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Pesticide Toxicity Prevention in Farmer's Community Movement

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Abstract

BACKGROUND: Pesticide toxicity is a serious problem in poor and developing countries agricultural communities, including Indonesia.

AIM: This study aims to design an effort of pesticide toxicity prevention.

METHODS: This is participation action research in look, think, and action cycle of pesticide use process as a qualitative study. The participants were taken by purposive technique and data collected with focus group discussion, in-depth interviews, self-report, and observation. Data were analyzed by thematic analysis. All participants are the commitment farmers that able to prevent and resolve the pesticide toxicity problem. This research has ethical clearance with number 1608/I/SP/2019.

RESULTS: The results found that the determinant factor of pesticide toxicity is a high risk such as direct contact, unusually personal protection used, bad behavior such as spraying while smoking, blowing pump hoses directly, poor personal hygiene, pesticide storage, and disposal action. Several factors that influence are ignorance of farmers about the toxic effects that cause chronic toxicity. To prevent pesticide toxicity, we found the eight principles of pesticide use that formulated based on the epidemiology prevention approach that meets the level of primary, secondary, and tertiary prevention. It called Community Movement in Toxic Resolve or Gerakan Masyarakat Petani Atasi Racun (GEMPAR) arranged as an effort to prevent toxicity, including recognizing the hazard of pesticide, completely personal protection used, paying attention to the wind direction and spraying route, store pesticides in a safe place, safely dispose of pesticides, personal hygiene, record, and report toxicity symptom, and going to organic farming.

CONCLUSION: The effort of pesticide toxicity could prevent in successful by a community movement called GEMPAR that divides into eight principles of prevention action in pesticide used.

Introduction

Pesticide toxicity is a serious problem that often occurs in agricultural communities in poor or developing countries. WHO reports that as many as one million people each year will experience acute toxicity due to pesticides and its prevalence continues to increase in Nicaragua, Indonesia, Vietnam, Brazil, China, Bangladesh, Cambodia, and India. The increase in toxicity rates that occur can reach 8.5–50% annually. In general, the groups most vulnerable to pesticide toxicity are children, women, workers in the informal sector, and poor farmers [1], [2], [3], [4], [5].

Development in the agricultural sector is in line with the higher of pesticide use as an intensification technology. However, it also followed by increasing exposure of pesticide hazards to pesticide sprayers [6], [7], [8]. It is generally caused by improper use of pesticides and characterized symptoms of toxicity and low activity of the cholinesterase [9], [10], [11], [12], [13], [14].

Karo Regency is one of the highlands that were farmers as the majority occupation of the people. Based on the latest test for cholinesterase activity data conducted in 2008, it was found that there was pesticide toxicity in farmers in several regions scattered in Karo District with an average of 55.26–91.25% of all [15]. Some cases handled by Kabanjahe General Hospital occurred as many as 21 cases starting from January to October 2017, generally caused by ingestion of herbicides, pesticides Gramaxone, and Roundup [16]. This percentage shows that the risk of toxicity is very high in pesticides used by farmers in the Karo communities.

Various efforts have been made to reduce the problem of toxicity due to pesticide use. Starting from the development of Integrated Pest Control (IPM) methods, the 6T Principle (Correct Target, Correct Quality, Correct Type of Pesticide, Correct Time, Correct Dosage or Concentration and Correct Way of Use) in pesticide use, biopesticides that are in line with the organic farming system and government also launched a program called Bedah Kemiskinan Rakyat Sejahtera as an empowering

community to improve the welfare of farmers and creating healthy agriculture [17], [18], [19], [20], [21]. To achieve the Sustainable Development Goals, goals of empowerment continues in various fields until the United Nations launched community empowerment by family farming model. It was followed by Indonesia with launching various empowerment programs such as forming independent villages, partnerships, utilizing corporate social responsibility, and establishing the Indonesian Healthy Agriculture Institute with the Healthy Farmers Empowerment program [2], [22], [23], [24], [25].

Horticulture farmers have a high-risk potential to exposure by pesticide cause the plant needs more frequency to be sprayed. The majority of Karo's communities have a high level of alliance and solidarity. The pesticide use is quite high, even farmers are very dependent on pesticides. This dependence is also in line with the risk of pesticide toxicity that can be experienced by farmers due to inappropriate pesticide use and defying to procedures. Farmers also often do not wear personal protective equipment (PPE), thereby increasing the risk of direct contact with pesticides.

It is a chronic problem that has to solve in pesticide toxicity among farmers. Therefore, the purpose of this research is to design an effort of pesticide toxicity prevention that carried out by community movement to reduce the risk of pesticide toxicity. The effort will be created with farmer community participation in action research to identify, analyze, and solve the basic problem behavior in pesticide used. Joint agreement resulting from community participation, stakeholders, community leaders, and researchers as a solution of the problem becomes an effort to prevent the risk of pesticide toxicity.

Methods

It is an applied study with a participatory action research approach cycle that carried out in look, think, and action stages to identify the behavioral risk related to the pesticide use, then analyzed to be used as a basis for formulating prevention efforts that will be carried out (evidence-based). The results of the comprehensive analysis will formulate actions step that taken on subjects and carried out by involving the active participation of the community [26], [27].

The farmers in Karo's communities' plants spread flowers, beans, carrots, potatoes, cabbage, broccoli, and chilies. Agricultural land managed by farmers is also not too large so that farmers have the potential to be empowered. The participants were taken by a purposive technique that selected by who will participate and willing to be an agent, committed, healthy, communicated, and able to work together. Participants will participate in all activities of research to identify (look stage), analyze (think stage), and solve the problem (act stage). Data collected using in-depth interviews and focus group discussion (FGD), self-report, and participatory observation. All action was analyzed in descriptively related to a thematic analysis approach that includes conceptual analysis and relationship analysis [28]. All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted by Universitas Sumatera Utara and the protocol was approved by the Health Research Ethics Committee of the Faculty of Nursing Universitas Sumatera Utara with number 1608/I/SP/2019. Ethical clearance has been proposed by giving freedom to participants (autonomy), doing good (beneficence), not harming (non-maleficence or do not harm), and confidentiality (confidentiality) of the ethical institutions.

Results

Improperly of pesticide use behavior is the basic problem in pesticide toxicity. The farmers' ignorance of the dangers and effects of pesticides always is a reason that shows the poor and dangerous of pesticide use among farmer. Based on the identification of farmers participation found that pesticide use in communities had a high risk such as direct contact with pesticides, not using protective driers, spraying while smoking, blowing pump hoses directly, and poor personal hygiene. Farmers never read the rules of pesticides used but done it according to the information in generations. As a result, farmers never pay attention to the procedures in using pesticides.

The farmers do not use personal protection even though they know it recommended. They do not feel the direct effects of the pesticides and also assume all exposure to pesticides will disappear after bathing. The farmers also disposing of pesticide leftovers around fields or ravines and being left scattered, generally store pesticides in an open bucket medium nearby the kitchen in their house, have poor personal hygiene that caused by the limited availability of water in farming, and take a bath after they have finished their field activities. The average participant has use 4–6 spray tanks for their large field with small hoses to spray. It giving more dangers of risk than using a large hose. There was inconclusive evidence for the association between occupational pesticide exposure and lung cancer (Table 1).

Based on the analysis results, it is necessary to formulate several steps that can be applied by farming communities for reducing the risk of pesticide toxicity. Intervention efforts were formulated jointly with participants who also gave roles as agents of change.

Table 1: Matrix of risk behavior in pesticide use among farming communities

Process in pesticide use	Hazard behavior	Toxicity effect
Media and spray equipment used	1. Suck the end of the spray hose 2. Pressing the end of the spray hose hole	3. Oral exposure (mouth) 4. Dermal (skin) exposure
The type of pesticide used is excessive	Using of three-five even more types at once in a day	Multicomplex intoxication
The process of mixing pesticides	Do not use PPE and the dose of pesticides does not match with packaging label	5. Direct contact 6. By inhalation 7. Splattered 8. Spillage
The process of transferring the mixture to the sprayer	Ergonomic posture (bending, squatting)	9. Sworn 10. Complaints about MSDs 11. Tired due to load frequency
Pesticide spraying process	12. Not in the direction of the wind 13. High spray frequency 14. Effect of plant height 15. Without PPE 16. Spray duration 17. Smoking	18. Splashed, inhaled, ingested, and exposed to pesticides 19. Cumulative intoxication 20. Direct exposure
Post pesticide spraying process	21. Poor personal hygiene 22. Dispose of the remaining pesticide packaging carelessly 23. Store the remaining pesticides in the open area	24. Indirect exposure 25. Environmental pollution

PPE: Personal protective equipment

Participation is carried out, starting from the formulation of the empowerment strategy to implementing the formulated actions and determining the formulation of the community movement steps. This effort created to anticipate the farmer's opinion and requires a social movement that can provide change for the farming community. Awareness of the dangers of pesticides is the first point that must be instilled in their minds. Even though farmers do not consider it to have any effect, farmers have to aware that they are likely to experience chronic poisoning due to the use of pesticides for long periods (Figure 1).

The participation of farmer communities showed the learning by doing process to reach daily habits. It makes it easy for to farmers be aware of the problems and decrease improper of pesticide use. FGD concluded that the intervention of pesticide toxicity is manifested in the social movement that called Community Movement in Toxic Resolve or in Bahasa called Gerakan Masyarakat Petani Atas Racun (GEMPAR). This intervention is very simple and easy to implement because it formulated as a solution from determinant analysis pesticide toxicity before. GEMPAR consists of eight movements that act as a form of social empowerment for the farming community. This action was carried out in such a way as to change the awareness of the farming community which uses pesticides inappropriately and correctly accompanied by the farmers slowly switching to using natural pesticides. GEMPAR actions are systematically arranged referring to the following levels of health prevention are: recognizing the hazard of pesticide used, completely personal protection used, paying attention to the wind direction and spraying route, store pesticides in a safely place, safely dispose of the remaining pesticide packaging, personal hygiene, record and report toxicity symptom and going to chemical-free and organic farming. The results show that participants can accept and participate in implementing GEMPAR as a whole in their daily lives action. A well-done of GEMPAR is expected to prevent the risk of pesticide toxicity and create a healthy community (Table 2).

Based on the evaluation results, the form of acceptance from GEMPAR has expanded by itself not only in the research locations that apply but also extends to all of the farmers that use pesticides. It also improves the safe behavior of pesticide use of pesticides by procedures that reduced the incidence of toxicity around 84%. Knowledge of working safer and healthier also is increased by about 93%. Farmers also use complete personal protection routinely by 100% and 60% of farmers begin to think about avoiding the use of chemical pesticides and switch to safer pesticides that are not even made of chemicals around. Implementation of GEMPAR always shows the increasing of differences changing between the farmer.

Figure 1: Joint meeting with GEMPAR participants

Discussion

Several factors that influence pesticide toxicity are the ignorance of farmers about the toxic effects and unusually personal protection used. They use pesticides based on experience and information from fellow farmers. It based on agricultural products as their income for daily life. Besides, the effects of pesticides felt by farmers are generally temporary and can disappear even though the possibility of reappearance can occur [29], [30], [31], [32], [33]. The results found that the farmers did not pay attention to the procedure. It looks in unsafe behavior that the potential to cause pesticide toxicity. Farmers are routinely exposed to high levels of pesticides, usually much greater than those of consumers. The exposure mainly occurs during the preparation and application of the pesticide

Table 2: Matrix of GEMPAR formulation changes

Initial formulation	First cycle	Second cycle	Third cycle (final formulation)
Recognize the dangers of the poison used	Read the pesticide packaging label	Read the packaging label before using	Read the dangers and effects of poisons on pesticide packaging labels
Use the appropriate PPE	Use PPE complete with waterproof material	Use complete PPE when using pesticides	Use the complete PPE
Pay attention to the wind direction when spraying	Ignoring the direction of the wind	Pay attention to the direction of the wind when spraying and the route/spraying path	Adjust the wind direction and spraying route/path
Store pesticides in a safe place	Store pesticides in closed cabinets	Store pesticides in a closed bucket	Store pesticides in a closed container
Plant all remaining pesticides	Defining and burning the remaining pesticide packaging	Dispose of the remaining pesticide packaging in a closed container	Dispose of the remaining pesticide packaging in a closed container
Personal hygiene	Take a shower after finishing in the fields and wash your hands after spraying	Washing hands with Acem Acem *(Oxalis dehradunensis)* leaves	Clean yourself after spraying
Report poisoning complaints immediately	Understand how to use the SEDARA card	Record complaints on the SEDARA card	Record and report toxicity complaints
Use natural pesticides so farmers are healthy	Not yet able to understand and switch to organic farming systems	Try entering the organic conversion stage	Going to an organic farming system

PPE: Personal Protective Equipment; GEMPAR: Gerakan masyarakat petani atas racun

spray solutions and during the cleaning-up of spraying equipment. The farmers could be exposed when mix, load, and spray pesticides due to spills and splashes, direct spray contact as a result of faulty or missing protective equipment, or even drift. However, farmers can be also exposed to pesticides even when performing activities not directly related to pesticide use. Understanding farmers' perceptions of the risk of pesticides and the determinants of pesticide overuse are important to modify their behavior toward reducing pesticide use [34], [35].

Exposure to the skin, eyes, or other body parts especially cannot be avoided if the plant has grown tall and accidentally exposed because of the changing wind direction when spraying. Skin contact when using pesticides both when mixing, spraying while smoking is one of the significant determining factor for developing health symptoms [36]. Chronic exposure to the body is an event that can gradually dangerous to health. Chronic toxicity is more difficult to detect because it is not immediately felt and does not have specific symptoms and signs. Usually it found in neurotoxic and dermal contact [3], [37], [38], [39], [40]. Spraying patterns in Sumber Mufakat villagers generally do not pay attention to the direction of the wind and are done by going back and forth following the plant beds. That action results in exposing the pesticide sprayed directly on the organs of the eye that are not protected with protective goggles, wind speed, and wind blow as the potential factor to increase the pesticide toxicity [37], [41], [42], [43].

This also happens to farmers in some countries where the farmer feeling uncomfortable after bearing the protective measures which leads to wastage of pesticides and time while doing the spray [44]. Pesticide exposures can be reduced by using PPE in all stages of pesticide handling to minimize pesticide effects on human health. The education of farmers on the hazards of pesticides is crucial for changing wrong behaviors in PPE use. Incorporate of farmers' preferences in extension or health and safety programs to promote safety measures during working with pesticides is important to do [45], [46], [47], [48], [49], [50], [51]. It is a strategy to maximize the protection of pesticide user from hazardous exposures and emphasis on lifelong training and education as crucial for changing wrong behavior in the handling of pesticides [52], [53].

However, awareness among farmers more importance in protecting themselves from hazards associated with pesticide applications is still lacking, especially in Indonesia [48], [54], [55]. Awareness of farmers and authorities needs to be raised regarding the use of protective equipment and correct in handling pesticides; also, there should be strict enforcement of existing pesticide regulations and monitoring policies to minimize the current threats related to pesticide hazards to human health and to the environment prevention strategies for reducing occupational pesticide poisoning, regardless of severity, should be recommended to all types of farming and the level of poisoning severity. Occupational safety and health studies show that safety behaviors among farmers can be affected by many factors, with perceptions, attitudes, and self-efficacy playing a major role [34], [56], [57], [58] [59].

The important behavior of pesticide use has to change where the farmers throw the pesticide package littering around the fields even into the ravine that pollutes the environment. Disposal or storage of pesticides must be done in a safe place and away from water and food sources. Acute and passive pesticide toxicity occurrences also are present in farmers' behaviors. The poor disposal and storage of pesticides could be the health hazards that exposed to farmers' health which may be chronic or acute effects. Production, use, storage, packaging, and disposal of packaging after use processes of pesticides should be controlled to reach the safety farmer [60], [61], [62], [63]. Critical for reducing the risk of developing pesticide-related symptoms and conditions and educational training programs are possible that could be used to control the respiratory diseases associated with pesticide exposure in occupational settings [64].

The health effort to prevent pesticide toxicity is still a scourge among the farmers. In general, farmers have experienced apathetic behavior toward government programs. It caused the top-down management and instantaneous without any definite continuation. The gaps arising from government

programs proclaimed by almost all are ignored by farmers. The apathetic also because the efforts given are only counseling that does not provide benefits for farmers. The changes that are expected from this social movement activity are a procedure of pesticide use and it will continuously grow the farmers' independence in preventing the risk of toxicity. GEMPAR as an empowerment effort can expand farmer networks both in cross-sector, national, and even international. It is because GEMPAR has been packaged as a model that meets the level of primary, secondary, and tertiary prevention efforts in reducing the risk of toxicity.

There is no bottom-up empowerment strategy before, and GEMPAR, as a new bottom-up social movement, made the farming community can be more independent in preventing the risk of pesticide poisoning. This empowerment strategy is more communicative and easy for farmers to implement, so changing habits to be safer and healthier while using pesticides. GEMPAR is unique and universal that combines the health and agriculture program. It could be developed with collaboration, improve the welfare and health of farmers, and open up more promising new market opportunities. The output of the eight-step movement does not require a relatively high cost and can even help improve the economy of farmers both in terms of agricultural production and the health of farmers. It is the specific reason why GEMPAR is a simple social movement to change the poor pesticide behavior into safety and health pesticide use behavior.

Conclusions

The effort to prevent pesticide toxicity in community movement formulated in eight actions that meet the level of primary, secondary, and tertiary prevention, namely, GEMPAR. It could be to increase the awareness of farmers as important prevention of toxicity, the creation of healthy farming communities, pesticide use in accordance with procedures, the creation of self-reliance, and the strengthening of farmer networks.

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