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Awareness Program of Pesticides Used among Farmers using Difficulty-Usefulness Pyramid (A Suggestion for Health Laws and Policies Regarding the Use of Pesticides)

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Abstract

Pesticides are toxic chemical substances that are used in agriculture to control **4**ant pests. Excessive use of pesticides and uncontrolled can cause negative effects among farmers, such as **vomiting, diarrhea, dyspnea, blurred vision, paresthesia, slurred speech, and chest pain**. The prevention effort through health education was used to prevent the risk behavior of farmer, however, it still found obstacles. There are many elements need to be improved and it must be selected which element that significant and priority to change risk behavior among farmers. This study had selected the elements based on Difficulty-Usefulness Pyramid (DUP). The sample was 100 respondents who knew about pesticides in Indonesia. Personal protective equipment (PPE), storage of pesticides, procedure for using pesticides, use of pesticide doses, duration and frequency of spraying pesticides, cleaning the equipment, spraying pesticides based on the wind direction, time of pesticide spraying were selected elements in this study. Difficulty and usefulness were indicators to determine the priority of attributes. Attribute scale (1 to 10) was used based on the level of importance in each attribute. Google form ques**5**naire was used to collect the data. Each element was measured by: (1) **7**difficulty and usefulness; (2) the **mean score of difficulty** and the **mean score of usefulness**; (3) range (from **mean score of difficulty** to **mean score of usefulness**). Then the range was sorted starting from the smallest and presented in the form of a pyramid. The pyramid showed that the priority elements were use of pesticide doses, procedures for using pesticides, personal protective equipment (PPE), cleaning the equipment, time spraying pesticides, duration and frequency of spraying pesticides, storage of pesticides, spraying pesticide based on the wind direction.

Keywords: *Difficulty-Usefulness Pyramid; awareness; chemical pesticides*

Introduction

Pesticides are all chemicals substances to control plant pests such as insects, rodents, nematodes, weeds, viruses, bacteria and microorganisms.⁽¹⁾ Pesticides can increase agricultural product, but it also harm the environment and human health. Excessive use of pesticides and uncontrolled can cause negative effect

among **4**rmers. The negative effects of pesticide exposure were **vomiting, diarrhea, dyspnea, blurred vision, paresthesia, slurred speech, and chest pain**.⁽²⁾ Pest**10**de exposure also depends on the amount of pesticide dose, **duration**7** of exposure and exposure modification factors such as the use of personal protective equipment (PPE)**.⁽³⁾

7 Pesticide exposure is caused by improper management of pesticides, low levels of knowledge about the dangers of pesticides, not paying attention to safety regulation.⁽⁴⁾ The Thai Department of Occupational Health reports that farmers' blood tests show an increase in pesticide exposure in the previous year (16% to 18%).

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This is due to the low level of knowledge, and the risk behavior of formulating pesticides that inappropriate with the instructions.⁽⁵⁾

Spraying pesticides is the most method to used pesticide, because 75% of pesticides are applied by spraying.⁽¹⁾ If the application inappropriate, it can have negative effect among users, targeted pests, as well as the environment.⁽⁴⁾

⁶ The World Health Organization (WHO) estimates that 1-5 million cases of pesticide poisoning occur annually in agricultural workers with death toll raise until 220,000. However, the Ministry of Health and the Department of Agriculture of Indonesia has already given the information related to pesticides.⁽⁶⁾

Farmers as chemical pesticide users often apply it without the standardized rules. Various efforts to control the use of pesticides from the ministry of agriculture to prevent negative effect of exposure and poisoning pesticide but it did not have affect on the behavior of farmers. The survey¹¹ showed that farmers who use chemical pesticides did not use personal protective equipment (PPE) when spraying, the dosage used was according to their preferences, spraying was not based on wind direction, and it made high exposure to pesticides. Based on these problems, it is necessary to conduct awareness program by identifying priority elements related to risk behavior of exposure to chemical pesticides.

Considering that many pesticide control programs in Indonesia are still in the initial and development stages, so this research aimed was to identify and collect public opinion about the difficulties and usefulness of awareness programs for risk behaviors of exposure to chemical pesticides among farmers by using difficulty-usefulness (DUP) pyramid.

Nugroho, et al (2018) introduced DUP as a method for selecting priority elements. In this method, the determination of the elements is conducted through

literature review, while the attributes that used as the basis for determining priorities are difficulty and usefulness. DUP gives equal weight to these two attributes, also the level of importance of difficulty and usefulness as a basis for improvement of elements is equal.⁽⁷⁾ Everyone has different views on the importance of difficulty and usefulness. Some people will assume that the difficult elements should be prioritized to be improved, but some people will assume that useful element should be prioritized to be improved. Based on the background, we proposed a method for selecting elements that will be prioritized, using DUP.

Method

The study was conducted in 2019. The sample was the general public who knew about the use of chemical pesticides in Indonesia. This study involved 100 respondents spread in Indonesia. This study used DUP to select elements based on priority and the difficulty and usefulness attributes. The following steps were:

1. Determination of the elements

The selection of the priority elements of the awareness program on the use of chemical pesticides among farmers based on DUP creation study.⁽¹⁾ The selected elements based on the review literature. Applications of pesticides from Djojosoemarto were: using personal protective equipment (PPE), storage of pesticides, the procedure for using, use of pesticide doses, duration and frequency of spraying pesticide, maintain cleanliness of equipment, spraying pesticides in the direction of the wind.

2. Determination of attributes

According to DUP, difficulty and usefulness were used as priority attribute.^(7,8) Based on DUP, difficulty was scored with a negative symbol (0 to -10), so the higher the difficulty of an element, the score was negative. Usefulness was scored with a positive symbol (0 to 10), so the higher the usefulness of an element, the score was positive.^(7,8)

Table 1. Questionnaire for selecting elements of awareness of pesticides used based on priority

Difficulty	Elements	Usefulness
High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 Low	Personal protective equipment (PPE)	Low 0 1 2 3 4 5 6 7 8 9 10 High
High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 Low	Storage of pesticides	Low 0 1 2 3 4 5 6 7 8 9 10 High
High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 Low	Procedure for using pesticides	Low 0 1 2 3 4 5 6 7 8 9 10 High
High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 Low	Use of pesticide doses	Low 0 1 2 3 4 5 6 7 8 9 10 High
High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 Low	Duration and frequency of spraying pesticides	Low 0 1 2 3 4 5 6 7 8 9 10 High
High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 Low	Maintain cleanliness of equipment	Low 0 1 2 3 4 5 6 7 8 9 10 High
High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 Low	Spraying pesticides in the direction of the wind	Low 0 1 2 3 4 5 6 7 8 9 10 High
High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 Low	Time spraying pesticides	Low 0 1 2 3 4 5 6 7 8 9 10 High

3. Data collection and analysis

At this stage, data collection was carried out through questionnaires (Table 1). Respondents were asked to fill in the Google form questionnaire that was sent via the Whatsapp application, one mobile number only can fill the questionnaire once. The next step was descriptive data analysis: (1) making the difficulty scores of each element with the importance of difficulty; (2) making the usefulness score of each element with the importance of usefulness; 3) calculating the mean score of difficulty and the mean score of usefulness; 4) calculating the range that starts from the mean score of difficulty to the mean score of usefulness; 5) rank according to the

smallest range; 6) draw a pyramid diagram based on the sorted range; 7) determine the elements based on priority order according to the pyramid diagram.

Findings

The results of descriptive data analysis were shown in Table 2. The ranges were arranged sequentially starting from the smallest as shown in Table 3. The sorted ranges were presented in the form of a pyramid diagram. The largest range was in the lowest position, while the smallest range was in the top position (Figure 1).

Table 2. Mean score and range

Mean score of difficulty	Elements	Mean score of use usefulness	Range
5.47	Personal protective equipment (PPE)	7.32	12.79
5.28	Storage of pesticides	7.1	12.38
5.85	Procedure for using pesticides	7.01	12.86
5.94	Use of pesticide doses	7.03	12.97
5.68	Duration and frequency of spraying pesticides	6.92	12.60
5.54	Maintain cleanliness of equipment	7.19	12.73
5.26	Spraying pesticides in the direction of the wind	7.09	12.35
5.49	Time spraying pesticides	7.12	12.61

Figure 2 showed the largest range (the lowest position in the pyramid) was the use of pesticide doses. Thus, to awareness of the use of chemical pesticides was priority “Use of pesticide doses, then the next priority is procedure for using pesticides, personal protective equipment (PPE), maintain cleanliness, time spraying pesticides, duration and frequency of spraying pesticides, storage of pesticides, and finally spraying pesticides based on wind direction. Further recommendation, the five elements with the largest range are prioritized for improvement (Use of pesticide dosages and links to resources, procedures for using pesticides, personal protective equipment (PPE), maintain cleanliness, time spraying pesticides, duration and frequency of spraying pesticides)

Table 3. The rank of mean score based on range

Mean score of difficulty	Elements	Mean score of use usefulness	Range
5.26	Spraying pesticides in the direction of the wind	7.09	12.35
5.28	Storage of pesticides	7.1	12.38
5.68	Duration and frequency of spraying pesticides	6.92	12.60
5.49	Time spraying pesticides	7.12	12.61
5.54	Maintain cleanliness of equipment	7.19	12.73
5.47	Personal protective equipment (PPE)	7.32	12.79
5.85	Procedure for using pesticides	7.01	12.86
5.94	Use of pesticide doses	7.03	12.97

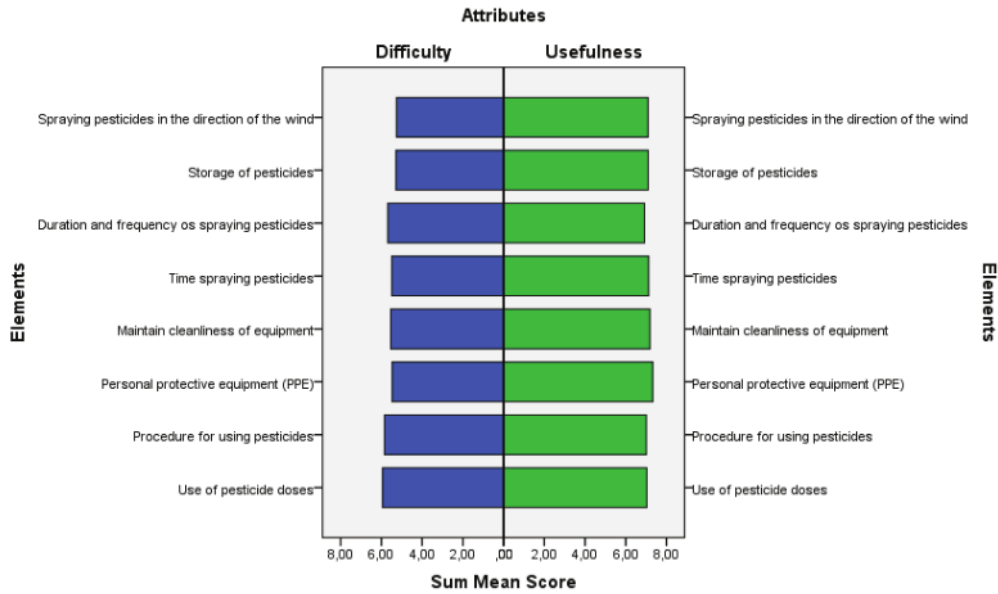


Figure 1. The rank of mean score

From the pyramid, it can be concluded that the range of the eight elements is almost the same, but if examined based on priorities, the four main elements that are prioritized for improvement are the use of pesticide doses, procedure for using pesticide, PPE and maintain cleanliness of equipment.

Discussion

This study had a new method to refinement the DUP. DUP is the initial method to develop awareness program of pesticides used among farmers. Determination of the awareness elements of the use of chemical pesticides are based on ten elements used in popular pesticide exposure prevention programs, namely use of pesticide doses, procedures for using pesticides, personal protective equipment (PPE), maintain cleanliness of equipment, time spraying pesticides, duration and frequency of spraying pesticides, storage of pesticides, and spraying pesticides based on wind direction

The attributes for determining priorities based on DUP were difficulty and usefulness. In the process of creating DUP, the two attributes were chosen based on literature review. The awareness program of pesticides used is a prevention program to prevent exposure to chemical pesticides when applying pesticides either in the field or in storage of pesticide. The determinants

were selected by using the text book of “Application of Pesticides” written by Djojsumarto⁽¹⁾. The analysis used the Difficulty-Usefulness Pyramid (DUP) theory. DUP mentioned that “difficulty” was an attribute that had to be reduced, so it had a negative score; while “usefulness” is an attribute that must be improved, so it had a positive score.^(7,8)

Figure 2 showed that the different ways of scoring for difficulty and usefulness, the result was the bars in the opposite direction. The left for “difficulty” and right for “usefulness”. In this case, the priority is the element with the largest range starting from the value of “difficulty” to “usefulness”. The use of pyramid diagrams is intended to analysis and understood the result quickly. From the pyramid, it can be concluded that the range of the eight elements is almost the same, but if examined based on priorities, the four main elements that are prioritized for improvement are the use of pesticide doses, procedure for using pesticide, PPE and maintain cleanliness of equipment.

Pyramid diagrams can be depicted using computers manually or using statistical software that provides facilities such as SPSS.⁽⁹⁾ In this study, DUP was created by using population pyramid, with several changes, namely: 1) “variable” form is filled by mean score, 2)

“show distribution over” form is filled by elements of alertness program use of pesticides, 3) “split by” form is filled by attributes.^(7,8)

By using DUP, drawing can be conducted easily because the results of data analysis are presented visually in the form of a pyramid. In this case, the element at the lowest position was the first priority, while the element at the top position was the last priority. Recommendations can also be conveyed more easily because they only refer to the priorities. Based on the conclusions and recommendations, managers can immediately plan for the improvement of the elements of awareness program of the pesticides used.

In this study, the DUP process was used to increase awareness of chemical pesticides used in the health and agriculture sectors, but it is also recommended to use DUP into other objects, such as hospital information systems, telemedicine, health service systems, e-Health, health e-journal and so on. In advance, elements must be selected through literature review, focused group discussion or brainstorming that involving the users of the related system.

Conclusion

Based on the result, it can be concluded that the four main elements that are prioritized for improvement are the use of pesticide doses, procedure for using pesticide, PPE and maintain cleanliness of equipment. This finding is expected to contribute significantly to increase awareness program of the pesticides used among farmers in agriculture, environmental toxicology and health.

Conflict of Interest: No

Source of Funding: Authors

Ethical Clearance: Yes

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6
