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Safety induction for agricultural workers in particular areas of Gadog Village in handling hazardous agrochemical exposures

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ABSTRACT

An integrated program of community service and chemical teaching has been conducted to deliver proper information to handle chemical agents that are commonly used in agricultural activities. This initiative addresses the limitation of chemical understanding among local farmers and livestock breeders regarding the safety aspect of common agrochemicals, leading to either health risks or environmental problems. Knowledge regarding agrochemical handling and disposal was delivered through presentations, discussions, and hands-on practices. Accordingly, through this community service, we encouraged agricultural workers with a basic understanding of the chemical properties of hazardous agrochemicals and the safety induction in handling and disposing of those compounds. Based on the activities carried out, the results of the pre-test and post-test showed an increase of 62% in farmers' understanding of hazardous chemicals and proper handling of these chemicals. In addition to providing some beneficial scientific information to enhance agricultural workers' safety in their working area, an activity related to education and training of agrochemicals could increase peoples' awareness toward hazardous chemicals that would be still freely commercialized, for example, in terms of mitigating risks associated with chemical threats.

Kata Kunci
Agrokimia
Paparan kimia
Pestisida
Induksi kimia

Induksi keselamatan pekerja pertanian di Desa Gadog dalam menangani paparan bahan agrokimia berbahaya. Program terpadu pengabdian masyarakat dan pendidikan kimia telah dilakukan untuk memberikan informasi yang tepat dalam hal penanganan bahan kimia yang biasa digunakan dalam kegiatan pertanian. Program ini diinisiasi untuk mengatasi kurangnya pemahaman petani dan peternak lokal mengenai keamanan bahan agrokimia yang umum digunakan, sehingga berpotensi menyebabkan risiko kesehatan atau masalah lingkungan. Pengetahuan mengenai penanganan dan pembuangan bahan agrokimia disampaikan melalui presentasi, diskusi, dan praktik langsung. Melalui pengabdian masyarakat ini, pekerja pertanian didorong untuk memiliki pemahaman dasar tentang sifat kimia bahan agrokimia yang berbahaya dan induksi keselamatan dalam penanganan dan pembuangan senyawa tersebut. Berdasarkan kegiatan yang telah dilakukan, perbandingan hasil *pre-test* dan *post-test* menunjukkan adanya peningkatan sebesar 62% pada pemahaman petani mengenai bahan kimia berbahaya dan cara tepat penanganan bahan kimia tersebut. Selain memberikan informasi ilmiah untuk meningkatkan keselamatan pekerja pertanian di wilayah kerjanya, kegiatan pendidikan dan pelatihan bahan agrokimia dapat meningkatkan kesadaran masyarakat terhadap bahan kimia berbahaya yang masih dijual secara bebas, misalnya dalam hal mitigasi resiko bencana akibat bahan kimia.

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INTRODUCTION

Hazardous chemical agents are chemicals present in the environment that can affect humans (James et al., 2018). According to Ministerial Decree No. 187 of 1999, hazardous chemicals refer to chemicals in both single and mixed forms that have chemical, physical, and/or toxicological properties that are harmful to workers, institutions, and the environment, either directly or indirectly. Hazardous and toxic substances have serious consequences for the environment, including coral reef destruction, air and water pollution, and negative impacts on human health such as increased risk of cancer, genetic mutations, and damage to body systems (Wanda & Pattiasina, 2022). The term "hazardous chemical agents" encompasses various compounds, including carbamates, organochlorines, organophosphates, and Dichlorodiphenyltrichloroethane (DDT). Hazardous chemical safety is a key component of work safety and public safety, so improving hazardous chemical safety in the Thirteenth Five-Year Plan period is critical (Wang et al., 2018). A hazard is typically defined as something that has the potential to cause harm (Scheer et al., 2014). Hazardous chemicals basically arise from the disposal of waste directly from the source (Utomo, 2012). This can cause disturbances to living things around the location or around the waste disposal site, including in the human body and if these harmful chemicals accumulate in the body, they can cause negative impacts on the body's health (Thristy et al., 2022).

Chemicals, in general, have been associated with different health challenges and they pose a risk for specific occupations that use them daily. Dangerous chemicals can cause damage to body tissue, itchy skin, peeling skin, skin burns, disrupt the respiratory system, and even long-term illnesses (Muh Shofi et al., 2021). High-risk groups exposed to pesticides include various roles such as production workers, formulators, sprayers, mixers, loaders, and agricultural workers. Engaging in the manufacturing and formulation processes tends to increase the risk of hazards as these activities are not without risks. There is evidence to suggest that professional exposure to chemical, physical, and biological risks can cause serious health impacts. According to the European Agency for Safety and Health at Work report in 2015, about 17% of workers in the European Union (EU) reported exposure to chemicals, products or substances at least a quarter of their working time (Papadopoli et al., 2020). Workers face higher risks in industrial environments as they handle various toxic chemicals, including pesticides, raw materials, toxic solvents, and inert carriers (Scott & Pocock, 2021).

Workers, in several areas, such as agriculture, fisheries, or electricity, may have a limitation in obtaining information regarding the negative effects of exposure from the use of chemicals they use every day, e.g., fertilizers, pesticides, polishing agents, etc. Intensive application of chemical fertilizers over a long period on agricultural land will lead to decreased productivity and land degradation, especially related to the decrease in organic carbon levels in the soil (Marwantika, 2020). In addition the use of pesticides, pesticides are chemical substances employed to prevent plant diseases, control weeds, manage pests, and improve the overall quality of food products (Rajmohan et al., 2020).The potential health risks stemming from pesticide exposure are contingent not only upon the toxicity of the components but also on the extent of exposure (Kim et al., 2017). Safe chemical process avoids hazards instead of controlling them, particularly by removing or reducing the amount of hazardous material in the plant or the number of hazardous operations (za, 2016). Poisonous agents or toxic agents are anything that can produce an adverse biological effect. It may be chemical, physical, or biological in form. For example, toxic agents may be chemical (such as cyanide), physical (such as radiation), and biological (such as snake venom) (Gupta, P., 2020).

As a consequence of the limitation of chemical understanding toward hazardous chemical agents, they may find difficulties in distinguishing between safe chemicals and poisonous agents. The health sector also requires serious attention because it affects the quality of life in the community (Devi & Kumalasari, 2024).Understanding the factors that influence the use of personal protective equipment (PPE) during handling of plant protection products (PPPs) is critical in designing tailored interventions to minimize exposure among farmers (Damalas & Abdollahzadeh, 2016). Hence, it is quite confusing to decide what kind of personnel protection equipment (PPE) should be used. For instance, the limitation of knowledge about personal protective equipment is one of the causes of poisoning, irritation, and dermatitis suffered by some farmers (Aeni et al., 2020).

Several efforts have been made to reduce the negative impact of agrochemical exposure. One of them is by replacing the composition of pesticides with other compounds registered by the United States Environmental Protection Agency (EPA) (Dodds et al., 2021). For example, according to its official website regarding pesticide registration, EPA displays some organophosphate compounds that could be alternatively replaced by various non-organophosphate compounds. However, this effort only partially mitigates the impact of pesticides (Yuantari et al., 2013). Direct approach toward agricultural workers, particularly in agrochemical handling and PPE training, should be also performed to provide them with appropriate methods to prevent direct or long-term exposure to pesticides and other potentially harmful materials in their working area.

To support the national surveillance in terms of Sustainable Development Goals (SDGs) on its mission of health and well-being (SDGs no. 3), chemical safety is one of the efforts to protect humans, facilities, and installations, as well as the environment in all parts of the work cycle of chemicals, from the misuse and improper use of chemicals. Accordingly, the issue of safety aspect in handling chemicals should be tackled for the sake of maintaining a healthy life and longevity, not only for laboratory workers or university technicians but also for broader professional applications (Zaip et al., 2021). In particular, safety induction of handling agrochemicals and its exposures to agricultural workers is ought to properly delivered to minimize negative impacts when handling hazardous agrochemicals (Said, 2023). In particular, safety

induction of handling agrochemicals and its exposures to agricultural workers is ought to properly delivered to minimize negative impacts when handling hazardous agrochemicals (Yenni et al., 2023).

Puncak Pass, commonly recognized as Puncak, is a popular destination close to the capital city of Indonesia. This area has an enormous and beautiful agricultural area that is capable of attracting both domestic and international tourists, such as Gadog village. Gadog is a part of the Puncak area where many agricultural workers skillfully grow various vegetables and fruits for consumption and leisure purposes. The topology of Gadog Village is surrounded by rice fields and others so the majority of the people work as farmers (Widyastuti et al., 2023). Although Gadog is well-recognized for its agribusiness and leisure activities, this agricultural area could be slightly busier than other agricultural areas on Java Island since this area is relatively closer to both the seaport of Jakarta and several industrial areas of Jabodetabek. Considerably, many agrochemical products could easily enter this area so the socialization of obtaining and utilizing those agrochemical products should be delivered to the agricultural workers (Lekei et al., 2014). Hence, this community service was generated at a particular agricultural area at Gadog, Bogor Regency by combining chemistry learning with safety induction toward professionals with non-chemical backgrounds to enhance the safety aspect of personnel as well as the environment.

METHOD

The first concern that needs to be known is the real situation of daily happening to the agricultural workers. Accordingly, before H Day, information regarding common issues that could be frequently faced by agricultural workers when handling agrochemicals was thoroughly gained, such as common pesticide products that are easily obtained in the market and symptoms after handling a particular pesticide. Based on that information, learning materials regarding the chemical and technical aspects of handling agrochemicals were prepared in the form of presentation slides. There are several factors to consider in enhancing the optimal knowledge transfer from instructors to the farmers, including the content of the material, the type of media used, and the implementation method. Thus, the presentation materials were slightly adjusted and simplified into conceptual information that could be found in the daily agricultural activities. Afterward, pre-tests and post-tests were designed to display the audiences' understanding. The pretest and post-test were designed to measure the agricultural workers' understanding of the safety aspects of handling chemical agents in agriculture before and after the safety induction activities. The result of the post-test was expected to enhance after the sessions.

At the beginning of the activity, participants filled out pre-test questionnaires before joining the presentation session. The pre-test is carried out in the form of an objective test, which is an assessment test using a score where if you are correct you get 1 point and if you are wrong you get 0 points (Magdalena et al., 2021). The presentation mainly described hazardous chemical agents that could be found in agrochemical products, e.g., organophosphates, carbamates, or DDT, and the safety aspect of handling those chemicals, subsequently. Afterward, the participants were guided to proactively be involved in practical training in wearing appropriate PPE as well as performing emergency aid in case any accidents happen in their work area. After the presentation and the practical training session, a discussion was conducted between the participants and the chemistry lecturers, as instructors, to solve their common problems when using some pesticides and fertilizers products. This discussion is important because discussions are a way for participants to broaden their points of view by expressing their own opinions and from there you will find various new ideas and concepts that will broaden your insight into something (Ermi, 2015). At the end of the program, participants filled out the post-test questionnaire which had the same content as the previous pre-test. The steps of the program are shown in Figure 1.

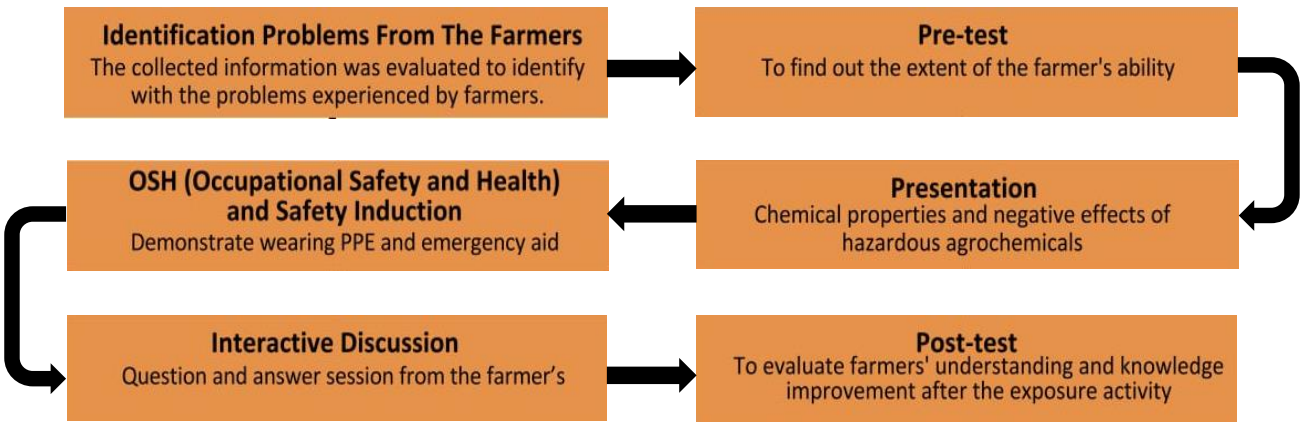

Figure 1. The flowchart for the whole socialization and safety training in handling hazardous agrochemicals

RESULTS AND DISCUSSION

This community service was attended by 30 audiences, while due to particular reason only 19 participants fully participated in the pre-test and post-test sessions. The pre-test itself is carried out at the beginning of the activity to measure the extent of the community's understanding before learning begins, which helps the material provider gather information about the community before teaching (Shivaraju et al., 2017). Most participants were excited in both the presentation and practical training session. Interestingly, some elderly did not find difficulties in the presentation of the PPE topic since one of the three instructors delivered the presentation in Sundanese. In the practical training session, some students creatively helped the participants to quickly memorize the steps of washing hands and wearing PPE by using a particular song followed by the participants. Figure 2 displays some of the activities conducted during the presentation session and the safety induction section.

Figure 2. Four main sessions of the safety induction: pre-test (top-left), socialization (top-right), PPE training (bottom-left), and emergency aid training (bottom-right)

At the end of the session, a post-test was given to the farmers and the result demonstrated an enhancement of their understanding. Post-test is a graded assessment given to recipients of the material after completing a curriculum that was introduced (Hati & Kurnia, 2023). Figure 3 displays a comparison between the pre-test and post-test results for the farmers in terms of their understanding of active pesticide ingredients. Based on the graph in Figure 3, farmers tend to have an increasing knowledge regarding their understanding of active pesticide ingredients and the safety of agrochemical handling. This can be observed in Figure 3, which shows the comparison of percentage values between the pre-test and post-test. According to the data in Figure 3, there is approximately 45% enhancement of the overall participants' understanding of hazardous chemical agents of agrochemicals and proper handling of these chemicals, i.e., from 28% to 52%.

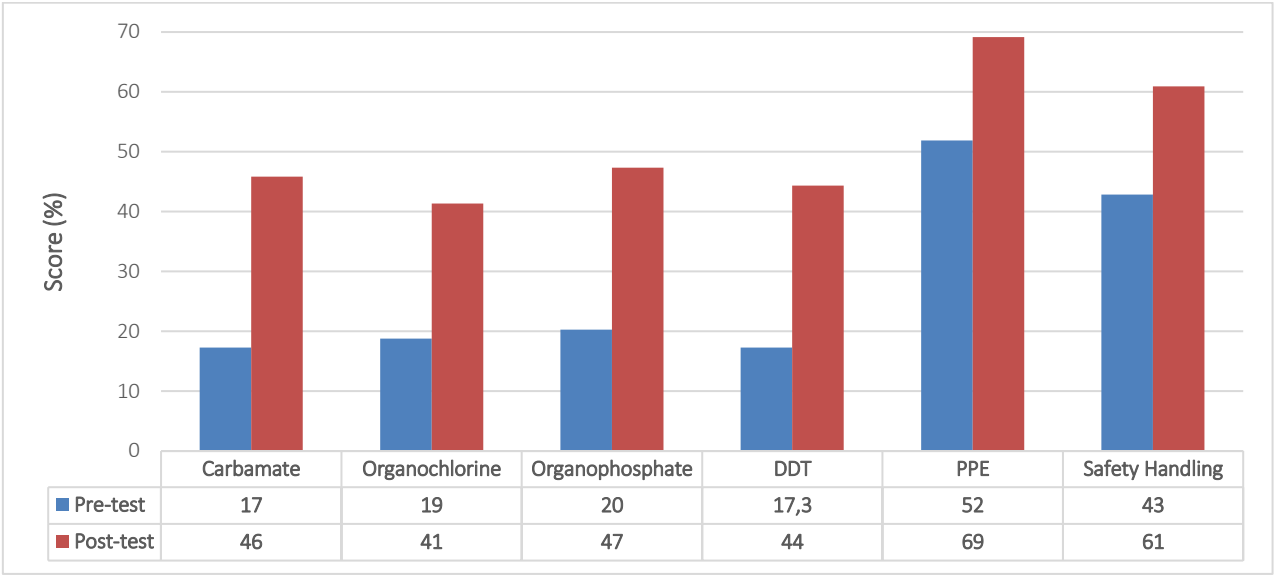

Figure 3. Participants' understanding of the active ingredient of pesticides and their safety handling

Figure 3 depicts an improvement in the audience's understanding of chemistry and technical knowledge of agrochemical handling. The pre-test result shows that most participants' initial understanding only reached below half of the achievement attained after the main session. This indicates that through community engagement, there is a tangible increase in knowledge and understanding among participants regarding exposure to hazardous chemical agents. This not only enhances farmers' awareness of the risks of chemical exposure but also improves their ability to implement preventive measures and proper handling. According to (Marete et al., 2021), in Kenya, the survey established that various classes of pesticides were used in horticultural crop farming and animal production in all three sub-counties, with the most frequently used (> 60 respondents out of 173) being parathion, diazinon, dimethoate, permethrin, pirimiphos methyl, endrin, deltamethrin, dieldrin, propoxur, and endosulfan. It was found that there is a gap between the existing government regulations on pesticide use and safe handling and the implementation of these regulations by dealers, farmers, and farm workers in the three sub-counties as some of the pesticides that were being used such as parathion, endrin, dieldrin, and carbofuran had been banned by the government. Rather than simply focusing on knowledge-based strategies, comprehensive interventions are needed to reduce both exposure and health risks, including training, improvements in labeling, measures to reduce cost barriers to the adoption of safe behaviors, promotion of control measures other than PPE and support for Integrated Pest Management (IPM) (Lekei et al., 2014).

A particular challenge was found during the presentation session, especially in introducing the chemical concept of harmful or deadly compounds of pesticides. Based on our brief observation, most agricultural workers involved in this activity might be unable to fully get the main information of each presentation slide showing the chemical structures of the hazardous agrochemicals since there was barely interactive communication observed in this section. Meanwhile, they started to be interested and proactively asked questions in the presentation session on the safety aspect of wearing PPE and the discussion section, respectively. A profound understanding of the types of chemical agents and effective handling measures is key to mitigating the risks of chemical attacks that can adversely affect society and infrastructure. The encouragement of non-pesticide alternatives for pest and weed control would also have a major impact on the health of both producers and consumers of agricultural products, bringing balance and health to the environment and to agricultural workers (De-Assis et al., 2021). For instance, they asked a confirmation regarding the suitability and safety aspects of mixing different pesticide products at the same time. Consequently, to effectively deliver the main message of appropriate agrochemical handling, it is encouraged to design in-context learning material that contains more technical concepts in relevant scope rather than put too many abstract concepts of chemical structures and their interaction results in the negative effect. In addition, the audience was excited about the session safety induction by the simulation of handling victims exposed to hazardous pesticides. Their interest is confirmed in the increasing result of post-tests.

CONCLUSION

This community service activity demonstrated the enhancement of agricultural workers' awareness regarding the safety aspect of handling and disposing of agrochemicals. Although some chemical concepts related to the chemical structure of harmful compounds of pesticides were challenging to fully deliver, the technical issues in handling agrochemicals were interactively informed and answered, subsequently, during the discussion session. Through this community service, we hope that the combination of their basic understanding of hazardous chemical ingredients and practical experience in handling agrochemicals exposure could diminish the negative impacts of agrochemicals on their health.

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