Case Study: Water Resources, Knowledge and Safety Practices of Pesticides Among Farmers Around Lake Diatas of West Sumatera

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Abstract. Lake Diatas is surrounded by agricultural activities that cannot be separated from the use of synthetic pesticides. Improper use of pesticides may endanger the health of farmers. This research aims to observe the clean water resources, as well as the knowledge and safety practices of pesticides among farmers around Lake Diatas. Interviews were conducted with 30 heads of families who lived and farmed around Lake Diatas. The results showed that 40% of farmers utilized rainwater as clean water, 30% used shallow well water which most of the wells were open and have no concrete ring, which vulnerable to contamination. There were 11 active ingredients detected used by farmers with one type with highly hazardous and two of them were moderately hazardous toxicity. For farmers’ knowledge, 76.7% of farmers know that the improper use of pesticides may cause health problems and environmental pollution. There were 73.3% of farmers determine the dose of pesticide regarding packaging label, while the rest determine the dose from the seller recommendation and also trial and error. All of the farmer respondents used personal protective equipment during spraying but mostly only googles, gloves, and mask, and 40% of farmers experienced health problems after spraying. From the results of the study, it can be concluded that the practice of PPE practice on farmers who farm and live around Lake Diatas still needs to be improved to prevent more health problems that can be caused by pesticide application.

Keywords: Water resources, PPE, Pesticide, Lake Diatas

1. Introduction

Agricultural activities are strongly related to the use of natural or artificial pesticides. Pesticides are persistent organic compounds which difficult to decompose and can be harmful if exposed to the environment and human beings. Pesticides are endocrine disruptor compounds (EDC) agents and thyroid disrupting chemicals (TDC) which can interfere with the work of endocrine and thyroid hormones, which will further endanger human health [1,2]. Improper use of pesticides can expose to the human body through inhalation, oral or dermal pathways. These pesticides may disrupt the activity of cholinesterase enzymes in red blood cells, which functions to maintain the balance of the nervous system. Cases of pesticide poisoning can occur due to lack of knowledge, attitudes, and actions, as well as mistakes or not wearing personal protective equipment (PPE) when using pesticides.
Solok regency is one of the agricultural areas in West Sumatera. Commodities produced in the form of vegetables, tea, and rice, and so on. While Lake Diatas, is a lake in Solok Regency, surrounded by vegetable farming with sloping topography are widely conducted around the lake. This agricultural activity cannot be separated from the use of synthetic pesticides. From its use, only a small proportion reaches the pests, while most of the pesticide residues reach the soil, water, air, and even exposure to humans. Agricultural runoff allows transport to surface or groundwater. The results of the study conducted by Marisa, et al (3) found that cholinesterase enzyme activity was below normal levels in farmers in Nagari Alahan Panjang, near Danau Diatas. While the results of research conducted by Gusti, et al (4) found that 60% of farmers in Alahan Panjang, found a significant relationship between the use of pesticides and neurotoxic symptoms. So, it is important to understand the water resources of farmers, as well as the knowledge and practice of pesticide use by farmers around Lake Diatas, the objectives of this study are to observe the water use by farmers who live and farm around lake Diatas and also to see the knowledge and safety practices of PPE by farmers around lake Diatas.

2. Materials and Methods
This research was conducted with a survey method on farmers around Lake Diatas, Solok Regency, West Sumatra. The survey was conducted in October 2019, with 30 respondents using a purposive sampling technique. The inclusion criteria of this survey were farmers who settled and farmed using pesticides with a radius of <500 m from Lake Diatas and use synthetic pesticides for agricultural practice. Data collected through observation and interviews using questionnaires.

The questionnaire consists of several data including characteristics of the respondent, the source of clean water, knowledge, safety practices regarding pesticide application, as well as health complaints due to the use of pesticides. The question about clean water sources contains information on the source of clean water used by the respondent, near or far from agricultural land, also the existing condition if respondents use groundwater well. Respondents were also asked questions related to general health complaints after using pesticides. The data obtained were analyzed using Microsoft Office Excel 2010. The results of the descriptive analysis are expressed in terms of frequency and percentage.

3. Results and Discussion
Interviews were conducted with 30 farmers, where most of the farmers were 60% were in the age range of 21-40 years. As much as 67% of the respondents were male, the rest were female. There were 56.7% of respondents have had a great experience from 10 years as farmers, and 80% of respondents work 7-9 hours/day, while the rest of the farmers work less than that working hour.

3.1 Pesticides Used By Farmers
From the results of a survey of respondents, data on pesticides used by farmers with active ingredients can be seen in Table 1. Generally, pesticides are used for insect and fungal pests. There are 11 active pesticide ingredients used by farmers in Danau Atas, one of which is toxicity class Ib, which is very dangerous, three active ingredients with toxicity class II are quite dangerous, one type of pesticide with a rather dangerous toxicity class (5). One active ingredient has no known toxicity, the rest is an active ingredient that has no acute impact on health.

| Table 1. Active ingredients of Pesticides Used Among Farmers |
|------------------------------------------------------------|
| Active ingredients | Types         | WHO Toxicity Class* |
|---------------------|---------------|---------------------|
| Abamectin           | Insecticide   | Ib                  |
| Emamectine Benzoate | Insecticide   | NC                  |
| Imidacloprid        | Insecticide   | II                  |
| Mancozeb            | Fungicide     | U                   |
Active ingredients | Types | WHO Toxicity Class*  
--- | --- | ---  
Propineb | Fungicide | U  
Acephate | Insecticide | II  
Glyphosate | Herbicide | III  
Cypermethrin | Fungicide | II  
Famoxadone | Fungicide | U  
Iprodione | Fungicide | U  
Procymidine | Fungicide | U  

*Ib: highly hazardous, II: moderately hazardous, III: Slightly hazardous, U: Unlikely to pose an acute hazard, NC: Not classified

3.2 Clean Water Resources

From Table 2, it was found that a small proportion of farmers used lake and spring water as clean water resources, and 40% of respondents used rainwater. As much as 33.35% use groundwater well water as a clean water resource, where 80% of the wells’ physical condition found without a concrete layer and uncovered. It has the potential for the transportation of contaminants from agricultural runoff and also domestic wastewater runoff. Clean water is used for cooking, washing, and bathing. As much as 56.7% of clean water sources are located far from the septic tank, and 86.7% are located > 10 meters from agricultural land. With quite a long distance, it is hoped that the transportation of contaminants from the septic tank and agricultural land will not reach clean water resources so that the water is deserved as clean water resources.

![Figure 1. Water resources of farmers around Lake Diatas, shallow groundwater (left) and rainwater (right)](image_url)

Table 2. Clean Water Usage Among Farmers

| Question                                      | Answer                          | n  | %    |
|-----------------------------------------------|---------------------------------|----|------|
| Clean water resource                          | Shallow well groundwater        | 10 | 33.3 |
|                                               | Rainwater                       | 12 | 40   |
|                                               | Lake water                      | 3  | 10   |
|                                               | Springwater                     | 5  | 16.7 |
| Condition of shallow well water              | well with concrete ring and cover | 0  | 0    |
| If using it as a clean water resource         | well with concrete ring and without cover | 1  | 10   |
|                                               | Well without a concrete ring with cover | 1  | 10   |
|                                               | Well without concrete ring without cover | 8  | 80   |
| Water usage                                   | For cooking and drinking        | 28 | 93.3 |
|                                               | For cleaning and bathing        | 25 | 83.3 |
|                                               | For irrigation                  | 0  | 0    |
| Water source distance to the septic tank      | <10 meters                      | 17 | 56.7 |
|                                               | >10 meter                       | 10 | 33.3 |
Knowledge and Safety Practices of Pesticides Use Among Farmers

From Table 3, it can be seen that people's knowledge about pesticide use. 16.67% of respondents chose pesticides with low toxicity and 13.3% chose pesticides that were effective in killing all pests. It was found that 73.33% of respondents were using pesticides dose according to packaging label, 13.33% was guided by the distributor's recommendation, while 3.33% of farmers determined the dosage by trial and error. Most of the respondents used pesticides 10-14 times before harvest. Regarding knowledge about negative pesticides on health can by farmers, 76.67% of respondents already know that the improper use of pesticides may damage health and the environment, while the rest of farmers only know that the improper use of pesticide can cause headaches and nausea. If farmers have low awareness of the toxic effects of pesticides, it will lead to improper use so that it can damage the health of farmers as well as the environment [5,6].

Table 3. Knowledge and Understanding of Pesticides Usage Among Farmers

| Question | n | %     |
|----------|---|-------|
| Not sure |   | 10    |
| Water source distance to agricultural land |   |       |
| 1-5 meters | 0 | 0     |
| 5-10 meters | 1 | 3.3   |
| >10 meters | 26 | 86.7  |
| Not sure | 3 | 10    |

| Question | n | %     |
|----------|---|-------|
| Reasons for choosing a pesticide |   |       |
| Low toxicity | 5 | 16.67 |
| Affordable price | 18 | 60 |
| Distributor recommended | 1 | 3.33 |
| Famous trademark and often used by others | 2 | 6.67 |
| Effective for all types of pest | 4 | 13.33 |
| Dose Determination |   |       |
| Recommended dose from packaging label | 22 | 73.33 |
| Recommended dose from seller | 7 | 13.33 |
| Reduce slightly from the prescribed dose | - | 0 |
| Add more of the dose | - | 0 |
| trial and error | 1 | 3.33 |
| Frequency of use from flowering to harvest |   |       |
| 1-5 times | 1 | 3.33 |
| 5-9 times | 2 | 6.67 |
| 10-14 times | 21 | 70 |
| >14 times | 6 | 20 |
| Countless | - | 0 |
| Known impact |   |       |
| Health problems and environmental pollution | 23 | 76.67 |
| Causes many health complaints | 5 | 16.67 |
| Headache and vomit | 1 | 3.33 |
| Headache | - | 0 |
| Mild pain | 1 | 3.33 |
| Complete PPE when stirring and spraying pesticides |   |       |
| Agree | 30 | 100 |
| Not sure | - | 0 |
| Not agree | - | 0 |
| Not mixing pesticides |   |       |
| Agree | 30 | 100 |
| Not sure | - | 0 |
All farmers agreed to use PPE when using pesticides and did not mix pesticides at the time of application, and 93.33% of farmers agreed not to use the clothes that were had been used when using pesticides for other activities. From this knowledge point of view, it appears that most farmers already have good knowledge of pesticide use.

The practice of using pesticides on farmers can be seen in Table 4, there were 83.33% of farmers who use all pesticides that have been registered at the agricultural department, 3.33% use partially registered pesticides, the rest did not know for sure about the legality of the pesticides used. As many as 63.33% of farmers have stored pesticides in a dry cabinet, tightly closed and out of reach of children and mixed pesticides based on the packaging label and direction from the agricultural department manual. After using pesticides, 76.67% of farmers took a shower and changed clothes, while the rest wash their hands and change clothes. When the pesticide gets on the face, all the farmers wash their faces with running water. There were 86.68% of farmers who adjust the position of spraying with the wind direction, and the rest stop spraying until the wind stops. There were 100% of farmers who Using PPE when using pesticides, considering wind direction and spraying as instructed. Forcing to do pesticide spray when the wind is unstable can cause pesticide drifts that pose a serious risk to health (6). Pesticide exposure can be increased if farmers do not use personal protection and pay less attention to wind direction (7).

| Question | n   | %   |
|----------|-----|-----|
| Not agree | -   | 0   |
| Not keeping pesticide mixture after spraying | Agree | 30  | 100 |
| Not sure  | -   | 0   |
| Not agree | -   | 0   |
| Not using pesticide-spraying-outfit for other activities | Agree | 28  | 93.33 |
| Not sure  | 1   | 3.33|
| Not agree | 1   | 3.33|

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| Table 4. Practices When Using Pesticide Among Farmers |
|----------------|-----|-----|
| Question | n   | %   |
| The pesticides used must be registered from the agriculture department | All registered | -   | 0   |
| Partially registered | 25  | 83.33|
| Some registered   | 1   | 3.33|
| None registered   | -   | 0   |
| Do not know      | 4   | 13.33|
| Pesticide storage after using | Stored in a dry cabinet, tightly closed and out of reach of children | 19  | 63.33|
| Stored in a dry cabinet and closed | 8   | 26.67|
| In a plastic bag  | 3   | 10  |
| Under the tree    | -   | 0   |
| Just left         | -   | 0   |
| Guidelines in diluting more than 1 type of pesticide | From the packaging label and direction from the agricultural service. | 19  | 63.33|
| From the packaging label | 4   | 13.33|
| Information from other user  | 5   | 16.67|
| Personal experience | 2   | 6.67|
| Trial and error   | -   | 0   |
| Spraying time according to pesticide packaging label | Everytime | -   | 0   |
| Usually           | 50  | 100 |
| Seldom            | -   | 0   |
Table 5. Personal protective equipment used by farmers during pesticide spraying

| PPE Used                        | n | %  |
|--------------------------------|---|-----|
| Mask                           | 4 | 13,33 |
| Long sleeves clothes and trousers | - | 0 |
| Google                         | 30 | 100 |
| Gloves                         | 30 | 100 |
| Boots                          | - | 0 |

However, the farmers were using incomplete PPE types of equipment while spraying. In Tabel 4, most farmers only use a mask made from cloth and also gloves, and wear long sleeves, long pants, and glasses. The importance of using a complete PPE when using pesticides must be socialized again to farmers. Another strategy is to monitor the use of pesticides by related parties so that safe pesticide use can run effectively (8). Improper use of PPE is related to farmers’ health complaints as served in Table 4, 40% of farmers experienced health problems, with 66.67% farmers experiences problems with the respiratory system, and 16.67% eye irritation. The study conducted by Tambe et al (9), which studied pesticide use among farmers in Cameroon, farmers’ health problems including backache, visual problems, and respiratory difficulties.

Table 6. Health complaints among farmers after pesticide spraying

| Number of health complaints | n | %  |
|-----------------------------|---|-----|
| Yes                         | 12 | 40 |
| No                          | 18 | 60 |

| Health complaints | n | %  |
|-------------------|---|-----|
| Skin              | 2 | 16,67 |
| Eyes              | 2 | 16,67 |
4. Conclusions
From the results of the study, it can be concluded that almost half of the farmers who live and farm around use rainwater as clean water, and one-third used shallow well water which most of the wells were open and have no concrete ring. Farmers around Lake Diatas already have sufficient knowledge and good practice on pesticide use. Most of the farmers use PPE during pesticide use. However, PPE is not used according to standard, making half of the respondents experiencing health difficulties after spraying. Further research can be conducted related to the use of PPE in farmers around Lake Diatas.

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