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Extension Design on the Production of Vegetable Pesticide from Belt Leaves in Controlling Aphids on Red Chilli in Kayukebek Village Pasuruan

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Abstract*. Kayukebek Village is one of the villages that has the potential for agricultural development in horticultural crop commodities, especially red chilies due to high market demand and quite good agricultural productivity, namely around 8.42 tons/Ha. However, the obstacle often faced by farmers is the attack of aphids on red chili plants, resulting in a decrease in production. The aim of this research is to design an extension design and analyze the increase in farmers' knowledge, attitudes and skills regarding the use of botanical pesticides in controlling aphids. The research was conducted from January to May 2024. The research method used was the Level III action research method with the stages followed, namely planning, action, observation and reflection. The results of observation and reflection show that extension is able to increase farmers' knowledge by 44%, from the pre-test value of 47%, it increases to 91% in the post-test value with a percentage of extension effectiveness of 82% and is in the effective category. Meanwhile, in the attitude aspect, the percentage is 87%, and in the skills aspect it is 93%, which can be categorized as a very high score. These results show that the extension design implemented has proven to be effective in changing farmers' behavior both in increasing knowledge and determining attitudes as well as developing farmers' skills in making vegetable pesticides to control aphids on red chili plants.*

Keywords: *Changes in farmer behavior, Extension design, Vegetable pestiside*

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INTRODUCTION

Red chili plants are one of the horticultural crop commodities that continue to be cultivated by farmers in every region in line with community growth and demand continues to increase. One of the areas in East Java that has potential in the agricultural sector, especially in the cultivation of red chili plants, is Kayukebek Village. Kayukebek village is located in Tutur sub-district, Pasuruan district at an altitude of 1,100-1,400 meters above sea level. Kayukebek Village has a red chili planting area in 2023 of 21.45 hectares with a total productivity of 8.42 tonnes/Ha (Tutur District Program, 2024).

Red chili plants are one of the leading commodities cultivated by farmers in Kayukebek Village alongside other commodities such as tomatoes, apples and oranges. However, in the course of its development, farmers' interest in cultivating red chilies has begun to decline, as evidenced by the decline in the number of areas planted with red chilies in recent years. Tutur District Program Data (2024), shows that in 2022, the planting area for red chilies will be 47.45 hectares and in 2020 it will be 49.23 hectares. The planting area for red chilies is much higher than the area planted for red chilies in 2023, which will only be 21.45 hectares. This is because red chili plants are often attacked by pests and plant diseases which cause material losses.

One of the pests that often attacks red chili plants is aphids. Attacks by aphids can result in losses to chili plants of around 10-30% and in the dry season this can increase to 40% (Ma'ruf et. al., 2024). Based on the impact caused by aphids on red chili plants, pest control needs to be carried out to reduce or control the level of aphid attacks so as not to cause damage to plants and decrease production. In general, the control measure that is often used is the application of synthetic pesticides, including profenofos, difenoconazole, dimehipo, cypermethrin, azoxistrophin, bamectin and propineb (Endrizal et. al., 2014; Meilin, 2018).

The use of synthetic pesticides in controlling aphids is not always beneficial for agricultural land and has several negative impacts, including making pests resistant (resistant) and exacerbating pests (resurfence) as well as the buildup of chemical residues on crop yields (Arifin, 2012). Based on this, it is hoped that farmers will need to look for other alternatives as a substitute for synthetic pesticides, which is in line with the agricultural development paradigm which leads to the concept of organic and environmentally friendly agriculture.

Efforts to control aphid pests that can be attempted are the use of pesticides made from plant materials which are more environmentally friendly and safe. One of the vegetable ingredients used in making vegetable pesticides is betel leaves. Betel leaves are a local ingredient that is easy to obtain because many residents in Kayukebek Village plant betel leaves in their yards to use as a medicinal plant. This makes betel leaves one of the plants that have the potential to be used as a botanical pesticide. Betel leaves have a distinctive aroma that comes from the essential oil content of 1-4.2%. The essential oil content in betel leaves contains natural phenols which have antiseptic power 5 times stronger than ordinary phenols (bactericides and fungicides). Betel leaves are also composed of hydroxy kavikol, kavibetol, estragol, eugenol and methyleneugenol which are generally used as medicines and also natural pesticides (Aulung, 2010).

As a result of an in-depth study of the problem carried out by researchers through interviews with farmers in Kayukebek Village, it can be seen that farmers still predominantly use chemical pesticides and have not used vegetable pesticides in efforts to control aphid pests. Based on the description of the problems and potential identified in Kayukebek Village, it is necessary to carry out outreach activities on making betel leaf vegetable pesticides in dealing with aphids on red chili plants as one step in disseminating innovation and learning processes for farmers in Kayukebek Village. With outreach, farmers are expected to be able to use vegetable pesticides to control pests in their farming activities and at the same time as an effort to implement the concept of sustainable agriculture.

The aim of this research is to develop an extension design that suits the characteristics of farmers and analyze the effectiveness of the extension design. With the extension activities, it is hoped that it can change the behavior (knowledge, attitudes and skills) of farmers in Kayukebek Village regarding the use of betel leaf vegetable pesticides to control aphids on red chili plants.

LITERATURE REVIEW

Betel leaves contain chemicals such as 0.8-1.8% essential oils which include chavikol, chavibetol, allylprocatechol, allypyrocatechol mono, diacetate, carvacrol, eugenol, p.cymene, cineole, caryophyllene, cadinene, esragol, terpenes, sesquiterpenes, phenyl propane, tannin, diastase, carotene, thiamine, ribovlavin and amino acids (Arsensi, 2013; Mistaji et. al., 2022). The kavikol content in betel leaf essential oil can weaken the

chitin layer that makes up insect cuticles. The chitin layer functions to protect the trachea so that it remains strong as a pathway for air flow throughout the insect's body (Lastri, 2017).

Agricultural extension is a process of social, economic and political change to empower and strengthen community capabilities through a participatory collective learning process so that behavioral changes occur in all stakeholders (individuals, groups, institutions) involved in the development process, in order to create an increasingly empowered life, independent and participatory (Zulkifli & Sibuea, 2022).

In general, it can be stated that the purpose of extension is to increase knowledge, skills and change farmers' attitudes in running their farming business towards better farming (Better Farming), more profitable farming (Better Business), and living a more prosperous life (Better Living). Specifically, the goal of extension is to increase knowledge, skills, attitudes and motivation, although there are very influential factors that must be faced in achieving this goal, namely driving factors, inhibiting factors and disturbing factors (Romadi & Warnaen, 2021).

RESEARCH METHODS

This research was carried out in Kayukebek Village, Tutur District, Pasuruan Regency. The research implementation period starts from January to May 2024. The research method used is the level III action research method where at this level the researcher conducts research to find problems, potential or initial conditions and then determines or develops actions and tests these actions as an effort. for troubleshooting and performance improvements.The data collection techniques used at the research stage were interviews, observation and documentation.The target sample for extension was determined using a purposive sampling technique, and the number of targets for extension was 20 respondents who were red chili farmers in Kayukebek village.

Analysis of extension evaluation data was carried out using qualitative and quantitative analysis methods. Qualitative methods for describing observation results include identifying areas, targeting interviews and analyzing the potential and problems of the Kayukebek Village area. Meanwhile, quantitative analysis uses scoring analysis techniques to determine specific values and is then used to conclude the level of success of the extension in the form of increased knowledge, attitude level and skill level of the extension target.

The results of data collection are presented in the form of percentage values and then categorized into value criteria according to Arikunto (2010), namely:

0-20% : Very low

21-40% : Low

41-60% : Currently

61-80% : Tall

81-100%: Very High

The effectiveness of the extension design in increasing farmers' knowledge was analyzed using the criteria for extension effectiveness according to Ginting (2005), namely:

Effective : > 66.66%

Effective enough : 33.33 - 66.66%

Less Effective : < 33.33%

The formula for the effectiveness of the extension design in increasing knowledge is used as follows:

$$E.P = \sum \frac{Ps - Pr}{N \,.\, t \,.Q - Pr} x100\%$$

Information:

EP: Effectiveness of Extension

PS: Post Test Score

Pr: Pre Test Score

N: Number of Respondents

t : Highest score

Q: Number of Questions.

RESULTS AND DISCUSSION

1. Determining Extension Objectives

The objectives of the extension were formulated according to the content of the problems found in the Kayukebek Village area which were then appointed as extension material by referring to the SMART principles (Specific, Measurable, Achievable, Relevant and Time Bound). The objective of the extension to be achieved in the implementation of the extension is to change behavior related to increasing the

knowledge, attitudes and skills of farmers in Kayukebek Village regarding the manufacture of betel leaf vegetable pesticides in controlling aphid pests on red chili plants.

2. Goal Setting

Extension targets are determined based on the results of identifying the goals and targets to be achieved in overcoming the problems found. Based on this approach, the extension targets set in this extension are red chili farmers who are members of the Taman Madani farmer group, Kayukebek Village. The number of extension targets set was 20 people who were then distributed based on the characteristics of age, education and farming experience. The complete data regarding the characteristics of extension targets is as follows:

Table 1. Characteristics of Extension Targets

Individual Characteristics	Category	Number of Individuals	Percentage (%)
Age (years)	17 – 25	4	20
	26 – 35	8	40
	36 – 45	5	25
	46 – 55	3	15
Total		20	100
Education	Elementary School	2	10
	Junior High School	3	15
	Senior High School	12	60
	S1	3	15
Total		20	100
Farming experience (years)	<10	13	65
	11-20	6	30
	>20	1	5
Total		20	100

Source: Primary data processed in 2024

Based on the data in Table 1, it can be seen that the characteristics of the targets based on age show that of the 20 extension targets, the largest number was in the 26-35 year interval, numbering 8 people with a percentage of 40%. Meanwhile, the lowest number of targets was in the 46-55 year interval, 3 people with a percentage of 15%.

If observed further, it can be concluded that the overall target of extension is in the productive age range (15-64 years). Farmers who are still in their productive working age generally have good abilities in developing their farming business and have greater motivation to seek information in the form of new knowledge that will be used to increase

their farming income. This is supported by the opinion of Setiyowati et. al. (2022), who said that the productive age group has high motivation and enthusiasm in running their farming business.

The target characteristics are based on educational level with the largest percentage being at the senior secondary school (SMA) level of 12 people with a percentage of 60%. Meanwhile, the lowest number was in the elementary school (SD) group with 2 people with a percentage of 10%. The level of education greatly influences the way of thinking and the ability to reason about knowledge so that it can influence a farmer in making decisions in developing his farming activities. With a higher level of education, the ability to adopt the innovations presented will be greater. This is in accordance with the opinion expressed by Kamarudin et. al. (2020), which states that education plays a strategic role in efforts to achieve sustainable economic development (substainable development) so that it can support production processes and other economic activities.

In general, farmers have farming experience that has been passed down from generation to generation because farming and raising livestock are daily activities to meet life's needs. According to Setiyowati et. al (2022), farming experience can be grouped into 3 groups, namely ≤10 years in the Low group, 11-20 years in the medium group and >20 years in the high group. Based on Table 1, it can be concluded that the majority of extension targets fall into groups who have farming experience of less than 10 years or can be categorized as farmers with less experience. This is relevant to the age characteristics of farmers and the level of education of farmers, the majority of whom are still in the age range of millennial farmers with formal education levels at the upper middle level, so there is a tendency for extension targets to choose farming activities as a job after completing their education.

3. Determination of Extension Materials

The extension materials used in extension are determined through several stages, namely collecting problems faced by farmers in Kayukebek Village, analyzing problems with problem priority testing and determining extension materials with an extension material decision matrix. The educational material delivered to farmers is related to the benefits, how to make it, how to apply it and the effect of applying vegetable pesticides on controlling aphids on red chili plants.

4. Method Determination

Based on the method selection stages that have been described, the methods that are suitable to be applied are anjangsana, group meetings, applied studies, and field visits which are implemented in extension activities.

a. Anjangsana method

The anjangsana or visit method is an agricultural extension activity carried out directly to the target. The anjangsana method is used in the first extension to specifically identify conditions related to farmers' knowledge, attitudes and skills before extension.

b. Group meeting method

Method selectionGroup meetings are intended so that each individual has the opportunity to voice opinions, share experiences and contribute to discussions so that decision making can be carried out collaboratively between researchers and extension targets.

c. Applied study method

The choice of the applied study method as one of the extension methods is to demonstrate a clearer understanding of the extension material to be conveyed because it is done together.-Same as the target of extension.

d. Field visit method

ElectionThe field visit method is intended so that the extension target has the opportunity to directly observe the learning objects that have been presented in the previous extension, so that the extension target has a contextual understanding of how to apply the betel leaf vegetable pesticide to deal with aphid pests on chili plants.

5. Media Determination

a. Leaflets and folders

The use of leaflets and folders is one form of implementation of printed extension media. In general, leaflets and folders have similar characteristicsdifferent so that their use needs to be adjusted to the goals to be achieved. Leaflets are a medium for information or learning about a specific material topic with a short, concise, easy to understand presentation and attractive pictures. Meanwhile, Folders have more complete, in-depth and structured characteristics.

b. Real media

It is hoped that the use of media can actually help improve farmers' understanding and skills in implementing better agricultural practices, especially regarding the manufacture and application of betel leaf vegetable pesticides to control aphid pests on red chili plants.The actual media used in this research are tools and materials for making betel leaf vegetable pesticides as well as samples of betel leaf vegetable pesticides that are ready to be applied with the aim of providing direct understanding to the outreach targets.

c. Tutorial video viewing

The choice of video media as a type of audio-visual media in agricultural extension activities is considered effective for conveying information visually and interestingly. Another advantage is that the message it conveys is quick and easy to remember, provides a more realistic picture, develops the target's thoughts and opinions and the video can be repeated to increase clarity.

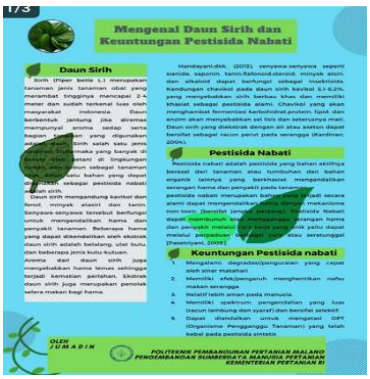

Figure 1. Leaflet

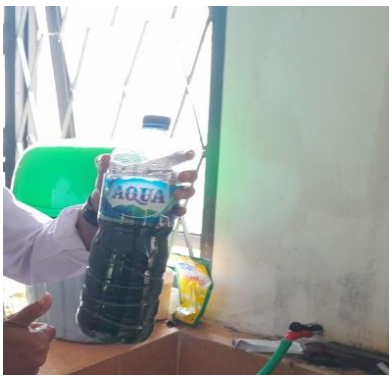

Figure 2. Vegetable Pesticides

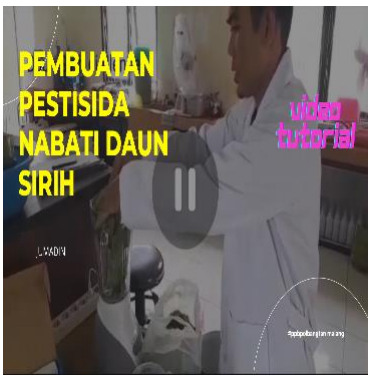

Figure 3. Video Tutorial

6. Implementation of Extension

Extension activities are carried out in 4 stages which are carried out at home or at the agricultural business location of the target of the extension with a specified implementation time that has been previously agreed between the researcher and the target. In its implementation, it must fulfill administrative files related to LPM (Extension Preparation Sheet), synopsis, minutes and attendance list, as well as a questionnaire that has been tested for validity and reliability as a data collection instrument.The complete implementation of extension at each stage is listed in Table 2.

Table 2. Agricultural Extension Curriculum Matrix

Target	Material	Method	Media
20 People	Introduction to betel leaves as a botanical pesticide to control aphid pests	Anjangsana	Leaflet
20 People	How to make betel leaf vegetable pesticide	Group Meetings	Real Folders and Objects
20 People	How to apply betel leaf botanical pesticide to red chili plants	Review the application	The Real Thing
20 People	The effect of applying betel leaf botanical pesticides on controlling aphids	Field Visit	Videos

Source: Primary data processed in 2024

In general, outreach is carried out with several outreach programs as follows.

a) Opening

At the beginning of the extension activity, it begins with an introduction and conveying the aims and objectives. This aims to create a more intimate atmosphere as part of the implementation of adult education.

b) Delivery of material

The delivery of the material is carried out as flexibly as possible with questions and answers that can arouse farmers' interest and curiosity in the material being taught.

c) Closing

The final activity is the closing which closes with thanks to the target of the outreach and at the same time saying goodbye.

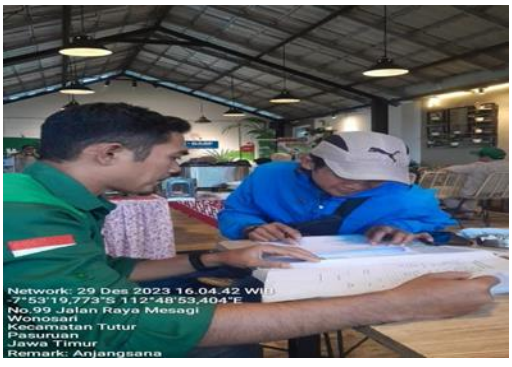

Figure 4. Phase I Extension

Figure 5. Phase II Extension

Figure 6. Phase III Extension

Figure 7. Phase IV Extension

7. Evaluation of Extension Results

Extension evaluation is carried out with the aim of assessing the extent to which the stated extension objectives can be achieved with the implementation of the extension design. The type of evaluation used in implementing this extension evaluation is the results evaluation type. Results evaluation is used by researchers to assess the impact of extension activities on the knowledge, attitudes and skills of extension targets as well as the results that can be achieved by providing education on the use of betel leaf vegetable pesticides to control aphid pests on red chili plants. The results of the extension evaluation are as shown in Table 3.

Table 3. Summary of Extension Evaluation Values

Aspect	Maximum Value	Evaluation Value				Enhancement	%
		Pretest	%	Posttest	%		
Knowledge	360	168	47 (currently)	331	91 (Very high)	163	44
Attitude	1,600	-	-	1,405	87 (Very high)	-	-
Skills	960	-	-	894	93 (Very high)	-	-

Source: Primary data processed in 2024

a). The effectiveness of extension design in increasing knowledge

The percentage increase in knowledge of the extension target can show that the extension carried out has succeeded in increasing knowledge of the extension target. In general, an increase in knowledge can occur due to the influence of the extension design used, so to find out the percentage of effectiveness of the extension design in increasing knowledge, it can be calculated using the following formula:

$$E.P = \sum \frac{Ps - Pr}{N \,.\, t \,.Q - Pr} x100\%$$

$$= \sum \frac{331 - 168}{20 \,.\, 1 \,.\, 18 - 168} x100\%$$

$$= 82\%$$

Based on the results of this analysis, it shows that the implemented extension design has an effectiveness percentage of 82% or can be categorized as effective in increasing knowledge of the extension target. This can prove that the process of determining extension methods and media which is carried out in stages and in accordance with the objectives and characteristics of the extension target has a great influence on the success of delivering extension material to the target.

In the established extension design, one of the approaches used is a group approach through group learninguse of group meeting methods. The application of the group meeting method is also supported by the availability of audio-visual education media such as showing video tutorials on making betel leaf vegetable pesticides. The use of audio-visual media is considered suitable in helping to deliver extension material because it can increase the focus of the extension target. This is supported by the opinion of Hamtiah, et. al. (2012), which states that the use of audio-visual or video media has a role in increasing the knowledge of respondents or audiences.

b). Attitude aspect

Based on the summary of the evaluation results in Table 3, it can be seen that the attitude value of the extension target is in the very high value category with a percentage of 87%. Changes in the attitude of the extension target can be influenced by other factors such as experience gained through the frequency of participation of the extension target in the extension stages designed by the researcher. The extension design prepared in this research uses the action research method and implements extension in 4 stages with different objectives at each stage. So it can be said that there is a relationship between changes in the attitude of the extension target and participation at each stage of the extension. This is supported by the opinion of Prasetyo et. al. (2021), which states that farmers' attitudes can be seen from the skills gained from their participation in the extension process carried out.

c). Skills Aspect

Based on the summary of the evaluation results in Table 3, it can be seen that the skill value of the extension target is in the very high value category with a percentage of 93%. These results show that all of the 20 people targeted for extension can be categorized as skilled and capable of making and applying betel leaf vegetable pesticides to control aphid pests on red chili plants. The application of several extension methods prepared by researchers is very appropriate or effective in developing skills. The learning method used can enable extension targets to participate in the practice of making and applying betel leaf vegetable pesticides directly, so that extension targets can understand the process of making and how to apply betel leaf vegetable pesticides correctly according to recommendations.

Another factor in developing the skills of extension targets can occur because the majority of extension targets have farming experience that is classified as medium (11-20 years) and high (>20 years), so that farmers are accustomed to developing innovations. This is supported by the opinion according to Amron & Imran (2009), that the more experience a farmer obtains, the more skilled and trained the farmer will be in his farming business.

CONCLUSION

The extension design implemented on the extension target was successful in increasing knowledge by 44% from the knowledge value before the implementation of the extension, namely 47% in the medium value category, increasing to 91% in the very high value category. In the aspect of attitude, the target of extension received a score of 87% and the skill level after extension was 93%, which can be categorized as a very high score, and the 20 people targeted for extension can be categorized as skilled and capable of making and applying betel leaf vegetable pesticides in controlling aphids in red chili plants. Increasing aspects of knowledge and attitudes can occur with several influencing factors, including the implementation of an extension design that is in accordance with the characteristics of the extension target. The effectiveness of the extension design in increasing knowledge of the extension target was 82% which can be categorized as effective.

Based on the conclusions that have been outlined, there are several suggestions that can be given for the sustainability of the extension program in the future. There needs to

be ongoing assistance by agricultural extension workers to ensure farmers can apply betel leaf botanical pesticides correctly. Developing a betel leaf botanical pesticide formulation that is easier and more practical for use by farmers by involving research and research institutions in order to study the effectiveness and potential development of betel leaf as a botanical pesticide.

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