

Analyzing the use of pesticides on health complaints

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Submission date: 02-Sep-2020 08:52PM (UTC+0700)

Submission ID: 1378207003

File name: Hamka_Analyzing-the-use-of-pesticides.pdf (723.75K)

Word count: 4579

Character count: 24165

Original

Analyzing the use of pesticides on health complaints of farmers in Waihatu Village, Indonesia

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ABSTRACT

Keywords:

Health complaints
Types of pesticides
Time of spraying
Use of pesticides

Objective: the study aimed to find the factors that contributed greatly to health complaints due to the use of pesticides.

Method: using the cross-sectional research design, the research was conducted in September – November 2019 on a group of horticultural farmers in Waihatu Kairatu West Village, Indonesia. The sample was determined using a total sampling technique. Data analysis was performed by path analysis using Smart PLS.

Results: the results of the study found that the use of pesticides affected the working time t-statistic 3.467. The use of pesticides affects health complaints t-statistic 2.586. Types of pesticides affect working time t-statistic = 2.808 and working time affects health complaints t-statistic = 2.227. The use of pesticides contributes greatly to health complaints while working time to mediate the types of pesticides contributes to health complaints. Improper timing of spraying and the frequency of spraying has a bigger impact on farmers' health complaints.

Conclusions: Spraying time has the greatest influence on health complaints. It is recommended that farmers reduce the frequency of spraying more than 2 times a day, spraying time in the morning, and pay attention to the wind direction to reduce exposure and health hazards due to pesticides.

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Análisis del uso de plaguicidas en las quejas de salud de los agricultores en la aldea de Waihatu, Indonesia

RESUMEN

Palabras clave:

Quejas de salud
Tipos de plaguicidas
Tiempo de pulverización
Use de plaguicidas

Objetivo: El estudio tuvo como objetivo encontrar los factores que contribuyeron en gran medida a las quejas de salud por el uso de plaguicidas.

Método: Utilizado el diseño de investigación transversal, la investigación se realizó en septiembre-noviembre de 2019 en un grupo de agricultores hortícolas en Waihatu Kairatu West Village, Indonesia. La muestra se determinó mediante una técnica de muestreo total. El análisis de datos se realizó mediante análisis de ruta utilizando Smart PLS.

Resultados: los resultados del estudio encontraron que el uso de plaguicidas afecta el tiempo de trabajo estadístico $t = 3.467$. El uso de plaguicidas afecta las quejas de salud. Estadístico $t = 2.586$. Los tipos de plaguicidas afectan el tiempo de trabajo estadístico $t = 2.808$ y el tiempo de trabajo afecta las quejas de salud estadístico $t = 2.227$. El uso de plaguicidas contribuye en gran medida a las quejas de salud, mientras que el tiempo de trabajo para mediar los tipos de plaguicidas contribuye a las quejas de salud. El momento inadecuado de la fumigación y la frecuencia de la fumigación tienen un mayor impacto en las quejas de salud de los agricultores.

Conclusiones: El tiempo de pulverización tiene la mayor influencia en los problemas de salud. Se recomienda que los agricultores reduzcan la frecuencia de fumigación más de 2 veces al día, el tiempo de fumigación por la mañana y presten atención a la dirección del viento para reducir la exposición y los peligros para la salud debido a los pesticidas.

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<https://doi.org/10.1016/j.gaceta.2020.05.008>

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Introduction

During a period of ten years from 2007 to 2016 based on doctor's medical records, occupational diseases in Norway totaled 648 cases and 469 of them occurred in farmers reaching a higher rate (72.4%). Some of the complaints of farmers related to work include hearing loss due to exposure to agricultural machinery noise, skin diseases, respiratory problems, allegedly due to exposure to chemical work environment factors (pesticides), the lowest percentage of musculoskeletal disorders and mental disorders.¹ WHO data sources note that workers in the agricultural sector experience pesticide poisoning of 1-5 million cases per year.²

Pesticide poisoning cases in Indonesia, according to the Food and Drug Administration, recorded 775 cases.³ Some areas in Indonesia such as Brebes, Istianah's research (2017) found cases of pesticide poisoning in several 55 farmers (63.96%).⁴ In addition to the problem of poisoning, other effects of pesticides on health were proven in previous studies, which revealed that horticultural farmers in Ngablak District, Magelang Regency, experienced a balance disorder of 34.3% and 14.3% abnormal blood cholinesterase levels.⁵ Body balance is regulated by the physiological work of organs in the body such as the nervous system, heart, hormones, blood, liver, and enzymes. Balance disorders can occur acutely or chronically. Pamungkas (2016) explained that individuals exposed to pesticides have a greater risk of developing cancer than those who are not exposed to pesticides. It was further explained that pesticides contain ingredients that cause cancer, and cancer is a chronic impact due to pesticides. The greatest potential for cancer to occur in farmers is leukemia.⁶

As mentioned earlier, the effects of pesticides can be acute or chronic. This is influenced by the mechanism of action of pesticides entering the body to find a target or non-target organisms. According to Soeripto (2008), the mechanism of pesticides and chemicals enters the body in 3 ways, namely: inhalation, skin absorption, and mouth (swallowing).⁷ Lushchak (2018) in his theory state that if pesticides enter the human body it will affect the physiology and biochemistry in the body and damage enzymes. The nervous system is the target of organochlorine pesticides, which are used in agriculture for environmental pest control.⁸ Samosir (2017) expressed his opinion that the serious conditions of health problems due to pesticides are determined by several factors, namely: the type of pesticide, the use of mixing pesticides, spraying, storage, exposure time, the mechanism of the pesticide entering the body, and pesticide levels. The results of his research proved that horticultural farmers' pesticide exposure to body balance disturbances was significantly influenced by 3 variables: length of work, length of work, and use of personal protective equipment.⁵ Santaweesuk (2020) expressed an opinion on the harmful effects of pesticides due to farmers' lack of knowledge about the dangers of pesticides, using pesticides in the wrong way and the wrong attitude while using pesticides.⁹

Pesticides have a bad effect, so use them safely and wear personal protective equipment.⁷ The same study of horticultural farmers in Brebes, states that 89.2% of farmers who use personal protective equipment while working in the healthy category have no complaints, and farmers who do not use personal protective equipment find several complaints that are felt such as dizziness, increased saliva, shortness of breath, frequent urination, numbness of the fingers, and blurred vision.¹⁰ The use of pesticides allows farmers to come into contact with these chemicals. Spraying activity causes farmers to be exposed to pesticides longer. This exposure can be reduced by designing spraying machines, so farmers are not in direct contact and contact times are lower. This has been done by farmers in India, spraying using a drone machine.¹¹

Waihatu Village is one of the villages in Kairatu Barat Subdistrict, West Seram Regency, Indonesia which has quite an extensive agricultural land of around 576 Ha2. The majority of people work in agriculture. A preliminary survey found that 68 horticultural farmers sprayed crops to eradicate pests and increase crop yields. However, some of the farmers used pesticides not according to the safe dosage recommended by the Ministry of Health, a reason to maximize yields. Based on observations of the pesticide use process which includes: mixing, stirring, and storing without using personal protective equipment, the process of stirring by hand (without tools). Likewise, when spraying is done several times, including spraying is done 2-3 times a day, when spraying is done in the morning then treating other plants, continued spraying in the afternoon, and in the evening.

The results of the initial data collection of complaints that were felt such as itching on the skin, dizziness, and nausea after spraying. According to the opinion of Santaweesuk (2020), Lushchak (2018), Samosir (2017), Soeripto (2008), based on the findings of previous studies, health complaints due to pesticides are influenced by the type of pesticide, the mechanism of the pesticide entering the body, working period, knowledge, process of use (mixing, spraying, storage), and attitudes including the use of personal protective equipment. Researchers put forward the assumption that health complaints felt by farmers were thought to be mediated by the timing of spraying, in contrast to the findings of the four previous researchers. The research objective was to analyze the use of pesticides on health complaints felt by farmers in Waihatu Kairatu Village, Indonesia. The research hypothesis was established: 1) the use of pesticides affects on working time. 2) The use of pesticides affects health complaints. 3) The type of pesticide affects working time. 4) Types of pesticides affect health complaints. 5) The working period affects health complaints. 6) working time affects health complaints.

Methods

This type of correlational research, based on the time of the study, was a cross-sectional design. This study does not have a difference in the time dimension between the variables studied.¹² The research was conducted in September - November 2019 on a group of horticultural farmers in Waihatu Kairatu Barat Village, Indonesia. The research population of horticultural farmers was 68 farmers. The sample was determined using a total sampling technique.

Data were collected using a questionnaire and observation. The questionnaire consists of respondent characteristics: age, gender, education, and years of service. Other data relating to the use of pesticides; use process, type of pesticides, working time, and health complaints. Observation data make observations on farmers while doing work, using personal protective equipment, mixing, and spraying. This data is used to explain the results of the inferential analysis of the variables under study which are described in the discussion.

Data analysis was carried out by path analysis using smart PLS so that the relationship between exogenous variables and its indicators could be obtained and the relationship between endogenous variables. The advantage of this analysis is that it can be seen that the relationship pattern of the 5 variables studied is direct or indirect.¹³ The hypothesis was tested based on a significant level of 0.05 and t-statistic > 1.96, the hypothesis decision was accepted.

Results

The characteristics of the research respondents are based on the results of the univariate analysis of the frequency distribution in Table 1 below:

Table 1. Social Demographic Characteristics of Horticultural Farmers in Waihatu Village, Indonesia 2019

Characteristics	Frequency	Percentage
Age		
25 – 43	34	50
44 – 61	26	38.2
62 – 79	8	11.8
Gender		
Male	49	72.1
Female	19	27.9
Education		
Primary school	51	75
Secondary school	11	16.2
Senior high school	6	8.8
Years of service (years)		
< 10	17	25
10 – 20	21	30.9
> 20	30	44.1

The majority of respondents aged 25 - 43 years as many as 34 people (50%), male gender as many as 49 people (72.1%), based on education level, the majority of primary schools are 51 people (75%) and the majority of the working period > 20 years 30 people (44.1%). The next analysis is the relationship between variables shown in Figure 1 below, which is the result of path analysis using Smart PLS.

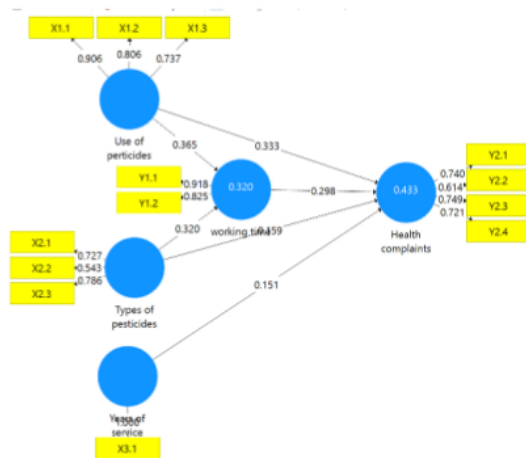


Figure 1. Pathway Analysis of the Relationship of Health Complaints due to Pesticide Use

Analysis of 5 variables along with their indicators, shows that all variable indicators of pesticide use, type of pesticide, years of service, working time, and health complaints are declared valid (p-value > 0.05). Furthermore, the hypothesis test results are shown in the table below:

Table 2. Analysis of the Hypothesis Test Pathway for Farmers' Pesticide Use in Waihatu, Indonesia 2019

Variable	Original sample	Sample mean	Standard deviation	t-statistic	p-value
Use of pesticides → working time	0.365	0.357	0.105	3.467	0.001*
Use of pesticides → health complaints	0.333	0.338	0.129	2.586	0.010*
Types of pesticides → working time	0.320	0.338	0.114	2.808	0.005*
Types of pesticides → health complaints	0.159	0.153	0.140	1.135	0.257
Years of service → health complaints	0.151	0.146	0.096	1.582	0.115
Working time → Health complaints	0.298	0.301	0.134	2.227	0.027*

health complaints

Table 2 shows the test results of the 6 established hypotheses, and the 4 hypotheses are declared significant. The use of pesticides affects working time (p-value = 0.001), the use of pesticides affects health complaints (p-value = 0.010), the type of pesticides affects working time (p-value = 0.005), and working time affects health complaints (p-value = 0.027). The rejected hypothesis was that the type of pesticide did not affect health complaints (p-value = 0.257) and tenure had no effect on health complaints (p-value = 0.115) based on t-statistical analysis (>1.96) or p-value (<0.05). The amount of influence in table 3 is as follows:

Table 3. Value of R – Square

Variable	R-Square
Working time	0.320
Health complaints	0.433

The strength of the influence of endogenous variables is divided into weak, medium, and strongly based on the r square value. Working time in explaining health complaints has a proportion of 0.433 or 43.3% in the moderate category (Hidayat, 2018). Statistically, the type of pesticide did not affect health complaints, however, the type of pesticide that was mediated by the working time affected health complaints. Furthermore, the Q-square can be calculated to determine the goodness of fit.

The calculation of the value of r square is as follows:

$$\begin{aligned}
 Q\text{-square} &= 1 - [(1 - R^2_1) \times (1 - R^2_2)] \\
 &= 1 - [(1 - 0.320) \times (1 - 0.433)] \\
 &= 1 - 0.38556 \\
 &= 0.61444
 \end{aligned}$$

The magnitude of the Q-Square value of 0.61444 shows that the research model of 61.44% has a diversity of research data which is very well explained by working time affecting health complaints. The remaining 38.56% is explained by other variables outside the study so that the research model is declared valid and reliable.

Discussion

The majority of respondents aged 25 - 43 years as many as 34 people (50%) are of productive age. The productive age according to the ministry of health is 15 - 64 years.¹⁴ In table 1 above, the age of the horticultural farmers who were the sample of the study was 8 people, ranging in age from 62 to 79 years. Even though they are over the productive age and the number is a minority, this is because the livelihoods of the people in West Kairatu are mostly hereditary farming until they are over 64 years old and can still do activities in agriculture. So that local income per year is high in the horticultural sector. According to Mukadar, et al. (2019) the horticulture sector provides the largest income contribution per year, followed by the livestock sector, non-agricultural sector and finally food crops.¹⁵

The majority of farmers in Dea Kairatu are male, as many as 49 people (72.1%) have similarities with the results of other studies. The majority of horticultural farmers in Cameroon are 90 male farmers (86.5%) and 14 female farmers (13.5%).¹⁶ The number of cases of occupational disease in farmers is higher in men (87%) in the age range of 55 - 74 years.¹ The characteristics of the majority of farmers are male, the farming community in Jember Regency considers that spraying pesticides is a job that is appropriate for men and women's work is related to household matters. The results of his research were all horticultural farmers who sprayed the male

gender.¹⁷

Based on the education level, the majority of elementary schools are 51 people (75%). The results of this study have similarities with the research of Tambe et al (2019), the use of pesticides and health hazards to farmers in Cameroon, the majority of junior high school level (second level) as many as 65 farmers (62.5%).¹⁶ Education level is a stage of the formal path that a person takes, and influences the ability to think, understand, accept, and act. Willingness to accept and follow health regulations as long as it is possible to spray pesticides is influenced by educational background. In this regard, the Ministry of Health said that the agricultural sector in Indonesia needs to take strategic steps to prevent the dangers of pesticides to farmers by empowering farmer groups and cross-sector support.² Socialization alone is not enough to prevent the bad effects of pesticides.

Malombo's research (2019) on knowledge and practice of farmers' pesticide use in Zambia, requires local government support in the form of basic training. The results of the study found that safe procedures including use, handling, storage, and disposal were influenced by the knowledge, experience, and counseling of the local government. It was found that 81% of farmers stored pesticides using used food and beverage bottles, only 15% used personal protective equipment, and 68% had no experience in using pesticides safely. Have never received a basic education and have never received training from the government and related institutions.¹⁸

Previous research on 411 farmers in Iran found that farmers who used pesticides to increase crop yields chose pesticides based on the following criteria: information about pesticides, effectiveness, use techniques, environmental factors, and price and availability of pesticides.¹⁹ The findings of this study indicate that farmers do not consider the effects and types of pesticide use on health. The provisions for choosing a pesticide must consider the minimal effect on health problems. WHO states that the classification and types of pesticides are based on uses and hazards to health, based on exposure to pesticides by mouth and skin, and types of pesticides, solid or liquid-based on pesticide levels LD50 (mg/kg body weight).²⁰ The Ministry of Health has provided the types of pesticides that are legally registered in Indonesia issued by the Ministry of Agriculture so that farmers can use the recommended types of pesticides based on the farmer's ability, quality, and legalization from the Ministry of Health.² Farmers use more than 3 types of pesticides to quickly kill pests. This has a very negative impact on health. Because it has a bigger effect. The use of more than several types of pesticides will accumulate toxins so that the risk of pesticide poisoning is greater.

This study found that the type of pesticide had no direct effect on health complaints, but the type of pesticide that was mediated by the working time affected the health complaints of farmers. Therefore farmers need to choose the working time or the spraying time. Observation results found that some farmers sprayed 2-3 times a day, namely in the morning and afternoon. Of course, it causes farmers to be exposed to pesticides more often. Farmers do repeated spraying in a short period because farmers spray themselves. The hope of getting the most from agriculture causes farmers to spray using pesticides for a long time and continuously. Demonstrating that they do not follow safe spraying provisions, supported by the results of Malombo's research (2019) concluded that farmers' pesticide use in Zambia is influenced by farmers' low knowledge of pesticide safety. Farmers are also not trained in pesticide use, storage and spraying, creating problems for the environment and farmers' health.¹⁸

The majority of farmers have a service life of > 20 years, and the results of the study show that tenure does not affect

farmers' health complaints. The results of the researcher's observations found that farmers who have a longer working period have a longer experience so they are careful to use pesticides. Farmers have also adapted and are familiar with the procedures for using pesticides. It has similarities with previous research experiences in determining good pesticide use practices.¹⁸ Based on their relatively long experience, farmers follow the spraying requirements according to the recommendations listed on the pesticide bottle so that they do not exceed the frequency of spraying. Another assumption is that the effects of pesticides can last a long time. This result is similar to previous research that shows that short-term and long-term exposure has different effects on health.⁶ It can be explained that pesticide exposure is not felt immediately at this time, it can have long-term effects because of its cumulative nature.

Previous studies have found that farmers' knowledge has a significant relationship with the safe use of pesticides. Farmers who have higher knowledge and education prefer to use pesticides safely. Farmers choose pesticides that have low health effects. During the spraying process, use personal protective equipment such as hats, masks, fully closed clothes, and boots and carry out health checks if symptoms of pesticide poisoning are found.²¹ Unsafe behavior was found through the same research by Joko (2020) that excessive use of pesticides was carried out to maximize crop yields including spraying 2-3 times, mixing pesticides 5 - 7 types.¹⁰ Researchers observed that farmers used unsafe pesticides during storage, put pesticides in the kitchen, and were also found by farmers putting on terraces exposed to the sun.

Based on the statistical model test, the type of pesticide has no direct effect on health complaints, but the type of pesticide is mediated by working time which affects health complaints. Even though they contain chemicals, the safety of pesticides is determined based on the level of chemical threshold values allowed according to the Ministry of Health of the Republic of Indonesia.²² The use of pesticides has provisions for safety standards, even the Ministry of Health provides a wide variety of alternatives. Types of pesticides in the safe category if used at the wrong time, for example spraying with a frequency of morning, afternoon, evening, have an effect on health complaints. The result of the calculation of the Q-Square value of 0.61444 means that the research model of 61.44% is very well explained by working time affecting health complaints. And the remaining 35.56% is explained by other variables outside the study. Some of the factors that were not observed in this study were farmer knowledge, use of personal protective equipment, smoking habits, and personal hygiene.

Conclusion

The type of pesticide does not affect health complaints, but the type of pesticide and the type of pesticide affects health complaints if the farmers do not follow the working time requirements (spraying). Spraying time that exceeds the recommended standard results in health complaints. The use of pesticides such as mixing, spraying, and storing affects health complaints. During this process, the farmer is in contact with chemicals based on the mechanism by which pesticides enter the human body. Skin exposure during mixing, airborne during spraying, and oral exposure during storage. Support from related sectors is needed, to provide guidance and increase knowledge of farmers about the process of using pesticides, choosing working hours (spraying) according to personal safety standards to minimize the effects of using pesticides both in the short and long term.

Conflict of interest

None

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