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Original Article

The Relationship of Risk Factors to the Incidence of Pesticide Poisoning in Shallot Farmers in Batu Nona Hamlet, Anggeraja District, Enrekang Regency

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ABSTRACT

Background: The use of pesticides in agricultural activities is commonly practiced to increase productivity and protect crops from pest attacks. However, pesticide exposure can pose health risks to farmers, especially when not accompanied by adequate use of personal protective equipment (PPE), good personal hygiene, and proper attention to wind direction during spraying. These factors play an important role in preventing pesticide poisoning among farmers. this study aimed to determine the relationship between the use of personal protective equipment (PPE), personal hygiene, and spraying wind direction with the incidence of pesticide poisoning among shallot farmers in Batu Noni Hamlet, Anggeraja District, Enrekang Regency.
Method: This research employed an observational design with a cross-sectional approach. The statistical test used was the Chi-Square test. The study sample consisted of 142 shallot farmers selected based on specific inclusion and exclusion criteria.
Result: The results showed a significant relationship between the use of personal protective equipment (PPE) and pesticide poisoning ($p = 0.001 < 0.05$), personal hygiene and pesticide poisoning ($p = 0.001 < 0.05$), as well as spraying wind direction and pesticide poisoning ($p = 0.001 < 0.05$).
Conclusion: There is a significant relationship between the use of personal protective equipment (PPE), personal hygiene, and spraying wind direction with the incidence of pesticide poisoning among shallot farmers. It is recommended that farmers increase awareness of the importance of using complete PPE, maintaining good personal hygiene, and paying attention to wind direction during spraying through participation in agricultural safety and health training programs.

INTRODUCTION

Pesticides are all chemical substances and other materials as well as microbes and viruses that are used to eradicate or prevent pests and diseases that damage crops, plant parts or agricultural products. In 2016, in Indonesia there were 771 cases of pesticide poisoning. However, in 2017, the number of cases dropped to 124 cases and two of them resulted in death (Jamin, Mustofa, Restu, Rusli, & Adhi, 2024). Based on the annual report of the Data and Information Center of the Food and Drug

Supervisory Agency of the Republic of Indonesia (BPOM RI) in 2019, nationally there were 334 incidents of pesticide poisoning, of which 147 cases were caused by the use of agricultural pesticides (Herdianti, 2018).

Approximately 95.29% of farmers use pesticides throughout all stages of the agricultural cycle in Indonesia, from crop care and land preparation to harvesting and post-harvesting. In 2016, there were 3,207 pesticide brands registered and approved in Indonesia, produced by 343 pesticide companies (Shekhar et al., 2024). Pesticide poisoning rates show a significant impact in several regions of Indonesia (Adiyatma, 2019). Research conducted on 347 farmers in Central Java revealed that 35.73 per cent suffered from severe pesticide poisoning, while 23.64 per cent suffered from moderate poisoning (Joko et al., 2023). Exposure to pesticides through the air is one of the main causes of chronic diseases among farmers. Once pesticides are dispersed in the air, they can be inhaled through the nose and mouth, reaching the lungs, damaging these organs, and quickly spreading into the bloodstream, thereby infecting the entire body. In Indonesia, organophosphate pesticides are often used on fruit and vegetable crops, such as shallots. The use of these pesticides causes the substance to spread throughout the plant. As a result, organophosphate pesticide residues can be detected in shallot bulbs, which are then consumed by the public (Khalishah, Saftarina, & Pardilawati, 2023).

Onion farmers are classified as high-risk for pesticide poisoning due to the very high intensity of pesticide use, approximately 3–5 times per week. In addition, most farmers use more than two types of pesticides simultaneously, with some using up to seven different types. This high frequency of spraying is influenced not only by farming practices, but also by environmental conditions and the growing season. (Bey, Ruliati, & Dodo, 2022). During the rainy season, high humidity levels create ideal conditions for the development of various types of pests, especially caterpillars that often attack shallot plants. These pest attacks can cause leaf damage and bulb rot prior to harvest, prompting farmers to increase the intensity of pesticide spraying to protect their crops. As a result, during this period, spraying may be carried out more than twice a week, even up to twice a day. (Amelia, Amelia, & Ibnusina, 2022). In general, spraying is carried out in the morning between 07:00 and 12:00, and continued in the afternoon or the following morning, with a frequency of 3–4 times a week. However, it is not uncommon for farmers to continue spraying regularly even when there are no signs of pest infestation (Mahawati, Surjati, Saputra, Sudasman, & Pertiwi, 2023). This practice demonstrates a high dependence on pesticides without regard for the principles of integrated pest management. In addition, inappropriate spraying techniques, such as spraying against the wind, can increase the risk of direct exposure to pesticides for farmers and people in the vicinity, thereby increasing the potential for pesticide poisoning (Rahmah & Nabila, 2020).

The use of pesticides by farmers provides benefits by eliminating pests from crops, which in turn increases agricultural yields. However, there are negative impacts associated with pesticide use, which include various health and environmental problems, both direct and indirect (Mwabulambo, Mrema, & Ngowi, 2018). Onion farmers face a high risk of these negative impacts. To protect the health of farmers and the environment from the adverse effects of pesticide use, it is important to implement appropriate self-protection measures, such as the comprehensive use of personal protective equipment (PPE) (Jannah, Asmaningrum, Rosyidi, & Nur, 2023).

Research by Fauziyyah, (2017)shows that this condition illustrates that farmers' awareness of the importance of using PPE is still low. Many farmers feel that wearing PPE hinders their comfort and agility while working in the field, especially in hot weather or during prolonged spraying activities. In addition, some farmers do not fully understand the benefits of wearing PPE to protect themselves from pesticide exposure, so they tend to ignore its use. In addition, farmers often spray pesticides without considering weather conditions, due to their low level of education. They do not realise that pesticide use is less effective in bad weather, strong winds or rain.

Based on data from the Enrekang Regency Agriculture and Plantation Service in 2019, shallot farmers tend to use more insecticides than fungicides. The number of types of insecticides used

reached 30 types, while fungicides reached 18 types. Among these insecticides, the most commonly found active ingredient was chlorpyrifos, which was found in 5 of the 30 types of insecticides used by shallot farmers. Research by Sabaria & Hidayat (Sabaria & Hidayat, 2020) conducted on shallot farmers in Anggeraja Subdistrict, Enrekang Regency, revealed that the rate of pesticide poisoning in the area increased from 2016 to 2018. This increase was associated with several factors related to pesticide poisoning, including the age of the farmers, using pesticides for more than five years, not using personal protective equipment (PPE), and improper pesticide mixing and spraying techniques.

Batu Noni is a hamlet located in Batu Noni Village, Anggeraja Subdistrict, Enrekang Regency, South Sulawesi Province. This hamlet has a population of 2,140 people consisting of 530 households, 220 of whom are onion farmers. According to data from the Batu Noni Hamlet Health Centre, Anggeraja Sub-district, Enrekang Regency, in 2023 there were 47 cases of pesticide poisoning. The symptoms they experienced included headaches, dizziness, and nausea. A preliminary survey showed that there were still onion farmers in Batu Noni Hamlet who did not pay enough attention to the use of Personal Protective Equipment (PPE) and personal hygiene. Farmers' compliance with the use of PPE was still very low. The use of PPE that does not meet occupational safety standards has resulted in many farmers experiencing health complaints, including poisoning due to pesticide exposure. The purpose of this study was to identify and analyse risk factors associated with pesticide poisoning among shallot farmers in Batu Noni Hamlet, Anggeraja Sub-district, Enrekang Regency.

METHODS

This type of research uses an analytical observational method with a cross-sectional approach, in which independent and dependent variables are analysed simultaneously at one point in time. The research was conducted in Batu Noni Hamlet, Anggeraja Subdistrict, Enrekang Regency, with a population of 220 shallot farmers. Sampling was conducted using simple random sampling techniques, and based on calculations using the Slovin formula, a sample size of 142 respondents was obtained. The independent variables in this study included the use of personal protective equipment (PPE), farmers' personal hygiene, and wind direction during pesticide spraying, while the dependent variable was the incidence of pesticide poisoning.

The criteria for PPE use are categorised as ‘compliant’ if farmers use all protective equipment (masks, gloves, long-sleeved shirts, long trousers, shoes, and head coverings) when spraying, and ‘non-compliant’ if one or more components of PPE are not used. For the personal hygiene variable, it is categorised as ‘compliant’ if farmers wash their hands and face after spraying, change their work clothes, shower before eating or resting, and store their work clothes separately. Conversely, it is ‘non-compliant’ if farmers do not perform any of these actions. The wind direction variable is categorised as ‘compliant’ if the farmer sprays in the direction of the wind, and ‘non-compliant’ if they spray against the wind.

Primary data was obtained through direct observation in the field and questionnaire completion by respondents to identify the relationship between independent and dependent variables. Meanwhile, secondary data was collected from the Batu Noni Hamlet monograph available at the Village Office, as well as supporting literature in the form of books, previous research journals, and relevant laws and regulations. Data processing was carried out with the aid of computers and presented in the form of frequency distribution tables and analytical tables. Data analysis was performed univariately to provide an overview of the distribution of each variable, and bivariately using the Chi-Square test to determine the relationship between independent variables (use of PPE, personal hygiene, and wind direction during spraying) and dependent variables (incidence of pesticide poisoning).

RESULTS

This study was conducted in Batu Noni Hamlet, Anggeraja Subdistrict, Enrekang Regency, with farmers as the research subjects. The methods used included direct interviews and observation of respondents using questionnaires and observation. The aim was to examine the relationship between the use of personal protective equipment, farmers' personal hygiene, and the direction of the wind when spraying pesticides on red onion farmers. The results of the study are presented in the form of tables and narratives as follows.

Table 1. Characteristics of Shallot Farmer Respondents in Batu Noni Hamlet, Anggareja Subdistrict, Enrekang Regency

Variables	n	(%)
Gender		
Male	142	100
worker age		
19-23 years old	23	16
24-28 years old	28	20
29-33 years old	25	18
34-38 years old	26	18
39-43 years old	21	15
44-48 years old	13	9
49-53 years old	5	4
54-58 years old	1	1
Employment Period		
1-4 years old	45	32
5-8 years old	55	39
9-12 years old	27	19
13-16 years old	3	2
17-20 years old	6	4
21-24 years old	2	1
25-28 years old	3	2
29-32 years old	1	1
Personal Protective Equipment (PPE)		
Does not meet requirements	91	64
Meets requirements	51	36
Personal Hygiene of Farmers		
Does not meet requirements	115	81
Meets requirements	27	19
Spraying Wind Direction		
Good	79	56
Bad	63	44

Source: Primary Data, 2024

Table 1 shows that research conducted on 142 shallot farmers in Batu Noni Hamlet indicates that all respondents were male (100%), suggesting that pesticide spraying is generally carried out by

men as it requires considerable physical strength. The majority of respondents were of productive age, with the largest age groups being 24–28 years (20%) and 34–38 years (18%). Most farmers had worked for 5–8 years (39%), indicating sufficient experience in pesticide spraying activities. The use of Personal Protective Equipment (PPE) was considered adequate by 64% of respondents, while 36% were not fully compliant. In terms of personal hygiene, 81% of farmers were compliant and 19% were non-compliant. Meanwhile, 56% of farmers sprayed with the wind direction in mind, while 44% did not pay proper attention to the wind direction.

Table 2. The Relationship between the Use of PPE, Personal Hygiene, and Wind Direction with the Incidence of Pesticide Poisoning in Shallot Farmers in Batu Noni Hamlet, Anggareja District, Enrekang Regency

Variables	Pesticide poisoning				p-value
	Yes		No		
	n	%	n	%	
Use of PPE					
Does not meet requirements	48	94	3	6	0.001
Meets requirements	1	1	90	99	
Personal Hygiene of Farmers					
Does not meet requirements	25	73.5	9	26.5	0.001
Meets requirements	24	22.2	84	77.8	
Spraying Wind Direction					
Bad	38	62.3	23	37.7	0.001
Good	11	13.6	70	86.4	

Source: Primary Data, 2024

DISCUSSION

The Relationship between the Use of Personal Protective Equipment (PPE) and Incidents of Pesticide Poisoning

The results of this study indicate a significant relationship between the use of personal protective equipment (PPE) and the incidence of pesticide poisoning among shallot farmers. These findings confirm that PPE plays an important role in protecting farmers from exposure to hazardous chemicals that can cause health effects ranging from skin irritation to systemic poisoning. However, most farmers are still reluctant to use complete PPE, especially masks, gloves, boots, and eye protection, citing discomfort and a lack of understanding of the benefits of PPE. This illustrates a gap between knowledge and behaviour, meaning that the risk of pesticide exposure remains high among farmers.

These results are in line with the research by Muslima et al (Muslima, Warzukni, & Hudnah, 2023) which found a significant relationship between the use of PPE and the incidence of organophosphate pesticide poisoning among farmers, while Siagian's (Siagian, 2022) research also reinforces these findings by showing a relationship between PPE compliance and pesticide poisoning among farmers in Sorong Regency. Research also suggests that incomplete use of PPE is a risk factor for pesticide poisoning (Yushananta et al., 2020). The similarity of these results shows that inadequate use of PPE is a major risk factor in pesticide poisoning incidents in various agricultural centres.

Theoretically, the use of PPE is an effective form of self-control to minimise exposure to pesticides (Ibrahim, Sillehu, Sely, & Rumaolat, 2024). PPE is designed to isolate workers from occupational hazards, including exposure to toxic chemicals. PPE is designed to protect farmers from pesticide exposure and includes head protection, hats, masks, and long-sleeved shirts (Darmiati,

2020). With the proper use of PPE in good condition, the risk of direct contact with pesticides can be significantly reduced, thereby protecting the health of farmers. However, in practice, incorrect behaviour is still found, such as continuing to experience symptoms of dizziness or nausea despite using PPE. This condition is usually caused by other factors, such as incorrect spraying techniques, such as spraying against the wind, so that PPE cannot provide optimal protection (Rustanti, Wardoyo, Kasjono, & Putri, 2025).

Based on these findings, the contribution of this research lies in strengthening empirical evidence regarding the importance of PPE use in preventing pesticide poisoning among farmers. This study adds the perspective that barriers to PPE use are not only due to availability, but also to factors such as comfort and farmers' understanding. Therefore, interventions are needed in the form of ongoing education, PPE use simulations, and the installation of information media in agricultural areas to raise farmers' awareness of the importance of occupational safety. These efforts are expected to reduce the incidence of pesticide poisoning while improving the health of the farming community.

The Relationship between Personal Hygiene and Incidents of Pesticide Poisoning among Shallot Farmers

The results of the study indicate a significant relationship between personal hygiene and the incidence of pesticide poisoning among shallot farmers. This condition shows that personal hygiene is an important factor in preventing excessive exposure to pesticides. Poor personal hygiene practices, such as not immediately changing or washing clothes after spraying, cleaning spraying equipment near water sources, and smoking or eating without washing hands first after exposure to pesticides, reflect farmers' low awareness of the health risks that can arise (Joko, Dewanti, & Dangiran, 2020).

Pesticide residues that stick to work clothes or skin can be a source of secondary dermal exposure, as these chemicals can be absorbed through the pores of the skin even after spraying is complete. In addition, oral exposure can also occur when farmers smoke, eat, or drink using hands contaminated with pesticides, causing chemical residues to be ingested and enter the digestive tract. These two mechanisms explain why poor personal hygiene practices can increase the risk of pesticide poisoning, both acute and chronic.

These findings are in line with Lamichane (2019) in Nepal, who also supports this by stating that farmers who neglect hygiene practices and proper spraying techniques have a higher risk of experiencing health problems (Gompo et al., 2020). Research by Widiastuty, et al., (Widiastuty et al., 2022) also suggests that personal hygiene is one of the risk factors associated with symptoms of poisoning among farmers. The consistency of the results from these various studies confirms that personal hygiene not only plays a role in protecting individuals, but also has important implications for the health of the environment surrounding farmers.

Theoretically, personal hygiene is part of self-care efforts to maintain physical and mental health. In the context of pesticide use, this includes washing hands with soap after spraying, changing contaminated clothing, bathing thoroughly, maintaining the cleanliness of spraying equipment, and avoiding risky habits such as eating, drinking, or smoking during and after work (Siahaan, 2020). If this is neglected, it can increase the chance of pesticide residues entering the body through dermal or oral routes, as well as trigger cross-contamination to family members or the surrounding environment.

This study confirms that personal hygiene is a key component in pesticide poisoning prevention strategies. The low level of awareness among farmers regarding personal hygiene indicates the need for more intensive interventions through health education, practical training, and the formation of farmer groups that can remind each other of the importance of hygienic behaviour (Suradi, Ramli, & Taslim, 2022). With a continuous educational approach, it is hoped that farmers' personal hygiene will improve, the risk of pesticide exposure will decrease, and the health of the agricultural work environment will become safer and more sustainable.

The Relationship between Wind Direction and Spraying Incidents of Poisoning Among Shallot Farmers

The results of the study indicate a significant relationship between wind direction during spraying and the incidence of pesticide poisoning among shallot farmers. The direction of spraying is an important factor that affects the level of pesticide exposure to farmers' bodies. Spraying against the wind is often practised because it is considered to reach plants more evenly. However, this condition actually increases the risk of pesticide exposure through inhalation and primary dermal exposure, where pesticides directly adhere to the skin due to the drift of spray particles carried by the wind towards farmers.

These findings are in line with Halisa et al., (2022) research, which states that spraying against the wind is associated with an increase in farmers' blood cholinesterase levels, indicating increased exposure to pesticides. A similar finding was reported by Ibrahim, et al., (Ibrahim, Sillehu, Santoso, & Nugroho, 2023), who found that farmers who did not pay attention to wind direction had a higher risk of pesticide poisoning. The consistency of findings from various studies confirms that wind direction is a crucial environmental factor in determining the level of pesticide exposure.

This condition confirms that even with the use of Personal Protective Equipment (PPE), spraying against the wind can still increase the risk of exposure. This shows that PPE cannot provide optimal protection when used in the wrong working conditions. PPE is designed to protect farmers from pesticide exposure through head protection, hats, masks, long-sleeved shirts, gloves, goggles, and boots. However, when spraying is carried out against the wind, pesticides can penetrate gaps in the PPE or stick to parts of the body that are not fully protected, increasing the likelihood of direct exposure.

Theoretically, safe pesticide spraying must take into account environmental conditions, including wind direction, spraying time, and the use of complete PPE. Spraying against the wind direction has the potential to cause double hazards, both to the health of farmers and to the environment, because pesticide residues can spread into the air, soil, or be carried to water sources (Dewi, Lizmah, Resdiar, & Chairuddin, 2022). Thus, the practice of safe spraying in the direction of the wind, accompanied by the use of complete PPE, is a key step in minimising risk.

Thus, spraying practices carried out in the direction of the wind and accompanied by the use of complete PPE are key steps in minimising the risk of pesticide poisoning. This study emphasises the importance of continuous education for farmers regarding the dangers of spraying against the wind. These efforts can be carried out through field practice training, safe spraying simulations, and the provision of educational media such as posters or instructional videos. With increased farmer awareness of wind direction and the importance of PPE, it is hoped that the risk of pesticide exposure can be reduced so that the health of shallot farmers is better protected.

Study Limitations

This study has several limitations: (1) the cross-sectional design does not establish causal relationships between risk factors and pesticide poisoning incidents; (2) the use of self-reported questionnaires may lead to recall bias or socially desirable responses regarding PPE use and hygiene practices; (3) potential confounders such as spraying frequency, pesticide concentration, nutritional status, and prior exposure history were not controlled; (4) the absence of biological exposure measurements, such as blood cholinesterase levels, limits the accuracy of poisoning confirmation; and (5) the study area was limited to one hamlet and conducted within a short time frame, restricting generalizability to other agricultural regions and seasons. Future research should adopt longitudinal designs, include biological and environmental exposure assessments, and expand the study area to enhance external validity and policy relevance.

CONCLUSION

The conclusion of this study indicates a significant relationship between the use of PPE, personal hygiene, and the direction of wind spray with the incidence of pesticide poisoning.

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BIBLIOGRAPHY

Adiyatma. (2019). Analisis Faktor Yang Berhubungan Dengan Keterpaparan Pestisida Berdasarkan Kadar Cholinestrase Darah Pada Petani Bawang Merah Di Desa Parinding Kecamatan Baraka Kabupaten Enrekang. *Jurnal Mitrasehat*, *9*(1), 1–14. https://doi.org/10.51171/jms.v9i1.10

Amelia, S., Amelia, M., & Ibnusina, F. (2022). Karakteristik dan Pengetahuan Petani Cabai Merah terhadap Penggunaan Pestisida Kimia : Studi Kasus di Kecamatan Payakumbuh , Kabupaten Lima Puluh Kota , Indonesia. *AgriHealth: Journal of Agri-Food, Nutrition and Public Health*, *3*(2), 133–142. https://doi.org/http://dx.doi.org/10.20961/agrihealth.v3i2.63032

Bey, K. M., Ruliati, L. P., & Dodo, D. O. (2022). Factors Affecting Acute Pesticide Poisoning Farmers in Nenu Village Manggarai Regency. *Lontar: Journal of Community Health*, *4*(1), 1–10. https://doi.org/https://doi.org/10.35508/ljch.v4i1.4172

Darmiati, D. (2020). Faktor-faktor yang berhubungan dengan risiko keracunan pestisida pada petani The factors associated with the risk of pesticide poisoning to farmers. *Jurnal SAGO Gizi Dan Kesehatan*, *2*(1), 81–86. https://doi.org/10.30867/gikes.v2i1.474

Dewi, Y. S., Lizmah, S. F., Resdiar, A., & Chairuddin, C. (2022). Persepsi Petani Tentang Penggunaan Pestisida di Desa Babul Makmur Kecamatan Simeulue Barat. *Jurnal Agrotek Lestari*, *8*(1), 1–8. https://doi.org/10.35308/jal.v8i1.4731

Fauziyyah, R. (2017). Studi praktik penggunaan pestisida dan kejadian anemia pada petani buah di desa tunggak kecamatan toroh kabupaten grobogan. *Jurnal Kesehatan Masyarakat*, *5*(5), 860–870. https://doi.org/https://doi.org/10.14710/jkm.v5i5.19211

Gompo, T. R., Shrestha, A., Ranjit, E., Gautam, B., Ale, K., Shrestha, S., & Bhatta, D. D. (2020). Risk factors of tuberculosis in human and its association with cattle TB in Nepal: A one health approach. *One Health*, *10*(April), 100156. https://doi.org/https://doi.org/10.1016/j.onehlt.2020.100156

Halisa, S. N., Ningrum, P. T., & Moelyaningrum, A. D. (2022). Analisis Pajanan Organofosfat Terhadap Kadar Kolinesterase Pada Petani Sayuran Kubis di Desa Tanjung Rejo Kabupaten Jember. *Jurnal Kesehatan Lingkungan Indonesia*, *21*(2), 144–151. https://doi.org/10.14710/jkli.21.2.144-151

Herdianti, H. (2018). Hubungan Lama, Tindakan Penyemprotan, Dan Personal Hygiene Dengan Gejala Keracunan Pestisida. *PROMOTIF: Jurnal Kesehatan Masyarakat*, *8*(1), 72. https://doi.org/10.31934/promotif.v8i1.232

Ibrahim, I., Sillehu, S., Santoso, H., & Nugroho, W. (2023). Risk Factors for Pesticide Poisoning in Horticultural Farmers in the Agricultural Area of West Seram Regency , Indonesia. *National Journal of Community Medicine*, *14*(10), 687–692. https://doi.org/10.55489/njcm.141020233232

Ibrahim, I., Sillehu, S., Sely, M. D., & Rumaolat, W. (2024). Perilaku Penggunaan Pestisida Kimia Yang Berisiko Pada Kesehatan Petani Hortikultura. *Jurnal Sains Dan Kesehatan*, *8*(1), 42–50. https://doi.org/https://doi.org/10.57214/jusika.v8i1.537

Jamin, F. S., Mustofa, D., Restu, K., Rusli, M., & Adhi, S. (2024). Penggunaan Pestisida dalam Pertanian : Resiko Kesehatan dan Alternatif Ramah Lingkungan Pesticide Use in Agriculture : Health Risks and Environmentally Friendly Alternatives. *Jurnal Kolaboratif Sains*, *7*(11), 4151–4159. https://doi.org/10.56338/jks.v7i11.6342

Jannah, N., Asmaningrum, N., Rosyidi, K., & Nur, M. (2023). Pengetahuan dan Sikap Petani tentang Alat Pelindung Diri dalam Penggunaan Pestisida di Desa Darungan Kecamatan Patrang Kabupaten Jember. *E-Journal Pustaka Kesehatan*, *11*(1), 34. https://doi.org/https://doi.org/10.19184/pk.v11i1.30390

Joko, T., Dewanti, N. A. Y., & Dangiran, H. L. (2020). Pesticide Poisoning and the Use of Personal Protective Equipment (PPE) in Indonesian Farmers. *Journal of Environmental and Public Health*, (Januari), 1–7. https://doi.org/10.1155/2020/5379619

Joko, T., Sulistyani, S., Setiani, O., Rahardjo, M., Darundiati, Y. H., & Arumdani, I. S. (2023). Komunikasi Informasi dan Edukasi tentang Bahaya Pajanan dan Residu Pestisida pada Petani Bawang Merah. *Journal of Public Health and Community Service*, *2*(1), 18–22. https://doi.org/10.14710/jphcs.2023.15845

Khalishah, I., Saftarina, F., & Pardilawati, C. Y. (2023). Penggunaan APD pada Petani yang Menggunakan Pestisida ditinjau dari Aspek Health Belief Model. *Agromedicine*, *10*(1), 86–92. Retrieved from https://juke.kedokteran.unila.ac.id/index.php/agro/article/view/3127

Lamichhane, S., & Shakya, N. M. (2019). Integrated assessment of climate change and land use change impacts on hydrology in the Kathmandu Valley watershed, Central Nepal. *Water (Switzerland)*, *11*(10). https://doi.org/10.3390/W11102059

Mahawati, E., Surjati, E., Saputra, M. K. F., Sudasman, F. H., & Pertiwi, I. (2023). Hubungan Lingkungan Fisik Rumah Dengan Kejadian Tuberkulosis Paru The Relationship Physical Environment Of The Home With The Incidence Of Pulmonary Tuberculosis. *The Indonesian Journal Of Infectious Disease*, *9*(1), 1–12. https://doi.org/https://doi.org/10.32667/ijid.v9i1.169

Muslima, L., Warzukni, S., & Hudnah, H. (2023). Hubungan penggunaan alat pelindung diri (APD) dengan kejadian keracunan pestisida golongan organofosfat secara fisik pada petani di desa batin baru Kecamatan Bandar Kabupaten Bener Meriah. *Journal of Pharmaceutical And Sciences*, *5*(2), 488–492. https://doi.org/10.36490/journal-jps.com.v5i2.168

Mwabulambo, S. G., Mrema, E. J., & Ngowi, A. V. (2018). Health Symptoms Associated with Pesticides Exposure among Flower and Onion Pesticide Applicators in Arusha Region. *Annals of Global Health*, *84*(3), 369–379. https://doi.org/https://doi.org/10.29024/aogh.2303

Rahmah, S. P., & Nabila, N. (2020). Analisis Risiko Pajanan Pestisida Pada Petani Sayur di Alahan Panjang. *Jurnal Keselamatan, Kesehatan Kerja Dan Lingkungan (JK3L)*, *01*(01), 35–40. https://doi.org/https://doi.org/10.25077/jk3l.1.1.35-40.2020

Rustanti, I., Wardoyo, E., Kasjono, H. S., & Putri, A. (2025). Mitigating the Risk of Organophosphate Pesticide Exposure through Community Empowerment of Farmers in Torongrejo Village , Batu City , East Java. *Frontiers in Community Service and Empowerment*, 104–110. https://doi.org/https://doi.org/10.35882/ficse.v3i2.6

Sabaria, S., & Hidayat, H. (2020). Faktor yang Berhubungan Dengan Gangguan Kesehatan Pada Petani Bawang Merah (Allium cepa) di Desa Saruran Kecamatan Anggeraja Kabupaten Enrekang. *Jurnal Sulolipu : Media Komunikasi Sivitas Akademika Dan Masyarakat*, *20*(1), 90–97. https://doi.org/10.32382/sulolipu.v20i1.1481

Shekhar, C., Khosya, R., Thakur, K., Mahajan, D., Kumar, R., Kumar, S., & Sharma, A. K. (2024). A systematic review of pesticide exposure , associated risks , and long-term human health impacts. *Toxicology Reports*, *13*(November), 101840. https://doi.org/10.1016/j.toxrep.2024.101840

Siagian, J. L. S. (2022). Hubungan Status Kesehatan, Dosis Penggunaan Pestisida dan Kebiasaan

Penggunaan APD dengan Kejadian Keracunan Pestisida. *Media Publikasi Promosi Kesehatan Indonesia (MPPKI)*, *5*(8), 957–963. https://doi.org/10.56338/mppki.v5i8.2469

Siahaan, S. (2020). Faktor yang Berhubungan dengan Kejadian Keracunan Pestisida Pada Petani Sayur dan Palawija di Desa Selat Kecamatan Pemayung Kabupaten Batang Hari Tahun 2018. *Jurnal Ilmiah Universitas Batanghari Jambi*, *20*(3), 1079–1085. https://doi.org/10.33087/jiubj.v20i3.1099

Suradi, A. R., Ramli, F., & Taslim, A. I. S. (2022). Analisis Perilaku Petani Dalam Penggunaan Pestisida Kimia di Kabupaten Enrekang. *Jurnal Sains Agribisnis*, *2*(1), 21–31. https://doi.org/https://doi.org/10.55678/jsa.v2i1.667

Widiastuty, L., Ekasari, R., Ibrahim, I. A., Karini, T. A., Adnan, Y., & Azwar, M. (2022). Keracunan Pestisida Pada Petani Bawang Merah di Desa Pasui Kecamatan Buntu Batu Kabupaten Enrekang. *Higiene : Jurnal Kesehatan Lingkungan*, *8*(1), 47–54. https://doi.org/https://doi.org/10.24252/higiene.v8i1.34521

Yushananta, P., Melinda, N., Mahendra, A., Ahyanti, M., Angraini, Y., & Bukit, B. (2020). Faktor Risiko Keracunan Pestisida Pada Petani Holtikultura di Kabupaten Lampung Barat. *Jurnal Kesehatan Lingkungan Ruwa Jurai*, *14*(6), 1–8. https://doi.org/http://dx.doi.org/10.26630/rj.v14i1.2138