

# The Impacts of Paraquat and Chlorpyrifos in Agricultural Production on Environment and Farmers' Health in An Giang Province, Vietnam

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**Abstract:** *This research was carried out in Thoai Son district (on rice crop), Cho Moi (on fruit crop) and Chau Thanh district (on vegetable crop) of An Giang province to evaluate the effects of Chlorpyrifos and Paraquat in agricultural production on farmers' health and environment in An Giang province. Most farmers chose herbicides with fluid leading features, killing the green part of the leaf or a combination of both, or they just chose from their habits (90%). Only 6% of farmers knew the name of the active substances of the herbicides in general and 11% of farmers knew the origin of Paraquat, in which the farmers in An Giang took the highest percentage. For the pesticide, the first choice of farmers was the chemicals with fluid leading and fast killing features, then chemicals with quick exposure, poisonous taste and fast killing, then the last one was the less poisonous pesticides. There were 90.9% of farmers using Chlorpyrifos for pest management without knowing the name of this active substance. Most farmers thought that the active substances Paraquat and Chlorpyrifos affected badly to human health and environment (92.2%) – particularly the percentage of agreement on the element that polluted the water to the alarm level (76.1%). However, the extent of use was still very high because they have not had any solution to replace these two active substances in agricultural production.*

**Keywords:** Paraquat, Chlorpyrifos, agricultural production, health, environment, An Giang

## 1. INTRODUCTION

Paraquat and Chlorpyrifos are 2 kinds of pesticides which have been limited in agricultural production by global community. (1) Paraquat is a fast-acting, non-selective contact herbicide that is used for broad-leaved plants, killing the green of leaves and causing leaf burn with strong oxidizing reaction [1]; This chemical has been banned for a long time for its hazard to environment. However, later it has

been permitted to be used up to now. (2) Chlorpyrifos is an insecticide originated from organophosphate, a group of chemicals which will affect the central nervous system of insects and the warm – blooded; This group of active substances takes a great part in the commercial products in the list of chemical pesticide trade names which are licensed to trade in Vietnam in 2013. Both two groups of chemicals are highly poisonous, but they are still permitted to be used in agriculture, so they have been used widely. However, knowledge of its hazard towards insects, animals, human and environment has not been mentioned in the training courses. This shows that farmers are ready to use highly poisonous products on their fields to control weeds and pests. Besides, the media are day and night advertised the pesticides, this leads to the overuse of pesticides and the increase of plant diseases. Moreover, people who grow rice, fruit, vegetables have been depended on the pesticides. Therefore, this paper is to understand the impacts of above 2 active ingredients on farmers' health and environment, from that point to recommend those safe measures for farmers in pesticide use.

## 2. DISCUSSIONS

### 2.1. The farmers' perceptions in applying Paraquat and Chlorpyrifos in agricultural production

#### \* Herbicides with active substance Paraquat

According to vegetable growing farmers in Chau Thanh, they usually used a specific herbicide, depending on the type of grass that they wanted to remove. However, the majority of them did not know the active ingredient of the herbicide they used, typical cases as the trade name "grass fire" which they used to remove grass in the field with active substance Paraquat. They usually sprayed after harvest to remove weeds in the field to start the new crop (7 days), along the of beds (2-3

times/season). But they also understood its poisonous characteristic so they didn't use it to remove weeds around the house, in a crowded residential area. On the other hand, they thought that this herbicide with active substance Paraquat would not affect the natural useful insects. This was worth worrying because in fact farmers did not realize that this herbicide could remove a broad spectrum of natural useful insects in the garden or fields (Group discussion, 2014).

For mango growers in Cho Moi district, the assessment of herbicide was more diverse and specific. They not only cared about the herbicide's effectiveness, but also concerned about its effects on health and the environment. Farmers thought that herbicide with active substance Paraquat was highly effective for small grass when cultivating vegetables, at level 1 of acute toxicity, exposure without fluidity leads. In addition, the herbicide had very unpleasant odor and caused eye irritation after spraying, people self-poisoning with Paraquat could not be saved. In addition, the herbicide also affected crop yields when farmers did not use special tools to spray (to use a funnel to focus only on the grass), the crops in the neighboring fields would wither and die if the wind blew the herbicide over there. Thus, for fruit growing farmers, only a few households used this herbicide, the majority of them used herbicides with other active substances such as Glyphosate, with less toxic and fluidity lead to have more effective results (Group discussion, 2014).

For rice growing farmers in Thoai Son district, they assessed the high effectiveness of the herbicide with fast removal, special treatment, saving time and labor for soil preparation and removing weeds. They understood the effects of herbicides. Similarly, vegetable growing farmers in Chau Thanh district were not interested in the active substance, the toxicity of the herbicide and user manuals, and health. However, some households did not use this herbicide because they said that it had no fluidity lead despite burning leaf faster than Glyphosate. They were often used for weed control on the bunds of the field. In addition, there were cases in which farmers sprayed herbicide on high lotus leaves on high without wearing protection mask so they had bitter mouth (In-depth interview, 2014). The smell of the herbicide was very poisonous, causing wilt in the nearby rice fields (Group discussion, 2014).

#### **\* Pesticides with active substance Chlorpyrifos**

Similar to herbicide Paraquat, the majority of vegetable growing farmers in Chau Thanh district didn't know which pesticides had the active

substance Chlorpyrifos and they also did not understand why they had to know the active substances when using them, they mainly knew the trade name and they used from their habit, from their neighbors, and from the dealers. Therefore, they were not aware of almost all information related to the use of this pesticide when they were interviewed. Because of the pests on vegetables happened regularly as well as the time the crop season was short, farmers primarily sprayed periodically to prevent more than to treat (1 spray in 3-4 days) and with higher dose spray than recommended (Group discussion, 2014).

However, mango growers in Cho Moi district were more aware of the information relating to the effect of this active substance to natural useful insects, water, and health. According to them, this active substance was high poisonous and steaming and mainly used for rice, it affected the water source and caused the death of fish, frogs, and eels as well as the blindness of crabs. In addition, farmers who used and exposed to it when spraying had itching and rash. Therefore, the majority of mango growers didn't use it. According to them, this pesticide was only used to kill rats (mixing 5-7 liters of lubricant with 1 liter of Tungcydan and pouring down to the surface of the field, rats swimming in contaminated water would get wet and die because of licking to dry their fur) (Group discussion, 2014).

As mentioned above, farmers in Cho Moi said that this pesticide was only used in rice, but according to records from group discussions with rice growing farmers in Thoai Son, they almost limited the use of this pesticide because of its toxicity. Currently, Chlorpyrifos hasn't been in use for 5 years due to the diverse market of plant protection chemicals and pesticides, it is now only used to kill rats in the field (30cc/average/1,000 square meters, a bottle of ½ liter + 2 liters of lubricant pouring on 2,000-3,000 square meters. 4 bottles/season for 6,000 square meters and it costs only 500,000VND). In the opinion of Uncle Nanh (Vinh Chanh Commune), the active substance Chlorpyrifos in Tungcydan pesticide did not have effect anymore, so it was often used in combination with other pesticides, mainly taking its poisonous smell. In addition, this pesticide had very high poisonous degree so farmers often felt hot when spraying. Moreover, it is non long-lasting, and non-fluide lead, quick removing and it may result in a bad yield when spraying during the flowering stage of rice. All farmers agreed that they had hot, itchy skin when exposing to water in the fields after spraying, so they decided not to use it on rice (Group discussion, 2014).

## 2.2. Factors impacts on farmers' decisions in applying active ingredient Paraquat and Chlorpyrifos

### \* Assessment according to gender

Difference gender had different knowledge, behavior of pesticides, particularly the knowledge related to Paraquat and Chlorpyrifos. Men had more knowledge about Paraquat than women, whileas men were lower than women in the knowledge of Chlorpyrifos. Men and women had the same attitude towards active substances Paraquat and Chlorpyrifos. Women had favorable behavior toward avoiding the harmful effects of 02 active substances with the statistical significance of 5% compared to men through LSD test (Table 1).

**Table 1. Assessment knowledge, attitude and behavior according to gender**

Content	Gender		T_test
	Male	Female	
General knowledge	8,29	8,58	ns
Knowledge of Paraquat	0,42	0,17	**
Knowledge of Chlorpyrifos	7,13	12,76	***
Attitude of farmers	29,35	28,61	ns
Behavior of farmers	11,78	16,13	***

**Notes:** *Ns*: not statistically significant at 5%, \*\*: statistically significant at 1%, \*\*\*: statistically significant at 1% through *T\_test*.

### \* Assessment according to education level

No influence of education on knowledge and attitude of farmers about Paraquat through Fisher test, education had implications for general knowledge, knowledge and behavior of farmers about clorpyrifos. Farmers with high school level and above would have good knowledge of Chlorpyrifos and better behavior to clorpyrifos and Paraquat than farmers with lower education (Table 2).

**Table 21. Assessment of knowledge, attitude and behavior according to education level**

Content		Education						F_test	
		Primary<=		Secondary		>= highschool			Total
General knowledge		6,46	c	8,34	b	10,37	a	8,38	***
Knowledge of Paraquat		0,40		0,28		0,23		0,30	ns
Knowledge of Chlorpyrifos		5,22	b	11,07	a	12,27	a	9,93	***
Attitude of farmers		29,68		28,29		29,45		28,92	ns
Behavirors of farmers		9,58	c	14,56	b	17,09	a	13,97	***

**Notes:** *Ns*: Not statistically significant at 5%, \*\*\*: statistically significant at 1% through Fisher test; In the same line, the characters following the same average difference was not statistically significant 5% through LSD test.

In general, (1) knowledge of Paraquat does not depend on the variables of general knowledge and some household characteristics. (2) Knowledge of Chlorpyrifos depends on the education and knowledge of common training, the owners of larger area have less knowledge about this chemical. (3) The attitude of farmers depends on the area of the land they hire and depends on their knowledge of Chlorpyrifos. (4) The behavior of farmers is better when farmer are aged, get higher education, have more training on general knowledge, knowledge of Chlorpyrifos and positive attitude offarmers, however, they will be adversely affected by income and the land they own. (5) The majority of the correlation is

evaluated weak to moderate, shown most valuable  $r < 0.5$ , although some correlation with statistical significance at the 5%, the coefficients correlation is not so high, the variables of knowledge, behavior and attitude are easily changed. Based on the correlation coefficient ( $r$ ), we can provide a solution to raise the awareness of people about the harmful effects of the above chemical. Since only understanding the poisonous chemicals can change the attitude and behavior of users.

### 2.3. The impacts of pesticides on health and environment

#### \* Judgement about pesticide impacts on human health

As noted by medical staff in the Department of emergency resuscitation in Chau Thanh district, An Giang province, most hospitals could not record cases of chronic poisoning due to pesticides, because the majority of farmers did not paid attention to health care and regular health checks in hospitals. At the same time, it was hard for the medical staff to determine that the exact cause of the disease was pesticides because farmers' health was affected by many external factors and pathological factors of the body. Cases of acute pesticide poisoning rarely happened, especially pesticides with Chlorpyrifos active substances, except for cases of poisoning themselves (suicide) with pesticides with Paraquat active substances. According to the medical staff, most cases of poisoning themselves (suicide) with pesticides with Paraquat active substances were dead, the difference in poisoning symptom of these two active substances were shown as:

Symptoms of Chlorpyrifos poisoning included: Muscannic syndrome (mild) included symptoms such as pupillary contraction, bradycardia, pulmonary secretions; Nicotic Syndrome caused muscle tremors; Neurological syndrome: altered mental status. Paraquat poisoning included the levels: Mild symptoms included vomiting, heavy head, dry throat; severe symptoms included severe respiratory failure, renal failure and systemic failure (In-depth interview, 2014).

According to the survey results, most farmers treated themselves at home for poisoning during spraying, the treatments were bathing, changing clothes, resting, drinking lemonade. Through a survey about the level of interest in the health of farmers, researchers were able to demonstrate that most farmers in An Giang Province in particular and in the Mekong Delta in general did not care about the dangerous effects of pesticides to their health after regular and long-term exposure. This accidentally created a significant barrier in the process of launching the restriction of pesticide use in the community.

#### **Box 1: Information about vegetable growing farmers (cucumber) who got pesticide poisoning as working without wearing workwear:**

Mr. N.V.Son, head of household, born in 1967, lived in Binh Thanh Commune, Chau Thanh District, An Giang Province. Previously he grew

rice, then switched to vegetable (cucumber), 5,000m<sup>2</sup>. The family consisted of eight members, including 4 males, 4 females, in which 3 men were in working age. He was accidental poisoning and exposing to chemicals and other harmful substances of unknown characteristics, at 19h dated 01.28.2014. while using pesticides, he wearing no workwear (goggles, mask, long sleeves shirt, gloves) when spraying Tungmectin 5.0 (the active substance is Emamectin), so when he opened the bottle, the pesticide splashed at his face, after first aid at home as washing his face, changing new clothes, and going to the nearest health center, he moved to the district hospital. After 5 days home from the hospital and continued to use eye drops for 7 days. Over 6 months from the date of poisoning, recently he didn't see clearly and felt painful when deeply focusing on something.

In-depth interview, 2014

#### **Box 2: A case of mistaken use of pesticides caused by not carefully reading the user manual on the package:**

Mr. Tran Van Fast, Vinh Chanh commune, Thoai Son district, reflected on the use of drugs Kinalux 25EC of An Giang Plant Protection Corporation on rice which led to the loss of 100% the rice over an area of approximately 6.000m<sup>2</sup>, caused by drugs containing active Paraquat. This was a non-selective herbicide, in addition to kill a lot of grass, it would also kill the rice plants if it was attached to the leaves or green parts of the plants. Therefore, using without reading the user manual on the package might lead to the unfortunate things affecting to the crop yields, the ecology, and human health.

In-depth interview, 2014

#### \* Assessment on the pollution of water environment

The majority (89.9%) of farmers identified the water as contaminated, 8.4% identified the water as not polluted, and 1.8% did not know. Using pesticides directly affected the aquatic environment as the agriculture depended entirely on water. Thus, 8.4% of the farmers said that "pesticides do not make water contaminated," was a matter of perception, so farmers should be helped to raise the awareness of environmental issues when using pesticides. 1.8% of the farmers who "do not know" or "do not care", although it was a small number, it was also an important issue because people were using without paying any attention to the environment. *Particularly*, rice growing farmers



(94.1%) perceived more of high pollution of the water environment than farmers in other types of farming (fruit and vegetable as 79.4% and 82.5%). The difference in the proportion of people who commented among the study sites and among different types of farming was expressed by  $\chi^2$  test with statistical significance at 1 % (for the study sites) and 1% (for the types of farming).

#### **2.4. Management and business of plant protection chemicals in an giang province**

Noting from the report of the department of Plant Protection (PPD) of An Giang, the total number of stores selling pesticides in Cho Moi district is 160 agents, of 105 stores in Chau Thanh and 111 shops in Thoai Son which sell pesticide products and fertilizers have joined professional training. According to local officials of plant protection station, the two active substances Chlorpyrifos pesticide and Paraquat herbicide are very popular and common in the list of agricultural chemicals which are permitted to use in Vietnam (KIP interview, 2014). However, the market of plant protection chemicals with these two active substances was managed strictly by the Plant Protection Department in collaboration with the Plant Protection Station and the authorities; they regularly check the stores, dealers and hold annual training for plant protection agents. In fact, the consumption of these active substances are also limited, according to the results of interviews with some pesticide stores in Chau Thanh District, the consumption rate is low because farmers mainly use pre-germing herbicide; and the active substance Chlorpyrifos is a broad-spectrum, the used rate is medium, farmers only use it when necessary, mainly for vegetables.

##### **Box 4: Interview pesticide store manager**

People in pesticide stores of level 2 in Chau Thanh district say that the best sold products with active Paraquat in the local are Gramoxone 20SL, Grass Fire 20SL, 20SL Nimaxone; and the best sold products with active Chlorpyrifos are Tungcydan 30EC, Dragon, Mocytex. Farmers use these active substances because they are highly effective. Among them, the most profitable products are Tungcydan, Nimaxone, Dragon (because import prices are relatively lower than other products and farmers use more). Typically, farmers got to the stores to ask for the special cure and the highest efficiency. However, compared with other pesticides and herbicides other, the amount used in the local is more restricted, due to their highly poisonous effects to health and water environment.

In-depth interview, 2014

#### **2.5. District solution for safe use of pesticides**

In order to limit the use of pesticides on crops in the current intensive farming situation, as well as to answer the urgent needs of the people, some of the training classes such as 1M5R (1 Must - 5 Reduction), high-grade quality rice, safety pesticide use on rice and vegetable crops, were held. Plant Protection Sub Division combined with district stations organized 284 workshops on agricultural extension with 11,586 participants [2]. Farmers were guided how to use pesticides safely and efficiently, to protect the environment and to know some other pests. In addition, farmers were encouraged to visit their fields regularly to discover and have measures to prevent and treat promptly the pests. On the other hand, 07 seminars were held to guide "05 Golden Rules and Principles 04 right in pesticide use" for 400 technicians, farmers and employees who directly sprayed pesticides in An Giang province. Specifically, in Chau Thanh, farmers had often been trained on "Safe use of pesticides", with an average of 7-8 seminars/commune/year; In 2013 the Plant Protection Station held 41 seminars to train the measures to discover and protect pests as well as launched the program to limit the use of pesticides [3]. In Cho Moi 66 seminars on agricultural extension were organized with 1,800 participants [4]. In Thoai Son, from the time of Winter-Spring 2014, the station had done 18 workshops on agricultural extension in all communes and townlets with content about preventing weeds, rats, yellow snails at the beginning of the crop, leaf blast disease, leaf rollers, and brown planthopper to help farmers prevent the outbreak of pests. The program had effectively reduced the use of pesticides of farmers down from 2-3 times/season(rice), 2-4 times (vegetables), and increased profits from 1.5-3 million VND/ha

Also, to limit farmers' use of pesticides with active substance Chlorpyrifos to kill the rats, each district of An Giang province had launched a campaign on manually killing rats in the community. Getting the rats on the small dikes by primarily using spades to dig, pumping water in to rats' caves where possible, zoning and selecting the appropriate time to kill rats (when 90% of the rice fields were harvested) (Group discussion, 2014).

With the above strategies, the plant protection station gradually help farmers realize the impact of preventing the pests – to limit the use of pesticides and to use at a safe level. This trend also gradually reached the development of the world - for the sake of the environment and public health. On the other hand, to limit the situation of self-poisoned by pesticides, the most urgent measures were still just

the carefulness of the Paraquat users and most of all was buying enough pesticide for each spraying time. The government should closely manage the purchase and use of this herbicide. For the health sector, to minimize mortality due to Paraquat, all health care centers should be equipped antivenom to remove as soon as possible and most effectively the toxins out of the body to save the patients in spite of the most fragile hope (Group discussion, 2014).

### 3. CONCLUSIONS

90% of farmers selected herbicide with fluid lead features, killing the green part or a combination of 2, or according to habits. While 11% of farmers knew Paraquat when using this herbicide, farmers in An Giang knew the most. Furthermore, farmers in An Giang selected chemicals as necessary and mainly solutions to pest management on rice, fruit and vegetables. Up to 90.9% of farmers used Chlorpyrifos to control pests without knowing the name of this active substance. In which, perceptions of farmers who cultivate fruits concerning the pesticide impacts of above 2 active ingredients are higher than others.

**Health issues and the environment:** The majority of pesticide poisoning was so mild and they just self-aided or rested at home, so the mild poisoning cases were not reported in the medical centers, only severe cases that needed emergency or first aid were recorded. This could be confirmed that the majority of people who directly worked with pesticides had chronic symptoms, which would affect the health of individuals depending on the level of toxic accumulation, but there wasn't any in-depth research in the medical field to have timely mitigation measures for farmers. Regarding to environment impacts, nearly 90% of farmers agreed that pesticide polluted the water, in which nearly 76.1% of farmers also agreed that water pollution was at the alarm level.

#### ***The correlation between knowledge, attitudes and practices:***

Knowledge of Paraquat did not depend on the variables of general knowledge and some household characteristics. Farmers' attitude depended on the area of the hired land and the amount of knowledge of Chlorpyrifos. Farmers' behavior would be better when the farmers had higher age, higher education, more training on general knowledge, knowledge of Chlorpyrifos and positive attitude.

### 4. RECOMMENDATIONS

**\* For farmers:** Farmers should be provided more information on the toxicity of chemicals in general and 02 active substances mentioned above. As increasing knowledge can change the attitudes and behavior of farmers. It is necessary to make clear all information on toxicity to human health and the environment of pesticides which are applied in production, the team believes that farmers will have a very different attitude through the research at this time and towards the application of safer and more ecological pesticides in the near future.

**\* For technicians, and medical management:** they should propose more strongly to the superior offices to eliminate the toxic pesticides such as Paraquat, Chlorpyrifos and other toxic substances that they observed. There should be more researches to prove the hazardous impacts of Paraquat, Chlorpyrifos pesticides and other common hazardous substances to human health. This will help the technical staff and policy makers of agriculture understand more about the problem and have more positive action in reducing the use of pesticides

**\* For policy makers in the local:** Advertisements on pesticides should be restricted in public or on media. Furthermore, Local governments should build more organic ecological models and support eco-organic products to seek for the product output.

**\* For policy makers in central level:** Complying with the treaty and the code of conduct as Stockholm, Rotterdam, FAO code conduct, in which rules of FAO code conduct are essential problems. The government should invest more for the studies on the effects of pesticides on health and the environment of pesticides with active substances which are commonly used to make conclusions about the impact on health, environment and ecology to have the appropriate policies to manage. Because Paraquat and Chlorpyrifos are toxic active substances recognized by the international and domestic, the government should soon ban the circulation of substances in Vietnam to preserve a healthy environment, a sustainable system of agriculture and healthy people.

### 5. ACKNOWLEDGEMENTS

It is our great pleasure to write a few words at the completion of this research thanking all those who have helped us during fieldwork. We must gratefully acknowledge the financial support given

by the PAN AP (Pesticide Action Network Asia & the Pacific).

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