering 5) Feeling tired all the time Trouble thinking clearly
8.2.5.	Have you often felt those kinds of Depressive thoughts? (please arrange the highest to the lowest)	1) Unable to play a useful part 2) Lost interest in things 3) Thought of ending your life 4) Feeling worthless
8.2.6	If you have any other symptoms besides the ones listed above, please indicate them.	

APPENDICE B

Questionnaire (Myanmar version)

“မြန်မာနိုင်ငံ၊ ရောဝတီတိုင်း မြစ်ဝကျွန်းပေါ်ဒေသရှိ စပါးစိုက်တောင်သူများအကြား ပိုးသတ်ဆေးအန္တရာယ်နှင့် လုပ်ငန်းခွင်အန္တရာယ်ထိတွေ့မှု” ဆိုင်ရာမဟာသိပ္ပံ ကျမ်းပြုသုတေသန စစ်တမ်း

မင်္ဂလာပါ၊ ကျွန်တော်/ ကျွန်မ နာမည်က --------------ပါ။ ဒေါ်မိုးသူခင်သည် ထိုင်းနိုင်ငံ၊ ထိုင်းနိုင်ငံ၊ ချူလာလောင်ကွန်းတက္ကသိုလ်၌ ဘေးအန္တရာယ် စီမံခန့်ခွဲရေး နှင့် သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဆိုင်ရာ မဟာသိပ္ပံဘွဲ့အတွက်တတ်ရောက်ပညာသင်ကြားနေသော မဟာသိပ္ပံကျောင်းသူ တစ်ယောက်ဖြစ်ပါသည်။ ဒေါ်မိုးသူခင်သည် “မြန်မာနိုင်ငံ၊ ရောဝတီတိုင်း မြစ်ဝကျွန်းပေါ်ဒေသရှိ စပါးစိုက် တောင်သူများအကြား ပိုးသတ်ဆေးအန္တရာယ်နှင့် လုပ်ငန်းခွင်အန္တရာယ်ထိတွေ့မှု” ဆိုင်ရာမဟာသိပ္ပံ သုတေသနကျမ်း ပြုစုရန် စီစဉ်နေပါသည်။ စစ်တမ်းကောက်ယူသည့် ဧရိယာများမှာ ဖျာပုံခရိုင်၊ ရောဝတီတိုင်း၊ မြစ်ဝကျွန်းပေါ်ဒေသဖြစ်ပြီး စပါးစိုက်တောင်သူများ၏ မေးခွန်းလွှာကို အသုံးပြု၍ အခြေခံအချက်အလက်များကို ကောက်ယူခြင်းဖြစ်သည်။ ကျွန်တော်၊ ကျွန်မက ဒေါ်မိုးသူခင် ကိုယ်တိုင် လာရောက်၍ ကွင်းဆင်းစစ်တမ်းကောက်ယူရန် ခက်ခဲပါသဖြင့် ဒေါ်မိုးသူခင် အတွက် စစ်တမ်းကောက်ယူခြင်း ဖြစ်ပါသည်။ သင်၏ ဖြေကြားချက်များသည် သင့်ဒေသခံလူထု၏ ဖွံ့ဖြိုးတိုးတက်ရေးနှင့် ကျန်းမာရေးအတွက်သာမက ဖျာပုံခရိုင်၊ ရောဝတီတိုင်း၊ မြစ်ဝကျွန်းပေါ်ဒေသတို့၌ လူမှုစီးပွားရေးအခြေအနေ အတွက်လည်း အလွန်အသုံးဝင်ပါသည်။ ကိုယ်ရေးကိုယ်တာကျင့်ဝတ်ဆိုင်ရာ တုံ့ပြန်မှု တစ်ခုစီကို အခြားသူများအား ပြန်လည်ဖော်ပြမည်မဟုတ်ပါ။ ဤသုတေသန တွင် ပါဝင်သူ (၄၀၀) ခန့် ပါဝင်မည်ဖြစ်ပြီး သင်၏ တုံ့ပြန်ဖြေဆိုမှုနှင့် ပတ်သက်သော လျှို့ဝှက်ချက်များကဲ့သို့ ဆက်လက်လုပ်ဆောင်မည်ဖြစ်သည်။ ဖြေဆိုချိန်၏ကြာချိန်သည် တစ်ဦးလျှင် (၄၅) မိနစ်ခန့်ဖြစ်သည်။ သင့်အဖြေကို ပါဝင်သူများ သည် ဤသုတေသနတွင် ၎င်းတို့၏ဆန္ဒအတိုင်း ပူးပေါင်းဆောင်ရွက်ရမည်ဖြစ်သည်။ သင်ဖြေချင်စိတ်မရှိသော မေးခွန်းများကို မေးမိပါလျှင် သင်ဆန္ဒအတိုင်း ဖြေခြင်းကို ရပ်နိုင်သည်။ သင်၏ ပူးပေါင်းဆောင်ရွက်မှုအတွက် ကျေးဇူး အများကြီးတင်ပါတယ်။

မေးမြန်းသူအမည် ----------------
ရက်စွဲ -----------------
လက်မှတ် -----------------

အပိုင်း (၁) လူမှု စီးပွားရေး အခြေအနေ နှင့် ပိုးသတ်ဆေး သုံးစွဲမှု အနေအထား

၁.၁။	မြို့နယ်	
၁.၂။	(ကျေးရွာအုပ်စု)	
၁.၃။	(ကျေးရွာ)	

၁.၄။	(အမည်)		
၁.၅။	(အသက်)	---------------- (နှစ်)	
၁.၆။	(ကျား/မ)	(ကျား)	(မ)
၁.၇။	(ကိုယ်အလေးချိန်) (ပေါင်/ကီလို/ပိဿာ)	------------------- (ပေါင်/ကီလို /ပိဿာ))	
၁.၈။	အရပ် (ပေ/စင်တီမီတာ)	------------------- (ပေ/စင်တီမီတာ)	
၁.၉။	(ပညာရေး)	အခြေခံ မူလတန်း အလယ်တန်း ဘွဲ့ရ ဘုန်းကြီးကျောင်း ပညာရေး တတ်မြောက်မှု မရှိ	
၁.၁၀။	မိသားစုဝင် အရေအတွက်	-----------------	
၁.၁၁။	လယ်ယာလုပ်ငန်းခွင်လုပ်သက်	------------------- (နှစ်)	
၁.၁၂။	(အလုပ်အကိုင်)	လယ်သမား လက်လုပ်လက်စား	

ဇယား ၂။ စိုက်ပျိုးမြေ ပိုင်ဆိုင်မှု နှင့် ဥတုရာသီ နှင့် ပတ်ဝန်းကျင် အနေအထား

၂.၁။	ပိုင်ဆိုင်မှု အနေအထား	(မြေပိုင်) ------------- ဧက	(အငှား) ------------- ဧက
၂.၂။	(စိုက်ပျိုးမြေ အမျိုးအစား)	• ရေသွင်းစိုက် • မိုးကောင်းသောက် • ကိုင်း/ကျွန်း • ဥယျာဉ်ခြံ • တောင်ယာမီးရှို့ • အခြား	
၂.၃။	ပိုင်ဆိုင်မှု ဧက	- ------------ ဧက	
၂.၄။	အဓိက စိုက်ပျိုးရေ အမျိုးအစား	• ဆည်ရေသောက် • မြစ်/ချောင်း • ကန်ရေ • မြေအောက်ရေ • တခြား	
၂.၅။	စိုက်ပျိုးရာသီအတွက် မုတ်သုံလေက ဘယ်လတွေမှာ ဝင်တတ်ပါသလဲ။	-------------------------------------- (ဥပမာ, မေလ အစောပိုင်း, မေလအကုန်)	

ဇယား ၃။ သီးနှံစိုက်ပျိုးမှု ပုံစံ နှင့် စိုက်ပျိုးဧက

၃.၁။	ဘယ်သီးနှံအမျိုးအစားကို စိုက်ပျိုးလဲ။	လယ်သီးနှံများ (စပါး၊ ဂျုံ၊ပြောင်းစသည်)	ဥယျာဉ်ခြံ သီးနှံများ (ဂေါ် ဖီထုပ်၊ မုန်လာဥနီ၊ ပန်းပွင့် စသဖြင့်)

			____________________
၃.၂။	ဒီရာသီမှာ သီးနှံဘယ်နှစ်မျိုး စိုက်ပျိုးခဲ့သလဲ။	-------------------------- သီးနှံ (ဥပမာ: ၂မျိုး၊ ၃မျိုး)	
၃.၃။	သင့်လယ်သည် ယခင်စိုက်ပျိုးရာသီတွင် စိုက်ပျိုးထားသော သီးနှံများတွင် ပိုးမွှားရောဂါများနှင့် ကြုံတွေ့ဖူးပါသလား။	(ကျရောက်သည်) ကျရောက်ခဲ့ပါသည်ဆိုလျှင် ရောဂါ/ပိုးမွှား အမည်ကို ဖော်ပြပါ. ____________________	(မကျရောက်ပါ)
.၃။	ပတ်ဝန်းကျင် လယ်ကွင်းတွေမှာ ငှက်၊အင်းဆက်ပိုး နှင့် လိပ်ပြာများ၊ ငါး၊ဖား၊ တီကောင် အများအပြားရှိနေတာကို ယခုနှစ်အတောအတွင်း တွေ့မိပါသေးသလား။ (သားကောင်များနှင့် အကျိုးပြု အင်းဆက်များကို ရည်ညွှန်းသည်၊ ပိုးမွှားများကို ကိုယ်စားမပြုပါ)	( ) နေရာအနှံ့အပြား ရှိပါသေးတယ်။ ( ) အများအပြား ရှိပါတယ်။ ( ) ရှိမှန်းတော့ သိပါတယ်၊ သိပ်မတွေ့မိပါ။ ( ) မတွေ့မိပါ။ ( ) တွေ့ဖူးခြင်းကို မရှိပါ။	
စိုက်ပျိုးသီးနှံ ၁.			
၃.၅။	သီးနှံ ၁။	------------------------------------- ဥပမာ, လယ်စပါး	
၃.၆။	စိုက်ပျိုး ဧက	-- ဧက	
၃.၇။	အထွက်နှုန်း (တင်း/ဧက)	--တင်း/ဧက	
၃.၈။	(သုံးစွဲသော မြေသြဇာ တံဆိပ်)	------------------------------------- (ဥပမာ, 15 ပတ်လည် မြန်မာသြဘာ)	
၃.၉။	(သုံးစွဲသော ပိုးသတ်ဆေး တံဆိပ်)	-- (ဥပမာ, ကွန်ပလိ မြန်မာသြဘာ)	
၄၊ စိုက်ပျိုးသီးနှံ(၁): ပိုးသတ်ဆေးများ သုံးစွဲမှု အခြေအနေ			
၄.၁.၁။	သုံးစွဲပုံ ယူနစ် (စိုက်ပျိုးရာသီ အလိုက် သုံးစွဲသော): ပိုးသတ်ဆေးသုံး အမျိုးအစား: အရည်၊ အမှုန့်၊ အခဲ စသည်	-- အရည်၊ အထုပ်၊ အခဲ စသည်	
၄.၁.၂။	သီးနှံတစ်မျိုး အတွက် စိုက်ပျိုးရာသီတစ်ရာသီ ၌ သုံးစွဲသော ပိုးသတ်ဆေးနှုန်းထား	------------------------------------- (ဥပမာ, ၂ (သို့) ၃ ပုလင်း၊ အထုပ်)	

၄.၁.၃။	ရေဖျော်ဆေးဖျန်းဗုံး တစ်ဗူးလျှင် ရေနှင့်ရောစပ်သော ပိုးသတ်ဆေးပြင်းအား နှုန်းထား	------------------------------------(ဂရမ်/ စီစီ)
၄.၁.၄။	ပိုးသတ်ဆေး ရောစပ်ပြီးသော ရေဖျော်ဆေးဖျန်းဗုံး စုစုပေါင်း အရေအတွက်	------------------------------------ ဘုံး
၄.၁.၅။	ပြီးခဲ့သော စိုက်ပျိုးရာသီတွင် ပိုးသတ်ဆေး ဖြန်းသော အကြိမ်အရေအတွက်	-------------------------------------ရက်
၄.၁.၆။	အလုပ်ချိန်	hrs. အချိန် အနည်းဆုံး နာရီ -- အများဆုံး နာရီ --
စိုက်ပျိုးသီးနှံ (၁) တွင် တမျိုးထက်ပိုသော ပိုးသတ်ဆေး၊ မှိုသတ်ဆေး နှင့် ပေါင်းသတ်ဆေးများ သုံးစွဲပါကအပိုင်း(၄)။ ။ ပိုးသတ်ဆေးများ သုံးစွဲမှု အခြေအနေ မေးခွန်း (၄.၁.၁) မှ (၄.၁.၆) အတိုင်း အစဉ်အတိုင်းမေးပါ		
မိမိမေးမြန်းသော တောင်သူသည် သီးနှံ (၂) သို့မဟုတ် (၃) စိုက်ပျိုးပါက မေးခွန်း (၃.၁၄) မှ (၄.၁၆) အတိုင်း အစီအစဉ်အတိုင်း မေးမြန်းပါ။ အကယ်၍ တမျိုးထက် ပိုသော ပိုးသတ်ဆေးများကို စိုက်ပျိုးသီးနှံ (၂) သို့ (၃) တွင် အသုံးပြုလျှင် အပိုင်း(၄)။ ။ ပိုးသတ်ဆေးများ သုံးစွဲမှု အခြေအနေ မေးခွန်း (၄.၁.၁) မှ (၄.၁.၆) အတိုင်း အစဉ်အတိုင်းမေးပါ		

အပိုင်း(၂)၊ ပိုးသတ်ဆေး ထိတွေ့မှုဆက်စပ်သော ပတ်ဝန်းကျင်ဆိုင်ရာ အသိပညာအခြေအနေ

မိမိကြိုက်နှစ်သက်ရာ အဖြေကို တစ်ခုသာ အမှန်ခြစ်ရွေးဖြေပေးပါ။		
၁.၁။	ပတ်ဝန်းကျင်ညစ်ညမ်းမှုအကြောင်း သင်ကြားဖူးပါသလား။	( ) လေးလေးနက်နက် ကြားဖူးပါတယ်။ ( ) ကြားဖူးပါတယ်။ ( ) ကြားနေ ( ) မကြားဖူးပါ။ ( ) ဆိုလိုရင်းကို နားမလည်ပါ။
၁.၂။	ပိုးသတ်ဆေးများသည် သဘာဝ ပတ်ဝန်းကျင် (လေ၊ မြေ၊ ရေ) ကို ထိခိုက်နိုင်သည်ကို သင်သိပါသလား။	( ) လေးလေးနက်နက် သိပါတယ်။ ( ) သိပါတယ်။ ( ) ကြားနေ ( ) မသိပါ။ ( ) ဆိုလိုရင်းကို နားမလည်ပါ
၁.၃။	အချို့သော ပိုးသတ်ဆေးများကို စိုက်ပျိုးရေးဦးစီးဌာနတွင် အဘယ်ကြောင့် ပိတ်ပင်ထားကြောင်း သင်သိပါသလား။	( ) လေးလေးနက်နက် သိပါတယ်။ ( ) သိပါတယ်။ ( ) ကြားနေ ( ) မသိပါ။ ( ) ဆိုလိုရင်းကို နားမလည်ပါ
၁.၄။	ပိုးသတ်ဆေးက လူကို အဆိပ်အတောက် ဖြစ်စေနိုင်သည် ဆိုတာကို သင်သိရှိပါသလား။ (ခန္ဓာကိုယ်၏ ဇီဝကမ္မဖြစ်စဉ်အပေါ် ပိုးသတ်ဆေး အကျိုးသက်ရောက်မှု ရှိသည်ဆိုသည်ကို သင်သိပါသလား)	( ) လေးလေးနက်နက် သိပါတယ်။ ( ) သိပါတယ်။ ( ) ကြားနေ ( ) မသိပါ။ ( ) ဆိုလိုရင်းကို နားမလည်ပါ

၁.၅။	သင်ပိုးသတ်ဆေးဖြန်းနေစဉ် တစ်ကိုယ်ရေ အကာအကွယ်ပစ္စည်း (PPE) ကို အသုံးပြုရမည်ကို ပါသလား။	( ) လေးလေးနက်နက် သိပါတယ်။ ( ) သိပါတယ်။ ( ) ကြားနေ ( ) မသိပါ။ ( ) ဆိုလိုရင်းကို နားမလည်ပါ
၁.၆။	သင် ပိုးသတ်ဆေးကို ရောစပ်အသုံးပြုနေစဉ်၊ ကိုင်တွယ်သိမ်းဆည်းသည့် အခါ အကာအကွယ်ပစ္စည်း (PPE) ကို အသုံးပြုရမည်ကို ပါသလား။	( ) လေးလေးနက်နက် သိပါတယ်။ ( ) သိပါတယ်။ ( ) ကြားနေ ( ) မသိပါ။ ( ) ဆိုလိုရင်းကို နားမလည်ပါ

၂။ ပိုးသတ်ဆေး ကိုင်တွယ်မှု၊ သိုလှောင်မှုနှင့် တစ်ကိုယ်ရေသန့်ရှင်းရေး၊ အလေ့အကျင့်ဆိုင်ရာ အသိပညာအဆင့်

သင်၏ကိုင်တွယ်မှု၊ သိုလှောင်မှုနှင့် တစ်ကိုယ်ရေသန့်ရှင်းရေးအလေ့အကျင့်ကို အမှတ်ခြစ်ပါ။			
၂.၁။	စိုက်ပျိုးရေးတွင် မှတ်ပုံတင်ထားသော ဓာတ်မြေသြဇာ/ပိုးသတ်ဆေးများကို သင်အသုံးပြုပါသလား။	( ) သုံးသည်။ ( ) မသုံးပါ။ ( ) မည်သည့်ကို ဆိုလိုမှန်း မသိပါ။	
၂.၂။	သင် ဆေးသုံးစွဲသည့်အခါ ပိုးသတ်ဆေး ပုလင်း/အထုပ်ပါ ညွှန်ကြားချက် (သို့မဟုတ်) အညွှန်းအတိုင်း ဖတ်ပြီး လိုက်နာ ပတ်ဖြန်းပါသလား။	( ) အမြဲတစေ လိုက်နာအသုံးပြုပါတယ်။ ( ) အသုံးပြုပါတယ်။ ( ) ကြားနေ ( ) မဖတ်မိပါ။ ( ) ဆိုလိုရင်းကို နားမလည်ပါ	
၂.၃။	ပိုးသတ်ဆေး ပုံမှန်အားဖြင့် မည်သည့်နေရာတွင် သိမ်းဆည်းတတ်ပါသလဲ။	1) သီးခြားအခန်း (သီးသန့်/ အမြင့်နေရာ / သော့ခတ်ထားသော သေတ္တာ) 2) ပိုးသတ်ဆေး၏ အန္တရာယ်ကို မသိသော ကလေး နှင့် တိရစ္ဆာန်များ လက်လှမ်းမမှီသော နေရာ 3) အစားအသောက် နှင့် ရေ အလှမ်းဝေးကွာ သောနေရာ 4) အထက်ဖော်ပြပါ နေရာများ တစ်ခုမှ မဟုတ်ပါ။ 5) လယ်ကွင်း ထဲတွင် ထုပ်ပိုးထားခဲ့	(-------) (-------) (-------) (-------)
၂.၄။	အသုံးပြုပြီးသော ပိုးသတ်ဆေးဘူးကို အစားအစာ သို့မဟုတ် အိမ်သုံးရေထည့်သည့်ပုံးအဖြစ် အစားထိုး အသုံးပြုပါသလား။	( ) မည်သည့်အခါမှ အသုံးပြုခြင်း မရှိပါ။ ( ) တရံတခါတော့အသုံးပြုမိပါတယ်။ ( ) အသုံးပြုမိပါသည်။ ( ) အမြဲတစေ ပြန်လည်အသုံးပြုနေကြ။ ( ) ဆိုလိုရင်းကို နားမလည်ပါ။	
၂.၅။	ပိုးသတ်ဆေးကို အစားအစာ (သို့မဟုတ်) သောက်သုံးရေနှင့် နီးစပ်သော နေရာတွင် သိမ်းဆည်းတတ်ပါသလား။	( ) အစားအသောက်/သောက်ရေနှင့် **အလှမ်း**ဝေးကွာသော နေရာတွင်ထားပြီး သိမ်းဆည်းပါတယ်။ ( ) အစားအသောက်/သောက်ရေနှင့် ဝေးကွာသော နေရာတွင် သိမ်းဆည်းပါတယ်။ ( ) တရံတခါတော့ သိမ်းဆည်းတတ်ပါတယ်။ ( ) သတိမထားမိပါ။ ( ) အမြဲသိမ်းဆည်းတတ်ပါသည်။	
၂.၆။		1) မည့်သည့်အခါမှ ပုလင်းပါ အညွှန်းအတိုင်း လိုက်နာခြင်း မရှိပါ။ 2) ပုလင်းပါ ညွှန်ကြားချက် အတိုင်းလိုက်နာကျင့်သုံးတတ်ပါသည်။ 3) အိမ်နီးချင်း ၏ အကြံပေးချက် အတိုင်း သုံးစွဲပါသည်။	(-------) (-------)

	ယေဘုယျအားဖြင့် ပိုးသတ်ဆေးကို ဘယ်လိုရောစပ်သလဲ။	4) တစ်ခုထက် ပိုသော ပိုးသတ်ဆေး များကို ရောစပ်အသုံးပြုပါသည်။	(-------) (-------)
၂.၇။	သင် ပိုးသတ်ဆေးကို ရေနှင့် ရောစပ်သည့် အခါ ဘယ်လိုရောစပ်သလဲ။	1) ရော်ဘာလက်အိတ် ဝတ်ဆင်ပြီး မွှေချောင်းကို အသုံးပြုပါသည်။ 2) အဝတ်လက်အိတ်များ ဝတ်ဆင်ပြီး မွှေချောင်းကို အသုံးပြုပါသည်။ 3) မိမိလက်ဖြင့် မွှေချောင်းကို အသုံးပြုပါ သည်။ 4) မိမိလက်တစ်မျိုးတည်း ကိုသာ အသုံးပြုပါသည်။	(-------) (-------) (-------) (-------)
၂.၈။	ပိုးသတ်ဆေးရောစပ်တဲ့အခါ ဘယ်တစ်ကိုယ်ရည်ကာကွယ်ရေးပစ္စည်းကိရိယာ (PPE) ကို သင်အသုံးပြုလေ့ရှိသလဲ။	1) မည်သည့်အရာမှ အသုံးမပြုပါ။ 2) ဓာတုလက်အိတ် 3) ဓာတုအကာအကွယ်မျက်နှာဖုံး 4) ဓာတုအကာအကွယ်မျက်မှန် သို့မဟုတ် နေကာမျက်မှန် 5) ဖုန်မှုန့် အကာအကွယ် မျက်နှာဖုံး 6) အဝတ်လက်အိတ် 7) ပုံမှန်မျက်နှာဖုံး 8) ရာဘာဖိနပ် 9) ဦးထုပ် 10) Apron ခါးစည်းအဝတ် 11) ရိုးရိုးအဝတ် 12) ပလပ်စတစ် 13) အဝတ်အစားများဖြင့် တကိုယ်လုံးကို ဖုံးအုပ်ထားသည်။	(-------) (-------) (-------) (-------) (-------) (-------) (-------) (-------) (-------) (-------) (-------) (-------) (-------) (-------) (-------)
၂.၉။	ပိုးသတ်ဆေးဖြန်းသည့် အခါ သင်ဘယ်လို အဝတ်အစားမျိုးကို ရွေးချယ်ဝတ်ဆင် တတ်ပါသလဲ။	1) တီရှပ်လက်တို- ဘောင်းဘီတို/၊ (လုံချည်) 2) တီရှပ်လက်ရှည်- ဘောင်းဘီရှည်၊ (လုံချည်) 3) အင်္ကျီလက်ပြတ်နှင့် ဘောင်းဘီတို 4) အင်္ကျီလက်ရှည်နှင့် ဘောင်းဘီရှည် 5) အင်္ကျီလက်ရှည်- ဘောင်းဘီတို 6) အင်္ကျီလက်ရှည် - ဘောင်းဘီရှည်	(-------) (-------) (-------) (-------) (-------) (-------)
၂.၁၀။	ပိုးသတ်ဆေး ရောစပ်ဖျန်းပြီးရင် သင့်ခန္ဓာကိုယ်ကို ဘယ်လို သန့်ရှင်းအောင် လုပ်မလဲ။	1) လက်နှင့် လက်မောင်းများကို ချက်ချင်းဆေးကြောပါသည်။ 2) နေ့လယ်စာမစားမီ လက်နှင့်လက်မောင်းများကို ဆေးကြောပါသည်။ 3) ဆေးဖြန်းပြီးပြီးချင်း ချက်ချင်းရေချိုး ပါသည်။ 4) နေ့လယ်ရောက်သည့် အခါမှ ရေချိုးပါသည်။ 5) ညနေရောက်သည့်အခါမှ လက်ကို ဆေးကြောပါသည်။ 6) ညနေစောင်း အလုပ်များပြီးသည့် အခါမှ ရေချိုးပါသည်။	(-------) (-------) (-------) (-------) (-------) (-------)
၂.၁၁။	ပိုးသတ်ဆေးတွေ သင့်အဝတ်အစားနဲ့ ခန္ဓာကိုယ်ပေါ်ကို ဖိတ်စင်သွားတယ်ဆိုရင် အဝတ်အစားလဲပြီး ခန္ဓာကိုယ်ကို ဘယ်အချိန်မှာ	1) စွန်းထင်းသွားသော အဝတ်အစားများကိုလဲလည်ပြီး ခန္ဓာကိုယ်ကို ချက်ချင်းသန့်ရှင်းပါသည်။ 2) ဆေးဖြန်းသော အလုပ်ပြီးတာနှင့် တပြိုင်နက် အဝတ်အစားလဲပြီး ခန္ဓာကိုယ်ကို သန့်ရှင်းပါသည်။ 3) နေ့လည် (သို့) နေ့တဝက်နေပြီး သည့်အခါမှ	(-------) (-------) (-------)

	သန့်ရှင်းရေးလုပ်မလဲ။	အဝတ်အစားလဲပြီး ခန္ဓာကိုယ်ကို သန့်ရှင်းပါသည်။ 4) လုပ်ငန်းခွင်သိမ်း တနေကုန်နေပြီးသည့် အခါမှ အဝတ်အစားလဲ သန့်ရှင်းပါသည်။	(-------)
၂.၁၂။	ပိုးသတ်ဆေးကို ထိတွေ့ရာစပ်ပြီးနောက် သင့်ခန္ဓာကိုယ်ကို သန့်စင်ရန် မည်သည့် ထုတ်ကုန်ကို အသုံးပြုသနည်း။	1) ရိုးရိုးရေ 2) ရေနှင့် ဆပ်ပြာ 3) ရေနှင့် ချေးချွတ်ဆေး 4) ရေနှင့် ပန်းကန်ဆေးဆပ်ပြာ	(-------) (-------) (-------) (-------)
၂.၁၃။	ပိုးသတ်ဆေးသုံးပြီးနောက်သင်ဝတ်ဆင်ထားခဲ့သည့် အဝတ်အစားများကို မည်သို့ ပြုလုပ်ပါနည်း။	1) ဆေးဖြန်းပြီးနောက် လယ်ကွင်းမှာပင် ချက်ချင်း အဝတ်သစ် ပြောင်းဝတ်ပါ သည်။ 2) အိမ်ပြန်ရောက်တဲ့အခါမှ အဝတ်အစား အသစ် ပြောင်းဝတ်ပါသည်။ 3) ညနေစောင်း အလုပ်များပြီးသည့် အခါမှ အဝတ်အသစ်ပြောင်းဝတ်ပါသည်. 4) ထိုဆေးဖျန်းပြီးသည့် အဝတ်များကို ညအထိဝတ်အိပ်ပြီး နောက်နေ့ရောက်မှ အဝတ်အသစ်ပြောင်းဝတ်ပါသည်။	(-------) (-------) (-------) (-------)
၂.၁၄။	ပိုးသတ်ဆေးနှင့် ထိတွေ့ပြီးနောက် သင့်အဝတ်အစားများကို မည်မျှအချိန်ရောက်မှ လျှော်ဖွတ်သနည်း။	1) အိမ်ရောက်သည်နှင့် ချက်ချင်းလျှော်ဖွတ်ဆေးကြောပါသည်။ 2) မလျှော်ဖွတ်ဘဲ သိမ်းထားပြီး နောက်နေ့တွင် ဆေးဖျန်းသည့် အခါတွင် ပြန်လည် ဝတ်ဆင် ပါသည်။ 3) မလျှော်ဖွတ်ဘဲ သိမ်းထားပြီး တစ်ပတ်လုံး ထိုအဝတ်များကို ပြန်လည်ဝတ်ဆင်ပါသည်။ 4) မလျှော်ဖွတ်ဘဲ သိမ်းထားပြီး တစ်လလုံး ထိုအဝတ်များကို ပြန်လည်ဝတ်ဆင်ပါသည်။	(-------) (-------) (-------) (-------)
၂.၁၅။	သင် အသုံးပြုပြီးသား ပိုးသတ်ဆေးအခွံများကို မည်သည့်ပုံစံနှင့် စွန့်ပစ်ပါသနည်း။	1) မြေပြင်ပေါ်တွင် ဒီအတိုင်း စွန့်ပစ်လိုက် သည်။ 2) အိမ်အမှိုက်ပုံတွင် စွန့်ပစ်လိုက် သည်။ 3) ကျင်းတူးပြီး စွန့်ပစ်လိုက်သည်။ 4) နီးစပ်ရာ မြစ်၊ ချောင်း စသည့် သဘာဝရေအရင်းအမြစ်တွင်စွန့်ပစ်လိုက်သည်။ 5) အများသုံး အမှိုက်ကန်တွင် သွားရောက်စွန့်ပစ်လိုက်သည်။ 6) မီးရှို့ဖျက်စီးလိုက်သည်။ 7) မစွန့်ပစ်ဘဲ တခြားပစ္စည်းများ နည်းတူ ပြန်လည် အသုံးပြုသည်။	(-------) (-------) (-------) (-------) (-------) (-------) (-------)

ဇယား (၃)- ပိုးသတ်ဆေး ထိတွေ့မှုနှင့် ပတ်သက်သော တောင်သူ၏ အပြုအမူ

၃.၁။	ပိုးသတ်ဆေးဝယ်ဖို့ ဆုံးဖြတ်တဲ့အခါ မည်သူ့ဆီမှ အကြံဉာဏ်များ နားထောင်ပါသလဲ။	( ) တပါးသူဆီမှ အကြံဉာဏ်များ ယူပြီးမှသာ ဝယ်ယူလေ့ရှိပါသည်။ (ကျေးဇူးပြု၍ သင့်ရွေးချယ်မှုတွင် အမှတ်အသားပါ) - အိမ်နီးချင်း (-------) - ပိုးသတ်ဆေးဆိုင်မှ ညွှန်းသော အမျိုးအစား (-------) - ကြော်ငြာများကြောင့် (-------) - စိုက်ပျိုးရေး အရာရှိ (-------)

		- အရောင်း ကိုယ်စားလှယ် (-------) ကိုယ်တိုင်ဆုံးဖြတ်ချက် ဆိုလိုရင်းကို နားမလည်ပါ။	
၃.၂။။	သင်ပိုးသတ်ဆေးအသုံးပြုနေစဉ်အတွင်း မည်သည့်အပြုအမူများကို ရှောင်ကြဉ်လေ့ရှိပါသနည်း။	( ) အောက်ပါအပြုအမူများကို ရှောင်ပါသည်။ - အစားစားခြင်း - ဆေးလိပ်သောက်ခြင်း - ကွမ်းစားခြင်း - အရက်သေစာ၊ ရေနွေးကြမ်း (သို့) အရည်သောက်ခြင်း (၂) မရှောင်မိပါ ( ) ဆိုလိုရင်းကို နားမလည်ပါ။	
၃.၃။	ပိုးသတ်ဆေးဖြန်းပြီးသောအခါ နေ့လည်စာ သင်ဘယ်မှာ ပုံမှန်စားတတ်ပါသလဲ။	အိမ်ပြန်ပြီးမှ စားတတ်ပါသည်။	(လယ်ကွင်းအနီးမှာ နေ့လည်စာ စားရင် မိမိပြုမူနေကြ အလေ့အထ တစ်ခုကို ရွေးချယ်ပါ) - အများအားဖြင့် စားဖြစ်ပါသည်။ - မကြာခဏ စားဖြစ်ပါသည်။ - တရံတခါမှာသာ စားဖြစ်ပါသည်။ - ကြုံကြိုက်သည့်အခါ မလွှဲမရှောင် အနေအထားရှိမှသာ စားဖြစ်ပါသည်။
၃.၄။	ပိုးသတ်ဆေး ဖျန်းပြီးပြီးချင်း လယ်ထဲမှာ ဆေးလိပ်သောက်သလား။	( ) ဆေးလိပ်မသောက်တတ်ပါ။ ( ) သောက်တတ်ပါသည်။ - အများအားဖြင့် - တစ်ခါတစ်ရံမှသာ - မကြာခဏ - ဆေးဖြန်းပြီး ဘယ်တော့မှမသောက်တတ်ပါ။ ( ) ဆိုလိုရင်းကို နားမလည်ပါ။	

ဇယား (၄): ရေသုံးစွဲမှုအနေအထား

၄.၁။	စိုက်ပျိုးရေးအတွက် မည်သည့်ရေအရင်းအမြစ်ကို အသုံး ပြုပါသလဲ။	1) ဝီစိတွင်း သို့မဟုတ် တွင်းရေ 2) ဆည်မြောင်းတူးမြောင်း 3) ချောင်း/မြစ် 4) ရေကန်/ စက်တွင်းရေ 5) မိုးရေ 6) တခြား	
၄.၂။	သာမာန်အားဖြင့်သင်ဘယ်လိုရေမျိုးကို သောက်သုံးရေအဖြစ် အသုံးပြု လေ့ရှိပါလဲ။	1) ပြင်ပမှ ရောင်းတန်းရေကို ဝယ်သောက်ပါသည်။ 2) ဝီစိတွင်း 3) ရေသန့်တွင်းရေ 4) ဆည်မြောင်းတူးမြောင်း 5) စမ်းချောင်း/မြစ် 6) ရေကန် 7) မိုးရေ 8) အခြား	
၄.၃။	အိမ်တွင်းသုံးရေ အတွက် မည်သည့်ရေအရင်းအမြစ်ကို	1) ဝီစိတွင်း သို့မဟုတ် တွင်းရေ	

	အသုံး ပြုပါသလဲ။	2) ဆည်မြောင်းတူးမြောင်း 3) စမ်းချောင်း/မြစ် 4) ရေကန် 5) မိုးရေ 6) အခြား	
၄.၄။	စားသုံးရန်အသုံးပြုသည့် ရေအရင်းအမြစ် သည် ပိုးသတ်ဆေးဖော်စပ်သည့် ရေအရင်းအမြစ်နှင့် တူညီသလား။	1) သောက်သုံးရေအရင်းအမြစ်နှင့် တူညီသည်။ 2) စိုက်ပျိုးရေးသုံး ရေအရင်းအမြစ် နှင့် တူညီသည်။ 3) အိမ်တွင်းရေအရင်းအမြစ်နှင့် တူညီသည်။ 4)အထက်ဖော်ပြပါတစ်ခုနှင့်မျှတူညီမှုမရှိပါ။	
၄.၅။	ပိုးသတ်ဆေး ရောနှောနေကြအရပ် နှင့် အိမ်သုံးရေအရင်းအမြစ် မည်မျှ ဝေးပါသနည်း။	1) 10 ပေထက်မနည်း 2) 11 ပေ မှ 20 ပေ ကြား 3) 21 ပေ မှ 50 ပေ ကြား 4) ပေ 50 နှင့်အထက်	

အပိုင်း(၃)။ ပိုးသတ်ဆေး ထိတွေ့မှုနှင့် ကျန်းမာရေး ပြဿနာ)

နောက်ဆုံး သီးနှံစိုက်ပျိုးခဲ့ရာတွင် ပိုးသတ်ဆေးကို ရှူရှိုက်ခြင်း (သို့မဟုတ်) ထိတွေ့ပြီးနောက် ၂၄ နာရီအတွင်း အောက်ဖော်ပြပါ ရောဂါလက္ခဏာ အမျိုးအစားများခံစားရပါသလား။						
စဉ်	**ရောဂါလက္ခဏာ အမျိုးအစား**	**မည်သည့်အခါမှ ဖြစ်ဖူးခြင်းမရှိပါ (၁)**	**ဖြစ်ဖူးပါတယ် (၂)**	**ပိုးသတ်ဆေး ဖျန်းပြီး သိပ်မကြာခင် ခံစားရပါသည်။ (၃)**	**ပိုးသတ်ဆေး ဖျန်းနေစဉ် အတောအတွင်း ခံစားရပါသည်။ (၄)**	**ပိုးသတ်ဆေး ဖျန်းပြီးတဲ့အခါ ချက်ချင်း ပြင်းထန်စွာ ခံစားရပြီး ပိုးသတ်ဆေး ဖျန်းနေသည်ကို ရုတ်ချည်း ရပ်တန့်လိုက်ရပါတယ်။ (၅)**
၁။	ခေါင်းကိုက်ခြင်း။					
၂။	ခေါင်းမူးခြင်း။					
၃။	ဗိုက်အောင့်ခြင်း။					
၄။	အမြင်အာရုံ မှုန်ဝါးခြင်း။					
၅။	ပျို့ခြင်း (သို့မဟုတ်) အော့အန်ခြင်း။					
၆။	အသားအရေများ ပူစပ်ပူလောင်ဖြစ်ကာ စုတ်ပြဲလာခြင်း။					
၇။	လက်နှင့်ခြေတို့တွင် ထုံကျင်ခြင်း၊ ထိလိုက်သည်ကို မခံစားရခြင်း။					
၈။	ခြေလက်များ အားနည်းလာခြင်း။					

၉။	သင့်လက် (သို့) ခြေထောက် များ တွင် အလိုအလျောက် အကြော ဆွဲခြင်း၊ မကြာခဏ အကြော ဆွဲတတ်ခြင်း။					
၁၀။	ရင်ဘတ်အောင့်ခြင်း။					
၁၁။	အသက်ရှူရ ခက်ခဲခြင်း။					

ဇယား(၂)။ ပိုးသတ်ဆေး ထိတွေ့ခြင်း၏ ပြင်းထန်သော လက္ခဏာများနှင့် စိတ်ပိုင်းဆိုင်ရာ ချို့ယွင်းခြင်း။

၁။	ပိုးသတ်ဆေးဖြန်းပြီးရင် ဘယ်လိုခံစားရလဲ။ (အမြင့်ဆုံးမှ အနိမ့်ဆုံးကို စီစဉ်ပေးပါ။)	1) ခေါင်းမူးခြင်း။ 2) ချွေးအလွန်အကျံ့ထွက်ခြင်း 3) အလွန်အကျံ့ တံတွေး ထွက်ခြင်း။ 4) ခေါင်းကိုက်ခြင်း။ 5) ခြေလက်တွေ အောက်ပိုင်း ပင်ပန်းနွမ်းနယ်ခြင်း။ 6) အစာစားချင်စိတ်မရှိခြင်း။ 7) ကြွက်သားအားနည်းခြင်း။ 8) ပျို့/အန်ခြင်း။ 9) အစာအိမ်နာခြင်း။ 10) အရေပြားယားယံခြင်း 11) ဝမ်းပျက်ဝမ်းလျှော	
၂။	ဒီလို စိတ်ဓာတ်ကျခြင်း/စိုးရိမ်ပူပန်တဲ့ လက္ခဏာမျိုးတွေကို မကြာခဏ ခံစားဖူးပါသလား။	1) စိတ်ဓာတ်ကျခြင်း၊ 2) စိတ်တိုလွယ်ခြင်း (သို့မဟုတ်) စိုးရိမ်ပူပန်ခြင်း။ 3) ကြောက်ရွံ့လွယ်ခြင်း။ 4) စိတ်မချမ်းသာဘူး။ 5) ပုံမှန်ထက် ပိုမို ငိုကြွေး တတ်ခြင်း။	
၃။	ဒီလို ရောဂါလက္ခဏာတွေကို သင် မကြာခဏ ခံစားဖူးပါသလား။ (အမြင့်ဆုံးမှ အနိမ့်ဆုံးကို စီစဉ်ပေးပါ။) (	1) ခေါင်းကိုက်တတ်ပါတယ်။ 2) အိပ်ရေး မကြာခဏ ပျက်တတ်ပါသည်။ 3) ဝမ်းပျက်ဝမ်းလျှော ဖြစ်လွယ်တတ်ပါသည်။ 4) အစာမကြေ မကြာခဏ ဖြစ် တတ်ပါသည်။ 5) အစားအသောက် မကြာခဏ ပျက်တတ်ပါသည်။ 6) လက်များ ကတုန် ကယင် ဖြစ်တတ် ပါသည်။	
၄။	အရေးပါတဲ့ စွမ်းအင်တွေ လျော့ပါးသွားတာမျိုးတွေကို မကြာခဏ ခံစားမိပါသလား။ (အမြင့်ဆုံးမှ အနိမ့်ဆုံးကို စီစဉ်ပေးပါ။)	1. မောပန်းလွယ်ခြင်း။ 2. ဆုံးဖြတ်ချက်ချရန် ခက်ခဲခြင်း။ 3. နေ့စဉ်လုပ်ငန်းဆောင်တာများကို ပျော်မွေ့ရန် ခက်ခဲခြင်း။ 4. နေ့စဉ်အလုပ်ပင်ပန်းခြင်း။ 5. တစ်ချိန်လုံး မောပန်းနွမ်းနယ်ခြင်း ၊ 6. ဆုံးဖြတ်ချက်ချရန် တွေဝေနေတတ်ခြင်း	

၅။	ဒီလို စိတ်ဓာတ်ကျတဲ့ အတွေးမျိုးတွေကို မကြာခဏ ခံစားဖူးပါသလား။ (အမြင့်ဆုံးမှ အနိမ့်ဆုံးကို စီစဉ်ပေးပါ။)	5) ပုံမှန်ပြုလုပ်နေကြ အရာများကို စွမ်းဆောင်ရာတွင် ခက်ခဲနေခြင်း။ 6) အရာရာကို စိတ်ဝင်စားမှု လျော့ပါးလာပါတယ်။ 7) သင့်ဘဝကို အဆုံးသတ်ဖို့ သည်အထိ စိတ်ကူးခဲ့ပါသည်။ 8) တန်ဖိုးမရှိသလို ခံစားလာရပါသည်။	
၆။	အထက်ဖော်ပြပါ လက္ခဏာများ အပြင် အခြားရောဂါလက္ခဏာများ ခံစားနေရပါက ဖော်ပြရန်		

Appendix (C)

Ethics Review Committee
Institutional Review Board
Defence Services Medical Research Center
Directorate of Medical Services
Ministry of Defence
Republic of the Union of Myanmar
Informed Consent Form for questionnaire

This informed consent form is for the Pesticide exposure and health risk assessment to the rice farmers Ayeyarwady, Delta Region, Myanmar. And who is inviting to participate in the research.

Name of Principal Investigator- Ms. Moe Thu Khin

Name of Organization- Hazardous substance and Environmental Management (international Program), Graduate School, Chulalongkorn University, Bangkok, Thailand

Name of Proposal: Pesticide exposure and health risk assessment: The Potential Risk and Occupational Exposure of Pesticides Among Rice Farmers in Delta Ayeyarwady Region, Myanmar

Part 1: Information Sheet

1)Introduction

I am Ms. Moe Thu Khin, who is studying for a master's degree in Hazardous substance and Environmental Management (International Program), Graduate School, Chulalongkorn University, Bangkok, Thailand. I am analyzing the study on pesticide exposure and health risk assessment: The Potential Risk and Occupational Exposure of Pesticides Among Rice Farmers in Delta Ayeyarwady Region, Myanmar. I would like to give you information and briefly explain the research of my study. This consent form may contain words that you do not understand, please ask me to stop and I will take the time to explain about clearance patiently and carefully.

2) Purpose of the research

The purpose of this study is to analyze the pesticide exposure and health risk assessment: The Potential Risk and Occupational Exposure of Pesticides Among Rice Farmers in Delta Ayeyarwady Region, Myanmar.

3) Type of the research Intervention

This research will involve the participation of the rice farmers by answering the questionnaire containing the following information: Part (1) Socio-demographic characteristics (age, gender, education, body weight, and working farming experiences); cropping pattern, sown areas and environmental condition; Part (2) Environmental Awareness on pesticides exposure on environmental knowledge and Part (3) Health symptoms of pesticide.

4) Participant Selection

The participants will be randomly selected following inclusion and exclusion criteria. The farmers who are rice growing mainly in their production

- the farmers who are experienced in pesticide applied in rice production and permanently lived in the study area since birth or a long period.
- Age >16 years old.
- No migration or change of residence.

5) Enumerator selection

The enumerators might have the following criteria.

- An enumerator who is familiar with the rice-growing activities and practices of the study area
- A questioner is a person who can skillfully contact to the local agricultural officers, staff, civil society organizations (CSOs) and households are being assigned to interview for the research.
- An interviewer of this study has already experienced the data collection and/or attended the training course attentively about the surveying.
- An enumerator might have got the responsibility of the concept of the various questionnaires and reviewing each completed questionnaire for accuracy.
- An interviewer must submit a completed questionnaire form to the researcher as well as keep all information received confidential.

6) Researcher participation

The researcher will be double-checked the online survey of the interviewee's rice farmers who are participants in the study. The researcher must be trained the enumerators well-prepared for the survey team before the actual training with the corporation of the agricultural officers or the related field expertise. The researcher will have the tasks of carefully explaining details of the facts and (main) points of the questionnaires and actively illustrating the training tools and materials (PowerPoint, handouts, worksheets and other sample equipment) for the questioners.

7) Procedure and Protocol

I am inviting the enumerators who are fully criteria of the study. If they are accepted to do research, I will explain the detail of the research and ask about their willingness to participate in the research. Then I will train the enumerators well-prepared for the survey team before the actual training with the corporation of the agricultural officers or the related field expertise. I will carefully explain details of the facts and (main) points of the questionnaires and actively illustrate the training tools and materials (PowerPoint, handouts, worksheets and other sample equipment) for the questioners. After the training, I will lead to collecting the data from the selected rice farmers by doing a sample for the training. I will have a chance to ask unexplained questions throughout the survey from the interviewers while I will be taking the time to patiently and carefully explain about clearance. If necessary, I will take photos of pesticides, spraying equipment and tools from the farmers with their permission.

8) Benefits

This study will directly benefit the participants of the rice farmers in the selected study areas, who are permanently living in Bogalae, Pyapon and Kyaitlat townships in the Ayeyarwady Region, Myanmar. This study will help indirectly in the health and development of the local community as well as in the Pyapon District, Ayeyarwady, Delta region.

9) Confidentially

The research being done in the community may draw attention and the participants may be asked questions by other people in the local community. The participants of answering have to cooperate with their owner's willingness in this research. If he questions that the participant doesn't have to be willing to answer, we can stop answering as their wishes. We will not be sharing information that we collect from the research project and will be kept private. Any information about the interviewee farmer will have a number on it instead of the interviewee's name. Only the researchers will know what the participant's number is and we will keep the number safely.

10) Sharing the Results

The knowledge that we get from this research will be shared with firstly enumerators, participants of the rice farmers, local agricultural officers, staff and local health authorities before it is made widely available to the public. Then results of the study will be informed to the Department of Agriculture, Ayeyarwady Region, Department of Public health Ayeyarwady Region and Department of Plant Protection Division and as well as other local authorities. We will publish the findings and results so that other interested people may learn from the research. The researcher will share the findings and results according to the following,

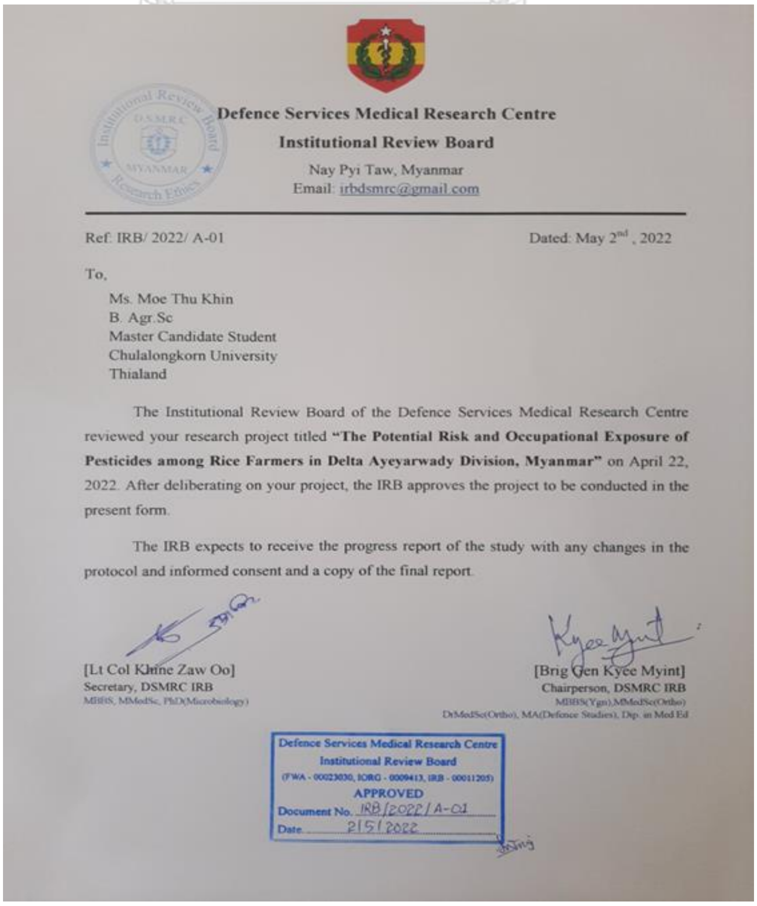
a) If the findings of the research will have weak or lack good practices related to pesticide handling, storage and application in the study areas, the researcher will communicate with agricultural officers and public health officers of those farmers by advising and extending their knowledge regarding pesticide handling, storage and hygiene practices.

b) The researcher will link to the agricultural extension officers to help farmers access information and establish safe pesticide handling and hygiene such as by demonstrating or providing pamphlets on safe usage of pesticides. If necessary, for the farmers who have acute or chronic symptoms due to pesticide exposure, the researcher will cooperate with the local public health officers can carry out engagement, consultation and publication on the occupational risk of the findings in the research.

11) Right to Refuse or Withdraw

The participants of the study do not have to take part in this research if they do not wish to do so, and choosing not to participate will not affect their rights and advantages in any way. The participants of the study do not have to take part in this research if they do not wish to do so, and choosing not to participate will not affect their rights and advantages in any way. If the questions that participants don't have to be willing to answer, participants can stop and withdraw answering easily as they wish

Appendix (D)



Defence Services Medical Research Centre
Institutional Review Board
Nay Pyi Taw, Myanmar
Email: irbdsmrc@gmail.com

Ref: IRB/ 2022/ A-01 Dated: May 2nd , 2022

To,
Ms. Moe Thu Khin
B. Agr.Sc
Master Candidate Student
Chulalongkorn University
Thialand

The Institutional Review Board of the Defence Services Medical Research Centre reviewed your research project titled **"The Potential Risk and Occupational Exposure of Pesticides among Rice Farmers in Delta Ayeyarwady Division, Myanmar"** on April 22, 2022. After deliberating on your project, the IRB approves the project to be conducted in the present form.

The IRB expects to receive the progress report of the study with any changes in the protocol and informed consent and a copy of the final report.

[Lt Col Khine Zaw Oo]
Secretary, DSMRC IRB
MBBS, MMedSc, PhD(Microbiology)

[Brig Gen Kyee Myint]
Chairperson, DSMRC IRB
MBBS(Ygn),MMedSc(Ortho)
DrMedSc(Ortho), MA(Defence Studies), Dip. in Med Ed

Defence Services Medical Research Centre
Institutional Review Board
(FWA - 00023030, IORG - 0009413, IRB - 00011205)
APPROVED
Document No. IRB/2022/A-01
Date 2/5/2022

VITA

NAME	Miss Moe Thu Khin
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