Media Kesehatan Masyarakat Indonesia
Volume 19 Issue 2 2023
DOI : 10.30597/mkmi.v19i2.25991
Website : http://journal.unhas.ac.id/index.php/mkmi

Pesticide Residues Impact on Drinking Water and Farmers Using Environmental Health Risk Assessment Study (EHRA)

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ARTICLE INFO

Article History:
Received Apr, 3rd, 2023
Accepted Jun, 23rd, 2023
Published online Jun, 30th, 2023

Keywords:
Pesticides;
EHRA;
difenoconazole;
drinking water;
farmer;

ABSTRACT
Public health problems and decreased environmental health can be caused by pesticides because they are dangerous toxic substances. Pesticides have had a risky impact on farmers in Jonggol village. Assessing the risk of pesticide exposure to drinking water sources in agricultural areas in Jonggol village in 2022 is the aim of this study. The research used the Environmental Health Risk Assessment study. Conducting interviews with questionnaires, measuring pesticides in drinking water sources, and observing are part of the research data collection. The results of research conducted at 3 points only found pesticides at the first point, namely in the well water in Kampung Kujang with a value above the standard of 0.0855 mg/l the location is only 2 m from the agriculture. In the next two points, namely well water in Karni village and river water in Bengkok village, no pesticides were detected and the distance from the agriculture was 20 m. Most of the water from wells in agricultural areas is consumed by farmers for drinking. The calculation result was 0.00246 mg/kg/day for non-carcinogenic intake values (real-time) and 0.001056 mg/kg/day for carcinogenic intake values (real-time). The results showed there was no non-carcinogenic risk with RQ value of ≤ 1 with a value of characteristics of non-carcinogenic risk was 0.246. The conclusion is that both in real-time and in a lifetime, farmers in Jonggol village are already at risk. The risk of health problems for farmers can be reduced by the importance of protecting farmers by carrying out risk management.

INTRODUCTION

Water is vital in supporting living things. Therefore, water supply must be adequate, safe, and easy to access. Increasing access to safe drinking water can be beneficial for health, so every effort needs to be made to get safe drinking water.[1] Drinking water is water that has met health requirements, through the treatment process or not through the treatment process but can be drunk directly by the community.[2] One of the sources of drinking water is groundwater. Groundwater is water in a saturated area underground and moves in the soil contained in the spaces between the grains of soil that form it and in the cracks of rocks.[3] Water is a very important element needed by living things, especially humans.[4] The water needed by humans is clean water suitable for the use that can be used to meet daily needs, especially for drinking water purposes.[4] Drinking water is water that goes through a treatment process or without a treatment process that can meet health requirements and can be drunk immediately.[5]

Pesticides are toxic materials that have the potential to harm the environment and biodiversity, causing resistance, resurgence, the emergence of new pests, as well as disruptions to human health and other living things, so they must be managed with caution.[5] According to Sumardiyono, fungicide is a type of pesticide used to kill or inhibit the development of fungi. Fungicide comes from two words in Latin: *fungus* and *credo*. *Fungus,* plural of fungi, means mushrooms, while *caedo* is killing.[6] In Indonesian, the word becomes fungicidal. According to the European Food Safety Authority acute toxicity of difenoconazole had oral Lethal-Dose 50 in rats of 1453 mg/kg bb, oral Lethal-Dose 50 in mice > 2000 mg/kg bb, Lethal-Dose 50 dermal in rabbits > 2010 mg/kg bb and inhaled LD50 in rats > 3.3 mg/L (4 hours exposure). The maximum limit value of triazole pesticide residues as difenoconazolezole in water is 0.1 ppb or 0.1 µg/l and has a reference dose value of 0.01 mg/kg/day.[7]

Several studies of water contamination by pesticides in Canada, China, and Sri Lanka found that pesticide residues had polluted waters in agricultural settlement areas. In the country of Sri Lanka, of the twenty pesticides tested, ten were detected in the water samples (pretilachlor, oxyfluorfen, thiamethoxam, chlorantraniliprole, fenobucarb, fipronil, diazinon, etofenprox, Tebuconazole, and captan) and concentrations of all detected pesticides exceeded national regulatory threshold limits.[8] In Canada, pesticides were detected consistently throughout all locations in water samples for both sampling years. Overall, concentrations were 3 times higher in 2020 when river discharge was ~2 times higher.[5] In China, multiple pesticide residues found in surface water were consistent with those in topsoil, suggesting a potential risk of water contamination in the rice-vegetable rotation. Water that has been polluted by pesticides in agricultural settlements will increase the risk of residents experiencing poisoning from consuming this drinking water source.[9]

Some researches and cases of pesticides in Bogor are that the proportion of respondents who have heard the term pesticide is the highest in Bogor Regency at 84.6%. Of this proportion, more than 86.6% know how to use pesticides/insecticides and more than 88.4% know how to store them. The proportion of respondents who used Personal Protective Equipment (PPE) in Bogor research was relatively low (no more than 22.6%). Cases of poisoning of drinking water sources have occurred in Bogor; as many as 51 students in Bogor have experienced poisoning and it has been identified that the poisoning comes from groundwater.[10]

Jonggol Village is one of the villages in the Jonggol District, West Java. Jonggol village has the majority of farmers spraying and mixing pesticides. Farmers in Jonggol Village also consume raw water on average in agricultural areas. The duration of activities in agricultural areas with a high level of pollution has the potential to causes disease disorders, both carcinogenic and non-carcinogenic. Several factors, including the duration of exposure, last contact, length of work, dosage, temperature, humidity, wind direction, and speed, pesticide residues in food, age, gender, smoking habits, knowledge, Personal Protective Equipment, and counseling influence pesticide exposure.[10] Environmental Health Risk Analysis (EHRA), or in Indonesia, called *Analisis Risiko Kesehatan Lingkungan (ARKL)*, is the process of estimating the risk of exposure to a toxic agent to human

health, including identifying uncertainty factors and taking into account the characteristics inherent in a toxic agent that is characteristic of a specific target. A total of five steps in the implementation of EHRA are hazard identification, dose-response analysis, exposure analysis, risk characteristics, and risk management.[11]

Jonggol Village was chosen as the research area because most farmers still actively use pesticides to overcome pests (Plant Disturbing Organisms). Based on the results of studies conducted on permanent farmers in Jonggol Village, it is known that 8 out of 10 permanent farmers interviewed have been farming in Jonggol Village for more than 10 years with an average length of farming is 8 hours/day. In addition, some farmers have experienced health problems, at risk of non-carcinogenic or carcinogenic risks. Based on the observations, the location of raw water sources in agricultural areas has poor sanitation.

There are pesticide spraying equipment and bottles of pesticides of fungicidal materials around the raw water source which has polluted the raw water in Jonggol. In the observation activity, farmers do not use personal protective equipment according to procedures. After spraying pesticides, they draw well water (raw water source) without cleaning their bodies first from pesticide exposure.

Many farmers experience carcinogenic health risks, including dizziness, headache, nausea, and vomiting. There is a farmer who is at risk of carcinogenic disease, cancer, and tumors. In observation activities, some farmers carry out burning activities such as burning garbage, smoking, and consuming burnt food which increase the carcinogenic risk. Therefore, based on the results of previous studies and preliminary research in many countries, researchers want to examine the level of environmental health risks due to exposure to pesticide residues of fungicidal substances in the habit of consuming drinking water in agricultural residential areas in Jonggol village, Bogor regency in 2022.

MATERIAL AND METHOD

This descriptive study used the EHRA method. EHRA is a method used to estimate the risk of exposure to a toxic agent to human health. EHRA focuses on the exposure of pesticides to fungicidal ingredients through drinking water sources located in agricultural locations based on the habit of consuming raw water in agriculture, with the subject being farmers. EHRA can also be used to account for characteristics in toxic agents that are targeted specifically. This research was carried out in the Jonggol village farm, lasting 6 months from January 2022 to June 2022. The research finished on 7 June 2022, with a total sample of 91 farmers.

One way to test pesticide residues in water sources is to use gas chromatography techniques. Chromatography is the separation of a mixture of components based on the difference in the degree of interaction with the two phases of the separator material. In the mixture to be separated, the phase of motion is brought, which is then forced to move or filtered through the stationary phase due to the influence of heavy forces or other forces.

The samples were samples of permanent farmers who carried out pesticide mixing and spraying activities. Environmental samples were taken from 3 samples of drinking water sources, those were Point 1 of Kujang Village Well Water, point 2 of Bengkok Village River Water, and point 3 of Karni Village Well Water.

Sampling was done by listing agricultural villages, observations on sanitary hygiene, and interviews with farmers who sprayed and mixed pesticides. Samples of well water and river water collected that day as soon as possible were taken to the Center for Quality and Goods Control laboratory of the Ministry of Trade of the Republic of Indonesia. Ethical Clearance Number of this research was Number: Ket 274/UN2.F10.D11/OOM.00.02/2022.

RESULTS

Based on the results of pesticide concentration measurements at 3 points in the Jonggol village agricultural area, it is found that the highest concentration of pesticide residues is at point 1 or 0.08 mg/L. The lowest concentration of pesticide residues is found at point 2, the Bengkok village river water area and

area 3, the Karni Village well water, which is undetected (Table 1). The quality standard value for difenoconazole pesticides in water is 0.10 ppb.

Based on Table 2, the average age of farmers in Jonggol Village is 55.31 years the average height of the respondents is 162.85 cm and the average weight of the respondents is 60.68 kg. Farmers' exposure duration obtained a mean value of 7.95 hours/day and a median of 8 hours/day. The frequency of farmers' exposure obtained a mean value of 342 days /year and a median value of 346 days/year. The duration of farmers' exposure obtained a mean value of 29.77 years and a median of 28 years.

Based on Table 3, the risk factors for farmers in the habit of wearing gloves are that most of them are not wearing gloves when mixing and spraying pesticides, which is 94.50%; for the habit of wearing boots, most of them does not wear boots when mixing and spraying pesticides, which is 94.50%. For the habit of wearing protective clothing, all farmers wear it when spraying and mixing pesticides, which is 100%. However, for the habit of bathing and changing clothes after spraying pesticides, they mostly does not take a shower and change clothes after spraying at 87.90%. Most of the farmers wash their hands after using pesticides at 97.80%.

Based on Table 4, the calculation results of non-carcinogenic real-time intakes, it is found that the minimum intake value is 0 mg/kg/kg/day, while the maximum intake is 0. mg/kg/kg/day. The results of the calculation of carcinogenic real-time intake, it is found that the minimum intake value is 0 mg/kg/day, while the maximum intake is 10.56 x 10^{-4}mg/kg/day.

Based on Table 5, the possibility of incurring carcinogenic risks can be amplified by finding the Critical Effect of exposure to the pesticide Difenoconazole. Based on research in Jonggol Village, possible risks can be strengthened based on public health profiles in terms of public health. In the variable of health problems or disease complaints for one year, = there were 74.70% of the farmers who experienced respiratory disorders, and the percentage of farmers who experienced indigestion is at 48.40%. Most farmers also have the habit of smoking, which is 72.50%, carrying out burning activities, which is 95.60%, living in areas around agricultural locations, which is 96.70%, and consuming burnt food, which is around 78%.

Table 1. Results of Pesticide Residue Measurement in Agricultural Settlement Areas in Villages Jonggol

Samples	Time Retrieval	Result	Average
Point 1 (Well Water Kujang Village)	09.30	0,0855 mg/L	0,0855 mg/L
Point 2 (Well Water Bengkok Village)	10.15	Not Detected	
Point 3 (Well Water Karni Village)	11.02	Not Detected	

Source: Primary Data, 2022

Table 2. Distribution of Farmers Charasteristic in Jonggol Village

Variabel	n	Mean	Median	SD	Min	Max
Age (Year)	91	55.31	55	10.87	31	79
Body Height (cm)	91	162.85	165	8.73	140	182
Body Weight (kg)	91	60.68	60	9.31	42	82
Duration Of Exposure (Hours/Day)	91	7.95	8	0.27	6	8
Duration Of Time (Years)	91	29.77	28	11.94	10	62
Frequency Of Exposure (Days/Year)	91	342	322	15.57	221	355

Source: Primary Data, 2022

Table 3. Distribution of Risk Factors for Farmers in Jonggol Village

Characteristics	n = 91	%
The Habit of Wearing Gloves		
Yes	5	5.50
No	86	94.50
The Habit of Wearing Boots		
Yes	5	5.50
No	86	94.50
The Habit of Wearing a Mask		
Yes	15	16.50
No	76	83.50
The Habit of Wearing Protective Clothing		
Yes	91	100
No	0	0
The Habit of Bathing and Changing Clothes		
Yes	11	12.10
No	80	87.90
The Habit of Handwashing		
Yes	89	97.80
No	2	2.20

Source: Primary Data, 2022

Table 4. Results of Calculation of Non-Carcinogenic & Carcinogenic Realtime Intake & Risk Quotient for Farmers in Jonggol Village

Non-Carcinogenic Intake	***Intake Realtime Non-Carcinogenic***	
	Minimum	**Maximum**
Realtime (ml/kg/day)	0	0.00246
Non-Carcinogenic Intake	***Carcinogenic Realtime Intake***	
	Minimum	**Maximum**
Realtime (mg/kg/day)	0	0.001056
Risk Quotient (RQ)	**Minimum**	**Maximum**
Realtime	0	0.246

Source: Primary Data, 2022

DISCUSSION

The pesticides in drinking water sources in agricultural and residential areas is the pesticide difenoconazole. When it is compared to the threshold from the European Protection Agency (EPA) and Integrated Risk Information System (IRIS), it is said to be above the upper threshold value of 0.0085 mg/l. However, the threshold value determined by American Conference of Governmental Industrial Hygienists (ACGIH) and Occupational Safety and Health Administration (OSHA) is intended for workers who work for 8 hours per day, while the value determined by ACGIH is for 10 hours per day.

In the results of measuring pesticide concentrations at 3 points in the Jonggol Village Agricultural Area, it is found that the highest concentration of pesticide residues is at point 1 or 0.0855 mg/L. The lowest pesticide residue concentration is found at point 2, the Bengkok Village River Water area, and area 3, the Karni Village well water, which is undetected. The quality standard value for difenoconazole pesticides in water is 0.1 ppb. The concentration value of difenoconazole pesticides in Kujang Village exceeds the quality standard of 0.0855 mg/l for a quality standard of 0.1 ppb or 0.0001 mg/l. Thus, the pesticide difenoconazole has polluted the raw water in the Well Water of Kujang Village. As many as 5 families routinely consume water in the Kujang Village well and the distance between the Kujang Village Well Water and agriculture is about 2 meters. In Bengkok Village, about 7 families use river water and the distance of river water to the farm is about 20 meters. There are about 10 families that use well water sources in Karni Village and the distance of Well Water in Karni Village is about 20 meters from the agricultural location. Related to the distance, not comparing with the location of Well Water and River Water with a radius that is quite far from the agricultural location.

Although both are located in agricultural and residential areas, there are only pesticide residues in the wells in Kujang Village; this can be strengthened because, during field activities and observations, the color of the well water in Kujang Village is different from the Well Water in Jagaita Village and Karni Village. The color of the water is slightly whitish in the Well of Kujang Village. Well Water's location as a drinking water source in Kujang Village also has inadequate sanitation. There are bottles used for spraying pesticides and tools for mixing and spraying pesticides, and farmers do not take a shower immediately after spraying pesticides. The pesticide residue can be decomposed by the air or attached to the farmer's body, hence when taking well water, pesticide residue can stick to the bucket held by the farmer, or pesticide particles can fall into the well.[7] If pesticide residues damage groundwater quality, they can see the contours of water flow in Kujang Village

Agriculture or use an accurate altimeter application.

One of the things that cause the presence of difenoconazole pesticide residues is that during field observation activities, the majority of farmers have poor sanitary personal hygiene to increase the risk of transferring pesticides to farmer bodies or spraying or mixing tools that can pollute well water through the air or pesticide particles that are from farmers when they are about to take water. The distance also affects because the distance of the well water that has difenoconazole pesticide residues is only about 2 meters from the rice fields and rice field environment surrounds the well water. In contrast to the well water in Karni Village and River Water in Jagaita Village, the distance with the rice fields is approximately 10 m and not too close to the rice field location, so the closer the distance to the rice fields, the higher the risk of well water being polluted by difenoconazole pesticide residues. Hence, the radius of the riskiest distance for raw water sources exposed to pesticides is approximately 2 meters from the agricultural location. Research in Sri Lanka also shows that drinking water sources that are closer to agricultural residential areas will have a higher risk of being contaminated with agricultural residues from spraying pesticides on agriculture. This is because the concentration of pesticides will accumulate more in the land closest to agricultural residential areas with the most pesticide spraying activities on site. The accumulation of pesticides will contaminate groundwater which will contaminate drinking water sources in wells in agricultural residential areas which will be consumed as drinking water for farming residents.[8]

In the field research activities, when conducting interviews and observations, it was found that farmers in Jonggol Village most often use pesticides for pesticide mixing and spraying activities with the brand 'E-Score' and after research that the pesticide is a fungicide and contains pesticides in the form of a type of triazole with the specific name of the pesticide, difenoconazole. Farmers also carry out fertilization activities, by using phosphate fertilizer. However, as farming activities progress, the frequency of farmers spraying difenoconazole pesticides is quite high to eliminate leafhopper pests, which can reduce the quality of agricultural products. In addition, POKTAN or farmer groups are also rarely given counseling and education activities on how to spray and mix pesticides. The majority are only given education about farming activities using fertilizers.

Kujang Village is the population at risk of being affected by health risks. Meanwhile, when conducting the interview, there were as many as 24 farmers whose houses in Kujang Village and lived close to the rice field location, approximately 20-50 m from the agricultural location. So that the population in Kujang Village has the greatest risk in Jonggol Village to cause health risk effects due to pesticide exposure. The majority of farmers also use well water instead of river water. As many as 5 families actively use Well Water in Kujang Village, so the population is most at risk of pesticide exposure from raw water sources. However, not all farmers consume raw water sources in Well Water and River Water that are tested, and some farmers use their own well water in their homes.

Table 5. Distribution of Farmers' Health Risks in Jonggol Village

Characteristics	n = 91	%
Respiratory Health Disorders		
Yes	68	74.70
No	23	25.30
Digestive Health Disorders		
Yes	44	48.40
No	47	51.60
Smoking Habits		
Yes	66	72.50
No	25	27.50
The Habit of Carrying out Burning Activities		
Yes	87	95.60
No	4	4.40
Living in a Farm Location		
Yes	88	96.70
No	3	3.30
Burned Food Consumption Habit		
Yes	71	78
No	20	22

Source: Primary Data, 2022

Pesticide residues in well water in Karni Village and River Water in Jagaita Village were not detected. The possibility is that the area does not have tools for spraying and mixing pesticides and the location of the well is quite high from the agricultural irrigation water area. It has a clear color along the distance between the location of the well and the rice fields, which is approximately 10 meters.

Older farmers in Jonggol Village have more health problems than younger ones. Exposure to difenoconazole pesticides is also related to the impact of health disorders on reproductive organ health.[12] A person with a high level of education generally has a good way of thinking and broader insights, including health-related insights.[13] Body weight below 55 kg affects the risk of higher pesticide absorption, due to the low immune system and disruption of the body's metabolic system. Lack of height can also cause an impact, causing becoming more easily sick due to the body's weak immune system.[9] The duration of exposure will increase the exposure of pesticides.[14] Farmers who do not use PPE will be more at risk of pesticide exposure because pesticide particles can enter the farmers' body through oral, dermal, or ingestion.[15]

Based on the results of calculations that have been carried out, a minimum real-time non-carcinogenic intake value is 0 mg/kg/day, for a maximum intake is 0.00246 mg/kg/day while the average lifetime non-carcinogenic intake value on the five-year projection is 0.0004 mg/kg/day. For the 10-year projection, it is 0.0008 mg/kg/day, for the 15-year projection is 0.0013 mg/kg/day, for the 20-year projection it is 0.0017 mg/kg/day, for the 25-year projection it is 0.0022 mg/kg/day. For the 30-year projection, it is 0.0026 mg/kg/day.

Meanwhile, based on the calculation results that have been carried out for carcinogenic intakes, the minimum real-time value is 0 mg/kg/day, for the maximum intake is 0.001056 mg/kg/day. While the average lifetime non-carcinogenic intake value on the five-year projection is 0.00018 mg/kg/day, for the 10-year Project, it is 0.0003722 mg/kg/day, for the 15-year projection is 0.0005658 mg/kg/day, for the 20-year projection it is 0.0007544 mg/kg/day, for the 25-year projection is 0.0009430 mg/kg/day and for the 30-year projection is 0.0011316 mg/kg/day, in the critical effect or critical effect in this research in relation to pesticides, triazole group fungicides, difenoconazole, which was not found.

Based on the results of the research, it is known that the value of the duration of exposure exceeds 6 hours while the duration of the average farmer's exposure has been more than 6.95 hours and 28 years, because the longer the farmer carries out farming activities in Jonggol Village, the greater the exposure received and the greater the risk that can cause adverse health impacts for farmers. Based on the research results, it is known that the farmer population in Jonggol Village already has a risk of causing non-carcinogenic effects in real time. This is known based on calculations, the RQ value <1 for both minimal and maximum intakes. As for the average non-carcinogenic lifetime exposure, on projections of 5 years, 10 years, 15 years, 20 years, 25 years, and 30 years, it does not have the risk of non-carcinogenic effects, because, based on the calculation results, it has an RQ value of <1, which is 0.246. In the critical effect in this research in relation to pesticides, triazole group fungicides, difenoconazole, was not found.

Non-carcinogenic effects caused by pesticide exposure include neurological symptoms such as drowsiness, dizziness, and headaches and can even cause loss of self-awareness.[16] In addition, it can also cause vomiting, seizures, and even irritation of the skin, eyes and upper respiratory tract in humans.[17] Pesticide exposure can also cause skin redness.[8] Meanwhile, in the carcinogenic effect, real-time exposure has a probability ECR value. The pesticide residue difenoconazole has a possible carcinogenic risk even though it has not been found in the EPA and IRIS.

The possibility of incurring carcinogenic risks can be amplified by finding the Critical Effect of exposure to the pesticide Difenoconazole. Based on research in Jonggol Village, possible risks can be strengthened based on public health profiles in terms of public health. In the variable of health problems or disease complaints for one year, most of farmers experience health problems, at 78%, respiratory disorders, at 74.7%, and indigestion, at 48.4%. Farmers also have a habit of smoking, which is 72.5%, carrying out burning activities, which is 95.6%, and living in areas around agricultural locations, which is 96.7%, consuming burnt food, which is 78%.

Farmers should be able to use Personal Protective Equipment in accordance with the procedures in the Standards of the Pesticide Commission, including wearing masks, gloves, foot protection, and clothing protection.[18] Farmers should also maintain sanitary hygiene, especially with the location around the drinking water source, by not leaving used bottles and pesticide spraying equipment.[19] Farmers should also maintain personal hygiene by cleaning themselves immediately after spraying pesticides so that they are at risk of exposure to pesticide particles.[20] Farmers should also have working hours in accordance with the standard duration of pesticide spraying activities.[21] The distance of the raw water source to the farm's location needs special attention in using the water source.[22]

The drawbacks of this research are that not all drinking water sources in the agricultural settlement area of Jonggol Village are examined for levels of pesticide residues and it does not check all drinking water in residents' housing due to research limitations. The next researcher should be able to periodically check the contamination of pesticide residues in each well in the agricultural settlement area along with the drinking water that residents consume as well as checking the contamination of springs in the area. Future researchers should also be able to examine the soil concentration and sustainable agricultural products from pesticide contaminated water consumed by the surrounding community to carry out an analysis of public health risk assessments along with the content of pesticide residues in the body of the community, especially farmers and farmer families.

CONCLUSION AND RECOMMENDATION

Contamination of the minimum concentration of difenoconazole pesticides is in the agricultural settlement area of Jonggol Village, which is 0 mg/l, and the maximum concentration is in the well water of Kujang Village, which is 0.0085 mg/l. In the observation activity, Kujang Village is a village with well water near the agricultural location. Around the well, water has poor sanitation, and farmers do not use complete PPE. In real-time, the intake of non-carcinogenic exposure pesticides in farmers ranges between 0.00246 mg/kg/day. In comparison, the intake value of carcinogenic exposure pesticides in farmers in real-time ranges from 0.001056 mg/kg/day. Obtained the value of non-carcinogenic risk in farmers in real-time is RQ > 1, which is 0.246, meaning that farmers do not have non-carcinogenic risks. Meanwhile, in terms of lifetime at the 30-year projection, the value of RQ<1, because it increases with the increase of years, and there are some health risks.

The results showed that farmers in Jonggol Village experienced health problems in the form of non-carcinogenic health risk effects and carcinogenic risks. The result of the calculation of the RQ value is that it has not caused a non-carcinogenic risk effectS and the result of the ECR value is that there is a possibility of carcinogenic risk. Farmers should be able to use Personal Protective Equipment in accordance with the procedures in the Standards of the Pesticide Commission, including wearing masks, gloves, foot protection, and clothing protection. Farmers should also maintain sanitary hygiene, especially with the location around the drinking water source. Farmers should also maintain personal hygiene and also have working hours in accordance with the standard duration of pesticide spraying activities. The distance of the raw water source to the farm's location related to the distance closer to the farm needs special attention in using the water source. The need for counseling activities for farmers to use PPE according to procedures and maintain their sanitation and hygiene.

AUTHOR CONTRIBUTIONS

Study conception and design GF and BW; Data collections GF; Data analysis and interpretation GF; Drafting of the article GF; Critical revision of the article GF. GF = Glenzi Fizulmi; BW = Bambang Wispriyono.

CONFLICTS OF INTEREST

There was no conflict of interest in this study.

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