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Assessment of the current status of pesticide use in triple-rice crops in Hoa Long commune, Lai Vung district, Dong Thap province, Vietnam

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***Abstract*— *This study was implemented to evaluate the current status of pesticide use in triple rice cropping in Hoa Long commune, Lai Vung district, Dong Thap province, Vietnam. The findings showed that the common pesticides used by the farmersin the study area belonging to toxicity Group II and III (World Health Organization (WHO) classification) accounted for 67.6%. Some farmers also usedpesticides containing banned active ingredients such as 2.4D, carbosulfan and carbendazole. The frequency of pesticide use was 5.5 times/crop which was relatively high. Basing on the active ingradientcompounds present in the study area, the potential environmental impact of pesticides is very seriously. The farmers used masks when spraying pesticides, however, they did not have a full understanding of the harmful effects of pesticide exposure. Packaging and bottles of pesticides after use have not been collected and disposed appropriately;it was commonly thrown away in the canals, ditches, and bare land after use. Local authorityhas not yet taken comprehensive measures to completely handle pesticide packaging and bottles due to funding constraints. In order to reduce the environmental and health risks associated with the use of pesticides and its wastes in the study area, local authority needs to increase the propaganda of knowledge about the management and use of pesticides while developing appropriate program for effective management of pesticidewastes.*

***Keywords*— pesticides, environmental pollution, toxicity, triple-rice crop, Lai Vung, Dong Thap.**

I. INTRODUCTION

Dong Thap has a natural area of 3,374 km^2, of which aerable land accounts for 276,206 ha. The population of the province 1.7 million people, with more than 82.73% living in rural areas, and 73.59% of agricultural labor. The value of agricultural production accounts for over 50% of the total economic values. Agricultural production is the main source of income for the majority of the rural people. Therefore, the issue of agriculture, farmers and rural areas is currently crucial to the socio-economic development of Dong Thap. In agricultural production, pesticide is one of the important supplies and is used in large quantities annually.

Toan et al. (2013) showed that the residues of active ingredient quinalphos were all present in the surveyed water bodies with the decreasing detection frequency from rice fields, rivers and in-field canals accounting for 40%, 50% and 67%, respectively. The concentration of active ingredients quinalphos in in-field canals and rivers in Summer-Autumn crop was higher than in Winter-Spring crop. In particular, at a number of survey sites, the concentration of quinalphos in water exceeded the acute toxicity level effective dose (EC_{50}) for invertebrates (0.66 µg/L). In the annual surface water monitoring program of the province, it is necessary to monitor the residues of pesticides that are commonly used in surface water. The main cause of pesticide residues is due to the fact that people often use pesticides of type II and III toxicity according to the World Health Organization (WHO) classification. The pesticide is often not used appropriately in terms of frequency, duration and dosage. Insecurity in use and storage is an issue of concern among the interviewed households (Toan et al., 2013). In addition, waste from the use of pesticides is often not properly managed and disposed of in the field as well as in the storage site. These situations could pose risks to public health and the surrounding environment. Cong et al (2015) reported that plant protection pesticides containing the active ingredient chlorpyrifos ethyl on cholinesterase can seriously affect the growth and development of snakehead

(*Channastriata*). Trung and Huong (2009) showed that the active insecticide quinalphos could seriously affect the enzyme activity of cholinesterase and glutathione-S-Trasnerase of the carp.

Several studies on pesticides and their effects on the environment and biodiversity have been reported, however, such study on the use of pesticides on triple-rice crop in Long Hoa commune, Lai Vung district, Dong Thap province is still limited. In order to have information to help scientists, especially scientists on environmental toxicology research evaluate the potential impact of pesticides on environment and biodiversity, this study was conducted to investigate current status of using and managing pesticide bottles in the triple-rice crop growing areas in Hoa Long commune, Lai Vung district, Dong Thap province, Vietnam.

II. METHODOLOGY

The study was carried out in a triple-rice crop area in Hoa Long commune, Lai Vung district, Dong Thap province, where farmers have a long tradition of rice cultivation. Information on the type and amount of pesticides used by farmers was collected by interviewing using semi-structured questionnaires. The study conducted with the interview of100 rice-growing farmers in Hoa Long commune, Lai Vung district, Dong Thap province of types, dosages,duration, and frequency of pesticide use. The study also collected information regarding methods of pesticide use as well as safety measures when spraying pesticides in the field. The management of package and bottles of pesticides after use was recorded through direct interview and field survey. In addition, the study also conducted interviews to collect opinions of commune officials on environmental management in agriculture in Hoa Long commune, Lai Vung district, Dong Thap province. The information from the interview was synthesized using Miscrosoft Excel combined with using simple calculation formulas such as SUM, AVERAGE, COUNIF to summarize collected data.

III. RESULTS AND DISCUSSION

3.1 General information of the respondents

Results of interviews with the households indicated that the average age of the household head was 45 years old. In particular, the highest age was 76 years old, the lowest age was 28 years old. Household heads aged 50 and under account for 66% of the total interviewees. The age of 50 and under is the age of healthy and experienced for many years in agricultural production. Respondents were 82% male, and 18% female, which is an important factor in determining the reliability of interview information because male respondents were directly involved in the use of pesticides. The survey results presented that the education level of the farmers in the study area is still low. Primary and secondary school farmers accounted for 86% (the majority of the farmers aged 40 to over 50 years old had low education level), while the high school level only accounted for 14%. The low levels of education of the interviewer farmers could be due to difficult rural conditions, unfavorable travel conditions, and time-consuming and costly education. The majority of the farmers in the study area are engaged in agriculture work in addition to some other seasonal jobs such as pesticide spraying, porting, knitting, making roofs to earn extra income to support their families.

The results of the study showed that households with land area from 7,000m^2 to 10,000m^2 accounted for 40%, land area of 10,000m^2 accounted for 34% and the rest was from 4,000m^2 to 7,000m^2. The land area pattern indicated the disparity in the land area which could lead to the use of pesticides differently in terms of doses and types. The low land area farmers often skipped the training programs relating to rice production techniques including the use of rice variety, fertilizer, and pesticide. This could lead to lack important information in environmental protection in agricultural production. In the study area, the farmers often use rice varity of Dai Thom 8 in Winter-Spring crop while IR50404 variety is used in Summer-Autumn and Winter-Autumn crops. The rice farming experience of the interviewed farmers was very well.According to the interviewing results, the number of households with rice production experience above 10 accounted for 74%, while 26% of the interviewed households have rice cultivating experience from 5 to 10 years. There was no household with the rice production experience of less than 5 years. Recently, pests and diseases have developed strongly leading to the increase of the use of pesticides in the rice fields. Consequently, risks of environmental pollution affecting human health and ecosystems become high.

3.2Farmers' knowledge of pesticides

According to the survey, up to 56% of the farmers did not know about banned pesticides in the market but they were sure that they do not use them. Only 44% of households said that they knew well about prohibited pesticides and could name the banned substances such as 2,4D and benomyl. These active substances are very toxic, which could kill natural enemies immediately. Therefore, farmers who know about these pesticides have limited use due to its toxicity. The research results showed that 40% of the households said that they know well about the harmful effects of pesticides, 54% of the households responded that they only know about pesticide exposure harms through newspapers, television, radio and relatives. Only 6% of the households are unaware of the harmful effects of pesticides and are not interested in knowing the impact. These households with the farmers aged over 50 and have primary school education.

The interview results showed that up to 94% of the farmers understood and knew about the harmful effects of pesticides on environments and human health. But when asked about the way of treating packaging and bottles of pesticides after use, up to 40% of the farmers chose tothrowdirectly in the fields, rivers or surrounding areas. There were 38% of the interviewed farmers sold and 22% burned packaging and bottles of pesticides after use. As could be seen that the interviewed farmers did have a good awareness of environmental protection as well as the harmful and long-term effects of pesticides. The selling and burning could result in human exposure to the residual pesticides. In addition, the pesticide residues would be absorbed into water and soil environment. Especially, plastic bottles and packaging are difficult to decompose when being discharged into the environment, which couldseriously pollute the environments.

There was a training course on how to properly manage packaging and bottles of pesticide after use, however there were only 54% of the farmers participated in the training course. In addition, local authority also organized integrated pest management (IPM) to improve the quality of pest management, reduce the use of pesticides and to protect the environment. Most farmers are rightly aware that throwing away pesticide bottles into the environment is wrong (of which 88% of the farmers said that they understood it was wrong-doing action but they have no other appropriate treatment method available). The farmers aged over 50 and have low education level (primary and secondary) said they have no interest in this issue. The research results also showed that the collection sites and containersfor packages and bottles of pesticide after use are not sufficient.

3.3Dosage and frequency of pesticide use

According to the survey, pesticides were used diversely with 31 trade names belonging to 35 active ingredients. This includes pesticides, diseases, growth stimulants, herbicides and raticides. Of the 35 active ingredients, up to 94.3% of the active ingredients were listed in the list of pesticides used in Vietnam according to Circular 03/2018/TT-BNNPTNT of the Ministry of Agriculture and Rural Development. The study discovered 2 prohibited active ingredients of pesticides (accounting for 5.7%) that have been used in the study area. This showed that the farmers still use illegal pesticides in the market. This could happen because 56% of the farmers did not know what are banned pesticides. In addition, the sellers are illegally trading.

Among the active ingredients investigated in the study area, there is one active ingredient belonging to the toxic group I. The pesticides in the toxic group II were the most used by farmers, accounting for 42.8%, the toxic group III accounting for 22.8%, and group IV accounting for 24%. Compared to the results of Toan (2013), the situation of using pesticides in rice production in the Mekong Delta shares similarities that rate of pesticide use is still high for the group II and III. Table 1 summarizes some of the active ingredients, toxicological classifications and potential environmental impacts of the pesticide used in the study area. The results showed that the pesticides found in the study area could cause serious environmental problems which could lead to irreversible effects on health and the environment without early remedies.

Table 1. Active gradients, toxic classification and potential impact of the pesticides present in the study area

Active ingredients	**Toxic classification**	**Potential impact**
Carbosulfan	- Group I; LD_{50}: 11 mg/kg; Time isolation 14 days.	- Toxic to humans and warm-blooded animals, but safe to plants; accumulate in the environment and food chains.
Abamectinh	- Group II; LD_{50}(oral) 300mg/kg; LD_{50}(skin)>1800mg/kg; Time isolation 7 days.	- Toxic to fish and bees; Irritating to skin and eyes.
Tricyclazone	- Group II; LD_{50}(oral) 250-314mg/kg; Time isolation 14 days.	- Less toxic to fish.

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Active ingredients	**Toxic classification**	**Potential impact**
Propiconazole	- Group II; LD_{50}(oral) 1517mg/kg; LD_{50}(skin) 4000mg/kg; Time isolation 7 days.	- Less toxic to the environment, human, cattle, fish and bees.
2.4D (2,4-Dichlorophenoxyacetic acid)	- Group II; LD_{50}(oral) 699mg/kg	- Relatively toxic to fish; considered carcinogen; is an ingredient in orange agent.
Fipronil	- Group II; LD_{50}(oral) 95-97 mg/kg; Time isolation 7 days.	- Bioaccumulation in the natural food chain, especially in fish and aquatic animals; Very toxic to bees, fish and other beneficial organisms; risk of causing cancer.
Carbendazim	- Group II; Time isolation 14 days.	- Causing infertility, cancer; Less toxic to bees and fish.
Metaldehyde	- Group II; Time isolation 14 days.	- Relatively toxic to fish and bees.
Profenofos	- Group II	- Very toxic to fish; toxic tobees.
Propanil	- Group II; Oral (rat): LD_{50} = 1.080 mg/kg; skin (rabbit /rat): LD_{50} > 2.000 mg/kg; inhalation (Rat): LC_{50} > 6.1 mg/L.	- Eye and skin irritation in rabbits.
Imidacloprid	- Group II	- Less toxic to fish; toxic to bees.
Quinalphos	- Group II; Time isolation 15 days.	- Very toxic to fish and bees.
Chlorfenapyr	- Group II; (oral) LD_{50}: 223mg/kg (male rat); LD_{50}(oral): 459mg/kg (female rat); LD_{50} (skin): ≥ 2000mg/kg (rabbit); Time isolation 14 days.	- Less toxic to fish; toxic to bees.
Isoprothiolane	- Group III; Time isolation 7 days.	- Toxic to fish; less toxic to bees.
Butachlor	- Group III	- Highly toxic fish; less toxic to bees.
Difennoconazole	- Group III; LD_{50} (oral) 1.453 mg/kg, LD_{50} (skin) 2.010 mg/kg; Time isolation 7 days.	- Toxic fish; less toxic to bees.
Metalaxyl	- Group III; LD_{50}(oral) 669mg/kg; LD_{50} (skin) 3100 mg/kg; Time isolation 7 days.	- Causes moderate eye irritation.
Propineb	- Group III; Time isolation 5 days.	- Toxic fish; less toxic to bees.
Hexaconazole	- Group IV; Time isolation 7 days.	- Less toxic fish and bees.
Copper oxychloride	- Group IV; LD_{50} (oral)1144.7mg/kg (mice), LC_{50}2.2 mg/g (carp) (48 h). - Time isolation 7 days.	- Less toxic to warm-blooded animals.

Active ingredients	**Toxic classification**	**Potential impact**
Kasugamyan	- Group IV; LD_{50} 4 mg/kg; Time isolation 14-21 days.	- Not toxic to fish and honey bees.
Chlorantraniliprole	- Group IV; LD_{50} (oral) > 550 mg/kg (rat); LD_{50} (skin) > 5000 mg/kg (rat); LC_{50} (inhalation) > 3,394 mg/l, (rat).	- Toxic to fish
Azadirachtin	- Group IV	- Less toxic to mammals. - Reduction of female ovaries, fallopian tubes, by seminal vesicles, glucose levels, the activity of several enzymes, affecting the male reproductive system.
Azoxystrobin	- Group IV; LD_{50} (oral)> 5.000 mg/kg, (skin)> 2.000 mg/kg	- Low toxicity for mammals, birds, bees, insects and earthworms. Very toxic to aquatic organisms.

The majority of the farmerssaid that the types of agrochemical use were highly varied. Pest and disease chemical accounted for 82%, plant growth regulators accounted for 34%, herbicides accounted for 38%. In addition, the farmers also used chemicals to kill rat and yellow snail. Regarding time of use of pesticides, it was responded that when there are occurrence of insects and diseases, the farmers would immediately spray pesticidesto control the potential outbreak that could lead to crop damage. The above evidence proves that the farmers did not know how to use pesticides properly. The finding in the present study showed that 74% of the farmers use pesticides empirically and 26% of the farmers use the pesticides under the guidance of the seller or from the instructions on the packaging.

According to the farmers in the study area, approximate 78% of the farmers used the thedose according to the instructions on the package and 22% of the farmers selected the dose based on the level of seriousness of the pests and diseases. Sometimes, the farmers empirically used the dose two-fold higher than the recommended dose to quickly and securely kill pests or diseases. The number of pesticide spraying times in each rice crop was 5.5 times/crop. Compared with the results obtained by the Mekong River Commission in 2007, the number of sprays per crop in the study area is similar to the frequency of spraying in the Vietnamese Mekong Delta (5.3 times/crop), 5.5 times higher than with the Red River Delta (1.0 times/crop). Previous study showed that the number of sprays per crop on rice was 7 - 8 times in HauGiang province (Nhan et al., 2018) and 7.1 times in Can Tho city (Binh, 2008). The use of pesticides in this study is still lower than in some other areas in the Vietnamese Mekong Delta.

3.4Farmers' understanding of health issues due to pesticide exposure

Up to 26% of the farmersunderstood the harmful impact of pesticides on health through dermal contact, inhalation, and ingestion. However, the farmers said that they did not observe any cases of pesticide poisoning. There are 56% of the farmers supposed that the pesticide has an unpleasant smell and causes discomfort when spraying, sometimes causing dizziness, guava, and headache. The remaining 18% of the farmers said that there was nothing happened when spraying pesticides (the majority of the farmers are over 50 years old and the education level is low). Up to 92% of the farmers used protective mask when spraying pesticides. There were no other safety devices. Some farmers supposed that the use of protective clothes would cause difficult for their spraying, for example, the confortable feeling. The majority of the farmers stored pesticides in the house where children could reach. Only 16% of the interviewed farmers stored pesticides in a separate place. Some farmers used after purchase so that the was no storate of pesticides. The finding showed that farmers did not really understand the potential impact of the use, storage of pesticides on health and environment.

3.5The management of pesticide bottles in the study area

Only about 12% of the farmers said that a container for pesticide packaging and bottles after use was placed near their fields. And 88% of the farmers answered that the containers of pesticides were placed far away from the fields. Although knowing the of disposal of pesticide packaging and bottles after use is wrong, but because the container is far away with a small volume and often filled with garbage. The results of the interview with local officials indicated that there is a container for farmers in the area to collect the packages and bottles of pesticides after use. However, budget is the main constraint for placing more and larger volume of the pesticide collecting containers.

Fig.1: Simple tank for containing pesticides bottles and packages

IV. CONCLUSION

The current status of pesticide use in Hoa Long commune, Lai Vung district is a matter of great concern. The common pesticides used by the famrers belonging to toxic group II and III accounted for 67.6%. The banned pesticides including 2.4D, carbendazim, carbosufan were being used in the study area. After the use, up to 45% of the farmers threw away bottles and packages into the environments, selling to the vendors or burning at the field sites. All the current practices are extremely inappropriate posing a potential risk to health and ecosystems. The frequency and dosage of pesticide use were still high. The protective measures for the farmers in the study area is not highly efficient since the farmers only used simple mask. The management of bottles and packages at home still has many potential health risks. The management of pesticide packaging and bottles after use is still limited due to budget limitation. In the coming time, the local environmental managers need to strengthen the management of pesticide bottles and packaging because they are hazardous wastes that may seriously affect health and the environment. Budget allocation for pesticide wastes and training for farmers in properly using pesticides are urgently needed.

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