ICAAD
International Conference on Agriculture and Agribusiness Development

INTERNATIONAL CONFERENCE on AGRICULTURE and AGRIBUSINESS DEVELOPMENT

UNIVERSITAS MURIA KUDUS
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"Nurturing a Resilient Future through Circular Economy Practices"

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FOREWARD FROM THE CHAIRMAN COMMITTEE

Distinguished keynote speakers, respected scholars, researchers, practitioners, and esteemed guests, Ladies and gentlemen.

It is with great honor that the Faculty of Agriculture, Universitas Muria Kudus, presents the International Conference on Agriculture and Agribusiness Development (ICAAD). This year's theme,

"Nurturing a Resilient Future through Circular Economy Practices," is not only timely but also profoundly relevant to the global discourse on sustainable development. This conference serves as an international academic forum that brings together scholars, researchers, professionals, and policymakers to exchange knowledge, share research findings, and discuss current trends and future directions in the fields of agriculture and agribusiness.

The rapid changes in global agricultural systems, driven by technological advancement, climate variability, and market globalization, necessitate continuous research and innovation to ensure sustainable agricultural and agribusiness development. The ICAAD provides an essential platform for presenting scientific research and promoting interdisciplinary collaboration aimed at addressing challenges related to food security, sustainability, and rural economic development.

The papers included in this proceeding reflect a wide range of topics, methodologies, and perspectives that contribute to the advancement of knowledge and practice in agricultural and agribusiness studies. It is our expectation that these scholarly contributions will provide valuable insights and serve as a reference for further academic inquiry, policy formulation, and practical applications in the agricultural sector.

The Organizing Committee extends its deepest appreciation to all contributors—keynote speakers, presenters, reviewers, and participants—for their invaluable participation and scholarly input. We also convey our sincere gratitude to the supporting institutions and partners whose collaboration and commitment have made this event and publication possible.

We hope that the proceedings of the International Conference on Agriculture and Agribusiness Development (ICAAD) will serve as a meaningful contribution to the global discourse on sustainable agriculture and agribusiness innovation.

Ir. Shodiq Eko Ariyanto, M.P
Chairman of the 1st ICAAD Committee

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International Conference on Agriculture and Agribusiness Development

THE RESPONSE OF BRAN AND UREA DOSAGE ON THE GROWTH AND YIELD OF CHICKEN LEG MUSHROOM (*Coprinus comatus*) ON RICE STRAW MEDIA

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Abstract Straw is one of the waste products from rice harvesting. Production of fresh rice straw produced from one hectare of rice fields varies between 12-15 tons/harvest season or around 4-5 tons/ha/dry straw which is still not utilized. The amount of straw waste is also found in Batealit District, Jepara Regency with ± 22.8 tons of straw waste that has not been utilized. The high cellulose content in rice straw has the potential to be utilized, as an alternative medium for the growth of chicken thigh mushroom (Coprinus comatus). Chicken thigh mushroom (Coprinus comatus) is a type of mushroom that can be consumed and has high nutritional value, and contains active compounds such as immunomodulators, hypolipidemic, anticancer, natural insecticides and antioxidants which have the potential as a source of medicine. Rice bran and urea fertilizer can also be used in the cultivation process of Chicken Thigh Mushroom (Coprinus comatus) to increase the nutrients needed in chicken thigh mushroom cultivation media. This study used factorial Complete Randomized Block Design (RAKL). Factors The first factor is the dose of rice bran (B), divided into three levels, namely 0%, 2% and 4%. The second factor is the dose of urea (U), which consists of three levels, namely 0.4%, 0.8% and 1.2%. The final results showed that there was no interaction between factors, but the dose of bran affected the initial appearance of the first mushroom fruiting bodies, the total number of mushroom fruiting bodies, and the average mushroom fruiting body diameter 8 days after incubation. The dose of urea affected the total number of mushroom fruiting bodies, the average fresh weight of the mushrooms each harvest, the total fresh weight of the mushrooms, the average diameter of the mushroom fruiting bodies, the length of the harvest period, the temperature of the mushroom media.

Keywords: *waste, Coprinus comatus, rice bran, urea*

INTRODUCTION

The rice farming area in Batealit District, Jepara Regency in 2021 reached 2,582,500 hectares, producing approximately 16,364,070 tons of paddy (BPS, 2022). According to the research (Herman et al., 2022), during the harvest season, rice straw is abundantly generated with an average grain yield of 5 tons per hectare. Therefore, it is assumed that each hectare can produce straw up to 7.5 tons with a rice straw ratio of 2:3. The fresh rice straw production per hectare varies between 12-15 tons per harvest season, or around 4-5 tons per hectare under dry conditions. Consequently, only a small portion of rice straw waste is utilized for animal feed, while the rest is disposed of in rivers, burned, or left to accumulate, contributing to environmental pollution. The potential use of rice straw as a substrate for mushroom growth can be observed from its high cellulose content.

Bran is a byproduct of the rice milling process that separates the husk from the grain, resulting in fine powder or brown-colored flour. Generally, bran contains nutritional elements such as protein ranging from 13.11% to 17.19%, fats from 2.52% to 5.05%, rough fiber approximately 370.91-387.3 calories, and is rich in vitamin B, particularly vitamin B1 (thiamine), according to the study by Luthfianto et al. (2017). The selection of bran as an additive is due to its ability to supplement sources of carbohydrates, carbon (C), and nitrogen (N) as indicated in the research by Sari et al. (2022). According to Siregar et al. (2014), carbon (C) serves as the primary energy

source, while nitrogen (N) supports mycelium growth and acts as a source of enzymes or proteins stored within the fungal body. One example of a fungus that can thrive optimally on rice straw substrate is the chicken leg mushroom (*Coprinus comatus*).

The chicken thigh mushroom (Coprinus comatus) is a type of mushroom that is edible and has high nutritional content, including carbohydrates ranging from 49.2 to 76.3 g, insoluble fiber 37%, soluble fiber 28.9%, protein 11.8-29.5 g, and fat 1.1-5.4 g (Nowakowski et al., 2020). In addition, the chicken thigh mushroom also has the potential as a medicinal source due to the presence of several active compounds (Perdanawati et al., 2022). These compounds have various benefits such as immunomodulatory, hypolipidemic, anticancer, natural insecticide, and antioxidant properties (Susanto et al., 2018). Considering the potential and challenges involved, this research will be conducted with the aim of investigating the impact of rice straw substrate, bran, and urea doses on the growth and yield of chicken thigh mushrooms.

MATERIALS AND METHODS

Time and Location of the Research

This research was conducted in Raguklampitan Village, Rt 23 Rw 05, Batealit District, Jepara Regency, Central Java Province, at an altitude of 250 meters above sea level. The research took place from December 2022 to February 2023.

Research Materials

The materials used in this experiment include rice straw, bran, urea, tape yeast, and lime (CaCO3). Meanwhile, the equipment involved consists of cardboard measuring 52 cm x 38 cm x 41 cm, polybags (90 cm x 100 cm), rubber gloves, tarpaulin, and banners. Writing tools such as ballpoint pens, markers, rulers, label sheets, as well as 70% alcohol handsprayer, tissue, adhesive tape, calipers, analytical scales, thermohygrometer, and pH meter (soil analyzer) were also used.

Research Methods

This study is a factorial experiment conducted using the Randomized Complete Block Design (RCBD) method with 2 factors and 3 replications. The first factor is the concentration of bran (B), with three levels, namely Bran 0% of the media weight (0 g/2.5 kg media) (B0), Bran 2% of the media weight (50 g/2.5 kg media) (B1), and Bran 4% of the media weight (100 g/2.5 kg media) (B2). The second factor is urea (U) with three levels, namely Urea 0.4% of the media weight (10 g/2.5 kg media) (U1), Urea 0.8% of the media weight (20 g/2.5 kg media) (U2), and Urea 1.2% of the media weight (30 g/2.5 kg media) (U2). Thus, from these two factors, 9 treatment combinations are formed. Observation data for each treatment is analyzed using the analysis of variance (ANOVA), and if there is a significant effect, the analysis is continued with the Duncan's Multiple Range Test (DMRT) at a significance level of 5%.

RESULT AND DISCUSSION

The beginning of the appearance of mycelium and the length of harvest

The initial observation of mycelium emergence was conducted by counting the mycelium that appeared on the medium when it reached 75% of the existing surface area. Harvesting was carried out by calculating from the first time the mushrooms were harvested until they stopped growing, and the results are presented in Table 1. Table 1 shows that the treatments of bran dosage, urea dosage, and the combination of both treatments do not have any significant effect on the initial appearance of mycelium. The use of urea doses at 0.8% (U2) and 41.2% (U2) resulted in the longest harvesting duration for chicken leg mushrooms, namely 22.58 days and 23.44 days, respectively. These findings are significantly different from the treatment with a urea dose of 0.4% (U1), which resulted in the fastest harvesting time for chicken leg mushrooms, namely 17.56 days.

Based on the above results, this is also in line with research indicating that the addition of bran can accelerate mycelium filling in mushroom cultivation media (Hartini et al., 2023) and the emergence of the first fruiting bodies, as well as an increase in the number and fresh weight of white oyster mushroom fruiting bodies. Additionally, the use of urea doses containing Nitrogen (N) elements present in the media will be employed for protein synthesis, ensuring optimal mycelium growth, thereby influencing mushroom yields and increasing harvest frequency (Bramanti, 2008).

Table 1. The Effect of Rice Bran Dosage and Urea Dosage on Straw Growing Media on the Initial Emergence of Mycelium and the Duration of Chicken Leg Mushroom Harvesting

Treatment	Initial Appearance of Mycelium (days)	Mushroom Harvest Period (days)
Rice Bran Dosage		
B0 (0%)	11,11 a	21,00 a
B1 (2%)	10,78 a	21,56 a
B2 (4%)	10,11 a	21,00 a
Urea Dosage		
U1 (0,4%)	10,56 d	17,56 e
U2 (0,8%)	11,00 d	22,56 d
U3 (1,2%)	10,44 d	23,44 d

continued

Average number of fruit bodies and diameter of mushroom fruit at each harvest

The average number of fruiting bodies is calculated by counting the number of mushrooms ready for harvest, based on the criteria that the mushrooms have protruded from the surface and have not yet undergone expansion, at each harvest time, per research unit, from the first harvest until it becomes unproductive. Additionally, the diameter calculation is performed by measuring the diameter of mushroom fruiting bodies using calipers on five randomly selected mushrooms during each measurement session and then averaging the results.

Based on the obtained results, presented in Table 2, the treatments of bran dosage and urea dosage showed no significant difference in the average number of chicken thigh mushroom fruiting bodies per harvest. The increasing application of bran tended to lead to an increase in the number of fruiting bodies per harvest with the addition of bran dosage. This suggests that the application of bran, which serves as

the growth medium for mushrooms and can be degraded by fungi, contains carbohydrate content (Alpandari & Prakoso, 2022). This makes it a favorable medium for mushroom growth, as carbohydrates are a primary source of energy utilized by fungi for their growth (Prakoso et al., 2022).

Table 2. The Effect of Rice Bran Dosage and Urea Dosage on Straw Growing Media on the Average Number of Fruit Bodies per Harvest and the Diameter of Chicken Leg Mushroom Cap

Treatment	Average Number of Fruit Bodies Each	Average Diameter of Mushroom Fruit Bodies (mm)
Rice Bran Dosage		
B0 (0%)	18,57 a	1,45 b
B1 (2%)	26,94 a	1,68 a
B2 (4%)	46,61 a	1,77 a
Urea Dosage		
U1 (0,4%)	18,49 d	1,41 e
U2 (0,8%)	40,65 d	1,19 f
U3 (1,2%)	32,99 d	2,31 d

Table 2 shows that the treatments of 2% bran dosage (B1) and 4% bran dosage (B2) exhibited the highest average diameter of chicken thigh mushroom fruiting bodies, measuring 1.68 mm and 1.77 mm, respectively. These results were significantly different from the 0% bran dosage treatment (B0), which had the lowest average diameter of chicken thigh mushroom fruiting bodies at 1.45 mm. Meanwhile, among the urea dosage treatments of 1.2% (U3), 0.8% (U2), and 0.4% (U1), there were significant differences observed between each treatment in terms of the average diameter of chicken thigh mushroom fruiting bodies. The 1.2% urea dosage treatment (U3) yielded the highest average diameter of chicken thigh mushroom fruiting bodies at 2.31 mm, while the 0.4% urea dosage treatment (U1) resulted in the lowest total fresh weight of chicken thigh mushrooms at 1.41 mm. Thus, the success of mushroom cultivation is influenced, in part, by the mushroom cultivation medium and its composition as a source of nutrition (Saputra et al., 2020), which is obtained from the presence of urea in the mushroom growth medium.

Average Fresh Weight of Each Mushroom Harvest and Total Fresh Weight of Mushroom Harvest

The fresh weight of mushrooms was measured by weighing fresh mushrooms at each harvest time, from the first harvest until unproductive. Meanwhile, the total fresh weight of mushrooms was calculated by summing up the entire fresh weight of mushrooms from the first harvest to the last harvest, and the data are presented in Table 3. Based on the observation results, it was found that the treatments of bran dosage and urea dosage significantly differed in the average fresh weight of chicken thigh mushrooms per harvest. The 2% bran dosage treatment (B1) and 4% bran dosage treatment (B2) showed the highest average fresh weight of chicken thigh mushrooms per harvest, at 8.49 g and 10.56 g, respectively. These results were significantly different from the 0% bran dosage treatment (B0), which had the lowest average fresh weight of chicken thigh mushrooms per harvest at 5.50 g.

The 1.2% urea dosage treatment (U3) yielded the highest average fresh weight of chicken thigh mushrooms per harvest, amounting to 15.54 g. This result was significantly different from the 0.4% urea dosage treatment (U1) and 0.8% urea dosage treatment (U2), which showed the lowest average fresh weight of chicken thigh mushrooms per harvest at 3.37 g and 5.64 g, respectively. In addition to the quality of mushroom spores, a factor influencing mushroom growth is the growing medium derived from organic materials (Prakoso et al., 2023). Generally, urea as a nitrogen source and organic material such as bran as a carbohydrate source are among the nutrients required by mushrooms to grow well (Fajari et al., 2021).

Table 3. The Influence of Rice Bran Dosage and Urea Dosage on Straw Growing Media on the Average Number of Fruit Bodies per Harvest and the Diameter of Chicken Leg Mushroom Cap

Treatment	Average Fresh Weight of Mushrooms Each Harvest (g)	Total Fresh Weight of Mushrooms (g)
Rice Bran Dosage		
B0 (0%)	5,50 b	122,67 b1)
B1 (2%)	8,49 a	193,61 a
B2 (4%)	10,56 a	239,55 a
Urea Dosage		
U1 (0,4%)	3,37 e	56,56 f
U2 (0,8%)	5,64 e	132,92 e
U3 (1,2%)	15,54 d	366,35 d

Meanwhile, the application of bran and urea treatments had a significant effect on the total fresh weight of chicken thigh mushrooms, but there was no interaction between the two treatments. Table 3 shows that the 2% bran dosage treatment (B1) and 4% bran dosage treatment (B2) exhibited the highest total fresh weight of chicken thigh mushrooms, at 193.61 g and 239.55 g, respectively. These results were significantly different from the 0% bran dosage treatment (B0), which had the lowest total fresh weight of chicken thigh mushrooms at 122.67 g. Meanwhile, the urea dosage treatments of 1.2% (U3), 0.8% (U2), and 0.4% (U1) showed significant differences between each treatment in terms of the total fresh weight of chicken thigh mushrooms. The 1.2% urea dosage treatment (U3) produced the highest total fresh weight of chicken thigh mushrooms at 366.35 g, while the 0.4% urea dosage treatment (U1) resulted in the lowest total fresh weight of chicken thigh mushrooms at 56.56 g. This aligns with the opinion of Hamzah et al., (2022), stating that when the nutrient content in the mushroom medium is sufficient, the mushroom mycelium will grow normally with even and thick mycelial growth, thereby increasing the harvest weight.

CONCLUSION

The dosage of bran and urea can influence the increase in the average fresh weight of mushrooms per harvest, the total fresh weight of mushrooms, and the average diameter of mushroom fruiting bodies.

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PESTICIDE HANDLING, STORING AND DISPOSING PRACTICES OF FARMER PARENTS IN THE PHILIPPINES: BASIS FOR DEVELOPMENT OF SAFE PESTICIDE MANAGEMENT PRACTICES HANDBOOK

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ABSTRACT: This study aimed to determine the status associated with the safety practices of handling, storing, and disposing of pesticides among farmer parents of NEUST students. The findings served as inputs to develop a safe pesticide disposal handbook for safety practices when dealing with hazardous pesticides. This study employed a quantitative research design following the descriptive method that describes the characteristics of the respondents. The respondents of this study were composed of 60 farmer parents of selected students of prominent State University in Central Luzon, Philippines. Results showed that the farmers sometimes practice the proper handling techniques of pesticides when applying and mixing. Results also showed that the farmers poorly practice the proper storing of pesticides and ineffectually comply with the proper handling practices. Worrying result showed that farmers seldom practice the disposing procedures. It also revealed that there is a relationship between the farmers' profile and practices of pesticide usage. Based on the findings, it can be concluded that farming practices regarding pest management process is poor thus the utilization of developed handbook on safety pesticide management practice is recommended.

Keywords: *Pesticide Management Practices, Farm Safety Practices, Pesticide handling, storing and disposal*

INTRODUCTION

The Philippines is among all other countries in the world which have abundant soil that is good for planting and growing crops like rice, corn, pineapple, coconut, onion, tomato, eggplant, etc. One of the top contributing producers of agricultural products in the Philippines is the province of Nueva Ecija which is known as the “Rice Granary of the Philippines” due to its principal crop which is rice. Besides rice, Nueva Ecija also produces corn, onion, and many nutritious vegetables.

However, in order to produce these crops farmers must protect them from insects, predators, and diseases which destroy and damage the crops. Farmers use different pesticides such as insecticides, herbicides, fungicides, and rodenticides to resolve problems regarding pests, weeds, insects, and diseases. Moreover, pesticides are very important in agriculture because they protect the crops and they help the farmers to grow more food and to have a bountiful harvest each year.

According to Fabro & Varca (2012), pesticides greatly benefit Philippine agriculture by reducing crop losses due to insects, weeds, plant diseases, rodents,

and other pests.

However, pesticides are poisonous and they can endanger humans and animals when used inappropriately without having enough knowledge of proper uses and application.

Aside from the fact that pesticides help farmers to protect their crops, pesticides can also harm their health. It happens when farmers have insufficient knowledge in proper handling, storing, and disposing of these chemicals. According to Perez (2015), poor handling may result in many illnesses like headache, shortness of breath, dizziness, nausea, and eye irritation. Poor storing of pesticides may result in confusion and improper use. This incident happens in Bohol last 2010, where the pesticide caused poisoning after being confused with flour. This incident caused severe stomach aches and diarrhea in 28 students before they passed out. On the other hand, poor disposal may affect soil, water, and air. It can also lead to pesticide exposure because most of the farmers used unsafe practices of disposing of empty pesticide containers. According to Jallow (2017), 5% of farmers reuse empty pesticide containers for domestic reasons, increasing their risk of chemical exposure.

Applying pesticides safely may lower the threat of exposure to users, the general public, and the environment. Studying how farmers handle, store, and dispose of pesticides safely is crucial for finding exposure scenarios and knowledge gaps. Additionally, for providing essential information that can support suggestions for both educational programs and government policies intended for avoiding or minimizing the harm that pesticides pose to human health and the environment.

In addition to that, this study is anchored based on the United Nations' Sustainable Development Goals. SDG numbers 3, 4, and 12 were the basis of this study. Through this, local farmers will not only be informed about pesticide safety but also be protected from the possible hazards associated with these chemicals. And finally, sustainable consumption and production of agricultural products will increase when farmers know how to dispose of these hazardous wastes properly.

Furthermore, the researchers conducted this study entitled “Pesticide Handling, Storing and Disposing Practices of Farmers Parents of NEUST Students: Development of Safe Pesticide Disposal Brochure” to determine the safety practices of handling, storing, and disposing of pesticides. It is because of their hope and confidence to find great solutions from the data and information that will be gathered to educate farm workers about the dangers of using various chemicals.

SCOPE AND DELIMITATION

This research was conducted in the second semester of the year 2023. The researchers want to focus on the Pesticide Handling, Storing, and Disposing Practices of Farmer Parents of NEUST Students.

The respondents of this study were the farmer parents of BSIE students from Nueva Ecija University of Science and Technology. They will be chosen using a purposive sampling method. In this technique, the researchers will make calculated choices in their sampling design to select a particular type of respondent.

The researchers limited this study to the respondents' profiles in terms of sex, level of training, farm size, farm ownership, and farming experience of the farmers.

Samples and Sampling Procedures

The researchers used a purposive sampling technique. According to Ashley Crossman (2020), purposive sampling is a non-probability sample that is selected based on characteristics of a population and the objective of the study. In this sampling method, the researchers will make calculated choices in their sampling design to select a particular type of respondents. This type of sampling is very useful in a situation where sampling for proportionality is not the main concern because the researchers can reach a targeted sample quickly when needed.

This method was used by the researchers to determine the pesticide handling, storing and disposing practices of farmer parents of BSIE and BTLED students.

RESEARCH INSTRUMENT

The researchers constructed a set of survey questionnaires in the form of closed-ended questions to gather data related to the study. The purpose of the researchers in using descriptive design is to determine the pesticide handling, storing and disposing practices of farm parents of BSIE students. This method was used by the researchers because survey questionnaires are more applicable and easy way of collecting information from the respondents.

The survey questionnaire was divided into two main sectors, the demographic profile of the farmers and the questions regarding the safety practices of handling, storing and disposing of pesticides. The profile contains socio demographic characteristics of the respondents such as name, age, sex, level of training, farm size, farm ownership, and farming experience.

A Likert scale was used by the researchers in order to assess the suitability of each indicator. According to Bhandari (2023), the Likert scale is a rating scale that measures opinions, attitudes, or behaviors and it consists of a statement or a question,followed by a series of four answer statements. The respondents were asked to rate their opinions and experiences with the statements using the following legends:

Table 1. Likert Scale

Scale	Range	Verbal Interpretation
4	3,26-4,00	Always
3	2,51-3,25	Sometimes
2	1,76-2,50	Seldom
1	1,00-1,75	Never

Table 1 presents the legends with their corresponding range and verbal interpretation. Respondents used these scales to rate their experiences in handling, storing, and disposing practices of pesticides. And their responses were interpreted using the following range to determine if they practice the safety procedures in handling, storing, and disposing of pesticides.

Data Gathering Procedure

The researcher of the study surveyed 60 students from Nueva Ecija University of Science and Technology whose parents are farmers to ask if they can take home the set of questions and let their parents answer it to gather enough information that will help them to achieve the objectives of their study.

The researchers used survey questionnaires as their data gathering tool and it was distributed through printed copies. To achieve the objectives of this study, the researchers reviewed related literature to adopt and constructed a set of questions to survey the respondents.

After the respondents answered the set of questions, the researchers gathered, calculated, tabulated, and interpreted the data and responses to formulate recommendations regarding pesticide practices to educate the farmers about the standard ways of handling, storing, and disposing of pesticides.

Ethics in Research

The references proper citations were done and acknowledged using the American Psychological Association style (APA). To avoid plagiarism cases, the researchers did not own any of the cited ideas, studies, and theories of other authors and credited them to the prospective owners/authors. The researchers made sure not to fabricate or falsify any information.

The researchers followed specific research rules and ethics and proper citation of the existing studies and data. In terms of handling information, the researchers handled all the data in a confidential, discreet, and honest manner.

Statistical Treatment of Data

After the survey has been collected, responses were tallied accordingly and organized in tables. Then, it was analyzed using appropriate statistical tools. The researchers use frequency, weighted mean, percentage, and Pearson r Correlation.

1. **Frequency and Percentage Distribution Formula** was used to determine the percentage usually for data on profile (e.g., age, gender, etc.), and also, the researcher will use this to determine the percentage to analyze the data we gathered.

   P= f ×100% –
   Where:
   P- stands for percentage f- stands for frequency N- stands for the total number of respondents

2. **Weighted Frequency** refers to the frequency with the weight applied which generally can be thought of as the estimated count in the population with the combination of values.

   WF= W×f

Where:W- stands for numerical equivalent
N stands for number of the respondents WN- stands for weighted mean

3. **Pearson r Correlation** main use is to measures the strength between the different variables and their relationships. It shows the relationship between the two variables calculated on the same interval or ratio scale.

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[\, n\sum x^2 - (\sum x)^2 \,][\, n\sum y^2 - (\sum y)^2 \,]}}$$

Where:
r = Pearson Coefficient
n= number of pairs of the stock
$\sum xy$ = sum of products of the paired stocks
$\sum x$ = sum of the x score
$\sum y$= sum of the y scores
$\sum x^2$ = sum of the squared x scores
$\sum y^2$ = sum of the squared y scores

Table 2. Pearson r Values and Verbal Interpretation

Values					Interpretation
				0	No Correlation
+/-	0.01	to	+/-	0.20	Slight correlation, almost negligible relationship
+/-	0.21	to	+/-	0.40	Slight correlation, definite but small relationship
+/-	0.41	to	+/-	0.70	Moderate correlation, substantial relationship
+/-	0.71	to	+/-	0.90	High correlation, marked relationship
+/-	0.91	to	+/-	0.99	Very high correlation, very dependable relationship
				+/- 1.00	Perfect correlation

Table 2 presents the range of the Pearson r values and the corresponding verbal interpretations.

RESULTS AND DISCUSSIONS

1. **The Profile of the Respondent**
   The respondents' profile encompasses general information. The general information exposes the respondents' sex, level of training, farm size, farm ownership, andfarming experience.

1.1 Sex

In terms of sex, the frequency and percentage were presented in Table 3 to show the numbers of male and female participants in this research.

Table 3. Distribution of the Respondents According to Sex

Sex	Frequency	Percentage (%)
Male	60	100%
Female	0	0%
Total	**60**	**100%**

Table 3 presents the number of males and females in this study. As seen in the table, all of the respondents are male (100%) and there was no female (0%) respondent. The result of this study is significant to the findings of Wang et al. (2017) that male farmers had a better knowledge of pesticide use and greater awareness of associated health risks. More men than women used pesticides and disposed of the pesticide containers correctly, but fewer men applied protective measures or behaviors when using pesticides. It implies that there is a gender gap in farming because females are facing significant inequities in farms locally and worldwide, specifically in developing countries. Female farmers are just as skilled as male farmers, but since they have less access to resources, their agricultural yields are much lower. It also suggests that farming is dominated by males.

1.2 Level of Training

Table 4. Distribution of the Respondents According to Level of Training

Level of Training	Frequency	Percentage (%)
Formal	16	27%
Informal	44	73%
Total	**60**	**100%**

As seen in the table, 27% of the respondents attended formal training about pesticides while 73% of respondents did not attend any training and only practiced the traditional mode of handling, storing, and disposing of pesticides. The result of this study contradicts to the findings of Damalas and Koutroubas (2017) that trained farmers showed higher levels of knowledge and safety behavior of pesticide use than non-trained farmers. In this context, the national authorities should play a pivotal role by providing up-to-date, accurate, and easy to understand information in the training of farmers to inspire confidence and trust among farmers. Farmers' sources of information and the degree to which they trust the informants may shape their perceptions of pesticide risk and the adoption of preventative measures. It implies that most of the respondents are at risk because they only practice what they think is right although that is very dangerous for them.

1.3 Farm Size

Table 5. Distribution of the Respondents According to Farm Size

Farm Size (Hectares)	Frequency	Percentage (%)
1.00 or less	20	33%
1.01 – 2.00	16	27%
2.01 – 3.00	14	23%
3.01 or more	10	17%
Total	**60**	**100%**

As seen in the table, 33% of the respondents managed farms 1.00 ha or lesswhile 27% of respondents managed between 1.01 ha and 2.00 ha. Meanwhile, 23% of respondents managed between 2.01 ha and 3.00 ha, and the remaining 17% managed 3.01 or more than a hectare of farmland. The result of this study contradicts to the findings of Gao ET. Al. (2021) that small and fragmented farms are a strong factor that leads to the overuse of pesticides in China. In every crop type, three factors contribute to a negative relationship between farm size and pesticide use. First, the spillover effects from the use of pesticides by other farmers in the same villages, second, the level of mechanization, and lastly the management ability of farmers. The first two factors play important roles in the cultivation of grain crops, while the last factor is the main reason why farmers with larger plots of land use fewer pesticides in the cultivation of vegetables. Most farmers have a small farm size to plant, cultivate, and grow crops. It implies that farmers who own a small farm have the smallest chance of being exposed to pesticides compared to a farmer who owns a large farm.

1.4 Farm Ownership

Table 6. Distribution of the Respondents According to Farm Ownership

Farm Ownership	Frequency	Percentage (%)
Lessee	42	70%
Lessor	18	30%
Total	**60**	**100%**

As seen in the table, 70% of the respondents were lessees and the remaining 30% were lessors. It only means that most of the respondents do not have their own farms. Not all profits gained from the farm were owned by the family, although they are directly doing farming activities like fertilization, crop protection, and many more. Thus, they are directly exposed to pesticides. The result of this study is significant to the findings of Mubushar et al. (2019b) that respondents who own land have a better knowledge of the possible effects of pesticides on human health, soil, and the environment than those who rent land for crop cultivation. Farmers who rent land do not care about their own health and are concerned only with how to maximize profits from the rented land.

1.5 Farming Experience

Table 7. Distribution of the Respondents According to Farming Experience

Farming Experience	Frequency	Percentage (%)
1-5 years	2	3%
6-10 years	10	17%
11-15 years	6	10%
16 years and above	42	70%
Total	**60**	**100%**

As seen in the table, most of the respondents (70%) have farming experience of 16 years and more while 17% have farming experience between 6-10 years. On the other hand, 10% of respondents have farming experience between 11-15 years, and only 3% of respondents have 1-5 years of farming experience. The result of this study is relevant to the findings of Mubushar et al. (2019) that the farmers who possess more experience have more knowledge of safety measures. A possible reason could be that farmers learn through their own experiences about the negative effects of pesticides, leading to them adopt safety measures. It means that by having more experience plus attending various training, farmers can learn the proper handling, storage, and disposal techniques on pesticiden practices compared to the farmers who are beginners in this field. Farmers who attend different training and seminars can protect the environment, animals, and people from the harmful effects of pesticides.

2. Handling Practices

Table 8. Summary of the Respondent's Rating in Handling Practices

Verbal Interpretation	Handling	Mean
Binabasa ko ang mga tagubilin sa mga lalagyan ng pestisidyo bago gamitin. *(I read the instructions on the pesticide containers before using.)*	3,90	**Always**
Sinusunod ko ang mga tagubiling nakasulat sa tatak/label ng bote. *(I follow the label instructions written on the bottle.)*	90	**Always**
Nagsusuot ako ng Personal Protective Equipment (PPE) sa tuwing humahawak ng pestisidyo. *(I wear Personal Protective Equipment [PPE] whenever handling pesticides.)*	3,57	**Always**
Naghahanda ako ng sapat lang na dami ng pestidiyong kakailanganin sa aplikasyon. *(I only prepare the amount of pesticide needed for application.)*	3,63	**Always**
Gumagamit ako ng wastong kagamitan at sumusunod sa mga kinakailangang gawin ayon sa tatak/label para sa aplikasyon. *(I use the proper equipment and follow the label requirements for application.)*	3,70	**Always**
Naliligo ako pagkatapos maglagay ng pestisidyo.	3,90	**Always**

(I take a bath after applying pesticide.)		
Dumadaloako sa mga pagsasanay/seminartungkol sa Integrated Pest Management (IPM). *(I attend training/seminars about Integrated Pest Management [IPM]*	2,77	**Sometimes**
Naghuhugas ako ng mga kamay pagkatapos maghalo/gumamit ng mga pestisidyo. *(Iwas my hands after mixing/using pesticides)*	3,97	**Always**
Nagkakaroon ng mga sintomas tulad ng pananakit ng ulo, pagduduwal, hirap sa paghinga, at iba pa, pagkatapos maglagay ng pestisidyo. *(I used to have symptoms like headache, nausea, difficulty breathing, etc. after applying pesticide.)*	1,07	**Never**
Naghahalo ako ng mga pestisidyo sa harap ng mga tao, kabilang ang mga bata. *(I mix pesticides in front of people, including children.)*	1,07	**Never**
Pooled Mean	3,21	**Sometimes**

Legends: *1.00 - 1.75 Never (1); 1.76 - 2.50 Seldom (2); 2.51 – 3.25 Sometimes (3); 3.26 - 4.00 Always (4)*

As seen in the table, handling practices have an overall weighted mean of 3.21 which has a verbal interpretation sometimes. The result of this study is relevant to the findings of Jallow et al. (2017c) that use of appropriate PPE, such as coveralls, and the adoption of other protective measures and good personal hygiene such as showering, not smoking, eating or drinking while handling pesticides are considered good practices to reduce occupational pesticide exposure. An increase in the use of protective measures decreases the probability of poisoning by 44% to 80%, whereas lack of PPE use increases the potential for dermal and respiratory exposure to pesticides. Education status and training in pesticide use and safety are strong determinants of the appropriate use of PPE. It implies that following the safety precautions in handling can pose a serious health risk to the farmers. Reading the instructions and complying with the safety precautions for handling the pesticides are the keys to a farmer's safety during pesticide handling. Additionally, wearing the right kind of clothes is also essential because it acts as the first line of defense against exposure.

2.2 Storing Practices

Table 9. Summary of the Respondent's Rating in Storing Practices

Verbal Interpretation	Storing	Mean
Sinusunod ko ang lahat ng tagubilin sa pag- iimbak na nakasulat sa tatak/label ng pestisidyo. *(I follow all storage instructions writtenon pesticide label.)*	2.60	Sometimes
Isinasaalang-alang ko ang mga lugar sa tuwing mag-iimbak ng mga pestisidyo. *(I consider the place whenever storing pesticides.)*	2.77	Sometimes
Pinananatili kong ang mga pestisidyo ay nasa lugar na malayo sa mga bata. *(I keep pesticides far away from children.)*	2.93	Sometimes

Sinusunod ko ang kinakailangang temperature sa pag-iimbak ng mga pestisidyo. *(I follow the temperature requirements when storing pesticides.)*	2.17	Sometimes
Iniimbak ko ang mga fungicides, herbicides, at insecticides sa iba't ibang lokasyonupang maiwasan ang hindi sinasadyang paggamit. *(I store fungicides, herbicides and insecticides in different locations to prevent accidental misuse.)*	2.40	Seldom
Iniimbak ko ang mga pestidiyo sa kanilang orihinal na lalagyan na may mahigpit na nakasarang takip. *(I store pesticides in their original containers with their tops tightly closed.)*	2.83	Sometimes
Iniimbak ko ang mga pestisidyo sa mga lugar na malayo sa mga pagkain, feeds, at sa apoy. *(Istorepesticidesfarawayfromfoods,feeds and flames.)*	2.97	Sometimes
Iniimbak ko ang mga pestidiyo sa mga naka- kandadong kabinet na itinalaga lamang para sa mga kemikal. *(I store pesticides in locked chemical cabinets designated only for pesticides.)*	2.63	Sometimes
Iniimbak ko ang mga pestidiyo sa lugar na ligtas sa bahang-tubig. *(I store pesticides in places which are free from water floods.)*	2.23	Sometimes
Iniimabak ko ang mga pestidiyo malayo sa aming tirahan, *(I store pesticides far away from our living area.)*	270	Sometimes
Pooled Mean	**2.62**	**Sometimes**

Legends: *1.00 - 1.75 Never (1); 1.76 - 2.50 Seldom (2); 2.51 – 3.25 Sometimes (3); 3.26 - 4.00 Always (4)*

As seen in the table, storing practices have an overall weighted mean of 2.62 which has a verbal interpretation of sometimes. The result of this study corroborated the findings of Jallow et al. (2017b) that there are some worrying practices about storage of pesticides, 20% of the farmers store pesticides in living areas or in refrigerators. This demonstrates the farmers' lack of knowledge of pesticides and the appropriate approach for storing pesticides. Storing pesticides in living areas can increase the potential for high exposure, especially when these areas are the places where farmers prepare food, eat, and sleep. Farmers also stored pesticides in animal housing that could pose a danger to farm animals. These risky behaviors can be attributed to farmers' lack of technical knowledge and training on safe pesticideuse. It means that means that farmers always follow the storing practices in pesticides such as storing pesticides in locked cabinets with tops tightly closed. Additionally, considering the storage requirements can avoid pesticide misuse and accidental poisoning that can harm humans.

2.3 Disposing Practices

Table 10 presented below the weighted mean and verbal interpretation of the farmers' disposing practices.

Table 10. Summary of the Respondent's Rating in Disposing Practices

Disposing Interpretation	Mean	Verbal
Sinusunod ko ang mga pamamaraang pangkaligtasan sa pagtatapon ng mga lalagyan ng pestisidyo. *(I follow the safety procedures in disposing of pesticide containers.)*	**3.70**	**Always**
Sinusunog ko ang mga lalagyan ng pestisidyo pagkatapos gamitin ang mga ito. *(I burn pesticide containers after using them.)*	**2.27**	**Seldom**
Itinatapon ko agad ang kasuotang PPE pagkagamit matapos kong maghalo/maglagay ng mga pestidiyo. (I immediately dispose of the PPE clothing I used after mixing/applying pesticides.)	**2.87**	**Sometimes**
Nagsusuot ako ng Personal Protective Equipment (PPE) sa tuwing magtatapon ng pestisidyo. *(I wear Personal Protective Equipment [PPE] every time I dispose of pesticides.)*	**3.03**	**Sometimes**
Dinadala ko para itapon ang mga tirang pestidiyo at mga pinaglagyan nito sa nakatalagang kolektahan ng mga mapapanganib na basura sa aming munisipyo. *(I bring pesticides stocks and containers to our municipal hazardous wastecollectionsite for disposal.)*	**2.50**	**Seldom**
Inilalagay ko ang mga basyong lalagyan ng pestidiyo sa mga basurahanomgadumpsterpara itapon. *(I place an empty pesticide container in garbage containers or dumpsters for disposal.)*	**2.67**	**Sometimes**
Ibinubuhos ko sa lababo, sa palikuran, o sa kanal sa kalye ang mga natirang pestidiyo. *(I pour leftover pesticides down the sink, into the toilet or down a street drain.)*	**120**	**Never**
Ibinebenta koo ginagamitmuliangmgabasyong lalagyan ng pestidiyo. *(I sell or reuse empty pesticide containers.)*	**1.63**	**Never**
Itinatapon ko sa bukid o kahit saang lugar ang mga basyo ng pestidiyo. *(I disposeemptypesticides inanopenfield.)*	**1.13**	**Never**
Itinatapon ko nang maayos ang mga basyong lalagyan ng pestidiyo ayon sa nakasulat sa tatak/label nito. *(I dispose properly of the pesticide containers according to label instructions.)*	**3.10**	**Sometimes**

continued

continued

Pooled Mean	**2.41**	**Seldom**

Legends: *1.00 - 1.75 Never (1); 1.76 - 2.50 Seldom (2); 2.51 – 3.25 Sometimes (3); 3.26 - 4.00 Always (4)*

As seenin the table, disposing practiceshave anoverall weighted mean of 2.41 which has a verbal interpretation seldom. The result of this study is relevant to the findings of Jallow et al. (2017c) and Sai et al. (2019) that respondents adopted unsafe behaviors such as throwing, discarding, incinerating or burying containers on-farm or open fields. These practices may lead to environmental contamination and a risk to human health and have been reported as a major problem in a number of studies. About 5% of the farmers indicated that they reuse the empty pesticide containers for household purposes, increasing their chances of exposure to pesticides. Unsafe disposal of both unwanted pesticides and empty pesticide containers could put general population at higher risk. It shows that proper disposal of pesticide waste is necessary to practice so the environment, groundwater, animals, and human beings are protected from the hazardous effects of pesticides. It implies that respondents seldom follow and practice the safe disposal procedures of pesticides. Throwing empty containers of pesticides anywhere can lead to soil and water contamination. It is dangerous because it can pose a threat to the environment, animals, and other people.

3. Hypothesis of the Problem

The profile of the respondents and farmers' practices on pesticide usage data revealed that there is a significant relationship among them.

Table 11. Relationshipbetween the profile of the respondents and farmers' practices on

Pesticides Usage	Level of	Handling	Storing	Disposing
	p-value	-.068	.366*	.443*
Training	Sig.(2-tailed)	.721	.047	.014
	N	30	30	30
	p-value	.273	-.067	-.148
Farm Size	Sig.(2-tailed)	.144	.726	.435
	N	30	30	30
	p-value	.004	.020	-.011
Ownership	Sig.(2-tailed)	.983	.916	.952
	N	30	30	30
	p-value	-.024	.326	-.032
Experience	Sig.(2-tailed)	.901	.079	.868
	N	30	30	30

continued

As seen on the table, Pearson r correlation was used to determine the relationship between the profile of the respondents and the farmers' practices on pesticides usage. Results showed that level of training is significant related to storing (r=.366) and disposing (r=.443). This finding suggests that level of training

influences how farmers may store and dispose the pesticides. It implies that farmers who attended training are more likely to have better pesticide safety practices as compared with those who do not.

Moreover, the study also examined the relationship between farm size, farm ownership, farming experience and farmers' practices on pesticides usage. An analysis of variance (ANOVA) was employed to compare the farmers' practices on pesticides usage across various groups. The results of the analysis revealed that pesticide practices had statistically equal level of practices in terms of handling, storing, and disposing of pesticides. It suggests that there may be different training programs for the farmers across various groups that will lead to safe and appropriate ways to handle, store,and disposal of hazardous chemicals. Thus, understanding these findings can help in determining effective ways and programs to inform and educate the farmers to broaden and widen their techniques, strategies, and practices to pesticides. It emphasizes the importance of complying with and considering the standard ways of pesticide practices across various areas. Therefore, the null hypothesis is rejected.

SUMMARY OF FINDINGS

This research study entitled "Pesticide Handling, Storing and Disposing Practices of Farmers Parents of NEUST Students: Development of Safe Pesticide Disposal Brochure" was conducted during the second semester of Academic Year 2022-2023 between January to May 2023.

The following are the specific questions on this study and their findings:

1. **How may the profile of the respondents may be described in terms of their sex, level of training, farm size, farm ownership, and farming experience.**

   All of the respondents in the study are male (100%) and there are no female respondents (0%). It suggests that farming is dominated by males. In terms of the level of training, 73% of the farmers execute the traditional mode of pesticide practices. Likewise, 2 7 % of the farmers have formal training. As for the farm size, 33% of the farmers have 1.00 ha or less, and 27% have 1.01 ha – 2.00 ha.

   Meanwhile, 23% of the farmers have 2.01 – 3.00 ha, and 5 or 17% have 3.01 ha or more. In terms of farm ownership, most of the farmers are lessees (70%) and few (30%) of the farmers are lessors. And for the farming experience, 70% have the highest number of years of farming and 17% are those who are in 6-10 years. Meanwhile, 10% of farmers are between 11-15 years and only 3% are newcomers.

2. **How the farmers' practices on pesticides usage may be described in terms of handling, storing, and disposing.**

   As for handling practices, the respondents stated that they always read and followed the label instructions on the bottle. Also, they always wear personal

protective equipment when handling pesticides. And after mixing and applying pesticides, they immediately take a bath. Luckily, despite being exposed to these chemicals they never show any symptoms and end up dying because of pesticide poisoning. It means that reading the instructions, complying with the safety precautions for handling the pesticides, and wearing the right kind of clothes are the first line of defense against exposure.Meanwhile, t o prevent p e s t i c i d e p o i s o n i n g , proper p e s t i c i d e s t r a g r o c e d u r e e e s s s s e n t i a l. The respondents always consider the storage requirements for pesticides and do their best to keep pesticides far away from children. Respondents said they kept pesticides away from food and flames. But sometimes they don't store items at the proper temperature. It only reveals that storing pesticides in a locked cabinet with tightly closed tops and following the storagerequirementscanavoidpesticide misuse that can harm humans.

On the other hand, disposal practices are crucial because they protect the environment, humans, and animals. The respondents always obey the safety pesticide disposal procedures as they never reuse or sell empty containers. Further, they never pour leftover pesticides anywhere to prevent soil and water contamination that can harm the species inhabiting in water and land. They seldom bring empty labeled containers to their collection site or burn them after use. Farmers sometimes use protective gear and immediately dispose of it after using it. Additionally, they sometimes dispose of those PPEs and empty containers according to label instructions. Proper disposal of pesticide waste is necessary to practice so the environment, groundwater, animals, and human beings are protected from the hazardous effects of pesticides.

3. Correlation of variables

The level of training is significantly related to storing (r=.366) and disposing (r=.443). It implies that farmers who attended training are more likely to have better pesticide safety practices as compared with those who do not. Therefore, the null hypothesis is rejected.

CONCLUSION

Considering the findings of this study, the following conclusions were drawn:

1. The researchers concluded that all of the respondents in this study were males. The results on the level of training show that most of the respondents do not have proper training regarding pesticide safety handling, storage, and disposal. On the other hand, farm size and farm ownership show that farmers have a greater chance of exposure to pesticides. Thus, it implies that by gaining more farming experience farmers can learn and adopt the proper handling, storing, and disposal of pesticides.

2. Furthermore, most farmers have poor practices on handling, storing and disposal of pesticides based on the weighted mean and verbal interpretation result.

RECOMMENDATIONS

Based on the summary and conclusions of this study, the following recommendations are presented:

1. The barangay should encourage farmers to attend seminars and training conducted in their barangay. Additionally, continue to plan and conduct more of these toincrease their awareness about the safety practices of handling, storing, and disposing of pesticides.

2. Seminars and training programs like Integrated Pest Management (IPM), Integrated Crop Management (ICM), and many more should be given to the farmers to improve their skills on farming and to widen their knowledge about crop protection in a safe and healthy way without damaging the environment, animals, and human beings.

3. It is recommended that farmers need to pay more attention and give importance to the training and seminars that your community has to prevent illness and to keep you safe during pesticide application.

4. The government needs to support our local farmers by conducting training in various provinces about pesticide safety. It is important to disseminate information and provide awareness about the safety practices of pesticides because local farmers also contribute to our economy.

5. The data proved that farmers have little knowledge and do not employ proper handling, storing and disposal of pesticides. Therefore, it is recommended that the government should build a hazardous waste site and encourage the farmers to collect and dispose of the empty containers on that waste site instead of burning them and throwing away anywhere. This practice will conserve and protect not only the environment, but also the other species, animals, and humans.

6. The utilization of handbook on pesticide safety use is highly recommended to be adopted by rural barangays and farmer residents for improved and safe farming method.

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POTENTIAL OF *Clitoria ternatea* AS LARVASIDES OF THE BAGWORM

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Abstract: The Fabaceae family's Clitoria ternatea has traditionally been widely utilized as a natural coloring agent for various human consumables, including food, drinks, and herbs, and has been extensively studied for its larvicidal impact on mosquitoes. This study aims to explore the potential of Clitoria ternatea as a larvicide against oil palm leaf-eating caterpillars, offering a natural control alternative to mitigate the environmental damage caused by the current use of chemical pesticides. Conducted at the laboratory of the Indonesian Oil Palm Institute of Technology, the research focused on two factors: oil palm leaf-eating caterpillars, comprising Metisa plana (U1) and Pteroma pendula (U2), and the concentration of C. ternatea seed extract, with seven treatment levels: K0 negative (control), K0 positive (acefat), K1 = 1%, K2 = 2%, K3 = 3%, K4 = 4%, and K5 = 5%. Data analysis involved the F test, followed by the Duncan distance test at a 5% significance level. The study revealed significant variations in the mortality of M. plana and P. pendula with the application of C. ternatea seed extract. The most effective concentration identified was K4 (4%) in this investigation.

Keywords: C. ternatea, Larvacids, bagworm, concentration

INTRODUCTION

One of the plantation commodities that has a role in the economy in Indonesia is oil palm. Sumatra and Kalimantan are the concentration areas of oil palm plantations with an area of 1.25 million hectares in North Sumatra, and the area of Indonesian oil palm plantations based on the status of exploitation in 2021 is 55% private large plantations, 3.76% large state plantations and 41.24% smallholder plantations (Cheong & Tey, 2012). In cultivating oil palms, it cannot be separated from pest attacks. One of the pests of oil palm plants is oil palm leaf-eating caterpillars (UPDKS) which consists of bag caterpillars and fire caterpillars which are the main pests in Oil Palm Plantations. UPDKS attacks can cause damage to the leaves of oil palm plants which can ultimately reduce oil palm production (Darmawan et al., 2020). UPDKS pests cause leaf damage reaching 50% and have an impact on a 30-40% reduction in yield (Dubey et al., 2012; Jamil & Pa'Ee, 2018). The percentage of bagworm pest attacks was 30% with an attack area reaching 7.5 ha at PT Indo Sepadan Jaya, Pangkatan District, Labuhanbatu Regency (Kelemu et al., 2004).

Oil palm leaf-eating caterpillars are important pests in oil palm plantations consisting of fire caterpillars, bag caterpillars and caterpillars. The leaf-eating caterpillar *Metisa plana* is considered the most destructive caterpillar in Malaysia, causing yield losses of up to 43%. The use of chemical pesticides causes environmental pollution and mortality of non-target pests (Kassim & Al-Obaidi, 2021). The bag caterpillar (*Pteroma pendula*) is no less destructive than *M. plana*. The reduction in fresh fruit bunch production amounted to 21.02-36.35%. *P. pendula* attack at the highest score had a significant effect on the sex ratio and the number of bunches produced (Priwiratama et al., 2019). More than 70 species of bagworm have been recorded in Indonesia, which is higher than the species richness recorded in neighboring countries. Caterpillar outbreaks are influenced by various factors, such as caterpillar biology, host plants and their natural enemies, as well as climate, and silvicultural practices (Lelana et al., 2022). In one private plantation in North Sumatra, *Mahasena corbetti* infestation reached 30% with an infestation area of 7.5 ha (Saragih et al., 2021).

Clitoria ternatea or known as telang flower from the Fabaceae family several studies have shown that *C. ternatea* as an antimicrobial. Ethanol extracts and pure extracts of *Clitoria ternatea* leaves are effective as insecticides against mosquito borers (Valdez et al., 2021). Proteins derived from C. ternatea exhibit a wide-ranging fungicidal effect by impeding the growth of mycelia in various fungi, including Curvularia sp., Alternatia sp., Cladosporium sp., Aspergillus flavus, Aspergillus fumigatus, Aspergillus niger, Rhizopus sp., and Sclerotium sp. (Ajesh & Sreejith, 2014). Methanol contained in Clitoria ternatea seed extract was effective against the larvae of the three species with LC50 values of 65.2, 154.5 and 54.4 ppm for *A. stephensi, A. aegypti* and *C. quinquefascitus*, respectively. Clitoria ternatea demonstrated larvicidal effects against mosquitoes, as reported by Dighe et al. in 2009. Additionally, this plant exhibits various pharmacological benefits, including antioxidants, hypolipidemic, anticancer, analgesic, antipyretic, antidiabetic, central nervous system (CNS), gastrointestinal, antiparasitic, and insecticidal properties (Al-Snafi, 2016).

Research on *C. ternatea* in the field of plantation crops has not been widely discussed. Until now, research on plant diseases has been carried out invitro, while pests of plantation crops have not yet found a source that can be adopted, so it is

necessary to research the potential of *Clitoria ternatea* seeds as a vegetable pesticide for controlling oil palm leaf-eating caterpillars.

RESEARCH METHODS

The research was conducted at the Laboratory of the Indonesian Institute of Palm Technology from June to August 2023. Research Design The research design will be used as a factorial Completely Randomized Design (RAL) with 2 (two) replications. The treatment in this study is the result of a combination of factors from all levels of treatment, consisting of 20 treatment combinations and 2 (two) replications. The treatment in this study is the result of a combination of factors from all levels of treatment, consisting of 20 treatment combinations and 2 controls, namely positive control with the application of acephate 75 SP pesticide and negative control with the application of distilled water. This research used the first factor, namely oil palm leaf eating caterpillars, consisting of 2 treatment levels: U1=*Metisa plana*, U2=*Pteroma pendula*. The second factor is the concentration of *C. ternatea* seed extract with 7 levels of treatment: K0 negative (control), K0 positive (acefat), K1=1%, K2=2%, K3=3%, K4=4%, and K5 =5%.

Data analysis was conducted to determine the effect of treatment using Analysis of Variance (ANOVA). If the treatment has a significant effect, it is continued Duncan Multiple Range Test (DMRT) at the 5% level.

The ingredients used are C. ternatea seeds, C. ternatea leaves, distilled water, 70% alcohol, insecticide with the active ingredient acephate 75 SP.

The tools used are hand sprayers, measuring cups, analytical scales, mortar, stationery, cameras, Implementation of Research in the Laboratory Preparation of Bagworms Metisa plana and Pteroma pendula Bagworms M. plana and P. pendula will be taken from several oil palm plantations that are attacked by bagworm pests in the amount of each treatment, namely 60 bagworms still attached to the oil palm leaves which will be placed in a container. wire walled. This treatment was repeated 2 (two) times.

Preparation of C. ternatea seed extract: C. ternatea seed extract begins with making a stock solution in a 1:1 ratio. Each seed was weighed at 1000 grams. Then each seed is finely ground using a mortar. After each leaf and seed has been ground, 1000 ml of distilled water is added as a solvent. Then the stock solution is stored for 1 x 24 hours. The next day the solution is filtered using filter paper, and the solution is ready to use.

Application of *C. Ternatea* seed solution: Application of *C. ternatea* seed extract taken from the stock solution and adjusted to the treatment concentration per liter of water. Spraying uses a hand sprayer that has previously been calibrated. Each treatment was sprayed 5 times by looking at the location of each bagworm larvae. Spraying is done once. After application, observations are made. Application of Acephate 75 SP pesticide: Application of acephate 75 SP pesticide as a positive control with a recommended dose of 0.5 g/l. Spraying was carried out 5 times. Spraying is done once. After application, observations are made.

Observation Parameters

a. Mortality (death of larvae): The death of M. plana and P. pendula bagworm larvae was observed after 5 hours of application by opening the bag to see mortality.

Larval mortality is calculated using the following formula:

$$\%\, mortalitas\ larva\ uuui = \frac{\Sigma\ larva\ uuui\ mati}{\Sigma\ larva\ uuui} x\ 100\%$$

If mortality in the control is <5% then it can be ignored, but if mortality in the control reaches > 5% - 20% a further test will be carried out, namely a correction test using the Abbot formula as follows:

$$AI = \frac{\mathrm{A} - \mathrm{C}}{100 - \mathrm{C}} x\ 100\%$$

Information:
AI: Death after correction
A: Death during treatment
C: Death in control

b. Morphology of bagworms

Observations were carried out after the research ended. The bagworm larvae are removed from the bag, and the color changes are observed.

RESULTS AND DISCUSSION

Mortality of *Metisa plana*

The results of observing mortality in this study by spraying *C. ternatea* seed extracts carried out 5 times at a time on *Metisa plana* and *P. pendula* can be seen in the following presentation.

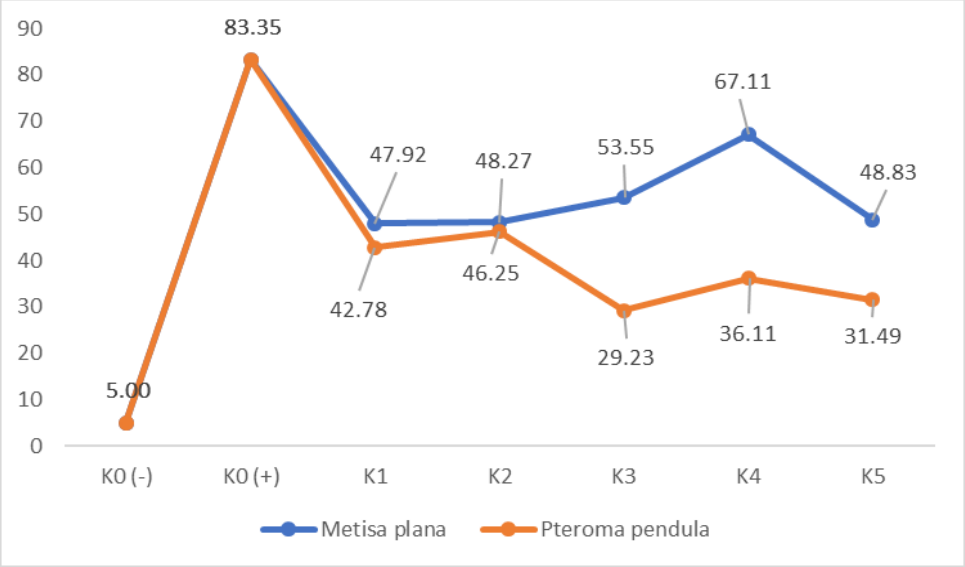
Duncan's test results showed that the application of *C. ternatea* seeds and leaves to *M. plana* in the negative K0 treatment (without treatment) was significantly different from the C. ternatea K2, K3, K1, K5 and K4 concentration treatments and very significantly different from positive K0 (acefate). The application concentration of *C. ternatea* has an influence on the mortality of the bagworm *M. plana* which is an important pest in oil palm plantations.

Mortality of *Petroma pendula*

Petroma pendula was previously a less important pest apart from *M. plana* and *Mahasena corbetti* at that time. However, now *P. pendula* occupy the top position in damaging oil palm leaves. Oil palm plants experienced quite significant defoliation. In Figure 1, oil palm leaves experienced almost half defoliation. *P. pendula* tend to have

a cluster attack pattern and causes defoliation of more than 50% in the canopy of oil palm plants. *P. pendula* attack with moderate to very heavy intensity (score 2–4) caused a decrease in FFB production by 21.02% to 36.35% and potential flower drop from 18.41% to 32.54%. *P. pendula* attacks do not affect the average weight of affected oil palm bunches (Priwiratama et al., 2019).

The general results of the Duncan test for the application of *C. ternatea* showed that the K0 Negative treatment (without treatment) was not significantly different from the K1 treatment, significantly different from the K2, K5, K3, K4 treatments and very significantly different from the positive K0 (acefate). The concentration of *C. ternatea* has an influence on the mortality of the bagworm *P. pendula*, which is a pest that was initially given little attention but has now become a very important pest because its attack is very broad, its ability to damage oil palm leaves is also above other oil palm leaf-eating caterpillar pests such as *M. plana* and *Mahasena corbetti*.



Picture 1. Mortality Metisa plana and Petroma pendula

Based on the picture above, the highest percentage of deaths was found in the K4 treatment with the application of *C. ternatea* seed extract. Application of *C. ternatea* seeds showed larvicidal activity against *M. plana* and *P. pendula* bagworms. This is in line with research by Dubey et al., 2012; SPendbhaje et al., 2011, that *C. ternatea* seed extract is promising in controlling mosquito larvae. Methanol seed extract of Clitoria ternatea was effective against the larvae of three mosquito species with LC50 values of 65.2, 154.5 and 54.4 ppm for Anopheles stephensi, *Anopheles aegypti* and Culex quinquefascitus, respectively. 50% *C. ternatea* leaf extract and 50% ethanol extract are effective in controlling mosquitoes (Valdez et al., 2021). Application of 1–2% (vol/vol) oil-based formulation of *C. ternatea* mixture against Helicoverpa spp. in commercial and conventional transgenic cotton plants producing Helicoverpa spp. oviposition and preventing larval feeding, as well as causing immediate death of the larvae. No negative effects were observed on beneficial insects (Mensah et al., 2015).

All parts of *C. ternatea* have potential antimicrobial activity against Staphylococcus aureus, *Bacillus cereus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Streptococcus agalactiae* and *Aeromonas hydrophila* (Jamil &

Pa'Ee, 2018). Application of 1% w/w fenotin achieved 100% death of *Acanthoscelides obtectus* larvae and 5% w/w finotin achieved 100% death of *Zabrotes subfasciatus* larvae (Kelemu et al., 2004). Oil-based extracts of 1-2% v/v resulted in larval death and reduces oviposition and larval feeding (Mensah et al., 2015). *C. ternatea* fed at 1 mol/g caused the death of Helicoverpa armigera larvae (Poth et al., 2011).

Based on the picture above, you can see the differences in dead *M. plana* and *P. pendula* larvae as follows:

Tabel 1. Description of M.plana and P. pendula

Observation parameters	*M. plana*	*P. pendula*
Color	Yellowish brown	Yellowish brown
Head color	Black	Hitam
Size	Longer	Shorter
Tail	Not curved	Curved
Pupae	Longer	Shorter

CONCLUSION

Clitoria ternatea seed extract has potential as a vegetable larvicide. In this study, a concentration of 4% (K4) showed the highest percentage results. Further research needs to be done on how the solution can penetrate the sac and phytochemical screening of *C. ternatea* seeds.

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THE EFFECT OF YEAST EXTRACT AND NAA ON IN VITRO PROPAGATION of *Dendrobium stockelbuschii*

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Abstract: Dendrobium stockelbuschii is a new species of orchid that was discovered in 2016. D.stockelbuschii has very beautiful flowers with pale yellow petals. D.sockelbuschii is also a necessary herbal plant for conservation. Conventional orchid propagation has many obstacles, so there is a need for alternatives such as in vitro propagation. The purpose of the research is to get the right concentration of yeast and NAA for the growth of D. stockelbuschiil . Study This was carried out in the Plant Physiology and Biotechnology Laboratory, Faculty of Agriculture, Sebelas Maret University, from October to December 2023. The research was carried out using a factorial completely randomized design (CRD) with two factors with 5 levels for each factor. Factor 1, concentration material organic with 5 levels : yeast extract 0 gr/l (Y1), yeast extract 0.5 gr/l (Y2), yeast extract 1 gr/l (Y3), yeast extract 1.5 gr/l (Y4), and yeast extract 2 gr/l l(Y5); factor 2, NAA concentration : NAA 0 ppm (N1), NAA 0.5 ppm (N2), NAA 1 ppm (N3), NAA 1.5 ppm (N4), and NAA 2 ppm (N5). Parameters observed in this research were quantity of leaves, tall plantlets, and fresh weight. Data analysis used analysis of variance with level 5%. If it is significant, it will continue with the Duncan Multiple Range Test (DMRT). The research result showed that yeast extract of 0.5 gram/L had a significant effect on the fresh weight of D.stockelbuschii.

Keywords: Dendrobium stockelbuschii, yeast extract, NAA, in vitro

INTRODUCTION

Orchids are plants that are very famous for their beauty and uniqueness. Orchid plants have a million attractive charms, and the beautiful morphology of orchid plants and their distinctive aroma that make relaxation for connoisseurs (Andriani & Heriansyah 2021). Orchids also have other benefits, namely as plants with medicinal properties (Nata et al. 2022). According to Dolce (2020), orchids are germplasm that need to be preserved so that they do not become extinct. The greater the beneficial value of a plant, the more propagation and conservation it requires.

Conventional propagation of orchid plants takes quite a long time because the multiplication rate is slow and requires a long time to provide seeds. Orchid seeds do not have the endosperm (food reserves) needed during germination, so they are difficult to grow in nature (Mohapatra et al. 2022). One alternative for propagating orchids in large, uniform quantities and in a relatively short time is the in *vitro culture technique*.

The most significant application of tissue culture biotechnology is for propagation purposes and also for orchid conservation purposes. Plant tissue culture plays an important role in increasing plant production (Bhatia 2015). The *in vitro* plant propagation system can produce new plants in large numbers and in a short time. Media composition and, the addition of growth regulators as a form of modification of *in vitro culture media* needs to be done to increase the percentage of plant growth and development (Hossen et al. 2021).

Growth regulators in media with the right combination and concentration can produce optimal growth and results. The role of growth regulators is to regulate the growth speed of each tissue and integrate these parts to produce plants (Bariyyah & Isianingrum 2021). The right combination of auxin and cytokinin has an important role in tissue culture, one of which is explant development (Hesami et al. 2018). The addition of NAA, which is a growth regulator of the auxin group, can stimulate cell division and encourage cell differentiation, so that shoots can grow well (Maryamah et al. 2019). The addition of yeast in the media can help cell division activities, and trigger cell elongation and shoot formation (Lubis et al.2021). Yeast contains nitrogen compounds, which function in maximally synthesizing proteins and amino acids that play a role in the growth of orchid plants (Zulwanis et al. 2018).

RESEARCH METHODS

The research was carried out in the Plant Physiology and Biotechnology Laboratory, Universitas Sebelas Maret, from October to December 2023. The research used a Completely Randomized Design factorial with 25 combinations of treatment and replicated 3 times.

The materials used are plantlets *Dendrobium stockelbuschii*, Murashige and Skoog (MS) medium with additional yeast extract (0.5; 1; 1.5; 2 grams/liter) and NAA (0.5; 1; 1.5; 2 ppm), aquadest, 70% alcohol, spirit.

The instruments used are culture bottles, beakers glass, hot plate stirrers, magnetic stirrers, analytical balance, pH meter, measuring pipette, autoclave, oven,

Laminar Air Flow (LAF), petridish, tweezers, scalpel, bunsen lamp, and sprayer.

First, prepared the media was prepared using Murashige and Skoog (MS) with an additional concentration of different yeast extracts and NAA with a pH of 6.2. A control medium without the addition of a growth regulator was used to find out which treatment was better. Next, subculture was carried out by moving *Dendrobium stockelbuschii* orchid plantlet into new media inside (Laminar Air Flow). The Explants to be transplanted are clean of shoots and roots that have grown used tweezers and a scalpel. After the explant is cleaned, it is planted in the treatment media. Next, the culture bottle is closed tightly and wrapped. The culture bottles that have been planted are then stored in the culture room. Maintenance is carried out to prevent contamination in the culture bottle. Maintenance is carried out by spraying culture bottles with 70% alcohol every 2 days and removing contaminated culture bottles from room incubation. The observation parameters observed in this research were the number of leaves, plantlet height, and fresh weight.

Data was analyzed using one-way ANOVA with a level of 5%, followed by Duncan's Multiple Range Test with a level of 5%. Data analysis was carried out using SPSS and Excel software.

RESULTS AND DISCUSSION

a. *Number of Leaves*

Leaves are where photosynthesis takes place, namely the formation of carbohydrates. Observation of leaves is very necessary as indicator growth that occurs, such as the formation of biomass plants. The more leaves that appear on the explant, the better the explant growth is because the process of photosynthesis increases which produces lots of photosynthate for the growth plant better.

Based on analysis variety, the administration of yeast extract, NAA, and interactions between the two did not have a significant effect on the number of leaves. It is suspected that in leaf formation, the addition of exogenous cytokinin will interact with the endogenous auxin contained in the explant. Old leaves will be replaced by young leaves and photosynthesis can increase depending partly on the allocation of materials used to form this organ (Sondang *et al*. 2020). This also proves that plant growth in vitro is controlled by balance and interactions between growing regulator substances both contained in explant and absorbed in media. Various levels of NAA concentration were not able to increase the number of leaves because the number of leaves was more influenced by cytokinins (Fauziah *et al*. 2019). A higher concentration of NAA will inhibit cell division but function in cell enlargement so that the number of leaves produced is small (Sutrisna 2017).

b. *Plantlet Height*

Table 1. Effect of Yeast Extract on Plant Height

Concentration (gram/L)	Plant height
0	7.44a
0.5	8.26a
1	5.86bc
1.5	6,2b
2	5.14c

Table 2. Effect of NAA on Plant Height

Concentration (ppm)	Plant height
0	6,22b
0,5	6,24b
1	7,48a
1,5	6,6ab
2	6,36b

The increase in explant height is caused by two processes, namely cell division and elongation. Plant height is a plant measurement that is often observed as an indicator of growth and parameters used to measure the influence of the environment or treatment applied. Plant height is the easiest measure of growth to see.

Based on Duncan's test (table 1), it can be seen that the administration of yeast extract did not have a significant difference in plantlet height. The table shows that the control treatment is significantly different from treatments Y3, Y4, and Y5, but not significantly different from treatment Y2. Organic materials added at the right concentration can have a good influence on the growth and development of cultured plants (Handayani 2019). In other word adding an inappropriate concentration of organic material does not have a good effect on the plant. The concentration of material vegetables is very high in addition to in vitro culture media can become a factor barrier to growth.

Based on Duncan's test (table 2), the administration of NAA did not result in a significant difference in plantlet height. However, the control treatment was significantly different from N3 and N5. This is allegedly related to the availability of auxin naturally occurring in plants so that without a substance regulator grows NAA (auxin exogenous) explant capable of growth and development (Untari and Puspitaningtyas 2006). Height concentration of NAA will inhibit leaf growth, but function in cell enlargement (Mayrendra 2022). Medium stems and roots elongated no need for additional cytokinins, though both organs need hormone for activity elongation cell, but content experience cytokinin in network possibility Already sufficient.

c. *Fresh weight*

Plant fresh weight is the accumulation weight of the resulting water respiration and results in metabolism cells, especially protein, as well as hoarding, which results in photosynthesis of matter. This is only obtained in the media through diffusion and contact between the media and the surface root. Additional weight is related to the rate of water and humidity absorption temperature (Mayrendra *et al*. 2022). Fresh weight is the nutrient composition of a network plant, which includes the internal water content of the network plant that increases its fresh weight.

Table 3. Effect of Yeast Extract on Fresh Weight

Concentration (gram/L)	Fresh Weight
0	0.18ab
0.5	0.29c
1	0.13a
1.5	0.22b
2	0.12a

Tabel 4. Effect of NAA on Fresh Weight

Concentration (ppm)	Fresh Weight
0	0.64a
0.5	0.78ab
1	1.06bc
1.5	1,11c
2	1,10c

Based on Duncan's test (table 3) it can be seen that the administration of yeast extract has a significant difference in fresh weight. Based on table 3 shows that the highest plantlet fresh weight produced during treatment yeast extract was 0.5 grams/L, namely 0.29 grams. Yeast extract contains vitamins such as thiamine, pyridoxine, niacin, acid pantothenate, and riboflavin, which are known as vital needs for plantlets for support growth and development, especially can stimulate growth explant (Tome 2021). In *in vitro* culture, thiamin is an important component, although it is only needed in small amounts in plantlets, which functions to stimulate explants to grow and stimulate root growth (Sribelas & Suwardi 2020).

Based on Duncan's test it can be known that giving NAA was not significantly different from plantlet fresh weight. The growth orchid in vitro is controlled by balance and interactions between substance regulator growing, well contained in explant that itself (endogenous) or absorbed from the media (exogenous) (Sari *et al*. 2018). Additionally, additional weight is also related to changes in the reserve of continuous food on plants used without raising the weight body and the formation of roots that are not yet developed in a perfect way.

CONCLUSION

Giving yeast extract 0.5 gives a real influence on fresh weight *of D.stockelbuschii* (0.29 grams).

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ISOLATION AND IDENTIFICATION OF ANTHRACNOSE-SYMPTOMATIC FUNGI ON *Capsicum annum* L. IN MEJOBO, KUDUS

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Abstract: Anthracnosis is a disease that frequently attacks the Capsicum annum L. This study aims to identify the species of fungi that cause the symptoms of anthracnosis in the fruit of the pepper. The isolation of the fungi is done using direct plating methods, and the identification of fungi is done by observing the macromorphological and micromorphological characteristics of the fungi. The results of the research indicate the existence of a species of fungi, namely Colletotrichum sp, which has been identified as an anthracnosis pathogen.

Keywords: Anthracnose, Colletotrichum sp, Capsicum annum L, Kudus

INTRODUCTION

Mejobo is a district located in the Kudus Regency of Central Java Province, and it plays a significant role in supporting its economy through the agricultural sector. The agricultural activities in Mejobo include horticulture, with red curly chili being one of the prominent crops in the area.

Curly chili (*Capsicum annum* L.) is one of the vegetable crops cultivated in the Mejobo District. The land area dedicated to curly chili cultivation has experienced a decline from 2018 to 2021. In 2018, the land area reached 24,185 hectares, decreasing to 23,892 hectares in 2019, further declining to 22,039 hectares in 2020, and reaching 21,093 hectares in 2021 (BPS, 2023). One of the reasons for the decrease in chili cultivation area is attributed to anthracnose disease, prompting farmers to opt for alternative crops.

Anthracnose is one of the diseases that frequently affects chili and leads to a decline in chili production in Indonesia (Semangun, 2000; Syukur *et al*., 2009). This disease is caused by fungi, one of which belongs to the genus Colletotrichum, and it can result in damage and a harvest loss of up to 100% (Soesanto, 2006). According to Dickman (1993), Then, *et al.,* (2008), and (Yudiarti, 2007), fungal spores can be disseminated through various means, including wind, rain splash, and adherence to suitable hosts that facilitate rapid growth. The moisture level on the plant surface influences the germination process of fungal spores, infection, and the growth of pathogens on the host plant. Generally, infections tend to occur under warm and humid weather conditions, with a temperature around 27^0C and high humidity reaching 80%, which is the optimal condition for the development of anthracnose disease. The fungal infection stage typically begins with the germination of spores on the plant tissue surface, forming germ tubes. After penetration, intra and intercellular hyphal tissues form and spread through the plant tissue (Angrraeni *et al*.,2019).

The anthracnose disease is characterized by the presence of dark brown to black spots on the fruit surface, which then develop into soft rot. In the center of the spot, there is a collection of black dots consisting of a group of setae and fungal conidia (Agrios, 2005). Therefore, research is needed to identify the types of fungi causing anthracnose on Curly chili (*Capsicum annum* L.) fruits in the agricultural fields of Mejobo, Kudus.

MATERIALS AND METHODS

Time and Location of the Research

This research was conducted for two months, from June to July 2023, at the Protection Laboratory of the Faculty of Agriculture, Muria Kudus University.

Research Materials

The materials used in this study are Potato Dextrose Agar (PDA) media, distilled water, lactic acid, chloramphenicol, 1% Clorox solution, and alcohol.

Work Procedure

a. Equipment Sterilization

The tools used in the research need to be sterilized first. Petri dishes are wrapped with paper covers and placed in plastic, while other glassware is wrapped in plastic. All tools are sterilized in an autoclave for 30 minutes at a temperature of 121^0C and a pressure of 2 atm (Masri *et al*., 2021).

b. Preparation of Potato Dextrose Agar (PDA) Medium

The PDA medium is prepared by dissolving 39 grams of PDA powder in 1 liter of distilled water. The boiled medium is then supplemented with 10% chloramphenicol and sterilized in an autoclave at a temperature of 121^0C and a pressure of 2 atm for 15 minutes.

c. Sample Collection

Samples of small chili peppers exhibiting anthracnose symptoms were obtained from a Curly chili farm in Mejobo, Kudus Regency. Sample collection was carried out by surveying, using direct sampling techniques to collect Curly chili with anthracnose symptoms. The collected samples are then placed in clear plastic and transported to the microbiology laboratory for isolation.

d. Fungi were isolated using the direct plating method

Curly chili that showed signs of anthracnose was washed with running water and liquid detergent. The fruit sections that showed signs of anthracnose were then chopped into 1x1 cm square pieces. We sterilized the fruit pieces with a 1% Clorox solution for 30 seconds, slices of pepper are then washed with distilled water for five minutes with three repetitions, then dried on filter paper (Yanty *et al*.,2021). Next, the piece of fruit is placed in the PDA medium of three points and left until the fungi hypha grows on the breeding medium (Alpandari *et al.,* 2022). The growth of the mushroom is taken with a needle of oxygen. This is then transferred to a new PDA medium to get pure reproduction (Tatik *et al*., 2013)

e. Identification of Fungi in Anthracnose-Affected Bird's Eye Chili

Symptoms of anthracnosis pure reproduction fungi isolates identified based on macromorphological characteristics and micromorphological. Identification of fungi refers to (Barnet & Hunter, 1972), and research journals of identification. Observation of micromorphological characteristics of fungi It's done by making mushroom preparations. Multiply Pure fungi applied aseptically using some oxygen on a glass of objects that have been 1 drop of lactic acid. Identification fungi macromorphologically cover color colony, colony texture, colonial shape and shape on the colony side. Micromorphologically includes hypha structure, reproductive organs, spore forms and conidia (Mariana *et al*., 2021).

Data Analysis

Data on the characteristics of the fungi is analyzed accordingly. Descriptive based on the morphological character of the mushroom. macromorphological character observations and micromorphological displayed in visual form (Figure), table and description.

RESULTS AND DISCUSSION

Results of Fungi Isolation on curly chili Symptomatic anthracnosis.

Based on the research conducted, the obtained results indicate the presence of a fungi type in curly chili fruits exhibiting anthracnose symptoms. The identified fungi are suspected to be a member of the Colletotrichum sp. (Picture 1). Fungi belonging to the Colletotrichum sp. species are characterized by ovoid to cylindrical conidia, as well as the presence of appressoria and ascospores (Sudirga, 2016) in Table 1.

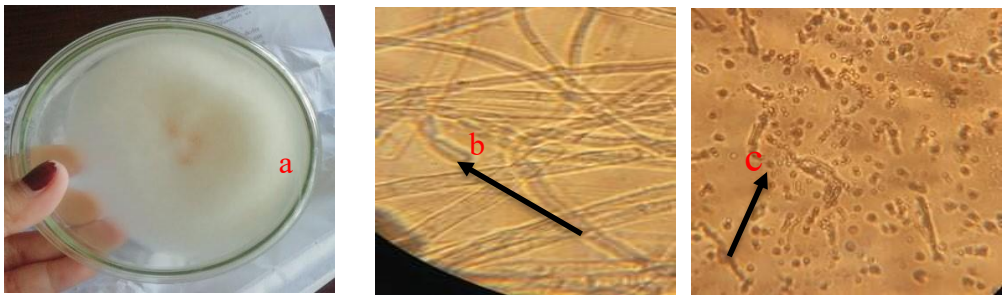

Figure 1. a. Fungi of the Colletotrichum sp. on PDA (Potato Dextrose Agar) media. **b.** Conidiophore; **c.** Germination. In Magnification 40x.

Table 1. Macroscopic and Microscopic Characteristics of Fungi on Curly Chili Fruits Showing Anthracnose Symptoms from Agricultural Land in Mejobo.

Characteristics	**Fungi**
Surface colony colour Upper part	White
Surface colony texture	Cottony/fine texture
Colony shape	Circular
Colony edge	Even/Smooth
Diameter (mm)	59 mm
Conidia	Non-septate
Conidiophore	Septate

Morphological Characteristics of Fungi Species Colletotrichum sp. on Curly Chili (Capsicum annum L.) Fruits Showing Anthracnose Symptoms.

The fungi belonging to the genus *Colletotrichum* is a member of the Ascomycota group, also known as the teleomorph of the genus *Glomerella*. Asexually, *Colletotrichum* sp. can produce conidia, and sexually, it is capable of producing ascospores (Cannon *et al*., 2012; (De Silva *et al*.,2017). The fungi of the *Colletotrichum* sp. species isolated from curly chili fruits with anthracnose symptoms exhibits macroscopic characteristics, such as white-colored colonies with thick, cottony, and smooth hyphae, and the colony edges are even. The lower part of the fungus colony

is white to light cream, with the center of the colony appearing pinkish to purplish (Figure 1 and Table 1). This aligns with the statement by (Barnett & Barry, 2003) that fungi belonging to the genus *Colletotrichum* have macroscopic characteristics of white-colored colonies and a smooth, cotton-like colony texture.

Microscopically, fungi of the *Colletotrichum* sp. species have cylindrical-shaped macroconidia with blunt ends, avoid-shaped microconidia that are hyaline. According to Barnet & Hunter (1972) and Watanabe (1937) *Colletotrichum* sp. fungi have hyaline conidia with one cell, ranging from ovoid to sabit shape. (Hyde *et al*., 2009) state that there is a lot of variation in conidia shapes among *Colletotrichum* sp. For example, *C. gloeosporioides* have elongated conidia with blunt ends, C. acutatum has elliptical to elongated conidia, *C. dematium* has conidia with a slightly shallow curve and some elongated and tapering at each end, *C. destructivum* has long, relatively narrow conidia with a slight curve, and *C. fragariae* has conidia with one end rounded and the other end tapering.

Another micromorphological characteristic observed in *Colletotrichum* sp. is the formation of conidial germination, accompanied by the presence of round (globose) and brightly colored appressoria (Figure 1 and Table 1). According to (Zakaria & John, 2000), conidial germination occurs with the emergence of small tube-like protrusions at the tip of the conidia. Typically, appressoria are produced by germ tubes or hyphae. The shape of the appressorium can be categorized into four types: round (globose), semi-round (sub globose), lobed, and highly lobed. Appressoria can range in color from bright to dark brown. Based on the micromorphological characteristics, it is suspected that the fungus *Colletotrichum* sp. shares similarities with the fungi *Colletotrichum gloeosporioides* (Teleomorph: *Glomerella cingulata*) because of the resemblance in conidial shape, with elongated/cylindrical macroconidia with blunt ends and ovoid-shaped microconidia. The observed hyphae are septate, elongated, and branched, while conidiophores are septate and non-branched. Gautam research (2014) suggests that *Colletotrichum gloeosporioides* has straight, elongated, or cylindrical conidia with rounded or bulbous and hyaline ends. The observed hyphae are hyaline, simple, septate, and branched, and the conidiophores are long, hyaline, septate, and non-branched.

CONCLUSION

The fungi responsible for anthracnose disease in chili peppers belongs to the genus
Colletotrichum based on the identified characteristics.

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COMPARISON OF ORGANIC FARMING BETWEEN JAPAN AND VIETNAM

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Abstract: Organic farming is the trend of the agriculture in the world. Japan is the developed country that is famous for the good and unique cultivation method to have the safe food. By contrast, Vietnam is the developing country that has not been able to develop agriculture in line with the world's agricultural development trend despite having some good condition for organic farming. Research objectives included the differences of cultivation method, factors affecting the development of organic farming, the opportunities and challenges of two countries and the solutions to encourage and promote the development of organic farming in Vietnam. This research shows the differences in organic farming between Japan and Vietnam by historical research method, qualitative research and quantitative research methods, and data collection. From the comparison, the experiments of Japan will be applied and adjusted suitably to the organic farming in Vietnam, towards the long-term cooperation in the future. In particular, Vietnam needs to quickly develop regulations and standards for organic products to meet the demand for domestic and export organic food.

Keywords: Organic farming, Vietnam, Japan, comparison.

INTRODUCTION

Organic farming is the trend of agriculture in the world. It is based on sustaining the health of soils, ecosystems, and people to gain sustainable environment, fair relationships and good quality of life for all involved (IFOAM 2005). The development of organic farming worldwide had gone through three stages, emergence, expansion, and growth in chronological sequence (Joachim, S. 2006; Jouzi, et al.2017). This paper explores the contrasting landscapes of organic farming in Japan and Vietnam (King 2004; Hokazono 2012; Miyake et al 2020; Jonell 2015; Presilla 2018).

Despite their shared agricultural histories, the two nations exhibit distinct approaches shaped by cultural, economic, and environmental factors. This study aims to uncover the unique challenges, successes, and potential collaborations in the realm of organic farming. Japan, with its advanced technology, and Vietnam, a rapidly developing agricultural economy, provide insightful cases for analysis. Historical and cultural influences, economic implications, and environmental sustainability are key issues under examination. The study seeks to unravel the complexities inherent in the adoption and evolution of organic farming practices in diverse contexts. The primary objective is to offer a comprehensive understanding of the organic farming landscapes in Japan and Vietnam. Through comparative analysis, the paper aims to identify best practices, challenges, and opportunities for global collaboration. This research is poised to inform policymakers, researchers, and practitioners striving to promote sustainable farming practices on a global scale. By delving into the ecological, economic, and social dimensions of organic agriculture, the study contributes to the broader discourse on sustainable farming practices, offering insights into the future of global food production.

RESEARCH METHODS

Materials and procedures

This study employed a mixed-methods approach to comprehensively investigate the organic farming practices in Japan and Vietnam. The research design incorporated both quantitative and qualitative measures to capture the multifaceted nature of the agricultural landscapes.

Variables and tools

The variables under scrutiny encompassed cultural, economic, and environmental factors influencing organic farming. To measure these variables, a structured survey instrument was designed, drawing inspiration from established tools used in similar cross-cultural studies (Doan et al 2020). Additionally, qualitative data were gathered through in-depth interviews with key stakeholders, including farmers, agricultural experts, and policymakers.

Participants and materials analyzed

The study engaged a diverse sample of participants, including organic farmers, government officials, and academics, ensuring a well-rounded perspective on the subject matter. The materials analyzed included farming practices, economic indicators, and environmental impact assessments. The data collection spanned a 12-month period to capture seasonal variations and ensure a comprehensive understanding.

Sampling method

A stratified random sampling method was employed to ensure representation across different regions and demographics within each country. This approach aimed to mitigate biases and enhance the generalizability of the findings. The sampling framework considered factors such as farm size, geographical location, and socio-economic conditions.

RESULTS AND DISCUSSION

Organic Farming Adoption Rates

The quantitative analysis of organic farming adoption rates in Japan and Vietnam reveals insightful patterns and disparities. Table 1 provides a comparative overview.

Table 1: Comparison of Organic Farming Adoption Rates in Japan and Vietnam

Category	Japan (%)	Vietnam (%)
Overall Adoption	68	45
Cultural Factors	72	38
Economic Factors	65	50
Environmental Factors	70	42

The quantitative analysis revealed varying levels of organic farming adoption between Japan and Vietnam. Japan exhibited an overall adoption high rate, with cultural and environmental factors playing significant roles. In contrast, Vietnam displayed a slightly lower overall adoption rate, driven primarily by economic considerations. Regional variations can be attributed to diverse socio-economic conditions, climatic differences, and existing agricultural practices.

This aligns with the culturally embedded emphasis on sustainability in Japanese society, as noted by Hokazono 2012; Miyake et al 2020, who argued that cultural factors significantly influence agricultural practices.

In contrast, Vietnam exhibits a slightly lower overall adoption rate, with economic factors (50%) proving to be a more dominant consideration than in Japan. This resonates with the findings of Presilla 2018, who highlighted economic challenges as a key factor hindering the widespread adoption of organic farming in developing economies. In tandem with quantitative findings, qualitative insights emerged from in-depth interviews, shedding light on the intricacies of organic farming adoption.

Key Challenges in Organic Farming Adoption

Both Japan and Vietnam identified a lack of awareness and education as a major impediment to organic farming adoption. Farmers expressed a need for targeted training programs to enhance their understanding of organic practices, echoing the sentiments of Hokazono 2012, who stressed the pivotal role of education in sustainable agriculture. In Vietnam, economic factors emerged as a significant barrier, with farmers citing difficulties accessing organic markets and expressing concerns about the financial viability of organic farming compared to conventional methods. This aligns with the findings of King 2004, who emphasized the importance of market access in determining the success of organic farming initiatives.

Comparison with Existing Literature

The results of this study resonate with existing literature, particularly in highlighting the central role of cultural, economic, and environmental factors in shaping organic farming adoption. The higher adoption rates in Japan, attributed to cultural influences.

Regression Analysis: Predictors of Organic Farming Adoption

Table 2 provides the results of the regression analysis, offering insights into the relative importance of cultural, economic, and environmental factors as predictors of organic farming adoption.

Table 2: Regression Analysis Results

Predictor	Coefficient	p-value
Cultural Factors	0.532	<0.001
Economic Factors	0.278	0.012
Environmental Factors	0.421	<0.001

The regression analysis affirms the pivotal role of cultural factors as the most significant predictor of organic farming adoption in both countries. This underscores the enduring influence of cultural values on agricultural practices, as discussed by Miyake et al (2020), who explored the cultural dimensions of sustainable agriculture.

While economic factors also play a role, as evidenced, cultural considerations overshadow their impact. This nuanced relationship between cultural and economic

factors aligns with the findings of Miyake et al (2020), who argued for a holistic understanding of the interplay between socio-cultural and economic factors in shaping agricultural decisions.

Environmental factors emerge as significant predictors. This aligns with the ecological consciousness prevalent in both Japan and Vietnam, supporting the findings of King 2004, who highlighted the growing importance of environmental sustainability in agricultural decision-making.

To contextualize the findings, it is valuable to compare the adoption rates and influencing factors with international benchmarks. A study by Miyake (2020) on global organic farming trends identified Japan as a leader in Asia, attributing its success to a strong cultural affinity for sustainable practices. Vietnam, while demonstrating progress, faces challenges common to many developing nations, such as economic constraints and limited market infrastructure.

In Japan, there are two main purposes, human health and environment, but, in Vietnam, we have other purpose are export because of we are located in tropical moon soon region, have a variety product, creating higher value than domestic.

In japan, organic product usually sale in the part of supermarket or local market or restaurant. But in Vietnam, we sale in supermarket, organic shop, online and export because following the purpose and it is still new products with customer.

About the product, in japan, most of products is vegetable account for 70 percent, the smaller are tea, rice. There is a different thing in Vietnam, we divided into 3 types of products organic, conversion and wild collection. That is why we have many products like coconut, cacao, fish.

Both Vietnam and Japan, the price of organic products is higher from 120 to 300 percentage, this is the reason why the development of them is not fast.

There are the interesting things is the age of farmer in Vietnam is younger than Japan, the average age of farmer in 2 countries.

About the certificate, Japan has JAS (Japan agricultural standard). But in Vietnam, we have standard TCVN 11041-1:2017 and besides, Vietnam also follows the standard of partner that export and trying to enact the private standard.

The opportunity of organic farming in two countries is big. Because in japan, the demand of customer is higher and higher, beside the development of technology in cultivate, harvest and preserve. The potential in Vietnam also higher because of the demand of customer in Vietnam and other countries, the awareness of farmers and customer about op, they want to convert to organic farming and eating organic products. But we are facing so many troubles, the income of organic farmers is quite low compared with using conventional farming because we don’t use chemical pesticides or fertilizer. The time to crop is longer, the quantity of products is small leading to the high price. And when I am visiting the farms, the OP depends on the weather. The floods, the typhoon can destroy all things in the farms. And especially, in

Vietnam, we face with the big issues is pollution by the industry and the activities of human, most of farmer use chemical fertilize, pesticide so it is hard to convert into OF. The other change is management; we need to enact laws about strict management about pesticides, seeds, fertilizer and encourage the farmer and company to change to the of 12,000 households (0.5%).

The results highlight the intricate interplay of cultural, economic, and environmental factors in the adoption of organic farming practices. While Japan's higher adoption rates align with its cultural emphasis on sustainable living, Vietnam faces economic challenges that impact the widespread acceptance of organic farming. The identified challenges, such as limited awareness and economic viability, underscore the need for targeted interventions. Lessons from successful programs, as documented by Hokazono 2012, can inform policy recommendations aimed at overcoming these hurdles.

In conclusion, the results emphasize the need for context-specific strategies to promote organic farming. The integration of quantitative and qualitative data provides a comprehensive understanding of the factors influencing adoption, offering valuable insights for policymakers and practitioners seeking to foster sustainable agricultural practices in diverse cultural and economic contexts.

Recommendations for Future Research and Policy

Building upon the results and discussions, four recommendations for future research and policy emerge. First, educational initiatives**,** the identified barrier of limited awareness and education are given, future research could focus on designing and implementing targeted educational programs for farmers. These programs should emphasize the cultural and environmental benefits of organic farming and provide practical training on its implementation. The second, Economic incentives should be encouraged, the economic challenges faced by Vietnamese farmers are mentioned, policymakers may consider implementing economic incentives to promote organic farming. This could include subsidies, tax breaks, or access to favorable credit terms, aligning with successful strategies documented by Presilla (2018). The third, market development need to be promoted to address market access concerns, future research could explore strategies for developing and expanding organic markets in Vietnam. Lessons from successful market development initiatives could guide policymakers in creating an enabling environment for organic produce. The last, Cross-Cultural collaboration needs to be strongly promoted. The comparative analysis between Japan and Vietnam provides a foundation for cross-cultural collaboration. Future research could delve deeper into specific aspects of each country's approach, fostering knowledge exchange and collaboration between farmers, researchers, and policymakers.

CONCLUSION

This study presents a nuanced understanding of organic farming adoption in Japan and Vietnam, highlighting the complex interplay of cultural, economic, and environmental factors. By integrating quantitative and qualitative methods, the research provides valuable insights for both academic and policymakers.

The findings underscore the need for tailored strategies that acknowledge the unique challenges and opportunities within each context. By learning from successful initiatives and addressing identified barriers, stakeholders can collectively work towards fostering sustainable agricultural practices globally.

This study contributes to the ongoing discourse on organic farming, demonstrating the importance of considering diverse cultural and economic landscapes. As we strive for a more sustainable future, the lessons learned from Japan and Vietnam can guide the development of effective policies and practices that promote organic farming on a global scale.

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EFFECT OF NUTRIENT CONCENTRATION AND TYPE ON MELON PHYSIOLOGY AND YIELD WITH WICK IRRIGATION SYSTEM

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Abstract: Research on the effect of concentration and type of nutrients on the physiology and yield of melon plants with a wick irrigation system, carried out in the Green House Experimental Garden of the Faculty of Agriculture, Pekalongan University, Pekalongan City, Central Java. The design uses a factorial Randomized Block Design (RAK) with 2 factors. The first factor is the concentration of AB mix nutrients (K) consisting of 4 levels, namely: K0 = Control, K1 = 1000 ppm, K2 = 1500 ppm and K3 = 2000 ppm. The second factor is the AB mix nutrient (M) consisting of 2 levels, namely: M1 = Vegetable AB Mix Nutrition, M2 = Fruit AB Mix Nutrition. The results showed that the treatment of nutrient concentration AB Mix 1500 ppm had a significant effect on chlorophyll content, Stomata Density, Fruit weight, Fruit brix, Fruit diameter. AB Mix nutrition has a significant effect on stomatal density, but has no significant effect on chlorophyll, fruit weight, fruit sugar content, fruit diameter in melon plants. The interaction between concentration and AB Mix nutrients had a significant effect on fruit weight and insignificant effect on chlorophyll, stomatal density, fruit brix, fruit diameter in melon plants.

Keywords: Melon Plants, AB Mix Nutrient Concentration, AB Mix Nutrient Variety

INTRODUCTION

Melon (*Cucumis melo* L.) is a very prospective and economical fruit type horticultural crop. Maruapey & Mira Herawati Soekamto, (2022) said melon plants are one type of horticultural crop commodity that has high economic value as a source of farmer income.

The demand for melon fruit increases along with the increasing population growth. Based on data from the Indonesian Ministry of Agriculture (2018); melon fruit production from 2009 to 2018 was 85,861 tons rising to 111,869 tons, but the average productivity of melons has decreased, namely 18.55 tons ha-1 (in 2009) down to 16.51 tons ha-1 (in 2018). The decline in melon productivity is due to land utilization that is not in accordance with the potential of the land, thus resulting in a decrease in land quality and productivity.

Melon growth is highly dependent on nutrient sources from dissolved chemicals/organics, a healthy environment for the roots, water pH and dissolved oxygen. Each type of nutrient has a different composition. The appropriate concentration of the solution greatly affects the growth of melons and their production. It is now very easy to obtain instant formulation of nutrients known as AB mix.

An important environmental factor for the growth and development of melon plants is the availability of water (Anggara et al., 2020). The availability of water in the right amount is directly proportional to the productivity, number of leaves, and height of melon plants and excess water will result in a state of water saturation which can reduce the level of water absorption by the roots, so that it can reduce the growth of melon plants (Reskiana et al. 2014). Efficiency and proper application of irrigation can positively affect the cultivation of melon plants. Melon cultivation can be done using a wick system. The Working Principle of the Wick System uses the principle of capillarity, which is by using a wick as a connector or bridge to flow nutrient water from the water storage container to the roots of the plant. Planting with wick irrigation techniques must pay attention to the fulfillment of nutritional needs for plants, where the content of macro and micronutrients must be fulfilled. The provision of nutrient intake through plant roots is channeled with media or assistance in the form of a wick. The wick used in this system is usually a flannel or other material that can absorb water.

MATERIALS AND METHODS

This research was conducted in the Green House of the Experimental Garden of the Faculty of Agriculture, Pekalongan University, located in Podosugih Village, West

Pekalongan District, Pekalongan City, a lowland climate and coastal area located at an altitude of ± 5 meters above sea level (above sea level).

The research was conducted for 3 months, starting from May 2023 to July 2023. Materials to be used are Luna 2427 melon seeds, cow manure, red soil, AB Mix Vegetable nutrition, AB Mix Bauh Melon nutrition, insecticides. The tools that will be used are Hoe, Cetok, Drill, Cutter, Scissors, Mild Steel, Wire, Measuring Meter, Flannel Cloth, Microscope, TDS Meter, Analytical Scales, Chlorophyll Meter, Marker, Flourish, Stationery Equipment, Rafiah Rope, Mine Rope, Wire, Ruler, Bamboo Tajar, Hand Sprayer, Knapsack Electric Sprayer, 2 Kg Bucket, 25 Kg Bucket, Tray, Green House.

This research used a factorial Randomized Group Design (RAK) with 2 factors. The first factor is the concentration of AB mix nutrients (K) consisting of 3 levels, namely: K0 = Control, K1 = 1000 ppm, K2 = 1500 ppm and K3 = 2000 ppm. The second factor is the AB mix nutrient (M) consisting of 2 levels, namely: M1 = Vegetable AB Mix Nutrition, M2 = Fruit AB Mix Nutrition.

RESULTS AND DISCUSSION

1. *Nutrient Concentration ab mix*

The results showed that the ab mix nutrient concentration was significantly different from the chlorophyll variable. The highest chlorophyll was achieved at the ab mix nutrient concentration of 2000 ppm (K3) with chlorophyll of 53.0 units. This is because chlorophyll levels in plants decrease and increase in line with nutrient adequacy, at the ab mix nutrient concentration of 2000 ppm has more N nutrientcontent which affects chlorophyll formation. Chlorophyll can be used to monitor plant N status because leaf chlorophyll levels are closely related to plant N levels.

The results showed that the concentration of ab mix nutrients was significantly different from the variable stomatal density. The highest stomatal density was achieved in the control treatment (K0) with a stomatal density of 579 mm2. This is because the number of stomata in plants has increased due to nutrient deficiency so that the density of stomata also increases. This is in accordance with the statement of Bukhari & Safridar, (2022) The more the number of stomata, the denser the distribution in the leaves. Stomata in the K0 treatment are smaller in size and do not open perfectly when compared to other treatments, this is thought to be due to the number and density of stomata affected by differences in nutrient stress. This is reinforced by the statement of Kurniawan et al., (2017) plants that lack N will result in leaf stomata stomata do not open and will instead close tightly so that plant transpiration will be disrupted until the plant's N requirement is met according to the plant's level of need. Potassium also plays a role in stomatal regulation.

The results showed that the concentration of ab mix nutrients was significantly different from the variable fruit weight. The highest fruit weight was achieved at 1500 ppm ab mix nutrient concentration (K2) with a fruit weight of 1326.5 grams. The availability of nutrients in sufficient and balanced amounts will accelerate the physiological and metabolic processes of plants to produce a large number of cells so as to produce an increase in weight. The high content of organic

matter in nutrients will optimize the process of nutrient absorption and the formation of photosistesis results in plants. According to Fahmi et al., (2022) To obtain optimal nutrient delivery efficiency, nutrients must be given in amounts that meet the needs of plants. If plants are given too much nutrition, it can cause reduced vegetative development and can cause poisoning for plants. Conversely, if too little nutrition is given, it can cause inhibition of root development, thereby disrupting plant nutrient uptake, even though the plant does not show visual symptoms of deficiency.

The results showed that the ab mix nutrient concentration was significantly different from the variable fruit brix, the highest fruit brix was achieved at 1500 ppm ab mix nutrient concentration (K2) with 16.3 fruit brix. The highest fruit brix was influenced by potassium nutrients that support plant growth, flowering and fruit formation. Darwiyah et al. (2021) stated that N functions to increase assimilates such as sugar storage and fruit production. This is thought to be because in the generative phase, melon plants require large P and K fertilizers, this is because P nutrients play a role in root formation, formation, and fruit ripening (Awliya et al., 2022). K nutrients can help plants translocate sugar to the parts of the plant that need it. In line with the opinion of Furoidah, (2018) which states that potassium functions as a catalyst for the formation of carbohydrates in the photosynthesis process, protein formation, and improves the quality of melons.

2. *AB Mix Nutrients*

The results showed that the type of nutrition was significantly different from the variable stomatal density. The highest stomatal density was obtained in the ab mix fruit nutrition (M2) which was 579 mm2. Stomatal density is influenced by nutrient sufficiency. Nutrition ab mix fruit has a nutrient content of N that can spur the growth of the number and density of stomata Kurniawan et al., (2017).

3. *Effect of Interaction of Concentration and AB Mix Nutrients*

The results showed that there was a significant interaction between the Concentration and AB Mix Nutrients on the variable weight of melon fruit. The best growth in the variable weight of melon fruit was obtained at a concentration of 1500 and a variety of nutrients ab mix fruit. Interaction can occur between the treatments of Concentration and AB Mix Nutrients give effect to the growth and production of melon plants. Two factors are said to interact if the effect of a treatment factor changes when the level of other treatment factors changes.

The results showed that the concentration of ab mix nutrition was significantly different from the variable fruit diameter, the highest fruit diameter was achieved at the concentration of ab mix nutrition 1500 ppm (K2) with a fruit diameter of 13.46 cm. The size of melon fruit occurs due to the accumulation of photosynthate which increases due to adequate nutrients, especially potassium (K). This is in accordance with the statement of Ambarwati et al. (2020) that the nutrients absorbed by plants will affect the size of the photosynthate that is channeled to the fruit so that it will affect the size of the results of the diameter and thickness of the fruit, but if too many nutrients are available, the plants are not able to absorb all these nutrients when the plants enter the generation phase. In addition

to potassium, N is also important in fruit enlargement. According to Rokhminarsi et al. (2020), nitrogen can stimulate the formation of auxin which functions to soften the cell wall so that the ability of the cell wall increases with the ability of the water intake process which causes cell size to increase.

Table 1. Mean numbers and statistical analysis of research data on the Effect of Concentration and Variety of AB Mix Nutrients on Physiological Characters and Yield of Melon Plants with Axis Irrigation System

Treatment	Chlorophyll	Stomatal Density (mm2)	Fruit Weight (gram)	Fruit Sugar Content (brix)	Fruit Diameter (cm)
AB mix concentration (K)					
K0 = Control	43,26375 b	597,375 a	159,75 c	11,825 b	6,6875 c
K1 = 1000 ppm	51,29375 a	287,875 b	1040,375 b	15,7875 a	12,1875 ab
K2 = 1500 ppm	49,835 a	271,375 b	1326,5 a	16,325 a	13,4625 a
K3 = 2000 ppm	52,9925 a	305,625 b	869,625 b	15,65 a	11,325 b
F hitung	16,33 **	114,55**	105,16**	11,56**	69,96**
F tabel 5 %	3.07	3.07	3.07	3.07	3.07
F tabel 1 %	4.87	4.87	4.87	4.87	4.87
Uji BNT 5 %	4,37	60,3	201,45	2,52	1,46
KK (%)	6,03	11,22	16,13	11,55	9,15

Treatment	Chlorophyll	Stomatal Density (mm2)	Fruit Weight (gram)	Fruit Sugar Content (brix)	Fruit Diameter (cm)
AB mix Nutrients					
M1 = AB Vegetable Mix	49,0675	333 b	804,3125	15,49375	10,75
M2 = AB Mix Fruit	49,625	398,125 a	893,8125	14,3	11,08125
F hitung	0,28	20,17**	3,41	3,85	0,88
F tabel 5 %	4.32	4.32	4.32	4.32	4.32
F tabel 1 %	8.02	8.02	8.02	8.02	8.02
Uji BNT 5 %	_	60,3	_	_	_
KK (%)	6,03	11,22	16,13	11,55	9,15

Notes: *Numbers in columns and treatments followed by the same letter indicate insignificant based on BNT test at 5% level**=highly significant*=significant and tn=not significant*

CONCLUSION

Based on the results of research and discussion, several conclusions can be drawn. as follows:

2. The treatment of ab mixes nutrient concentration showed significant results on chlorophyll variables, stomatal density, fruit weight, fruit sugar content, fruit diameter. The most optimum concentration was obtained in the 1500 ppm treatment.

3. The treatment of ab mix nutrition showed significant results on the variable stomatal density. The best ab mix nutrition was obtained in the treatment of fruit ab mix nutrition.

4. There is an interaction between ab mix nutrient concentration and ab mix nutrient type on fruit weight variable. The best treatment combination is obtained in the treatment of 1500 ppm concentration and nutrition ab mix fruit.

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CULTIVATION OF *Coprinus comatus* MUSHROOMS WITHOUT STERILIZATION OF GROWTH MEDIA

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Abstract: Edible mushrooms were generally cultivated on wood sawdust or paddy straw enriched with rice bran, gypsum, and organic and inorganic fertilizers. The planting medium must be sterilized first, and fungal inoculation was carried out aseptically. However, this research was carried out without the planting medium's sterilization or pasteurization and Coprinus comatus inoculum. Its inoculum comes from the growing media used. The cultivation technique is very simple, easy to do, and easy to adopt by the public. The research used a Completely Randomized Design with 7 treatments of planting media composition and was repeated 3 times. The media used are paddy straw, corn cobs, sugar cane milling waste, mung bean and soybean pod husk, banana leaves and midrib. Each medium was enriched with rice bran, cassava fermentation yeast (tape yeast), and urea fertilizer. The best results were obtained from a medium derived from a mixture of 3 kg of mung bean pod husk with paddy straw that was enriched with 0.5 g cassava fermented yeast, 30 g of crushed limestone, 100 g rice bran and 20 g urea and produced 885.10 g of fresh mushrooms per 3 kg of dried media.

Keywords: agricultural waste, C. comatus, rice bran, cassava fermented yeast, urea

INTRODUCTION

Edible mushrooms were generally cultivated on wood sawdust or rice straw enriched with rice bran, gypsum, organic and inorganic fertilizers. The planting medium must be sterilized first, and fungal inoculation was carried out aseptically.

Some edible mushrooms in Indonesia that are cultivated using composting technology and pasteurization of growing media (paddy straw) are *Vovariella volvacea* and *Agaricus bisporus*. The groups of mushrooms that are cultivated through composting and sterilizing planting media in the form of wood sawdust with various combinations of palm oil waste, banana leaves and stems, coconut fiber or corn cobs are oyster mushrooms (*Pleurotus ostreatus*), *Auricularia* spp, shiitake (*Lentinus edodes*), and Lingzhi (*Ganoderma sp.*) (Saskiawan & Hasanah, 2018; Saskiawan & Retnowati, 2021). There is one type of mushroom that is not widely known and cultivated by Indonesian people, namely the *Coprinus comatus* mushroom.

Coprinus comatus (Müll.) Gray, also known as chicken drumstick mushroom, the shaggy ink cap (If it's old, it will crumble and produce black ink) lawyer's wig or shaggy mane and Indonesians call it chicken thigh mushroom, is a novel cultivated edible mushroom in China. For its good nutritional properties, delicious taste and particular figure (like chicken drumstick), more and more people like to eat it. *C. comatus* is a therapeutic mushroom helpful in the management of Diabetes Mellitus (Khan et al, 2023). Some people cultivate it using corn cob planting media that is not sterilized and the optimal media composition for its growth has not been stated with certainty. There is no information regarding the type of agricultural waste that can be used as a basic medium for *C. comatus*. Some people cultivate it using corn cob planting media without sterilization and the optimal media composition for its growth has not been stated with certainty. Apart from that, there is no information regarding the type of agricultural waste that can be used as a basic medium for *C. comatus*.

The aim of this research is to determine the types of agricultural waste that can be used for cultivating *C comatus*, to evaluate *C comatus* production on various types and planting media compositions then find the best planting media composition for *C. comatus* production. This research on *C. comatus* production was carried out without sterilization or pasteurization of the planting medium and without *C. comatus* inoculum. The inoculum comes from the planting medium used.

RESEARCH METHODS

The basic ingredients for making media are agricultural waste consisting of paddy straw (PS), corn cobs (CC), sugar cane milling waste (SCMW). Sugar cane milling waste was taken from white sugar factory waste in the form of course fiber which is blackish brown in color, mung bean pod husk (GBP), and soybean pod husk (SPH). banana leaves (midrib, stalk and lamina). Additional ingredients for cultivation are Cassava fermenting yeast or tape yeast (yeast), rice bran (bran), $CaCO_3$ (lime) and carbamide (urea) fertilizer. The equipment used consisted of a thermo hygrometer, pH meter, analytical scales, black plastic waste, measuring flask, cardboard measuring length x width x height (36x24x21 cm) and camera.

The research used a Completely Randomized Design (CRD), with 1 treatment factor consisting of 7 levels with 3 replications. The data for each treatment was analyzed using Analysis of Variance (Anova) and if there was a real effect, it was continued with the LSD (Least Significant Difference) test at the 5% level via MS software. Excel 2016 and Minitab version 18. The 7 experimental levels are: Paddy Straw 3 Kg + Yeast 1.5 g + Rice Bran 100 g + $CaCO_3$ 30 g + Urea 20 g (M1); Corn Cob 3 kg + Yeast 0.25 g + Rice Bran 90 g + $CaCO_3$ 75 g + Urea 10 g (M2); Sugarcane Milling Waste 3 kg + Yeast 0.28 g + Rice Bran 100 g + Urea 20 g (M3) Mung Bean Pod husk 3 kg + Yeast 1 gr + Rice Bran 100 gr + $CaCO_3$ 30 gr + Urea 20 g (M4); Mixture of Mung Bean Pod husk and paddy Straw 3 Kg + Rice Bran 100 g + $CaCO_3$ 30 g + Yeast 0.5 g +

Urea 20 g (M5); Soybean pod husk 3 kg + Yeast 0.28 g + Rice Bran 100 g + Urea 20 g (M6); Banana midrib and leaves 3 kg + $CaCO_3$ 75 g + rice bran 90 g + Yeast 0.25 g + urea 10 g (M7).

Implementation of research

Basic materials for planting media from various types of agricultural waste, dried in the Sun and weighed as much as 3kg/experimental unit, soaked for 24 hours and drained until the water content is 60%, mixed evenly with rice bran and lime. The media is put in a cardboard box covered with black plastic to keep it warm. The bottom of the plastic is perforated to drain the remaining spray water. The basic media ingredients that have been mixed with rice bran and lime are put into a cardboard box, then watered evenly with half of the urea recipe and yeast tape that has been dissolved in 500 ml of water. Half the basic media ingredients are piled again on top and watered again with the remaining urea and yeast tape. The cardboard is covered tightly with plastic and incubated in a warm room until the mushroom grows. In this study, in order to achieve an incubation temperature of around 30 ^{0}C, all experimental units were covered with wide plastic (tarpaulin). Observations include the Day of Fruiting Body Emergence (day after incubation,) Harvesting period (day), Fresh Weight Every Harvest and Total fresh weight (g).

RESULTS AND DISCUSSION

All types and compositions of media tested could produce *C. comatus* mushrooms, even though it was not inoculum of *C. comatus* and the media was not pasteurized or sterilized. The mushrooms that grow are small and large. Large mushrooms are produced from sugar cane milling waste, soybean pod husk and mung bean pod husk. Other media grow smaller mushrooms.

1. The fruiting body Emergence

The beginning of the fruiting body appears from each medium it is not the same. Soybean pod husk media (M6), has the fastest time (7 days from the incubation period) and mung bean pod husk (M4) has the longest fruiting body emergence time (16 days), followed by the mixture of mung bean pod husk and paddy straw planting medium (M5). On paddy straw planting medium (M1, light blue), corn cobs (M2), sugar cane milling waste (M3) and banana leaves (M7), the emergence of fungal fruiting bodies was relatively uniform, namely 11.89, 10.67, 10.67 and 10.68 day respectively (Table 1.)

The fruiting bodies of *C. comatus*, appeared between 7-16 days in various types of agricultural waste and the composition of the media tested. Media derived from soybean pod skins are able to produce mushroom fruit earlier than mung bean pod skins and other agricultural waste. Growing *C. comatus* fungus requires moisture and oxygen for its emergence. The required humidity ranges from 85-95%. Fruiting bodies will form within 7-10 days from inoculation depending on air circulation and water content in the media (Liu et al. 1999; Chen 2000). Air circulation in the corn cob medium was actually better than in the soybean pod husk medium, but the fruiting bodies in the corn cob medium formed more slowly because the humidity was higher (87-91%) than the humidity in the soybean pod husk medium (87-89%). Other media that have humidity above 90%, the formation of fruiting bodies was slower (Table1.) In addition, the density of the media during the growth period of mushroom determines air circulation. In soybean pod husk media, air circulation was better than in other media which appears to solidify after the incubation process takes place.

Tabel 1. The Humidity of Planting Medium and Fruiting Body Emergence

Treatment	The humidity of planting medium (%)	The Day of Fruiting Body Emergence (day after medium incubation)
Paddy Straw 3 Kg + Yeast 1.5 g + Rice Bran 100 g + $CaCO_3$ 30 g + Urea 20 g	88-94	11,89b
Corn Cob 3 kg + Yeast 0.25 g + Rice Bran 90 g + $CaCO_3$ 75 g + Urea 10 g	87-91	10,67 b
Sugar Cane Milling Waste 3 kg + Yeast 0.28 g + Rice Bran 100 g + $CaCO_3$ 30 g + Urea 20 g	85-92	10,67 b
Mung Bean Pod Husk 3 kg + Yeast 1 gr + Rice Bran 100 gr + $CaCO_3$ 30 gr + Urea 20 g	88-95	16,00 a
Mixture of Mung Bean Pod Husk and Paddy Straw 3 Kg + Rice Bran 100 g + $CaCO_3$ 30 g + Yeast 0.5 g + Urea 20 g	85-93	14,67 a
Soybean pod husk 3 kg + Yeast 0.28 g + Rice Bran 100 g + Urea 20 g	87-89	7,00 c

Banana midrib and leaves 3 kg + Yeast 0.25 g + rice bran 90 g + $CaCO_3$ 75 g + urea 10 g	85-95	10,33 b

Note: Numbers followed by the same letter indicate not significantly different in the 5% LSD test.

2. Fresh Weight Every Harvest and Total fresh weight (g).

There are three groups of media that produce *C. comatus* mushrooms with low, medium and high fresh weight categories. The low production category (1-400 g fresh weight/3 kg media) was obtained from three types of media, namely corn cob media (Corn Cob 3 kg + Yeast 0.25 g + Rice Bran 90 g + CaCO3 75 g + Urea 10 g,), Sugar Cane Milling Waste 3 kg + Yeast 0.28 g + Rice Bran 100 g + CaCO3 30 g + Urea 20 g) and banana leaves (Banana midrib and leaves 3 kg + Yeast 0.25 g + rice bran 90 g + CaCO3 75 g + urea 10 g). The medium production category (401-800 g fresh weight/3 kg media) was obtained from paddy straw, mung bean and soybean pod husks. The Medium with the highest average value of total fresh weight of mushrooms production (>801g/3kg media) came from a mixture of Mung Bean Pod Husk and Paddy Straw 3 Kg + Rice Bran 100 g + $CaCO_3$ 30 g + Yeast 0.5 g + Urea 20 g.

Many factors influence *C. comatus* production. One of the factors that determines the growth and production of *C. Comatus* is the nitrogen source (urea). If the media was not given urea fertilizer, then *C. comatus* will not grow but other waste decomposing fungi will grow on the media such as *Trichoderma* sp and *Aspergilus* sp. Urea greatly influences the emergence of fruit bodies, fresh weight per harvest and total fresh weight (Ristiawan 2021). The best medium was the mixture of paddy straw and mung bean pod husk, on the corn cob and banana leaf media, mushroom production was less (Table 2), because the amount of urea fertilizer was added in half the recipe (10 g) compared to other mediums (20 g).

Tabel 2. Fresh weight per harvest and total fresh weight of *C,comatus* on various types of media tested.

Treatment	**Fresh Weight every Harvest (g/3kg media)**	**Total Fresh Weigh (g/3 Kg Media)**
Paddy Straw 3 Kg + Yeast 1.5 g + Rice Bran 100 g + $CaCO_3$ 30 g + Urea 20 g	25,69 abc	517,51 ab
Corn Cob 3 kg + Yeast 0.25 g + Rice Bran 90 g + $CaCO_3$ 75 g + Urea 10 g	13,88 c	353,78 b
Sugar Cane Milling Waste 3 kg + Yeast 0.28 g + Rice Bran 100 g + $CaCO_3$ 30 g + Urea 20 g	17,7 bc	353,98 b
Mung Bean Pod Husk 3 kg + Yeast 1 gr + Rice Bran 100 gr + $CaCO_3$ 30 gr + Urea 20 g	25,91 abc	582,53 ab
Mixture of Mung Bean Pod Husk and Paddy Straw 3 Kg + Rice Bran 100 g + $CaCO_3$ 30 g + Yeast 0.5 g + Urea 20 g.	36,29 a	885,10 a
Soybean pod husk 3 kg + Yeast 0.28 g + Rice Bran 100 g + Urea 20 g	31,96 ab	639,13 ab

Banana midrib and leaves 3 kg + Yeast 0.25 g + rice bran 90 g + $CaCO_3$ 75 g + urea 10 g	12,98 c	357,58 b

Note: Numbers followed by the same letter indicate not significantly different in the 5% LSD test.

3. Harvesting frequency and peak Harvest

Mushroom harvest begins 7 -16 days after the incubation period depending on the type of planting medium used. The harvest period for straw mushrooms lasts between 14 – 29 days with a harvest frequency of 17.33 – 28.33 times. If the number of mushrooms is large, harvesting is done twice a day (Figure 1).

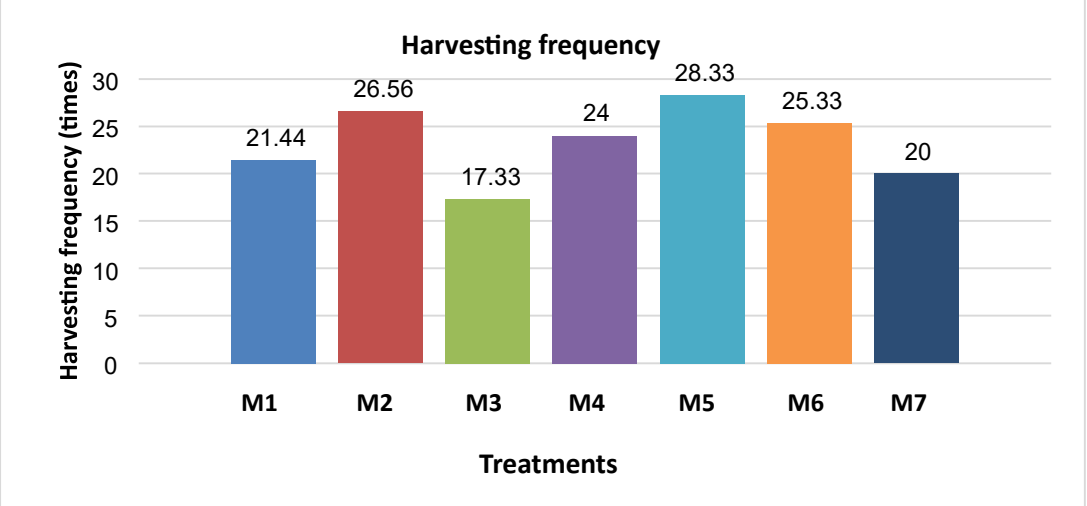

Figure 1. The fruiting body Emergence of *C,comatus* in the treatments tested. Paddy straw (M1); corn cob (M2); sugar cane milling waste (M3) mung bean pod husk (M4); mixture of mung bean pod husk and rice bran (M5); soybean pod husk (M6); banana midrib and leaves (M7).

The fresh weight of mushrooms at the beginning of the harvest period is on average low and the peak of harvest varies depending on the type of media. Peak yields from straw, corn and banana leaf media occurred on days 3-6 from the start of the harvest period and on sugar cane milling waste (M3) mung bean pod husk (M4) media; mixture of mung bean pod husk with paddy straw (M5) and soybean pod husk (M6), peak harvest occurs on the 9-14th day after harvest.

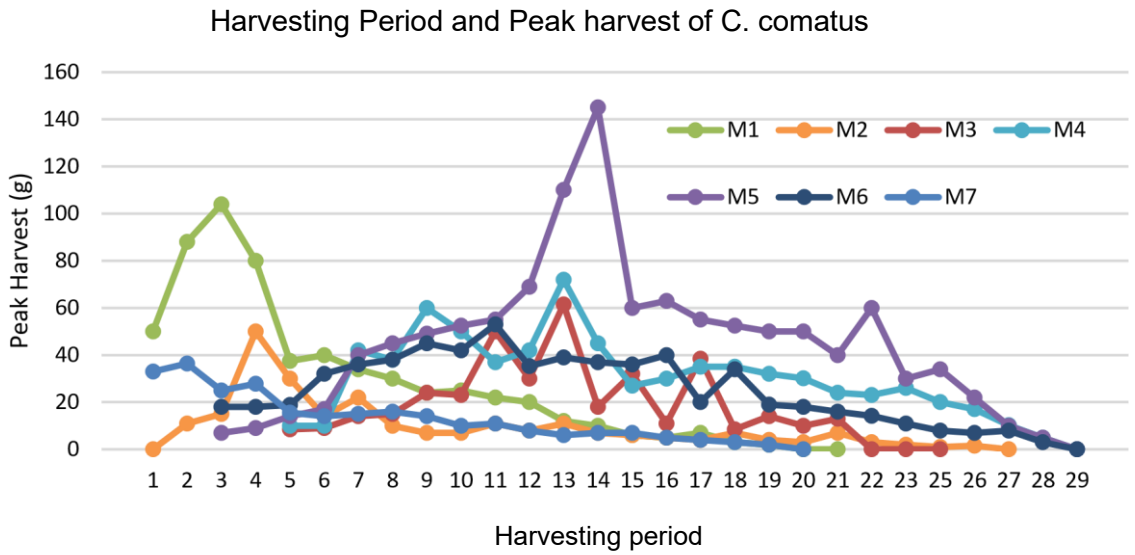

Figure 2. Harvesting period and peak harvest of *C. comatus* in media tested: paddy straw (M1); corn cob (M2); sugar cane milling waste (M3) mung bean pod husk (M4); mixture of mung bean pod husk and rice bran (M5); soybean pod husk (M6); banana midrib and leaves (M7).

There are two types of media that have the longest harvesting period, namely corn cob media (27 days) and a mixture of soybean pod husk and paddy straw (26 days). The shortest harvesting period occurred for sugar cane milling waste and banana midrib and leaves (20 days) (figure 2).

Fresh weight at peak harvest (g)

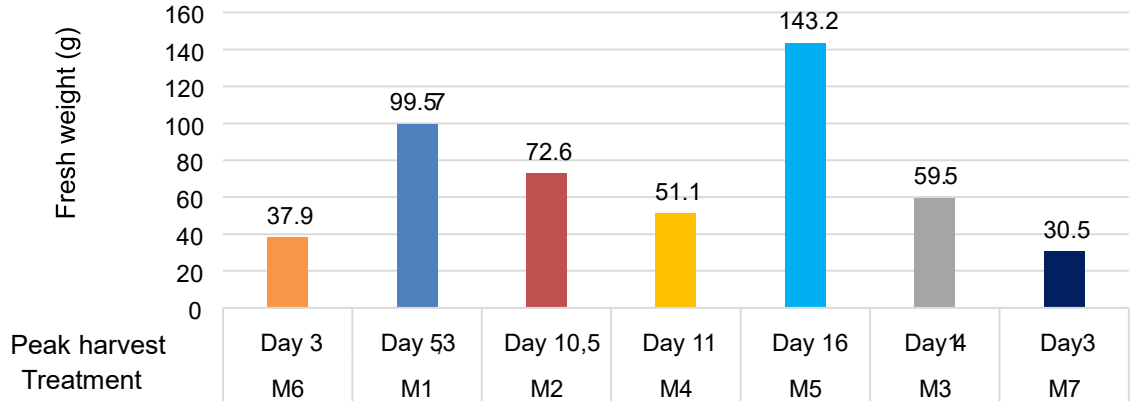

Figure 3. Harvesting period and peak harvest of *C. comatus* in media tested: paddy straw (M1); corn cob (M2); sugar cane milling waste (M3) mung bean pod husk (M4); mixture of mung bean pod husk and rice bran (M5); soybean pod husk (M6); banana midrib and leaves (M7).

The highest fresh weight of mushrooms in one harvest for all types and media compositions ranged from 30.5-143.2 g with the total fresh weight during the harvest period being 353.78 g-885.10 per 3 kg dry weight of the growing media used (Figure 3).

CONCLUSION

C. comatus mushroom can grow on all tested media namely paddy straw, corn cob, sugar cane milling waste**,** mung bean pod husk, the mixture of mung bean and soybean pod husk banana leaf and midrib. Production of fresh mushrooms for all types of media ranges from 353.78 g – 885.10 g per 3 kg of base material, with a harvest period ranging from 20-27 days. The best medium is a mixture of mung bean pod husk and paddy straw enriched with 0.5 g cassava fermented yeast, 30 g of crushed limestone, 100 g rice bran and 20 g urea and produced 885.10 g of fresh mushrooms per 3 kg of dried media.

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International Conference on Agriculture and Agribusiness Development

ENHANCEMENT OF SHALLOT (*Allium cepa.* var. *aggregatum*) RESISTANCE TO BIOTIC STRESS FROM FUNGI: REVIEW

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Abstract: Fungal attacks decrease shallot productivity by 30 to 100%. Using systemic fungicides or insecticides causes harm to consumers and the environment, and it makes the pathogen more resistant. To understand how three different forms of fungi attack shallot plants and how conventional and molecular processes may increase their resistance, information about these mechanisms is being gathered in this review study. The pathogen association, attack mechanism, and response of Fusarium oxysporum, Colletotrichum gloeosporioides, and Puccinia allii fungus on shallots constitute to produce systemic acquired resistance (SAR), a type of resistance driven via biotrophic infections. Traditional methods of enhancing resistance consist of selecting resistant plants, integrating Allium roylei traits into Allium cepa, and using the monosomic addition line (MAAL) method for Fusarium oxysporum. Molecular methods, on the other hand, involve identifying resistance gene markers such as NBS-LRR and TM-LRR, as well as marker-assisted breeding techniques like ARFLP, RAPD, SCAR, and SNP. The omics pathways were employed to determine the metabolite profiles of resistant and susceptible onions. In addition, research has been done on quantitative trait loci (QTL). These findings can be used as a guide and to design shallot plants that are more resilient to pest infestations.

Keywords: infection, fungus, resistance, onion.

INTRODUCTION

Shallots are an essential commodity for vegetable crops of the Allium genus in Asian countries, Japan, China, and Korea, including Indonesia (Yamashita et al. 2010). The area of harvested land and production of shallots is increasing; from 2016 to 2017, the location of harvested land increased 22.5% from 149 635 ha to 158 172 ha, while production increased 1.7% by 14 468 602 kw to 14 701 546 kw (Ministry of Agriculture of the Republic Indonesia 2018). The increase in production was carried out to meet the export target of shallots to neighboring countries such as Singapore, Malaysia, Thailand, and Vietnam from 2017, with exports of 7,750 tonnes to 15 thousand tonnes in 2018. The export target for shallots, apart from quantity, is the quality of shallots. Exports that must be met include sizes ranging from medium to large, bright red color, moderate water content, and freshness (Kompas 2018; Ministry of Agriculture of the Republic of Indonesia 2018).

One of the obstacles to increasing agricultural productivity is both quantity and quality because the loss of agricultural products due to disease attacks causes a

significant reduction in both the quantity and quality of production results, even up to 100% (Fritsche-Neto and Borém 2012). Nearly 70% of disease attacks on plants are caused by fungal families such as oomycetes and myxomycetes. Infected plants can produce approximately 100 million spores, which cause secondary infections that inhibit the plant's biological processes. This disease is difficult to eradicate because it can survive by dormancy in soil, decaying plants, and even healthy plants (Pereira et al. 2012).

Disease attacks from fungi on shallots are caused by Colletotrichum gloeosporioides and Colletrotichum coccodes, which cause anthracnose, also known as leaf twister disease (Alberto 2014; Basyal-Gurel 2014). Fusarium oxysporum f. cepae causes fusarium wilt disease in onions (Isniah and Widodo 2015; Aprilia 2018). Fungus attacks reduce the quantity and quality of production by causing a decrease in productivity of shallots ranging from 30-100% (Koike et al. 2011; Farid 2012).

Management of disease attacks is still carried out by regularly spraying fungicides and synthetic pesticides on onion plants. However, this method is unsatisfactory because onion plants have slippery lancelot leaves with a layer of wax, making the insecticides and pesticides used experience a lot of run-offs (Brewster, 2007). Handling disease attacks using systemic insecticides or fungicides, apart from causing environmental damage and the risk of synthetic chemical residues for consumers, also causes pathogen resistance to these chemicals (Inakagi et al. 2011). To deal with this problem, plants with varieties that are resistant to disease attacks are needed.

The mechanism of plant interaction with pathogens and vice versa needs to be understood because it is related to the mechanism of plant adaptation to pathogen attack. It is necessary to know the mechanism of pathogen attack to prevent or slow down the process of pathogen attack on plants. It is essential to see the association of pathogens with plants to determine the compounds or enzymes that degrade plant cell walls as well as the mechanisms for plant adaptation to compounds released by pathogens to associate with plants and the genes that play an active role in both plants and pathogens (Rana et al. 2017). So, it can facilitate plant breeding activities in both conventional and molecular approaches.

RESEARCH METHOD

The research method used was by collecting the paper research and book published both from Indonesian and international publisher regarding shallot research as the literature resource. The literature resource then reviewed to compile the information to construct the paper review.

RESULTS AND DISCUSSION Mechanism of Pathogen Interaction with Plants (Shallots)

Fungi spread through wind, water, animals, and even soil. Fungi can survive in soil and dead plant tissue. Fungi that live in plant tissues can multiply more quickly if conditions are optimal for the fungus' life cycle. Fungi develop optimally at a temperature of 10–15 °C and air humidity of 97%. Symptoms include yellowing and drying of the leaves and yellowish-brown bumps. The fungus survives by forming conidia, which then attach to the substrate or host plant. Fungi are associated with

plants by connecting their spores to germinate on the surface of the leaf cuticle, which is a hydrophobic layer. This hydrophobic layer containing polystyrene plays a role in the attachment of some fungal conidia to the leaves. Oxidation of this compound causes a decrease in the attachment of Botrytis cinerea urediniospores (Vidhyasekaran 1997; Widodo et al. 2017).

The high content of glycoprotein compounds in fungi cell walls also functions as a suppressor on the surface of plant cell walls as well as an elicitor molecule that plants recognize. These elicitor molecules activate self-defense mechanisms in plants (Vidhyasekaran 1997). Apart from that, pathogens also release compounds such as auxin (IAA) and gibberellin (GA) during the process of attacking plants. Alberto (2014) stated that the secondary metabolite content of gibberellin and auxin acid increased during an anthracnose attack by the fungus Colletotrichum gloeosporioides on onion plants. The increase in GA occurs because the fungus releases GA and IAA exudates, which are used by the fungus as material for the hydrolysis process. Apart from that, this auxin compound is also a pathogenic pattern for mimicking compounds produced by plants, such as auxin, which functions as a plant growth regulator.

This pattern of imitation of auxin compounds has become a sign of the interaction of pathogens and plants, where bacteria that form galls around the root collar, such as Agrobacterium tumefaciens, produce auxin compounds to associate with plants. However, excess auxin compounds in plants actually reduce their resistance to disease. The results of research conducted by Park et al. (2007) and Wang et al. 2007 showed that plants treated with recombination of the exogenous hormone auxin and salicylic acid reduced the resistance expression of the PR1 gene marker compared to plants treated only with salicylic acid. This is because, in the phytopathogen A. tumefaciens, IAA is a signal molecule that inhibits the expression of virulent genes (Spaepen and Vanderleyden et al. 2011). In addition, overexpression of the YUCCA 1 (YUC1) gene in transgenic Arabidopsis 35S: YUC1 plants that act on auxin biosynthesis increases susceptibility to Pseudomonas syringae strain DC3000 by possibly suppressing salicylic acid-mediated defense (Mutka et al. 2013).

Fu and Wang (2011) and Kunkel and Harper (2018) stated that the P. syringae and P. savastoni genomes encode the iaaL gene, which codes for the enzyme IAA-Lysine synthase (IaaL), where this enzyme functions to catalyze the conjugation of the amino acid lysine into IAA, also converts free IAA to indole-acetyl-ε-l-lysine (IAA-Lys), where this IAA-Lys conjugate is believed to be a less active form of IAA. In addition, P. savastoni pv. Neri also encodes enzymes in the IAM pathway that work in the synthesis of IAA and IAA-Lys, which were observed in the PtoDC3000 iaaL mutant and the P. savastanoi iaaL mutant, causing hypervirulence in oleander plants.

The fusarium fungus causes Fusarium disease; 30 strains of fusarium are pathogenic, including Fusarium oxysporum f.sp. cepae, F. vasinfectum var. zonatum (Smith, 2009). This fungus is a soil-borne pathogen, infecting through open wounds on plant parts and onion bulbs that come from the storage room, so it is called a secondary invader or directly without going through an open wound (primary invader). The fungal spores that reproduce then infect plants by releasing pectinase enzymes, which then break down pectin compounds in plant cell walls. The layers of onion bulbs and the midribs of the leaves have a high sugar content. It is known that sugar suppresses the synthesis of pectic enzymes, thereby slowing the growth of this

fungus. Meanwhile, the stem and apoplast parts have lower sugar content, so F. oxysporum attaches first to these parts (Carmer 2000; Halves and Knox 1985). F. oxysporum, which has penetrated the roots, develops in the intercellular part of the cortex. The hyphae then branch and invade nearby cells and continue towards the plant's vascular system near the root tip. The fungus develops into the prospective stem, and if conditions permit, it will grow.

Adaptation Mechanisms of Plants (Shallots) to Fungal Stress

Plant adaptation to biotic stress is generally divided into two, namely constitutive and inductive mechanisms, with structural and biochemical mechanisms and constitutively divided into structural (wax, cuticle, hair, shape and activity of stomata), biochemical (inhibitors before the formation of pathogens, and phenolic compounds). By induction, the structural mechanism is by forming a plug and abscission layer in the form of papillae, tylosa and sap. Meanwhile, biochemically, the induction resistance mechanism includes a hypersensitivity response and release of phytoalexin.

The mechanism of adaptation to disease attacks by releasing certain compounds to combat the biological weapons of pathogens. Plants secrete metabolite compounds to suppress invasion by pathogens. This mechanism can also be explained as a systemic or induced resistance mechanism, better known as systemic acquired resistance (SAR) and induced systemic resistance (ISR). Instructions for reading signals to activate plant genes for disease resistance by releasing certain metabolite compounds. The process of plant resistance to pathogens by removing secondary metabolite compounds as phytoalexins related to pathogen-related proteins (PR proteins) is known as the induced resistance mechanism or Systemic Acquired Resistance (SAR) (Vallad and Goodman 2004; Conrath 2006). The SAR resistance system is a resistance system that requires coordination with the gene that codes for the PR protein, which produces salicylic acid compounds. Systemic resistance not only suppresses pathogens in infected areas but also increases resistance in other areas.

Meanwhile, the ISR resistance system involves jasmonic acid and ethylene as signals in the disease resistance process that originate from the expression of genes that are not related to PR. In addition, the ISR resistance system is triggered more by Neotropic pathogens and bacterial strains that live in the soil. In contrast, biotrophic pathogens and abiotic factors such as synthetic chemicals trigger SAR resistance. The SAR and ISR resistance system is shown in Figure 1.

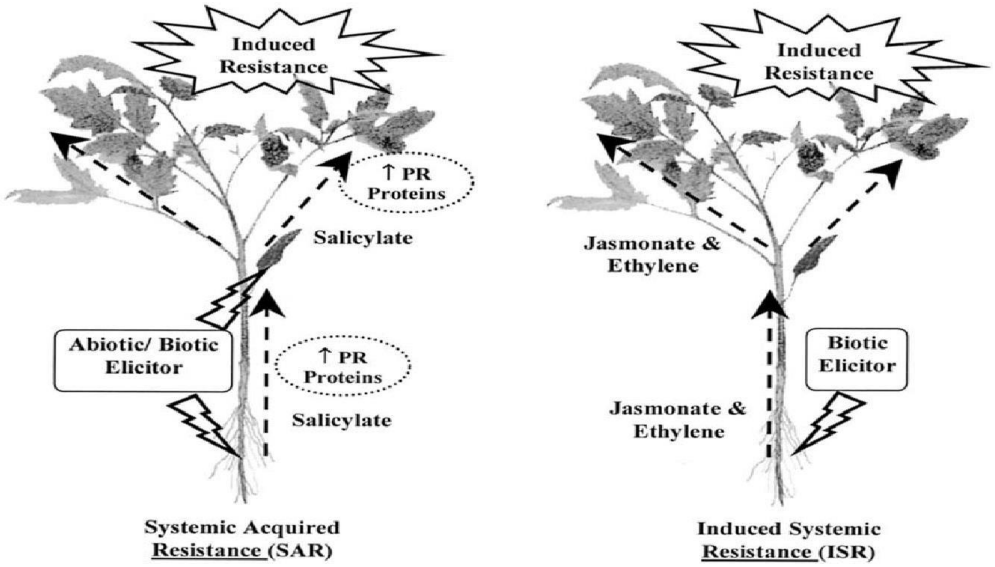

Figure 1. Induction of biotic and abiotic factors on SAR & ISR resistance mechanisms

The signal induction mechanism of jasmonic acid (JA), ethylene (ET) and salicylic acid (SA) in the SAR and ISR resistance mechanisms is explained in Figure 2. This resistance mechanism explains that the induction of the fungus Fusarium oxysporum var. cepae and Colletotrichum gloeosporioides are biotrophic pathogens that induce systemic plant resistance.

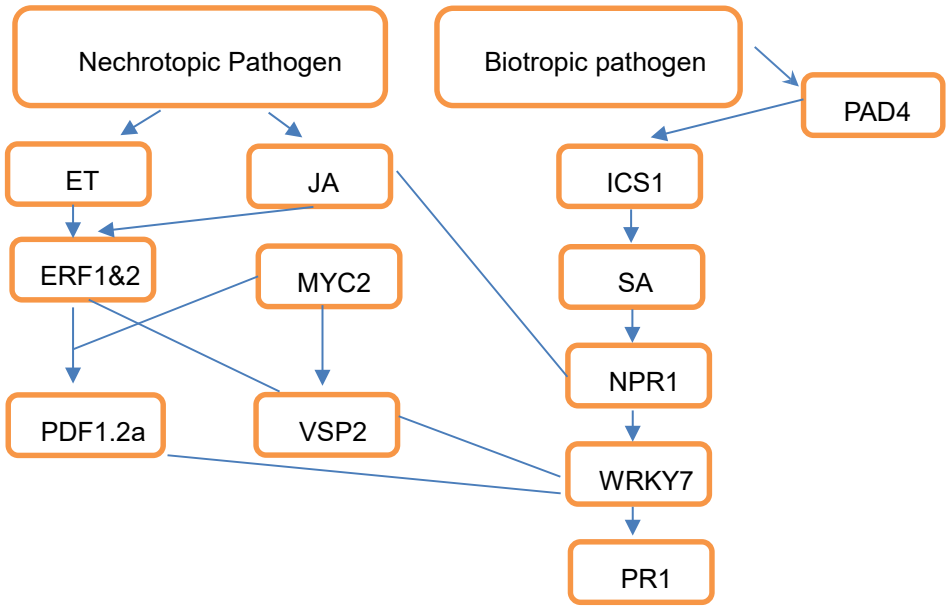

Figure 2. Mechanism of induction of jasmonic acid (JA), ethylene (ET), and SA signals on SAR and ISR resistance through Pathogen Induction (Walley et al. 2008).

Shallots release secondary metabolite compounds, such as various types of phenolic compounds, in the process of disease resistance. Alberto (2014), in his research on three shallot cultivars (Allium cepa L.), stated that the accumulation of total phenol content was usually higher in resistant genotypes, shallot cultivars that were susceptible to the fungi C. gloeosporioides and G. moniliformis were identified as having high levels of glucose. And lower protein compared to plants that were not inoculated.

Identification of secondary metabolite compounds for resistance to fusarium wilt attacks using the NMR method in leek plants resulting from the monosomic addition line of donor chromosome 2A from shallots showed the presence of the same furastanol saponin and alliospirosidae compounds as the donor plants. The increase in chlorogenic acid compounds in rice lines 32R and pipecolic acid 29S, which were inoculated with Rhizoctonia solani, causes leaf blight disease. In addition, compounds such as α-glucose, saponins, such as salicylic acid, chlorogenic phenyl-propanoic acid and feruloyl quinic acid of the phenolic group were identified in the disease resistance process (Conrath 2006; Abdelrahman et al. 2017; Suharti et al. 2016; Leiss et al. 2010; Syatori and Murti 2018). The MAAL of the Allium cepa 2 AA chromosome into the *A. fistulosum* chromosome was also effectively used to determine the chromosomal location of genes involved in flavonoid biosynthesis, sulfur assimilation, and sucrose metabolism (Masuzaki et al. 2006a, 2006b; McCallum et al. 200; Yaguchi et al. 2008).

Conventional and Molecular Breeding

It is hoped that breeding shallots can reduce the use of pesticides and insecticides. Increasing plant resistance is carried out both conventionally through field breeding, laboratory and molecular approaches by understanding the working mechanisms of genes through transcriptomics to metabolomics.

Conventional Breeding in the Field and Laboratory

Shallots have been planted since ancient Egyptian times, so they have spread throughout the world and adapted to various types of climates, thus forming diverse landraces and having local characteristics. Onion germplasm collections can be used to obtain and develop varieties with desired and introduced characteristics (Akter et al. 2015; Khosa et al. 2015; Karic et al. 2018). Conventionally, this is done by specific hybridization and crossing (Putrasemadja 2002, Scholten et al. 2007) and field-scale selection (Galvan et al. 1997, 2008). Shallot breeding on a laboratory scale is carried out using physical mutations (Batubara et al. 2015; Ginting et al. 2015; Kurniajati 2017 and chemical mutations (Suminah et al. 2002) as well as laboratory-scale selection.

Field breeding of shallots that have been carried out includes a selection of varieties that are resistant to disease, interspecific hybridization, establishing MAAL populations, as well as increasing resistance to disease through the induction of specific compounds such as fusaric acid for resistance to fusarium wilt using tissue culture. Interspecific hybridization in the onion genus makes it easier for researchers to transfer valid characters from close onion relatives into onion bulbs. Such as the introgression of characters from Allium roylei into Allium cepa in powdery mildew disease (Scholten et al. 2007).

Selection for disease resistance has been carried out in the field on several onion varieties against C. gloeosporioides, which causes anthracnose, which was carried out on A. cepa in the Philippines, indicating that the Condor, Robin, and Tanduyong varieties were tolerant to anthracnose with attack levels ranging from 0–6. % (Alberto et al. 2001). Selection of shallot varieties in Indonesia, it was reported that the Rubaru or Sumenep, Bali Karet or Batu Hijau, and Maja varieties were resistant to anthracnose (Suhardi and Semangun 1995; Galvan et al. 1997). Apart from that, the

Rubaru and Bali Karet varieties are also known to be resistant to fusarium wilt in the field (Galvan et al. 2008; Aprilia 2018).

Wako et al. (2016) conducted a selection of red onions and bunching onions to obtain leaf rust-resistant onion varieties. Red onions are known to have higher resistance to leaf rust disease compared to bunching onions. Four shallot varieties, Shenshu-chuko-ki, Kaiduke-wase, Imai-wase, and Shonan-red, were inoculated with leaf rust; the number of uredinia per cm of leaf length was only 0.10 ± 0.02 to 0.24 ± 0.10, while for ten varieties of Japanese leek, the number of uredinia per cm of leaf length was observed to be approximately between 1.01 ± 0.15 to 1.82 ± 0.21. Clone no. 2004/11, the result of crossing local Green and Filipino shallot varieties carried out by the Vegetable Research Center, had high growth and productivity and was relatively resistant to C. gloeosporioides attacks (Putrasemadja et al. 2012).

The formation of a Monosomic addition line (MAAL) population from chromosome 2 AA of Allium cepa into the Allium fustilosum (FF) chromosome was carried out so that A. fustilosum was more resistant to fusarium wilt. A. fustilosum, which has an additional chromosome 2A, carries a gene for resistance to fusarium wilt and also codes for an enzyme that plays a role in producing antifungal secondary metabolites to fight F. oxysporum. So, it can secrete secondary metabolite compounds furastanol saponin and alliospirosidae for resistance to fusarium wilt (Shigyo et al. 1996; Vu et al. 2012; Abdelrahman et al. 2017).

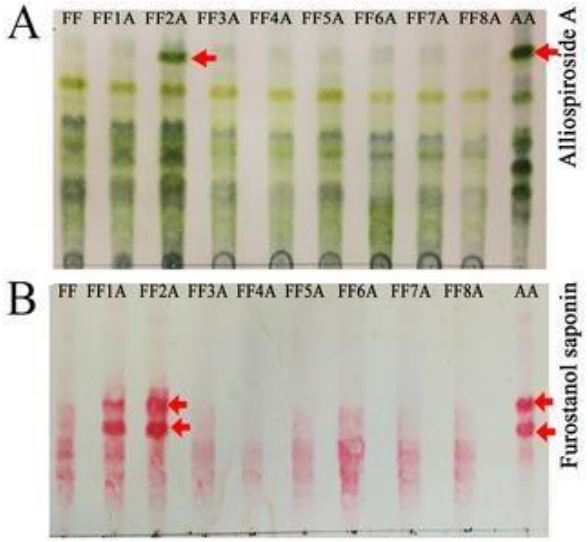

Figure 3. Secondary Metabolites of Antifungal MAAL Population (Abdelrahman et al. 2017).

Laboratory Scale Breeding and Utilization of Non-Pathogenic Fungi

Conventional breeding against biotic stress can also be carried out on a laboratory scale. Breeding onions against fusarium wilt can be done using tissue culture using media containing an inducer in the form of salicylic acid with a fusaric acid selector medium. Breeding by inducing salicylic acid to produce fusarium wilt-resistant shallot clones showed that at concentrations of 5 ppm and 7.5 ppm, salicylic acid was able to increase the resistance of shallot plantlets from susceptible to moderate (Juwanda et al. 2016).

Efforts to obtain resistant plants are also carried out by selecting fungi from the same formae but which are non-pathogenic. Induction of the non-pathogenic Fusarium oxysporum fungus from isolates P13a, P21a, and T14a was able to reduce the incidence of onion fusarium root rot disease to an average efficacy of above 50%, higher than treatment using a fungicide containing the active ingredient benomyl (Isniah and Widodo 2015). So, it is hoped that it will be able to reduce the use of fungicides significantly.

Molecular Breeding: Molecular Markers, Omics, and Analogous Gene Resistance.

Marker-assisted breeding (MAS) is used to facilitate plant breeding using genes associated with plant characteristics, including disease resistance characteristics. Genomics-assisted breeding or Marker-assisted breeding (MAS), along with conventional breeding, helps in increasing the diversity of crops. The development of molecular markers and mapping of QTL or genes of interest is needed to enable genomics-assisted breeding for various characters in onion bulbs. Next-generation sequencing provides a rapid and cost-effective method for developing genomic resources for molecular analysis and breeding in shallots. Transcriptomics and genomic sequencing provide candidate genes and molecular markers. MAS selection is widely used in onion breeding (Baldwin et al. 2012b; Duangjit et al. 2013; Kim et al. 2014; Finkers et al. 2015).

Omics approaches, both transcriptomics and metabolomics, are also used to facilitate understanding of the working mechanisms of genes. The transcriptomics approach is an approach through sequencing at the RNA level, while the metabolomics approach is at the level of the compounds produced, which is helpful for gene identification, expression profiling, and variant discovery to identify candidate genes and markers such as SSR and SNP for MAS. This breeding approach by knowing the compounds that play a role in resistance to plant pest organisms to select plants based on differences in the metabolite compounds produced is known as metabolomics. Identification of metabolite compounds is carried out through testing using various methods such as Gas Chromatography (GC), High-Performance Liquid Chromatography (HPLC), Mass Spectrometry (MS), Nuclear Magnetic Resonance (NMR), Fourier Transform Infrared Spectroscopy (FT-IR), Molecular Spectroscopy (MS) (Khusalappa and Gunnaiah 2013; Santos 2015; Syatori and Murti 2018).

The development of molecular markers by introgressing powdery mildew resistance characters from A. roylei into A. cepa is an essential example of a breeding marker-aid in Allium (Scholten et al. 2007). Utilizing a bulk segregant analysis approach found three specific A.roylei RAPD markers on chromosome number 3 (Michelmore et al. 1991; De Vries et al. 1992a,b). These markers were converted into SCAR markers, but several years later, they could not be used to differentiate between susceptible and resistant plants. AFLP markers have been identified that are associated with starch tuber resistance and should be helpful for MAS (Sholten et al. 2007). Wax layers play an essential role in cultivars that are resistant to sucking insect pests (Gent et al. 2006). Shallots have a variety of wax coating amounts and types (Bag et al. 2014; Damon and Havey 2014). Accessions with smooth and slightly slippery leaves with low wax content were associated with non-preference for onion

trip pests. Hentriacontanone-16 is the most abundant wax found in accessions with high amounts of waxy leaves, followed by slightly smooth and smooth types (Damon and Havey 2014). Two loci on chromosomes 2 and 5 control the amount of wax via the acyl reduction and decarbonylation pathways. SNP markers associated with these regions were identified for MAS to alter the amount and type of wax coating to develop cultivars resistant to onion thrips (Bag et al. 2014; Damon and Havey 2014). Although there have been no MAS studies on these two chromosomes regarding resistance.

CONCLUSION

The mechanism of attack and association of the fungal pathogens Fusarium oxysporum, Colletotrichum gloeosporioides, and Puccinia allii on shallots and the plant response is systemic acquired resistance (SAR) which is induced by biotrophic pathogens. Fungi secrete glycoprotein compounds as elicitors by plants. The breeding of shallots, both conventionally and molecularly, to increase resistance to the fungus Fusarium oxysporum has been carried out quite a lot, but there is still much that needs to be researched. Meanwhile, diseases caused by the fungus Colletotrichum gloeosporioides and Puccinia allii on shallots are still rarely found, especially Puccinia allii.

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IN VITRO GERMINATION OF *Dendrobium sp.* ORCHIDS ON MEDIA WITH COMBINATION OF DIFFERENT CONCENTRATIONS OF SHALLOT BULB EXTRACT AND NAA GROWTH REGULATOR

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Abstract: The success of in vitro orchid seed germination is influenced by the use of the appropriate culture medium, including the addition of growth regulators and organic extracts. This research aims to determine the effective combination of concentrations of red onion bulb extract and NAA hormone on the germination of Dendrobium sp. orchid seeds. The study employed a Completely Randomized Design (CRD) with 6 treatments, each repeated 5 times. Dendrobium sp. orchid seeds were planted on VW (Vacin and Went) medium with the addition of a combination of red onion bulb extract and NAA hormone as follows: without treatment (A), red onion bulb extract 50 g/L + NAA 1.25 ppm (B), red onion bulb extract 100 g/L + NAA 1 ppm (C), red onion bulb extract 150 g/L + NAA 0.75 ppm (D), red onion bulb extract 200 g/L + NAA 0.5 ppm (E), red onion bulb extract 250 g/L + NAA 0.25 ppm (F). The culture was incubated in a well-lit room with 40-watt TL lamps for 24 hours, at a temperature of 22°C-25°C, and a relative humidity of 60%. The results indicated that the addition of red onion bulb extract and NAA hormone to the VW culture medium significantly affected the growth of Dendrobium sp. orchid seeds. The medium supplemented with a combination of red onion bulb extract at a concentration of 50 g/L and NAA hormone at 1.25 ppm proved to be the most effective,

yielding a germination percentage of 77.53% at 4 weeks after planting, 10.8 embryo development phases at 8 weeks after planting, and a 17.87% growth of plantlet (Plb) at 12 weeks after planting.

Keywords: dendrobium sp., red onion bulb extract, in vitro culture, naphthalene acetic acid

INTRODUCTION

Dendrobium is a type of orchid that occupies the top position in the order of orchid market trends (Novianto, 2012). More than 50% of the market share is controlled by the orchid genus Dendrobium, from potted orchids, collections, and cut flower orchids (Trubus Editorial Team, 2005). Dewanti, et al. (2020) stated that orchids are one of the plants that have high economic value in the domestic and international markets. The supply of orchid products is smaller than market demand. In orchid gardens (nurseries) there is always a shortage of orchid products for sale. This shortage is due to demand continuing to increase and not accompanied by the supply of orchid products (Rangkuti, Thamrin and Siregar, 2018). Indonesian orchid production in 2020 was 11.68 million stalks, this number decreased by 37.22% compared to orchid production in 2019 which reached 18.61 million stalks. Apart from decreasing production, orchid harvest area in Indonesia also decreased by 0.44% in 2020 (Central Statistics Agency, 2020).

Therefore, various efforts are needed to increase orchid production, and to meet the demand for orchid plants while maintaining their sustainability, this must be accompanied by the provision of orchid seedling on a large and uniform scale.

Orchids are plants that have a relatively slow growth rate (Iswanto, 2002). Reproduction of Dendrobium orchids is difficult in nature, because the lack of food reserves in orchid seeds causes low levels of natural orchid seeding (Gerry, Permatasari and Dewi, 2020). Therefore, special techniques are needed to propagate Dendrobium orchid plants. Tissue culture technique is a technique that is often used for plant propagation through seeds (Parthibhan, Rao and Kumar, 2015).

According to Prasetyo (2009), the selection of explants from seeds is carried out so that the seedling produced are uniform in commercial quantities and in a short time. The first stage of orchid seed germination method is through tissue culture, namely by planting orchid seeds in a planting medium in the form of agar which contains various important nutrients such as sucrose and minerals as an energy source that helps the growth of orchid seed sprouts. The second stage is the germination of orchid seeds into Protocorm Likes Bodies (PLB), namely the form of leaves, roots and shoots of plants that are very small and cannot be distinguished (Dewanti et al., 2020).

The successful growth of orchid plants in vitro is determined by a good combination of culture media in which the explants live, with the addition of growth

regulators and the addition of other organic materials which will have a good effect on the growth of the explants in in vitro culture. According to Sucandra, Silvia and Yulia (2015), Vacin and Went (VW) media is a culture medium that is often used in orchid plant tissue culture. At this time, VW media has been modified to optimize explant growth. Modifications to the VW culture media can include adding extracts of natural growth regulators.

There are two groups of plant growth regulators that are often used in tissue culture, namely cytokinins and auxins (Lestari, 2011). Based on how to obtain growth regulators (ZPT), they are divided into two types, namely, ZPT obtained from organic compounds and synthetic compounds (Herawati and Zakiah, 2021). The use of growth regulators from synthetic compounds such as the use of the NAA hormone in in vitro culture has a positive effect on plant growth, however, there are several obstacles, including the price being relatively expensive and the method of obtaining it being difficult, so efficiency in its use is required. Using natural or organic growth regulators is quite easy because they are widely available in nature and the price is relatively cheap (Trisnawan et al., 2017).

One organic material that is rich in growth regulators is shallot bulbs. According to Siskawati, Linda and Mukarlina, (2013) shallot bulb extract contains the natural hormone auxin. Adding a combination of shallot bulb extract with the right concentration to the in vitro culture media will stimulate the growth of orchid seeds.

The use of this combination with shallot extract is very rarely used in in vitro plant propagation techniques. The research aims to determine the effect of adding a combination of shallot bulb extract concentration and NAA hormone to the in vitro culture media on the growth of Dendrobium sp orchid seeds, as well as to determine the combination of shallot bulb extract concentration and NAA hormone which has a good effect on the growth of Dendrobium sp orchid seeds.

RESEARCH METHODS

The research was carried out at the Biotechnology Laboratory, Faculty of Agriculture, Siliwangi University and at the BRIN Tissue Culture Laboratory, Bogor Botanical Gardens from August to November 2023.

Preparation of orchid seeds

Selecting orchid fruit as an explant, then the orchid seeds which are still covered in the peel of the orchid fruit were sterilized outside laminar airflow, namely sterilizing the explant in running water and using sufficient soap for 30 minutes, then the orchid fruit was rinsed using sterile distilled water 3 times, then the orchid fruit were stored in empty bottles for further sterilization using 95% alcohol in laminar airflow, then the orchids are stored in sterile bottles to be taken to the planting room.

Making shallot extract

Red onion bulb extract is made in the following steps: (a) prepare 1000 grams of peeled and washed red onions and 1 L of sterile distilled water. Shallots bulb was cutted into small pieces, (b) grind the shallots bulb using a blender, (c) the shallot

extract was then filtered so that the shallot pulp was separated, (d) the extract was added with sterile distilled water until the volume reaches 1 L and stored in a sterile container.

In vitro seed culture

The in vitro culture experiment used a non-factorial Completely Randomized Design (CRD) with 6 treatments and 5 replications. As a treatment, the addition of combination of onion extract and NAA to the seed culture media of Vacin and Went (VW) : A = no treatment (control), B = shallot bulb extract 50 g/L + NAA 1.25 ppm, C = shallot bulb extract 100 g/L + NAA 1 ppm, D = shallot bulb extract 150 g/L + NAA 0.75 ppm, E = shallot bulb extract 200 g/L + NAA 0.5 ppm, F = shallot bulb extract 250 g/L + NAA 0.25 ppm.

In vitro seed culture begins with sterilizing orchid fruit in laminar airflow, then planting seed explants in bottles and petridishes containing media according to the treatment being tried. The orchid fruit in the bottle was taken, then the orchid fruit was dipped in 95% alcohol and burned over a Bunsen fire and left until the fire goes out. This step is repeated 3 times and then after being sterilized the orchids are stored in a petridish. The tip of the fruit is split with a sterile knife following the skin line into 3 segments. Next, the seeds inside the fruit were carefully taken using a spatula, then planted onto the surface of the media according to the treatment. The number of seeds planted in the media was 100 seeds per bottle. Culture bottles containing media that have been planted with explants were stored in the incubation room/culture room with optimal lighting (1000 lux light or the equivalent of 40-Watt TL lamp) with temperatures ranging from 24°C to 26°C with 49% humidity (Saepuddin, Yulianto and Aeni, 2021). The culture was then observed for parameters: seed germination phase, embryo development phase, and percentage of Plb that grew.

The data obtained was then processed and analyzed using variance (ANOVA), and to determine the difference between the average treatment values, the Duncan multiple interval test (DMRT) was used at the 5% level ($P<0.05$).

RESULTS AND DISCUSSION

Time for Protocorm formation

Protocorm is a seed containing an unorganized embryo consisting of hundreds of cells that form a tuber-like structure during seed germination (Zulkarnain, 2009). Protocorms are dense green round structures that are ready to form shoots and roots, functioning as a precursor to seed germination without endosperm (Bey, 2006). After the protocorm is formed, the next stage is the formation of leaves and roots, which then become plantlets.

Table 1. Effect of adding shallot bulb extract and NAA hormone to the in vitro culture media on the time of protocorm formation

Treatment	Time of protocorm formation (WAP)
A = without treatment	8

B = shallot bulb extract 50 g/l + NAA 1,25 ppm	3
C = shallot bulb extract 100 g/l + NAA 1 ppm	3
D = shallot bulb extract 150 g/l + NAA 0,75 ppm	3
E = shallot bulb extract 200 g/l + NAA 0,5 ppm	3
F = shallot bulb extract 250 g/l + NAA 0,25 ppm	3

Note: WAP = week after planting

The results showed that protocorms were formed in the 3rd week after planting in media treated with the addition of shallot bulb extract and the NAA hormone (Table 1). The earliest protocorms to appear occurred in explants planted in media with the addition of 50 mg/l of shallot extract + NAA 1.25 ppm. Protocorms that grew in treatment media with the addition of 50 gr/l shallot bulb extract + 1.25 ppm NAA hormone and treatment media with the addition of 100 gr/l shallot bulb extract + 1 ppm NAA hormone produced rhizoids. Rhizoids are pseudo roots that function as a tool to attach themselves to the place where the plant grows. This is thought to be due to the addition of the NAA hormone at the appropriate concentration to trigger the growth of false roots (rhizoids) in orchid seed explants, because according to Restiani et al. (2016) in Kartiman et al. (2018) certain concentrations of NAA can initiate root growth in plants.

Treatment A (control) in the 3rd week after planting had just reached phase 1, where the embryos in treatment medium A (control) began to experience swelling. In the 8th week after planting, protocorms appeared on medium A (without treatment). These results were in accordance with the research results of Diantina et al. (2020) which stated that protocorms in epiphytic orchids grown in VW media appeared 2 months after planting. Protocorm growth that occurs earlier in media with the addition of shallot bulb extract, and the NAA hormone occurs because the addition of organic material, shallot bulb extract contains natural growth hormones such as auxin, cytokinin and gibberellin which can encourage faster cell division (Gresiyanti et al, 2021). The activation of the gibberellin hormone in this tissue is in line with the activation of the hormone's auxin and cytokinin. Auxin and cytokinin added to the culture medium spread through an active diffusion and transport process which allows auxin to enter the embryo cells, resulting in cell differentiation which causes the embryo to swell so that the seed coat (testa) ruptures.

Seed Germination phase

Observation of seed germination was carried out by counting the seeds that had begun to germinate under a microscope. The earliest stage of germination of epiphytic orchid seeds was indicated as seeds that were absorbed with embryos that were swollen and still covered by testa (Diantina et al. 2020). Germination percentage is the percentage of normal sprouts that can be produced by pure seeds under favorable conditions within a specified time period (Purnobasuki, 2011). The results of the analysis of variance showed that the addition of the NAA hormone and shallot bulb extract had a significant effect on the germination percentage of Dendrobium sp orchid seeds. The germination percentage can be seen in Table 2.

Table 2. Effect of adding shallot bulb extract and NAA hormone on the germination percentage of Dendrobium sp orchid seeds (4 WAP)

Treatment	Percentage of germination
A = without treatment	0,00 a
D = shallot bulb extract 150 g/l + NAA 0,75 ppm	11,66 b
E = shallot bulb extract 200 g/l + NAA 0,5 ppm	13,99 bc
F = shallot bulb extract 250 g/l + NAA 0,25 ppm	17,00 c
C = shallot bulb extract 100 g/l + NAA 1 ppm	25,81 d
B = shallot bulb extract 50 g/l + NAA 1,25 ppm	27,16 d

Note: numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test at a significance level of 5%.

Based on the results of statistical analysis, it shows that media treatment with the addition of shallot bulb extract and the NAA hormone produces a percentage of Dendrobium sp seeds germination which was significantly different compared to media without the addition of shallot bulb extract and NAA hormone (control). The addition of 50 g/l shallot bulb extract and 1.25 ppm NAA hormone resulted in a germination percentage of 27.16%, which was the highest compared to other treatments. This is because the addition of shallot bulb extract contains growth hormones such as auxin, cytokinin and gibberellins as well as the addition of the NAA hormone as a source of auxin which has a role in cell differentiation, cell elongation and division (Asra, Ririn and Mariana, 2020).

Activation of the gibberellin hormone synergistically activates the hormones auxin and cytokinin. The mechanism of action of auxin in influencing cells is through regulating the cell's osmotic pressure so that fluid can move in and out of the cell, cell walls become looser due to acidification due to auxin suplemented. Acidic conditions activate cell wall stretching enzymes and proteins (Kriswanto, 2020). When auxin encounters the acidic environment of the cell wall, its molecules will bind H^+ hydrogen ions so that they become neutrally charged. As a small, charged molecule, auxin passes through the plasma membrane. After arriving inside the cell, the auxin molecule will turn into negatively charged and H^+ ions because the pH on the inside of the cell is 7. The auxin hormone will be inside the cell because the plasma membrane is permeable to H^+ ions compared to neutral molecules. The difference in pH outside the cell and inside the cell is regulated by a proton pump controlled by ATP. Auxin can exit from the cell to specific carrier proteins found in the plasma membrane (via the base part of the cell). The flow of auxin in a plant part is caused by the presence of a proton pump. This is caused by the pressure when auxin passes through the membrane, thereby helping auxin transport in cells (Taiz and Zeiger, 2006). The cytokinin hormone works with the auxin hormone to accelerate cell division and influence the differentiation pathway in cells. Meanwhile, the gibberellin hormone plays a role in breaking seed dormancy, the mechanism is that after water is absorbed, gibberellin is released from the embryo which activates enzymes that play a role in breaking down food reserves in the seeds. This material provides energy for the growth of the embryo which will break through the seed coat (Wareing and Phillips, 1981). This easier water absorption accelerates embryo swelling, thereby affecting orchid seed germination in in vitro culture media.

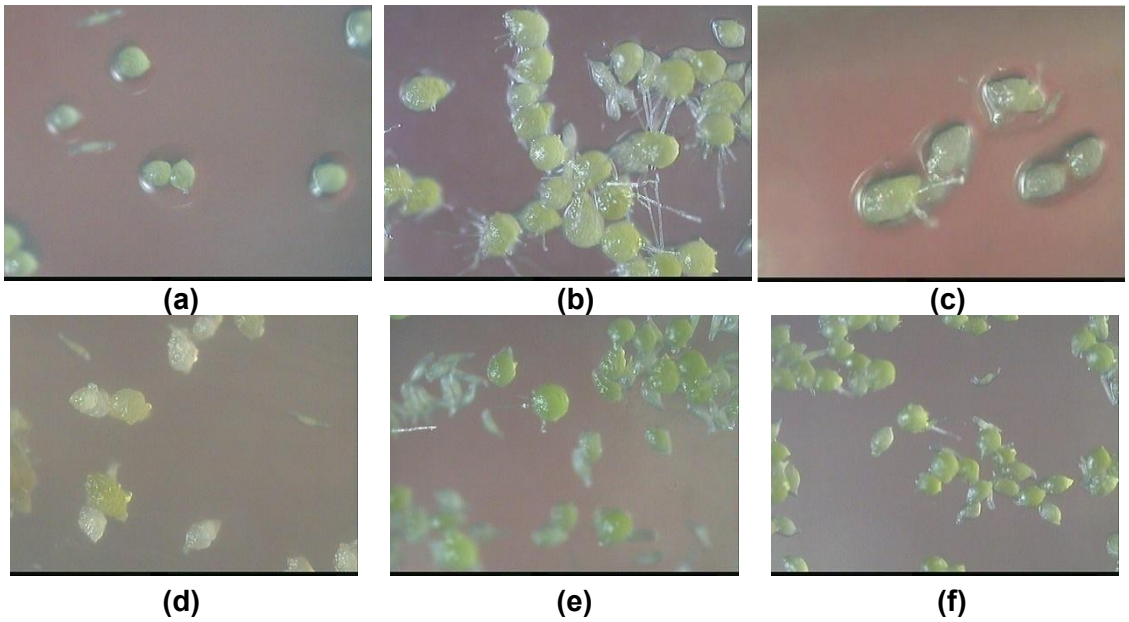


Figure 1. The resulted germination of *Dendrobium sp* seeds in **(a)** medium A, **(b)** medium B, **(c)** medium C, **(d)** medium D, **(e)** medium E, **(f)** medium F. The addition of 50 g/l shallot bulb extract and 1.25 ppm NAA hormone resulted in a germination percentage of 27.16% (medium B) was the highest compared to other media. (4 WAP) Magnification 4x.

Seed germination can be influenced by internal and external factors, internal factors such as the level of maturity of the seeds and the availability of food reserves in the seeds. The right concentration of phytohormones can stimulate or inhibit the germination process, depending on the type of orchid and the concentration of phytohormones added to the culture medium. At low concentrations, phytohormones may stimulate germination, whereas at high concentrations, phytohormones may inhibit germination (Neuman et al., 2009). Meanwhile, external factors such as seed germination media, availability of water, oxygen and nutrients in the germination media. The result of seed germination as seen in Figure 1.

In vitro germination of orchid seeds is a prerequisite for providing plants in large quantities for conservation, reintroduction and breeding programs. However, nutrient requirements for in vitro germination can differ significantly between species, and even within species originating from different habitats within the same geographic region, as these habitats may produce locally adapted ecotypes (Hufford and Mazer, 2003). The addition of ZPT in the media affects the level of endogenous hormones which are factors driving the growth and morphogenesis processes (Gunawan, 1988), so that the addition of exogenous ZPT can influence the percentage of germination of orchid seeds in the in vitro culture media.

Embryo Development phase

The results on 8 weeks after planting (MST) showed that the growth of Dendrobium sp. seeds was in accordance with the results of research by Diantina et al. (2020) regarding the growth phases of epiphytic orchids that go through each phase of embryonic development. The number of embryonic development phases observed in this experiment can be seen in Table 3.

Table 3. Effect of adding shallot bulb extract and NAA hormone on the number of developmental phases of Dendrobium sp embryos (8 WAP)

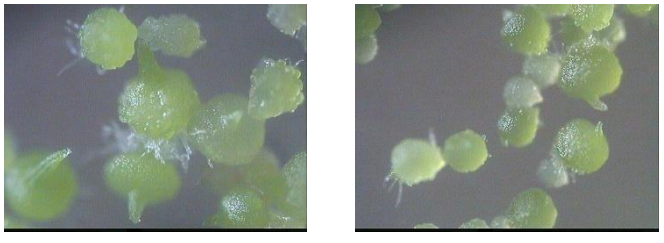
Treatment	Number of embryo development phase Treatment			
	Phase 0	**Phase 1**	**Phase 2**	**Phase 3**
A	49 d	94,26 d	5 a	0 a
B	19 a	58,2 a	64,4 e	10,8 d
C	27 b	59,2 a	54 d	9,2 d
D	37,2 c	83,2 c	29 b	0 a
E	28,6 b	73,4 b	42,2 c	4,6 b
F	24,2 ab	72,8 b	46 c	6,6 c

continued

Note: Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test at a significance level of 5%.

Based on statistical analysis of adding shallot bulb extract and the NAA hormone to the in vitro culture medium of Dendrobium sp seeds had a significant effect on the number of each phase of embryo development. The media used without treatment with adding shallot bulb extract and the NAA hormone (Treatment A), only reached the orchid seed phase to form protocorms (phase 2). Meanwhile, for media with suplementing onion bulb extract and the NAA hormone, the orchid seed growth phase showed that it reached the protocormeristem phase (phase 3), except for treatment medium D, it still reached the protocorm phase (phase 2). It is suspected that seed explants in medium D formed callus, which was caused by the combination of adding 150 g/l of onion bulb extract and 0.75 ppm NAA hormone which produced quite high auxin activity. According to Gunawan (2009), the activity of the hormone auxin in high concentrations is known to play a role in inducing the formation of callus on explants in culture media. The presence of auxin in cells causes an increase in cell permeability to water so that the pressure on the cell walls decreases, causing the seed coat to burst. When auxin is present in the right concentration, it can trigger a response in embryo cells and stimulate embryonic development in the cells (Lisnawati, Hayatul and Nurcahyo, 2022). The observed embryonic development phases can be seen in Figure 2.

(a) (b) (c)



(d) (e)

Figure 2. (a.) phase 0 of Dendrobium sp orchid embryo development in medium B, **(b.)** phase 1 of orchid embryo development in medium A, **(c.)** phase 2 of development of orchid embryos in medium A, **(d.)** phase 3 of orchid embryo development in medium B, **(e.)** phase 3 of orchid development in treatment medium F, 4x magnification (8 WAP)

The orchid embryo is the initial stage of orchid development after the fertilization process occurs inside the flower. The embryo that is formed after the fertilization process has the potential to grow into a new plant. At the developmental stage, the embryo develops into initial structures, namely swelling of the embryo which is still protected by the testa (phase 1), rupture of the testa (phase 2), until shoots and roots emerge (phase 3) (Diantina, et al, 2020). This can happen if orchid embryos are grown in suitable conditions such as proper nutrition, humidity and temperature. This stage of orchid embryo development is important in the orchid life cycle and is the initial stage for further growth to form a new orchid plant. In the results of this research, each treatment has a different time in reaching the growth phase, in accordance with Young's (2017) statement that each growth phase has a different time because of the different abilities of individual orchid seeds.

The percentage of Plb that is growing

The number of PLB that grew was counted manually in each bottle per treatment. The results of statistical analysis show that there is an influence on the number of PLB that grow by adding shallot bulb extract and the NAA hormone to the culture media, which can be seen in Table 4.

Table 4. Effect of adding NAA hormone and shallot bulb extract on the percentage of PLB that grow (12 WAP)

Treatment	Percentage of Plb
A = without treatment	0,00a
D = shallot bulb extract 150 g/l + NAA 0,75 ppm	1,46a
E = shallot bulb extract 250 g/l + NAA 0,25 ppm	13,49b
C = shallot bulb extract 150 g/l + NAA 1 ppm	14,84bc
F = shallot bulb extract 250 g/l + NAA 0,5 ppm	15,50cd
B = shallot bulb extract50 g/l + NAA 1,25 ppm	17,87d

Note: Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test at a significance level of 5%.

Based on the results of statistical analysis, the addition of shallot bulb extract and the NAA hormone had a significantly different effect on the percentage of the number of Plb that grew 12 weeks after planting. The highest average percentage of the number of Plb was in the media with the addition of 50 g of shallot bulb extract /l and the NAA hormone 1.25 ppm, that was 17.87% of the growing Plb. The percentage of Plb that grows in the treatment media is thought to be due to the addition of exogenous hormones from shallot bulb extract which contains the hormones auxin,

cytokinin and gibberellin (Kurniati et al, 2019) as well as the NAA auxin which are suitable for the formation of Plb in media of Dendrobium sp.

Exogenous hormones added to the culture medium is transported to the cell elongation area thereby stimulating cell growth by binding to receptors built in the plasma membrane. When tissue is hydrated, gibberellins cause the tissue to secrete hydrolytic enzymes. Apart from that, synergistically, the activation of gibberellins is also accompanied by the activation of auxin and cytokinin (Paramartha, Dini and Siti, 2012). The presence of auxin stimulates plasma membrane proton pumping and over time, auxin will increase the membrane potential and reduce the pH of the cell wall. This acidification of the cell wall will activate an enzyme called expansin, which breaks the hydrogen bonds between cellulose microphylls and loosens the cell wall structure. An increase in membrane potential will increase the uptake of ions into the cell, which causes water to be taken up by osmosis. Water uptake, along with increasing cell wall plasticity, allows cell elongation to occur (Ratna, 2008). Auxin influences gene expression regulates cell division, and its influence on the regulation of other hormones such as cytokinins can influence protocorm morphogenesis. Cytokinin stimulates cell division in seeds, which if auxin and cytokinin are in balance will grow meristem cells which continue to divide and form organs. Increasing the concentration of auxin in cells is a stimulus for activation of cytokines which will increase the rate of protein synthesis which is a cell building protein so that with the addition of red onion bulb extract and the NAA hormone, new cells are formed which ultimately differentiate into certain organs. The research result of Astutik, Sumiati and Sutoyo (2020) stated that the addition of the NAA hormone can stimulate the growth of Dendrobium sp in vitro.

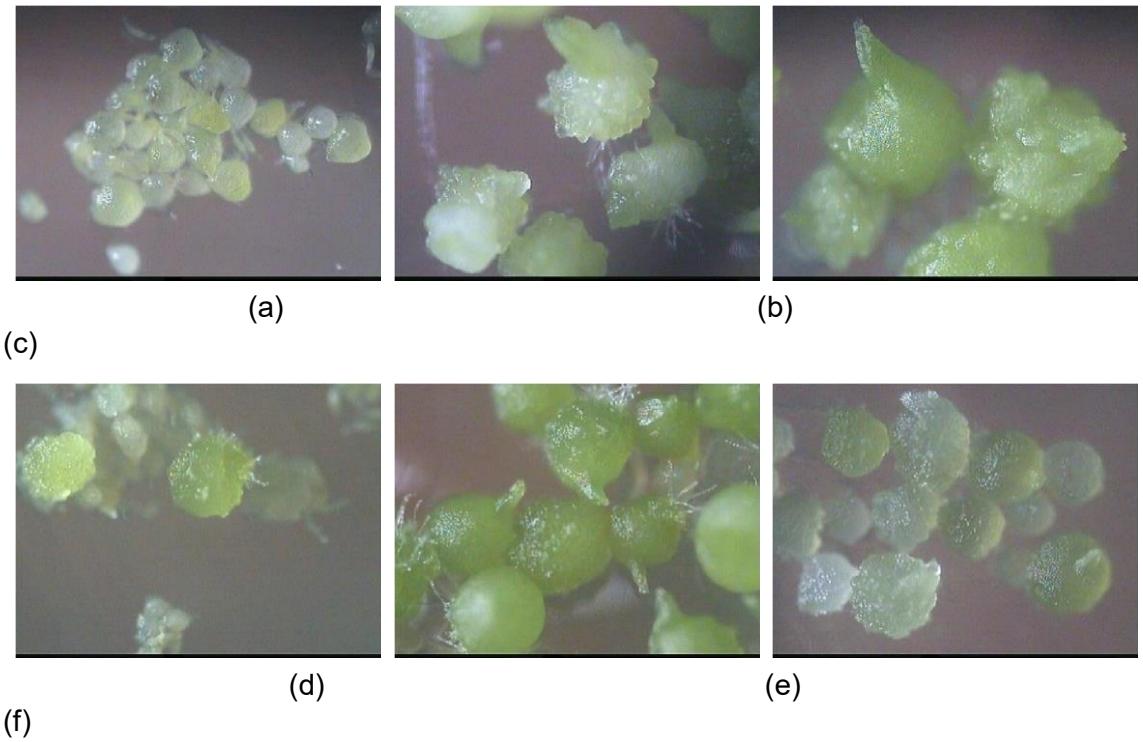


Figure 3. (a) plb growing on medium A, **(b)** plb growing on medium B, **(c)** plb growing on medium, **(d)** plb growing on medium D, **(e)** plb growing on medium E, **(f)** plb growing on F medium.
4x magnification (12 WAP)

The PLB growth resulted have different colors as seen in Figure 3, according to Dwiyani (2013) Plb orchids have several colors, namely white, greenish yellow and green. The color in protocorms is produced from chlorophyll which is a green substance found in plants and is needed when plants undergo photosynthesis, so chlorophyll will play a very good role in plant regeneration. Plb that grow at 12 WAP in this media are transferred/subcultured for further regeneration, this is because media used for more than 12 weeks will experience significant nutrient degradation, so that the media becomes dry and can no longer meet the nutrient needs of the explants. A green Plb has high potential for subsequent regeneration into shoots (plantlets).

CONCLUSION

1. The addition of shallot bulb extract and the NAA hormone to the in vitro culture media had an effect on the growth of Dendrobium sp orchid seeds.

2. The concentration of shallot bulb extract of 50 g/l and the NAA hormone of 1.25 ppm was the concentration that had the best effect on the seed growth phase, embryo development phase and the percentage of growing Plb.

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WATER AVAILABILITY AND SOIL AGGREGATE STABILITY IN TEAK AGROFORESTRY

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Abstract: Different types of agroforestry land use can improve the quality of soil physical properties, including improving soil structure. The research aims to assess the level of bulk density, water content, and soil aggregate stability in Jati Unggul Nusantara (JUN) agroforestry-based land use. The study was conducted in Cogreg Village, Bogor Regency, West Java Province, in 2021. The research used a Completely Randomized Design (RAL) with three treatments, namely: (1) Jati Unggul Nusantara (JUN-M) monoculture land use type, (2) Agroforestry JUN integration with arrowroot plants (JUN-G), (3) JUN integration with taro plants (JUN-T), and (4) Type of grassland use (R). The parameters observed include soil weight, water content, and soil aggregate stability. Statistical analysis uses the STAR (Statistical Tool for Agriculture Research) application. The

research results show that JUN monoculture land has the lowest soil bulk density, porosity, and the highest water-holding capacity. The JUN-G, JUN-T, and grass monoculture treatments did not significantly affect the observed parameters. The JUN-G and JUN-T, land use types, can cause lower soil bulk weights of 1.24 g/cm3 and 1.26 g/cm3, respectively, compared to the higher grassland use type, namely 1.41 g/cm^3. Soil porosity and water content are higher in the JUN-garut and JUN-talas land use types compared to the grass land use type. The level of soil aggregate stability is higher in the grassland use type (R) compared to the monoculture land use types JUN-M, JUN-G, and JUN-T.

Keywords: agroforestry, soil bulk density, soil moisture content, aggregate stability

INTRODUCTION

The agroforestry system is an agricultural system where trees are planted intercropped with one or more types of annual crops. Various problems, including decreased soil fertility, erosion, loss of flora and fauna, floods, droughts, and even global ecosystem changes, are known to be caused by the conversion of forest land to agricultural land. (Yuniti et al., 2022). The agroforestry pattern under teak forest stands offers a solution for ecological and economic sustainability (Pujiono et al., 2021). This is possible because forestry plants are combined with agricultural plants. Land use systems and technology are increasingly developing in the same spatial and temporal settings, where there is mutual interaction between ecological aspects, including land and water (R. Kadigi *et al*., 2021). This system has a significant influence on the physical properties of the soil, which tends to improve soil structure (Singh *et al*., 2018). Tree roots and shrub vegetation help break down soil into larger aggregates, which increases soil porosity and air circulation (Luo *et al*., 2023; Gusli *et al*., 2020). This makes the soil more accessible to water, nutrients and plant roots, reducing soil erosion risk (Sarto *et al*., 2022). Trees and shrub vegetation in agroforestry systems often provide organic material in the form of leaves, twigs, and litter that falls to the ground (Gama-Rodrigues, 2011). This organic material enriches the soil with humus (Clivot *et al*., 2020), increases the water-holding capacity of the soil (Masnang, 2023), and increases the availability of nutrients for plants (Do *et al*., 2023). Vegetation in agroforestry systems has deep roots, which can help improve the soil's ability to absorb and store water (Sarto *et al*., 2022). This reduces the risk of soil drying out and optimizes plant water availability. Overall, agroforestry has a positive impact on the physical properties of soil by improving structure (Siswanto Aji *et al*., 2021), organic matter content (Rinady *et al*., 2023), water absorption capacity (Masnang, 2023), and protection from erosion (Do *et al*., 2023).

Teak tree-based agroforestry is an agricultural system combining teak tree planting with crops in a farming area. The function of teak tree-based agroforestry includes various aspects that are beneficial for the environment, economy, and society.

Teak trees have a robust root system and are resistant to soil erosion. Planting teak around agricultural land can help reduce soil erosion and maintain soil stability (Litschel *et al*., 2023). Teak trees can also play a role in maintaining water quality and mitigating water pollution problems. Teak tree's fallen leaves and twigs can become organic material used as natural fertilizer to improve soil fertility on agricultural land (de Freitas *et al*., 2018; Singh *et al*., 2018).

One type of teak that can be developed as an agroforestry type is the Nusantara Unggul Jati (JUN) type. Teak (Tectona grandis L.f.) Unggul Nusantara is a superior seed for yield and tissue culture propagation that was first developed in the laboratory and has good quality parent plants. The advantages of Jati Unggul Nusantara (JUN) seeds are that they are able to mature more quickly, have a high level of uniformity, have straight and cylindrical stems. Hence, they are more economically valuable and are more adaptive in various growing conditions (Susdiyanti *et al*., 2023).

Agroforestry has a positive influence on soil bulk density (Hairiah *et al*., 2020); a decrease in bulk density can indicate better soil physical properties (Purnama *et al*., 2022). The roots of trees and shrubs create gaps and channels in the soil. This increases the space between soil particles, this reduces bulk density because the soil becomes lighter and more open to air and water circulation (Musongora *et al*., 2023). In good agroforestry conditions, soil bulk density tends to be lower than in conventional farming systems (Siahaan & Kusuma, 2021). This indicates that agroforestry can produce better soil physical properties, which in turn can support higher soil productivity and agricultural sustainability in the long term. Agroforestry can influence soil water content, varying depending on the type of agroforestry used (Masnang *et al*., 2023). Compared to monoculture farming, Agroforestry systems tend to have more vegetation, including trees and shrubs. The roots of these trees and shrubs can cause increased water storage in the soil because the roots can hold water and prevent excessive evaporation (Litschel *et al*., 2023; Zhang *et al*., 2020). Based on the role of agroforestry stated above, research was carried out aimed at determining the level of water availability and soil aggregate stability in the Jati Unggul Nusantara (JUN) agroforestry-based land use type.

RESEARCH METHODS

Time and Location of Research

The research occurred from November 2020 to February 2021 at the Nusa Bangsa University experimental garden. The research location is administratively within the Cogreg village area, Ciseeng sub-district, Bogor Regency. The land area is 11 Ha, located between 6'25'40'S and 106'41'05'E. The observation area is 150 meters above sea level, topography with a gentle slope ranging from 3-8%, Latosol soil type, acidic soil at pH 5. Average rainfall is 2750 mm per year; average daily temperature is 280C with an average minimum of 230C and maximum of 38^0C (BPS, Bogor Regency, 2019).

Based on observations at the research location, there are four types of land use based on teak trees (*Tectona grandis*. L.F) aged 7 and 11 years on a land area of 11 Ha. The 11-year-old teak monoculture land use type is on the largest land of around 7 Ha, and two types of land use in the form of agroforestry, namely a combination of

teak trees with taro plants (*Colocasia esculent* Linn), arrowroot plants (*Maranta arundinacea*), each occupying land area of 1 Ha. The planting distance for teak trees is 2 m x 5 m, taro 1 m x 1 m, and arrowroot plants. At the time of observation, the intercropping plants were 3 months old. Farmers around the land have cultivated intercropping crops continuously since the teak plants were planted.

Research Procedures

In this research, there are four types of agroforestry used as observation plots for treatment, namely: (1) monoculture of Nusantara Unggul Jati trees (JUN-M), agroforestry combination of teak and taro plants (JUN-T), agroforestry combination of teak and arrowroot plants (JUN -G), mini elephant grass monoculture (G) each repeated three times. In each plot, soil samples were taken using purposive sampling (Figure 1).

(a) (b) (c)

(d)

Figure 1. Types of land use JUN monoculture (a), JUN-garut (b), JUN-talas (c), and grass land (R)

The physical characteristic parameters of the soil observed include (1) Soil bulk density (g/cm3), measurements following the Blake, G.R. procedure; Hartge, K.H. (1986); (2) Porosity (%), calculated assuming a mineral soil particle density of 2.65 g/cm3 (Weil, R.; Brady, N, 2017); (3) Soil water content at depths of 0-30 cm and 30-60 cm (%), and field capacity water content (%) using gravimetric methods; (4) Aggregate stability follows the procedure proposed by Gusli (1986).

In this research, the steps were to take soil samples for each type of land use using available tools and materials. Materials and tools used include Soil samples, 2 packs of 2 kg plastic bags, markers, plastic containers, buckets, two large cutters, sample rings, boards/beams, hammer, hoe, soil fork, soil drill, gloves, scales, and oven.

The collected soil samples were then analyzed at the Nusa Bangsa University MIPA Laboratory. The parameters observed in this research were used to determine soil bulk density, soil aggregate stability, water content, and field capacity.

Soil Bulk Density (g/cm3) and Soil Porosity (%)

Soil bulk density (g/cm3). Bulk density measurements follow the procedures of Blake, G.R.; Hartge, K.H. (1986). Soil samples were taken entirely using a sample ring with an inner diameter of 7.5 mm and a height of 4 meters. Based on soil bulk weight data, porosity (%) can be calculated assuming a mineral soil particle density of 2.65 g/cm^3

(Weil, R.; Brady, N, 2017). How it works to determine bulk density: The surface of the soil is cleaned of grass by scraping the soil a little to make the location of the soil to be sampled. The sample ring is stuck on the surface of the soil using a hammer to push the sample ring into the soil, then the second sample ring is placed on it. Top of the first sample ring so that the sample ring enters a deeper soil layer. Next, use a soil fork to pry and pull carefully to keep the soil in the two sample rings intact. The two sample rings were separated by slicing using a cutter on the outside of the sample ring to remove any remaining soil attached, then the sample ring was closed tightly on both sides, then the sample was ready to be taken to analyze the weight of its contents. Next, the samples were analyzed in the laboratory by placing them in an oven at 105ºC for 24 hours. Formula:

$$\text{Bulk density} = \text{Soil Oven Dry Weight} / \text{Sample ring volume}$$

$$\text{Porosity} = 1 - \frac{\text{Bulk density}}{2{,}65} \times 100$$

Soil Water Content (%) at a depth of 0 – 30 cm and 30 – 60 cm

Soil samples were taken using a soil drill at a predetermined depth, namely 0 – 30 cm and 30 – 60 cm from the ground surface, which had previously been marked using a marker to determine the depth of the soil. Next, a soil sample is taken and placed in a tightly closed container. The sample is then analyzed in the laboratory to determine its water content using the gravimetric method.

Formula:

$$\text{Water Content} = \frac{\text{Wet Weight of Soil - Dry Weight of Oven}}{\text{Dry Weight of Oven}} \times 100\%$$

Note: BB = Wet Weight of Soil, BK = Dry Weight of Oven

Water Content Field Capacity (%)

A pot containing two kilograms of soil sample was filled with water and left until the water was saturated, as evidenced by water leaking below the pot's surface. Samples of soil were gone for a full day or until the gravity water ceased or there was no more leaking. The sample was then heated to 105ºC for 24 hours to extract the water content.

Determination of Soil Aggregate Stability

The soil surface was cleaned using a soil fork, and then four intact soil aggregates with a diameter of approximately 1 cm were taken. Next, the sample was immersed in a square plastic container containing 200 ml of water; then, the sample was left for 2 hours to observe whether there was any breakdown of the aggregate (slaking) or dispersion. To determine aggregate stability, the following aggregate stability criteria (Table 1) are used:

Table 1. Criteria for determining scores for the level of aggregate destruction

SCORE	CRITERIA
0	No slaking
1	Weak slaking is characterized by small cracks at the edges of the aggregate, but the soil aggregate is still cohesive.
2	Moderate slaking is characterized by marked aggregate disintegration, although most of it (more than half of the aggregate) is still united.
3	Slaking is strong; less than half of the aggregate is united, and more than half is destroyed.
4	Total slaking, all parts of the aggregate disintegrate.

Reformation of soil aggregates under moist conditions that are approximately equal to the field capacity if no dispersion occurs. The muddy soil samples are formed into balls with a diameter of 3-5 mm, which are soaked in distilled water as with air-dry aggregate. Next, leave it for 2 hours and then observe the dispersion level score based on the criteria in Table 2 as follows:

Table 2. Criteria for determining scores on the level of dispersion

SCORE	CRITERIA
0	No disperse
1	Weak dispersion is characterized by cloudy water bordering the aggregate

Data Analysis

The collected soil bulk density, porosity, water content, and field capacity data were then analyzed descriptively by calculating each parameter's mean and standard deviation/standard deviation using the STAR (Statistical Tool for Agricultural Research) application). Anova is carried out to identify or test whether there are differences in land use regarding the observed parameters. This is followed by the Tukey HSD test if the variance analysis shows significant differences between variables. Meanwhile, aggregate stability data based on scores follows the procedure proposed by Gusli (1986).

RESULTS AND DISCUSSION

Soil Bulk Density, Porosity, and Soil Water Content

The role of agroforestry on the physical properties of the topsoil is the part that is most quickly and easily affected by various changes and treatments. The statistical analysis results in Table 3 show that the JUN monoculture land use type (JUN-M) significantly influences bulk weight, porosity, and soil water content. The bulk density of the soil is significantly lower, and the apparent porosity is higher in the teak monoculture type coupled with the level of field capacity water content compared to the teak-garut agroforestry (JUN-G), teak-taro agroforestry (JUN-T), and grassland (G) types.). In general, the top surface layer becomes compressed because the pore space is reduced. The bulk density level of soil in teak monoculture, namely 1.19 g/cm^3, is lower than the bulk density in natural grass, namely 1.41 g/cm^3. The results of research with the same bulk density pattern stated by (Khaki *et al*., 2016) showed a bulk density of

1.16 g/cm^3 in natural forests and 1.28 g/cm^3 in natural grass. Thus, the bulk density of teak monoculture is almost similar to the bulk density of soil in natural forests.

Soil size and density, which can improve aeration and water content, and determine the proper air-to-water ratio, determine soil porosity. Soil particle density refers to the weight of soil per unit volume. Soil with a high particle density will have low porosity because the soil particles are denser. On the other hand, soil with a low particle density will have higher porosity. The activity of organisms, such as earthworms and bacteria, can create small pores in the soil through processes such as decomposition and plant root formation. This can increase soil porosity (Winara, 2020). Soil with a high organic matter content tends to have better porosity because organic matter can help prevent soil compaction and create micropores. Soil's ability to hold water is influenced by porosity. Soil bulk density was lower, and porosity was higher in JUN-G and JUN-T agroforestry than in grassland (Table 3). This is because there is a lot of vegetation and litter on the surface of the soil, thus protecting it from aggregate damage. The organic material content in the soil, such as humus, can increase aggregate stability. Organic matter plays a role in binding soil particles together, helping prevent erosion, and increasing aggregates that are more resistant to rain and soil surface erosion (Umam *et al*., 2022).

Table 3. Soil bulk density, porosity, water content at depth (0-30 cm and 30-60) cm, and field capacity water content

Land use type	Bulk density	Porosity	Water content (%)		Field capacity (%)
	g/cm^3)	(%)	0 – 30 cm	0–60 cm	
JUN Mono	1.19 a	54.91 a	37.45 a	33.75 a	44.65 a
JUN-G	1.24 a	53.00 a	36.57 a	32.57 a	49.00 a
JUN-T	1.26 a	52.50 a	33.52 a	34.13 a	50.00 a
R	1.41 a	48.50 a	28.48 a	35.41 a	35.00 a

Notes: The means followed by the same letter in each column for each parameter are not significantly different at $p<0.05$.

The type of agroforestry land use maintains soil porosity, as shown in Table 3, namely 53% for JUN-garut agroforestry and 52% for JUN-taro agroforestry, while grassland use without stands has the lowest porosity, namely 48.50%. The reason is that the area is covered with lots of plants and litter to protect the soil surface from the energy of falling rainwater. The destruction of soil particles that can close pores is the first step in aggregate disintegration which can be avoided in this way. Stable soil aggregates can produce a physical environment that promotes plant root development by influencing porosity, aeration, and water holding capacity. Decaying plant litter and roots can also increase the amount of organic matter in the soil.

The analysis results show that the use of JUN-garut agroforestry and JUN-taro agroforestry land has a positive impact on maintaining the number of soil pores. The quantity and quality of organic material that falls to the ground determines the extent to which the litter layer develops on the soil surface. The diversity of vegetation causes differences in the quality of organic material that falls to the ground, thereby thickening the litter layer so that it lasts longer on the soil surface. This creates moist soil

conditions and temperatures that support the activity of soil biota and provide an energy source for soil organisms.

The existence of stable soil aggregates reflects the relationship between porosity between various soil layers. The more pores there are, the faster water can move across the soil profile. Roots also play an important role in creating gaps or cavities in the soil, which increases the rate of water infiltration both vertically and horizontally. Differences in the depth of tree root distribution can influence this. The distribution and size of roots are more varied in agroforestry land use, thereby increasing their role in creating soil porosity (Suhaendah et al., 2021).

The size and texture of the soil, which can increase soil water content, has an impact on increasing soil porosity. The results of this study (Table 3) show the soil water content in the JUN-garut agroforestry type (36.57% at a depth of 0-30 cm and 32.57% at a depth of 60 cm) and JUN-taro agroforestry (33.52% at a depth of 0-30 cm and 34.13 % at a depth of 60 cm) is higher than the soil water content in grasslands (28.48% at a depth of 0-30 cm and 35.41% at a depth of 60 cm). Likewise, the level of water content in field capacity is also higher (49% in JUN-garut and 50% in JUN-talas) compared to the water content in grassland which is 35%.

Aggregate Stability

The aggregate stability index for the grassland use type without standing vegetation shows a very stable level of aggregate stability based on the aggregate stability level criteria. This is caused by the contribution of grass vegetation that grows densely, covering the surface of the soil and functions to protect it from moisture, which has the potential to damage soil aggregates. Furthermore, the influence of root exudates and the relatively high population of soil organisms around the roots are most likely responsible for aggregate stability which is in the stable category in the JUN-G agroforestry and JUN-T agroforestry land use types (Figure 2). Plant roots directly influence the amount of soil organic matter and the stability of soil aggregates. Plant roots both directly and indirectly contribute to the amount of soil organic matter and soil aggregate stability through the material in their roots and the activity of microorganisms in the surrounding environment (Hikmawati & Prijono, 2022; Umam *et al*., 2022).

Figure 2. Observation of aggregate stability

The multi-layered vegetation canopy layers in the JUN-garut and JUN-T agroforestry land use types (Table 4) can also contribute to the high aggregate stability index. Having a multi-level canopy layer can reduce the height of raindrops when they fall, thereby reducing the impact of energy on the soil surface, which can destroy soil aggregates. In addition, the

amount of rainwater reaching the ground surface is reduced because raindrops are trapped in the canopy before reaching the ground surface.

Table 4. Level of aggregate stability in various types of land use

Land use type	Score	Criteria
JUN-G	1. Score 0 = 3 aggregate Score 3 = 1 aggregate 2.Score 0 = 2 aggregate Score 3 = 2 aggregate 3. Score 0 = 3 aggregate Score 2 = 1 aggregate	The level of aggregate stability does not experience crushing of more than 50%
JUN-T	1.Score 1 = 1 aggregate Score 2 = 2 aggregate Score 3 = 1 aggregate 2.Score 0 = 2 aggregate Score 2 = 1 aggregate Score 3 = 1 aggregate 3.Score 0 = 2 aggregate Score 1 = 2 aggregate	The level of aggregate stability does not experience crushing of more than 50%
R	1. Score 0 = 3 aggregate Score 1 = 1 aggregate 2.Score 0 = 2 aggregate Score 1 = 2 aggregate 3. Score 0 = 4 aggregate	All aggregates experienced only weak slaking
JUN-M	1.Score 0 = 3 aggregate Score 3 = 1 aggregate 2. Score 0 = 2 aggregate Score 3 = 2 aggregate 3. Score 0 = 3 aggregate Score 2 = 1 aggregate	The level of aggregate stability does not experience crushing of more than 50%

continued

In addition, litter that has not decomposed and can be used as mulch will appear if the old vegetation canopy falls to the ground. By improving the physical quality of the soil, mulch can not only reduce the energy impact on the soil surface but also encourage the development of soil macrofauna and bacteria. These organisms directly contribute to the breakdown of mulch into smaller materials and play an important role in the production of soil organic matter. Although macro aggregates can form due to the activity of plant roots and fungal mycelium, the stability of micro aggregates depends on the presence of binding organic materials (Hikmawati & Prijono, 2022). According to Gunawan & Rohandi (2019), microorganisms can metabolize and utilize organic matter in soil. Litter on the ground surface functions as a soil cover or mulch which can reduce the level of water evaporation and fluctuations in soil temperature. The thicker the litter layer on the soil surface, the less water evaporates, so the soil water content remains high. Through intercropping, soil processing is more intensive, resulting in better soil properties. By improving soil properties, the soil becomes easy to cultivate, has good aeration and drainage, is easily penetrated by roots, and is able to retain added water and plant nutrients.

Many basic soil grains are grouped together and arranged in a hierarchy to form soil aggregates. Hierarchical structure impacts aggregate stability. The lowest hierarchical arrangement, or clay particles, is affected by dispersion, which destroys

the entire aggregate. However, lower hierarchies are not affected if total destruction occurs at higher hierarchical levels, for example, due to land cultivation. Organic compounds easily form complexes with soil that can change soil porosity and contribute to the production of solid aggregates.

CONCLUSION

The land use type of the Jati Unggul Nusantara Agroforestry with the integration of arrowroot plants (JUN-garut), the land use type of the Jati Unggul Nusantara Agroforestry with the integration of taro plants (JUN-talas), and the type of grassland use did not have a statistically significant effect on the observed parameters. However, different types of land use can determine the level of physical quality of the soil. The JUN-garut and JUN-taro land use types can cause low soil bulk weights of 1.24 g/cm^3 and 1.26 g/cm^3 respectively compared to the higher grassland use type, namely 1.41 g/cm^3. Porosity or total pore space, soil water content is higher in the JUN-G and JUN-T land use types compared to the grass land use type due to root activity in JUN-G and JUN-T which is good for plant root development through its influence on porosity, aeration, and water holding capacity, while aggregate stability is higher in the grass land use type.

Land cultivation in the form of teak agroforestry-based land use is the appropriate type of land use to improve the physical properties of the soil. However, it is necessary to consider development with the integration of livestock in the system so that it can increase productivity and balance the ecosystem.

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EFFECT OF CHITOSAN CONCENTRATION AND TYPE OF SILENCER IN POST-HARVEST WATER GUAVA ON MICROORGANISM DEVELOPMENT

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Abstract: Guava has non-climacteric respiration activity with high water content, so improper post-harvest handling will trigger fungal growth. This study aims to determine the effect of chitosan concentration and type of fruit damper on post-harvest handling of guava fruit on the development of microorganisms during storage. This study used a factorial Randomised Complete Group Design (RAKL) consisting of two factors. The first factor is chitosan concentration (K) consisting of 4 levels of 0% control (K0), 1% concentration (K1), 2% concentration (K2), 3% concentration (K3). The second factor is the type of damper (P) is without damper (P0), net foam (P1), shredded paper (P2). Thus, twelve treatment combinations with three treatments were obtained. The results showed that the treatment of chitosan concentration and the combination of chitosan concentration treatment with fruit absorbers had a significant effect on the percentage of fruit rot at the age of five days and ten days after storage. For the treatment of fruit absorbers, there was no significant effect. The effect of chitosan concentration on microorganisms that attacked the fruit during storage was fungi of the genus Mucor and Penicillium at the most in treatment K2 (2% chitosan). Based on the results of this study, it is recommended to conduct further research by reducing the level of chitosan used as edible coating.

Keywords: water guava; edible coating; chitosan concentration; fruit suppression; microorganisms

INTRODUCTION

Water guava is a fruit originating from Asia and has been cultivated in almost all parts of Indonesia. Some other countries that cultivate water guava are Malaysia, Thailand and India. Based on data from the Central Statistics Agency (2021) water guava production in 2021 has increased by 206,423 tonnes compared to 2020 whose production was 182,908 tonnes. The increase in water guava production is inseparable from the large number of consumer demand because it has a sweet and fresh taste. Water guava plants have a long life and can be harvested up to three times a year, there are important contents, namely sugar and vitamin C. Water guava leaves contain a variety of chemical compounds that have pharmacological properties such as antidiabetes, antimicrobial, antioxidant, antibacterial and anti-inflammatory (Anggrawati & Ramadhania, 2016).

Water guava fruit is known as a fruit that has a lot of water content in it up to 87% (Rahmawati, 2021), and has a thin fruit skin, causing the fruit to rot easily and be attacked by pathogens. Water guava is a type of climatic fruit that carries out respiration, transpiration and other biochemical activities during the storage process, resulting in a decrease in quality and the storability of the fruit cannot last long (Kalsum et al., 2018; Sree et al., 2020). Based on previous research, the 6th day of guava

storage is a critical period, at this time changes in aroma, taste and texture occur, and can cause fungal growth (Sumanti et al., 2020).

Storage of guava fruit can reduce quality and restrictions on shipping distance. Therefore, post-harvest handling and proper packaging are required. Post-harvesting is an agricultural product processing activity that aims to maintain the physical quality of the fruit and prevent the decline in fruit quality. Recently, there has been a lot of research on alternatives to control post-harvest deterioration, reduce spoilage and avoid adverse health effects due to excessive application of synthetic fungicides. Recent studies have focused on biodegradable natural compounds of plant and animal origin (Kibar & Sabir, 2018).

A way that can be used to prevent the decline in the quality of water guava is by coating the fruit or chitosan-based edible coating. Edible coating is a thin coating on the surface of the fruit that is safe for consumption and useful for inhibiting the rate of respiration, so as to maintain the quality of fruit freshness. Edible coatings have barrier properties that can maintain fruit moisture, control fruit nutritional content, as well as antifungal and antimicrobial properties (Kinasih et al., 2019). Chitosan is an edible polymer isolated from the shells of Crustaceae animals. Chitosan is a natural product that is non-toxic and environmentally friendly. High molecular weight cationic polysaccharides from deacetylated chitin can be applied in post-harvest handling applications as they have excellent film-forming, antifungal, antibacterial and biochemical properties (Sree et al., 2020). Chitosan-based edible coatings have been widely studied for their benefits in inhibiting spoilage and extending the shelf life of perishable products such as papaya (Firmansyah et al., 2016), strawberry (Panataria & Saragih, 2019), tomato (Sree et al., 2020), mango (Leihitu et al., 2021), red guava (Kinasih et al., 2019), red chilli (Hayati., 2021) and broccoli (Setyaputri & Kurnia, 2019).

The post-harvest chain that has the most influence on water guava fruit damage is the storage and distribution process. During the distribution process, fruit damage often occurs as a result of fruit stacking, fruit friction, fruit collision and moisture in the packaging. Improvement and modification of packaging is an effective way to reduce physical damage to fruit during transport (Iswahyudi et al., 2015). Packaging design can be added with fruit dampers that can prevent collisions between fruits. Bruises caused by collisions between fruits can make fruits more susceptible to pathogens, so there needs to be an appropriate combination between the packaging used and the type of fruit damper.

Based on the two factors above and the lack of research on post-harvest water guava, a study was conducted with the title "Effect of Chitosan Concentration and Type of Silencer on Post-Harvest Quality of Water Guava (*Syzygium samarangense* L.)".

RESEARCH METHODS

The research was conducted at the Protection Laboratory of the Faculty of Agriculture, Universitas Muria Kudus, Jalan Lingkar Utara, Kayuapu Kulon, Gondangmanis, Kecamatan Bae, Kabupaten Kudus, Provinsi Jawa Tengah with an average altitude of 55 metres above sea level (BPS, 2019) and was conducted in February 2023. The materials used were water guava, chitosan from CV. ChiMultiguna, vinegar acid, net foam, shredded paper, 1% amylum, 0.01 N iodine solution, 2N H2SO4, distilled water,

agar, potato, sugar, chloramphenicol. The tools used were cardboard boxes measuring 35 cm x 26 cm x 16 cm, digital scales, measuring flasks, beakers, erlenmeyers, petri dishes, funnels, pipettes, mortars, ose wires, filter cloth, cameras / mobile phones, label paper, markers, stationery, microscopes, refractometers, pick-up cars, buckets, gloves.

The research was conducted using an experimental method using a factorial Randomised Complete Group Design (RAKL) consisting of two factors as treatments and three replications. The first factor is chitosan concentration (K) consisting of 4 levels of 0% control (K0), 1% concentration (K1), 2% concentration (K2), 3% concentration (K3). The second factor is the type of damper (P) is without damper (P0), net foam (P1), shredded paper (P2). Thus twelve treatment combinations were obtained. Each treatment was repeated with 3 replicates so that there were 36 experimental units.

Observation data for each treatment was analysed by analysis of variance (Anova), and if there was a real or very real effect, it was followed by Duncan's Multiple Range Test at the 5% level. Qualitative data on organoleptic test parameters and postharvest disease incidence were analysed descriptively.

RESEARCH IMPLEMENTATION

Chitosan Preparation

Chitosan solution was prepared by mixing 960 ml of water and 40 ml of vinegar, then adding chitosan with concentrations of 1% (10 g), 2% (20 g) and 3% (30 g). The solution was heated and stirred until homogeneous.

Selection of Guava Fruit

The water guava fruit used came from the water guava plantation of Menawan Village, Gebog District, Kudus Regency. Water guavas were selected based on the same level of maturity, size, shape, colour and no sign of physical damage or pathogen attack.

Application of Chitosan Coating

The guava fruits were dipped in chitosan solution with concentrations of 1%, 2%, 3% for 5 minutes, then drained and aerated for 30 minutes until the coating dried. After the coating dried, the guavas were stored for 15 days in each treatment. As a control, guava fruits were soaked with water for 5 minutes.

Fruit Packaging

The fruits that had been dipped in chitosan solution were then coated with net foam to avoid physical and microbial damage. The fruits with the shredded paper treatment were placed directly into cardboard boxes with shredded paper in each layer to cushion the fruits.

Fruit arrangement in cardboard boxes

The arrangement of guava fruit was done by putting ± 3.5 kg of fruit in each box. The weight of fruit sorted from the farmer's harvest is 1 kg, there are 9 guavas, so the number of fruits per box contains 32 fruits. The arrangement of guava fruit in cardboard boxes by placing the fruit on opposite sides of each fruit, this aims to make the fruit in the box fully filled and if shaken during the delivery process, the fruit will not waver and remain in its original position.

Preparation of Cardboard Packaging

The arrangement of cardboard packaging is done randomly during the transport process by pick-up car and indoor storage. The cardboard packs were stacked 3 high with block 1 at the bottom, block 2 in the middle and block 3 at the top.

OBSERVATION PARAMETERS

Percentage of fruit rot

The percentage of fruit rot was conducted by taking ± 1kg samples which were placed into cardboard boxes. This sample has been given a mark which will then be used as a calculation of the percentage of fruit rot. The decay of water guava due to fungal infection or microorganisms is calculated every 5 days, namely on the 5th, 10th, 15th day and recorded as a percentage. Fruit observations were made during 15 days of storage. The percentage of fruit rot was observed physically by taking samples of fruit infected with fungi, then the fruit was observed how many fruits were affected by rot. The percentage of water guava fruit rot can be determined using the formula (Dharmaputra et al., 2021): Fruit Rot (%) = Jr/Ja X 100% Description:

Jr = number of rotten water guava fruit
Ja = number of initial water guava fruits

Post-harvest disease incidence and microbiological analysis

Microbiological analysis test was conducted on day 16 HSP because it is assumed that microbes will be maximised after storage. This test was taken from fruit samples of different treatments by preparing samples of fruit samples affected by mould. Next, take the fungus on the part of the guava that is affected by the fungus with an ose wire, then scratch it on a petridish containing PDA media Incubate the petridish that has contained microbes at room temperature for 7 days. Furthermore, macroscopic and microscopic analyses were carried out. Macroscopic identification is done by direct eye, while microscopic identification is done by putting the petridish containing microbes under a binocular microscope with weak (10 x 10), medium (10 x 40) and high (10 x 100) magnification (Elfina et al., 2012).

RESULTS AND DISCUSSION

Results

The results of variance showed that the treatment of fruit absorbers had no significant effect on fruit rot on days 5 to 15 HSP. Chitosan concentration treatment had a very significant effect on fruit rot at 10 HSP. There was no interaction between the combination of fruit suppressant treatment and chitosan concentration on fruit rot (Table 1).

Table 1. Percentage of Fruit Rot of Water Guava Treated with Chitosan Concentration and Fruit Silencer at 5 Days After Harvest to 15 Days After Harvest

Treatment	Fruit Rot (%) day after harvest		
	5	10	15
Chitosan Concentration			
Without chitosan (K0)	0.12 b	1.85 b	1.99
1% chitosan (K1)	0.23 ab	1.94 ab	2.00
2% chitosan (K2)	0.46 ab	1.98 a	2.00
3% chitosan (K3)	0.80 a	2.00 a	2.00
Fruit Silencer			
No silencer (P0)	0.46	1.95	2.00
Net Foam (P1)	0.26	1.92	2.00
Shredded Paper (P2)	0.49	1.95	2.00
Treatment Combination			
K0P0	0.00	1.93 hi	2.00
K0P1	0.00	1.75 i	1.98
K0P2	0.35	1.89 hi	2.00
K1P0	0.35	1.92 hi	2.00
K1P1	0.35	1.95 hi	2.00
K1P2	0.00	1.95 hi	2.00
K2P0	0.35	1.95 hi	2.00
K2P1	0.35	2.00 h	2.00
K2P2	0.70	1.98 h	2.00
K3P0	1.15	2.00 h	2.00
K3P1	0.35	2.00 h	2.00
K3P2	0.90	2.00 h	2.00
Interaksi	-	-	-

continued

The results of the 5% DMRT test showed that the treatment of fruit rot silencers significantly affected fruit rot at 5 HSP. The treatment of chitosan concentration had a significant effect on fruit rot at 10 HSP. The observation results of 5 HSP showed the lowest fruit rot was in treatment K0 (without chitosan) by 1.24%, while the highest fruit rot was in treatment K3 (chitosan 3%) by 11.11%; the lowest fruit rot at 10 HSP was treatment K0 (without chitosan) by 74.07% and the highest fruit rot was in treatment K3 (chitosan 3%) by 100%. On the 15th day of observation, rotting occurred evenly in treatments K1 (1% chitosan), K2 (2% chitosan) and K3 (3% chitosan).

The combination of fruit dampening treatment and chitosan concentration had a significant effect on fruit rot at 10 HSP and no significant effect at 5 HSP and 15 HSP. The lowest fruit rot was observed at 10 HSP in treatment K0P1 (without chitosan; net foam) with 59.26% and the highest fruit rot was observed in treatments K2P1, K3P0, K3P1 and K3P2 with 100% each. Observation of 15 HSP experienced fruit rot evenly in all treatments, except treatment K0P1 (without chitosan; net foam) at 96.3%.

Based on the results of fungal isolation from guava fruit, seven isolates were obtained which were grown on PDA medium. After identification, five isolates were obtained that had macroscopically different characters seen based on the colour of the isolate. Then further identification was carried out microscopically, so that four isolates obtained belonged to the genus Mucor, while one other isolate belonged to the genus Penicillium. To distinguish isolates with the same genus, the naming of each genus is given a numerical suffix written at the end of the genus name (Table 2).

Table 2. Successful isolation and identification of fungal isolates

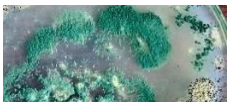
Figure	Isolat	Genus Isolat	Treatment
	1 (Black)	*Mucor* sp$_1$	K0, K1, K2, K3
	2 (Dark Green)	*Mucor* sp$_2$	K0, K1, K2, K3
	3 (Yellow)	*Mucor* sp$_3$	K1, K2, K3
	4 (White)	*Mucor* sp$_4$	K1, K2, K3
			continued
	5 (Gray)	*Penicillium* sp	K0, K2

Table 2. It can be seen that in the K0 treatment there are fungi from the genus Mucor sp1 in black, Mucor sp2 in solid green and Penicillium in grey. The K1 treatment contained fungi from the genus Mucor sp1 in black, Mucor sp2 in solid green, Mucor sp3 in yellow and Mucor sp4 in white. Treatment K2 contained fungi from the genus Mucor sp1 in black, Mucor sp2 in solid green, Mucor sp3 in yellow, Mucor sp4 in white and Penicillium sp in grey. Treatment K3 contained fungi from the genus Mucor sp1 in black, Mucor sp2 in solid green, Mucor sp3 in yellow and Mucor sp4 in white.

DISCUSSION

The treatment of chitosan concentration had a very significant effect on the observation of 10 HSP with treatment K1 (1% concentration). The lowest percentage of fruit rot was in the K0 treatment (without chitosan) at 74.07%. K3 treatment (3% chitosan) gave the highest fruit rot results. The decay of chitosan-coated fruit was suspected to be the growth of fungi in the fruit. This is in line with research conducted by Nurlatifah et al. (2017) in Aini et al. (2019) the use of chitosan coatings that are too

thick can have an impact on anaerobic respiration which results in reduced or no oxygen content in the fruit, which can lead to the growth of microorganisms that produce acids or alcohol. In addition, the result of anaerobic respiration will cause inhibition of the metabolic process, thus affecting the faster ripening of the fruit and the fruit will experience softening to decay (Aini et al., 2019).

The effect of fruit rot on the chitosan coating treatment gave the result that the fruit rotted significantly, in contrast to the fruit without coating which had a low level of fruit rot. It is suspected that during the coating application process, the chitosan used was too thick, so that the chitosan could not dry completely, this situation made the guava experience moisture during storage, as a result the guava would be more susceptible to pathogens. The manufacturing process and materials used for edible coating will affect the condition of the fruit. The method of making chitosan edible coating solution in this study refers to several other researchers who added acetic acid in the solution (Firmansyah et al., 2016; Hapsari et al., 2020; Marsigit et al., 2022).

The addition of acetic acid into the chitosan solution is used as a chitosan solvent. A good chitosan solvent is acid with a concentration of 0.2% - 1.0%. The solvent often used to dissolve chitosan is acetic acid or vinegar with a concentration of 1%-2%. Acidsoluble chitosan is unique in that it can form a stable gel and has two poles, namely the positive charge pole on the NH group and the negative pole on the carboxylic group. The characterisation of chitosan can be determined by its solubility. Chitosan will dissolve more easily in 1-2% acetic acid and will form ammonium acetate salts. Hassan et al. (2020) who showed that 0.5% chitosan concentration was more effective in inhibiting fungal spoilage, thus increasing the shelf life of strawberries. Strawberries coated with 0.5% chitosan showed relatively better fresh weight, carbon metabolism in these fruit tissues may be relatively more active to maintain respiration and other cellular activities. It is suspected that water guava fruit has a thicker texture than strawberry fruit, so a thicker concentration coating was used.

The effect of chitosan concentration on microorganisms attacking the fruit during storage can be seen in Table 4.6. Microorganisms can grow on the surface of the fruit skin, causing the fruit to become damaged. This damage is caused by microorganisms that multiply and metabolise, so that the fruit undergoes changes. Microorganisms will break down complex compounds into simple ones so that they can be synthesized, so that they can affect the taste, texture, aroma and colour of the fruit (Firmansyah et al., 2016). Microorganisms that attack water guava fruit during storage are fungi from the genus Mucor and Penicillium. Mucor is a genus of class Zygomycetes and Penicillium is a genus of class Deutoromycetes (Carter, 1997 in Sanjaya et al., 2010). Macroscopically, Mucor has black, solid green, yellow and white colours, and has an irregular colony shape. The results of microscopic observations at 400x magnification are non-concentrated hyphae, single conidiophores, round sporangium. Simamora et al. (2022) explain that Mucor fungi macroscopically have uneven surface characteristics, white in colour and threadlike mycelia. Microscopically it has hyaline sporangiophores, branched, sporangia formed at the end of the conidiophores, dark brown or black in colour and round in shape. Penicillium fungi macroscopically have grey characteristics, and fungal colonies are evenly distributed. In accordance with the research of Simamora et al. (2022) stated that Penicillium macroscopically has an irregular shape and colony edges, flat surface, grey in colour and can fill petri dishes. The results of microscopic observations with a magnification

of 400x are that it has concentrated hyphae, multiple conidiophores with a single stem. Setiawati et al. (2020) stated that Penicillium has the character of a concentrated, cylindrical conidiophore consisting of a single rod with several phialids, long and hyaline in colour, as well as a round conidia shape and a bottlelike phialid shape.

The effect of fruit dampening treatment on fruit rot gave the best results in treatment P1 (net foam). The use of net foam in water guava fruit storage is due to the thin skin of water guava fruit, making it vulnerable to mechanical damage and attacked by microorganisms, resulting in serious fruit rot. If the fruit is not properly protected, it greatly affects its commercial value (Zheng et al., 2022). As research conducted by Shisheng et al. (2023) that if fresh apples are not well packed, they will suffer from cuts, skin cracks and other mechanical damage. This can lead to apple spoilage, which affects the appearance and freshness of apples, resulting in huge losses in transport, storage and sales. An effective way to prevent apple damage is to wrap the apples in foam net before boxing them. Perdana et al. (2019) stated that in the research that has been conducted, data obtained that packaging with organic materials at each frequency obtained a range of mechanical damage values with a higher difference. This is because the organic material used has rougher properties than Styrofoam material. On the third day, organic packaging has higher damage than Styrofoam.

The fruit dampening treatment had no significant effect on all observation indicators. This is presumably because the distance travelled during the transportation of guava fruit was still too short at around 12 km, as a result the guava fruit did not experience shocks or friction, thus giving almost the same results between without fruit absorbers, net foam and shredded paper. Several researchers have conducted trials on the distance travelled and vibrations made to test fruit resistance to fruit absorbers. Iswahyudi et al. (2015) conducted a transportation test on camplong water guava using a distance of 123.7 km and a time of 2 hours 30 minutes with road conditions in the city and traffic was slightly jammed, giving the result that camplong water guava fruit suffered the greatest damage in the control treatment of 20.87% and the best treatment using the packaging design with a partition of 7.70%. Zheng et al. (2022) stated that packaging using EPE foam layers and separated by hard plastic partitions undergoing simulated transport for 3 hours, there was no significant difference in fruit damage rate and low fruit decay rate during storage. When the package underwent simulated transport for 10 hours, the damage rate of Hongmeiren oranges increased.

The results of the study on the treatment of fruit absorbers and chitosan concentration showed an interaction in the 15 HSP sugar content test (Table 4). This occurs due to the effect of chitosan concentration during storage that can inhibit metabolic processes, as well as the presence of additional ingredients that can minimise the occurrence of respiration and transpiration so as to maintain fruit content in the fruit. In accordance with the research of Fonseca et al. (2021) which states that fruit absorbers in papaya fruit show a slight increase in sugar content, followed by a decrease during storage.

The treatment combination of chitosan concentration and fruit absorbers gave a significant effect on fruit rot at 10 HSP observation. The lowest fruit rot was in the combination treatment of K0P1 (without chitosan: net foam) at 59.26%. Fruit coating with chitosan was suspected that during the application process, the chitosan used

was too thick, so that the chitosan could not dry completely and caused the fruit to be attacked by pathogens.

CONCLUSIONS

Chitosan concentration had a very significant effect on fruit rot at 10 HSP with the lowest rottenness in treatment K0 (without chitosan) at 74.07% and the highest rottenness in treatment K3 (3% chitosan) at 100%. Fruit absorbers had no significant effect on all observation parameters. The combination of fruit dampening treatment and chitosan concentration significantly affected fruit rot at 15 HSP with the lowest fruit rot at treatment K0P1 (without chitosan: net foam) at 59.26%.

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MANAGEMENT OF TEMPE INDUSTRIAL WASTE AS ORGANIC FERTILIZER AND ITS APPLICATION IN PAK COY (*Brassica rapa* L)

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Abstract: Tempe waste is a type of food waste that has high organic content and also contains macro and micronutrients that have the potential to be used as organic fertilizer. This research aims to determine the growth response of pak choy plants to the application of various concentrations of liquid fertilizer from soybean husks waste. This research was carried out from December 2022 to July 2023, at the Sanja Village Experimental Garden, Citeureup, Bogor. The experimental design used was a Randomized Block Design (RBD) with four replications. Treatments consisted of control (without applying liquid fertilizer), 5%, 10%, 15% and 20%. Observation variables consisted of plantheight, number of leaves, and leaf area. The observation data was analyzed using Analysis of variance, then continued with the Duncan's Multiple Range Test (DMRT) with R 3.4 software. The results of the analysis of variance showed that treatment and week had a very significant effect on plant height, number of leaves and leaf area. The 5% concentration of soybean husks liquid fertilizer treatment was the best treatment which could increase the average plant height, number of leaves and leaf area and was significantly different from the control treatment, 15% and 20%. The effect of the consistency of soybean husks liquid organic fertilizer on the growth of pak choy plants still needs to be further evaluated.

Keywords: Liquid organic fertilizer, leaf area, number of leaves, pak choy

INTRODUCTION

Waste is a serious problem faced by almost every industry, including the tempe industry. Processing soybeans into tempe will produce by-products in the form of solid and liquid waste which have the potential to pollute the environment. The Central Statistics Agency (2018) noted that waste accumulation in 2016 reached 6.5 million tons, of which 48% came from households and 60% was organic waste. Tempeh waste is a type of food waste that has high organic content and also contains macro and micronutrients which have the potential to be used as organic fertilizer (Edahwati et al., 2021).

The use of organic fertilizer can improve the physical and chemical propertiesof soil (Anand et al. 2019). The use of soybean epidermis waste as organic fertilizer is very good because soybean husk contains various types of amino acids and several vitamins and minerals such as Fe, Ca, K, P, and Mg which are needed by plants. Apart from that, soybean epidermis also contains 24.5% C-Organic; Nitrogen 0.43%; Phosphorus 0.071%; Potassium 0.41%; C/N Ratio 57% and Water Content 8.02%(Yunarwan et al., 2022). The concept of sustainable agriculture has begun to

be developed by reducing the use of chemical fertilizers and replacing them with organic fertilizers that are environmentally friendly and produce plants,especially for food, that are free of chemicals. Organic fertilizer is available in solid and liquid form. Liquid organic fertilizer is more easily absorbed by plants than solid organic fertilizer (Purbajanti & Setyowati, 2020).

Increasing consumer awareness of health and the need to consume vegetables including pakchoy that are free from chemicals causes demand tocontinue to increase, therefore it needs to be balanced with the availability of organic vegetables to meet consumers. Mustofa et al. (2022) reported that organically grown pak choy plants had higher chlorophyll and carotene contents and lower glucosinoate levels than those grown conventionally. Through theapplication of organic farming, it is hoped that the balance between organisms andthe environment will be maintained. The presence of microorganisms in organic fertilizer acts as a decomposer of organic material, thereby helping in the availability of nutrients for plants (Verdoliva et al., 2021). This research aims to determine the growth response of pak choy plants to the application of various concentrations of liquid fertilizer from soybean husks waste.

RESEARCH METHODS

This research was carried out from December 2022 to July 2023, at the Sanja Village experimental garden, Citeureup, Bogor. The materials used in this experiment were green pak choy, soybean husks, sugar (molasses), EM4, roasted husks, and soil. The experimental design used was a Randomized Block Design (RBD) with four replications. Treatments consisted of control (without applying liquid fertilizer), 5%, 10%, 15% and 20%. Observation variables consisted of plant height, number of leaves, and leaf area. The observation data was analyzed using variance, then continued with Duncan's Multiple Range Test (DMRT) with R 3.4 software.

RESULTS AND DISCUSSION

The results of the analysis of variance showed that treatment and week had a very significant effect on plant height, number of leaves and leaf areas, while replications had no significant effect on the observed variables (Table 1). This shows that there is at least one treatment concentration that influences plant height, number of leaves and leaf area, as is the case with weekly treatments. Rianti et al. (2019) reported that organic chicken feather compost tea fertilizer had a very significant effect on plant height and number of pak choy leaves.

Tabel 1. Analysis of variance of liquid organic fertilizer treatment of soybean husks on plant height, number of leaves and leaf area

Source of diversity	db	Middle square (MS)		
		Plant height (cm)	Number of leaves	Leaf area (cm^2)
Treatment	4	1.4875**	15.257**	0.928**
week	3	9.5506**	57.837**	3.4757**

replication	3	0.0092^{tn}	0.813^{tn}	0.0196^{tn}
Residual	69	0.1503	1.066	0.0598

Note: * is significantly different at the 5% level, ** is significantly different at the 1% level, tn is not significantly different.

DMRT test results showed that the 5% concentration of soybean husks liquid fertilizer treatment was the best treatment which could increase the average plant height, number of leaves and leaf area and was significantly different from the control treatment, 15% and 20% (Table 2). This is different from the research results of Andriani (2020) that a 10% concentration of liquid organic fertilizer fromegg shells and skins is the best treatment to increase the growth and yield of mustard greens. Soybean husks liquid organic fertilizer at concentrations of 10% and 15% was not significantly different from the control for leaf number variables,as was the case at a concentration of 20% for leaf area. The concentration and frequency of organic fertilizer that will be given to plants needs to be considered so that plant growth and yields are maximized (Hakim & Eko, 2021; Hapsari & Suparno, 2023).

Tabel 2. Average plant height, number of leaves and leaf area for various concentrations of soybean husks liquid organic fertilizer

Variables	**Liquid Organic Fertilizer Concentration (%)**				
	Control (0)	**5**	**10**	**15**	**20**
Plant height (cm)	8.85c	13.64a	11.93ab	11.34b	8.34c
Number of leaves	5.73b	7.31a	6.46b	6.4b	4.69c
Leaf area (cm^2)	3.45c	5.84a	5.14ab	4.57b	3.02c

Note: Numbers followed by the same letter in the same column are not significantly different.

The availability of nutrients is an important factor that influences plant growth and development (Agustin & Wahyuningrum, 2019). Providing fertilizer, including liquid organic fertilizer, can increase growth because it contains thenutrients that plants need. The macro and micronutrient content in liquid organic fertilizer is more easily and quickly absorbed by plants than solid organic fertilizer (Rusdiyana et al., 2022).

Observations of plant height, number of leaves and leaf area of pak choy during each week after being given treatment are presented in Figure 1. Figure 1 shows that the mean values of all observed variables increased every week after administering liquid organic soybean husks fertilizer.

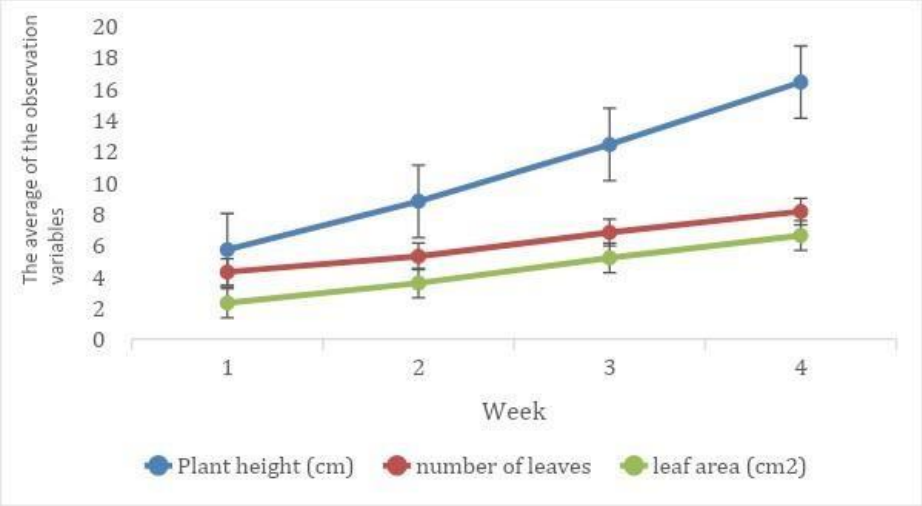

Figure 1. The Average growth of pak choy every week

Based on research results, giving various concentrations of liquid organic fertilizer from soybean husks can increase the growth of pak choy. Berdasarkan hasil penelitian pemberian berbagai konsentrasi pupuk organik cair kulit ari kedelaimampumeningkatkan pertumbuhan pakcoy. According to Hidayat & Suharyana, 2019) that liquid organic fertilizer is effective in increasing the growth and yield of pak choy. The higher the concentration of organic liquid fertilizer used, the higherthe shoot length, leaf area and greenness of pak choi leaves (Wati et al., 2023).

CONCLUSION

Based on the research results obtained, it can be concluded that liquid organic fertilizer for soybean husks with various concentrations gives significantly different responses to plant height, number of leaves and leaf area. 5% concentration of liquid organic fertilizer was able to increase the average plant height, number of leaves and leaf area compared to the control, 10%, 15% and 20%.

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INFLUENCE OF PHOSPHATE AND BORON ADDITION TO MIXED LIQUID FERTILIZER ON THE GROWTH AND YIELD OF RED CHILI CULTIVATED IN THE SUBSOIL LAYER

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Abstract: This study assesses the impact of adding phosphate and boron in a mixed liquid fertilizer on the growth and yield of red chili plants cultivated in a subsoil environment. The experiment was conducted to comprehend how these nutrients affect the performance of red chili plants, particularly when cultivated in less-than-ideal conditions such as subsoil, a remnant of excavation for brick production. The research was carried out at the Ciparanje Garden of the Faculty of Agriculture, Padjadjaran University. The research design employed a Simple Randomized Block Design with the following treatments: A = Control (degraded soil without fertilizer), B = 0% MLF + 1 NPK, C = 0.25% MLF + 1 NPK, D = 0.50% MLF + 1 NPK, E = 0.75% MLF + 1 NPK, F = 1.00% MLF + 1 NPK, G = 0.5% MLF + 3/4 NPK, H = 0.5% MLF + 1/2 NPK, I = 0.5% MLF + 1/4 NPK, J = 0.5% MLF + 0 NPK, and K = 1 NPK in normal soil. The results revealed that the addition of phosphate and boron in MLF significantly influenced the growth and yield of red chili in subsoil conditions. The recommended Mix Liquid Fertilizer concentration was 0.75%, alongside the standard NPK dose. These findings provide crucial insights for the development of more efficient and sustainable agricultural practices, especially in challenging soil conditions like subsoil, where nutrient availability can be a determining factor for agricultural success.

Keywords: Boron (1), Mixed Liquid Fertilizer (MLF) (2), Phosphor (3), Subsoil (4), Yield of Red Chili (5).

INTRODUCTION

The growth of red chili (*Capsicum annuum*) plays a crucial role in efforts to meet global food demands. However, various factors, including soil conditions, significantly impact the growth and yield of these plants (Ibrahim *et al*., 2019; Qin *et al*., 2019). One challenge is when red chili peppers are cultivated in less fertile soil layers, such as subsoil in areas used for red brick production. Subsoil layers possess different physical and chemical properties compared to the topsoil, potentially affecting nutrient availability for plants (Mesfin *et al*., 2018; Ning *et al*., 2022).

Soil nutrient availability, such as phosphorus (P) and boron (B), is critical for the growth and development of red chili plants. Phosphorus contributes to root development (Khanal *et al*., 2021), flowering, and fruiting (Karak *et al*., 2019), while boron is essential for the reproductive processes of chili plants (Faiziya *et al*., 2022), including flower and fruit or seed development (Harris *et al*., 2018). Therefore, enhancing nutrient availability becomes relevant in the effort to restore red chili productivity in subsoil areas previously used for brick production.

Mixed Liquid Fertilizers (MLF) have become a common choice for improving crop productivity. Their primary advantage lies in ease of use and significant benefits for plants (Sadriddinovich *et al*., 2022). The key advantage of mixed liquid fertilizers is that they are water-soluble, making them easy to apply. This solubility ensures that the nutrients in liquid fertilizers are readily available in a form easily absorbed by plants. According to Patil and Chetan (2018), plants can uptake these nutrients through various parts, including roots, stems, and leaves (flexibility in application methods). In situations where farmland is less fertile, mixed liquid fertilizers offer a quicker response, making them a promising alternative (Phibunwatthanawong and Riddech, 2019).

However, further research is needed to understand the impact of adding phosphate and boron in mixed liquid fertilizers on the growth and yield of red chili grown in subsoil layers. This study is expected to provide deeper insights into addressing agricultural challenges in less fertile soil conditions and, ultimately, support the growing demand for chili peppers.

MATERIAL AND METHOD

The research was conducted at the Experimental Field of the Faculty of Agriculture, Padjadjaran University, Jatinangor, Sumedang Regency, West Java, Indonesia, located at an elevation of approximately 768 meters above sea level. The soil used as the medium was subsoil soil retrieved from a red brick production area (soil layer at a depth of 50-10 cm). The red chili seeds were obtained from the Faculty of Agriculture's CB1 Varietal Breeding Program. The research activities encompassed various stages, commencing with the formulation of the Mixed Liquid Fertilizer (MLF) in the laboratory, simultaneous seed germination and the preparation of subsoil in polybags, the placement of the growing medium, transplanting inside a screen house, followed by maintenance, fertilization, and observations until harvesting. Observations of plant height and productive

branches were conducted weekly, and plant tissue analysis was carried out in the 6th week (42 Days After Transplanting).

This research employed a Simple Randomized Block Design (SRBD) experimental method, consisting of combinations of MLF concentrations with NPK (urea, TSP, and KCl). The total number of treatment combinations was 10, with descriptions as follows: A = Control (degraded soil without fertilizer), B = 0% MLF + 1 NPK, C = 0.25% MLF + 1 NPK, D = 0.50% MLF + 1 NPK, E = 0.75% MLF + 1 NPK, F = 1.00% MLF + 1 NPK, G = 0.5% MLF + 3/4 NPK, H = 0.5% MLF + 1/2 NPK, I = 0.5% MLF + 1/4 NPK, J = 0.5 MLF + 0 NPK, andK = 1 NPK in normal soil. Each treatment was replicated three times, resulting in a total of 10 x 3 experimental units, amounting to 30 experimental units. Each experimental unit consisted of two individual plants, one for observation until harvest, and the other as a destructive sample for plant tissue analysis at the maximum vegetative stage.

Mixed Fertilizer Formulation

The fertilizer formula consisted of a mixture of solid and liquid cattle manure waste, molasses, and mineral nutrient sources, specifically phosphorus from rock phosphate and boron from boric acid. All components were weighed and mixed using water as a solvent, followed by a three-week (21 days) fermentation period. Upon the completion of fermentation, marked by the disappearance of foul odors, the mixed fertilizer was filtered and transferred to sealed bottles.

Fertilizer Application

Mixed Liquid Fertilizer for application was diluted in 1 litre of water, with varying concentrations according to each treatment. One percent (1%) MLF was obtained by pipetting 10 ml of MLF into 990 ml of ion-free water. The application method involved spraying the diluted solution onto the entire plant.

Data Analysis

Data analysis was performed using the SPSS software. Data obtained from this structured experiment were input into the software to identify significant differences among the different treatment groups.

RESULT AND DISCUSSION

Plant Height

The addition of phosphate and boron to mixed liquid fertilizer significantly influences the height of red chili plants grown in subsoil, affecting the growth and development of red chili plants. The height of red chili plants exhibited significant variation from the beginning to the end of the observation period. Differences in plant height among those subjected to mixed liquid fertilizer (MLF) concentrations with NPK treatments showed growth patterns nearly identical to those in the normal soil treatment. An intriguing finding is that plants cultivated in the control treatment (subsoil) displayed suboptimal growth, while treatment J (subsoil with mixed liquid fertilizer) exhibited better growth, even in the absence of NPK fertilizer addition. The data for plant

height growth, observed in weeks 2, 4, 6, and 8, are presented in Figure 1 below:

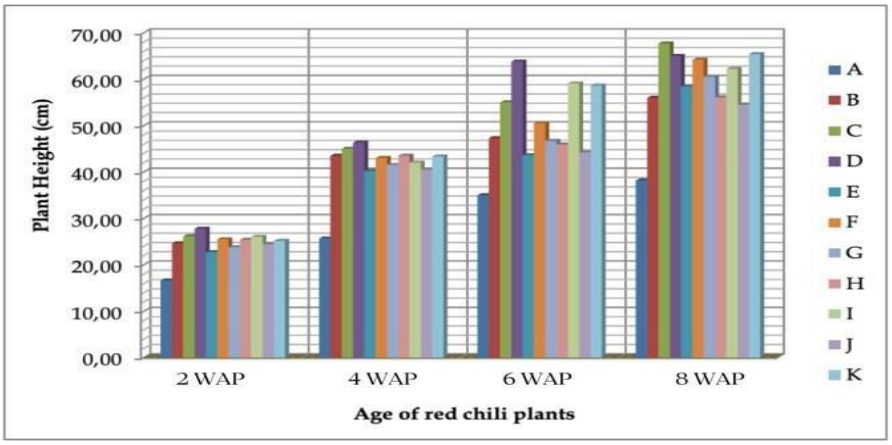


Figure 1. Height of red chili plants in various treatments

Thus, this research unveils that the addition of phosphate and boron in mixed liquid fertilizer, especially in combination with subsoil, has the potential to enhance the growth of red chili plants. Treatments C, D, F, I, and H yielded significant and promising plant growth, and the results of this study provide valuable insights for the development of more efficient and sustainable agricultural practices.

This finding aligns with the results of Rahadian *et al*. (2023), which concluded that a lack of phosphorus (P) can hinder the growth of chili plants, especially vegetative growth like plant height. Therefore, the addition of P can boost plant height growth in chili plants. Additionally, Wimmer *et al*. (2019) posited that boron is also crucial for plant growth, particularly in its role in cell wall formation and plant metabolism. A deficiency of B can disrupt plant growth, including height growth.

Stem Diameter

The application of Mixed Liquid Fertilizer (MLF) with NPK also has a positive impact on the growth of the stem diameter in chili plants. Figure 2 illustrates significant differences in fertilizer application in subsoil. The stem diameter in the control treatment showed limited development, making it the smallest. Several MLF treatments with NPK enhanced the stem diameter of chili plants in subsoil, matching that of the normal soil treatment, with some even surpassing it.

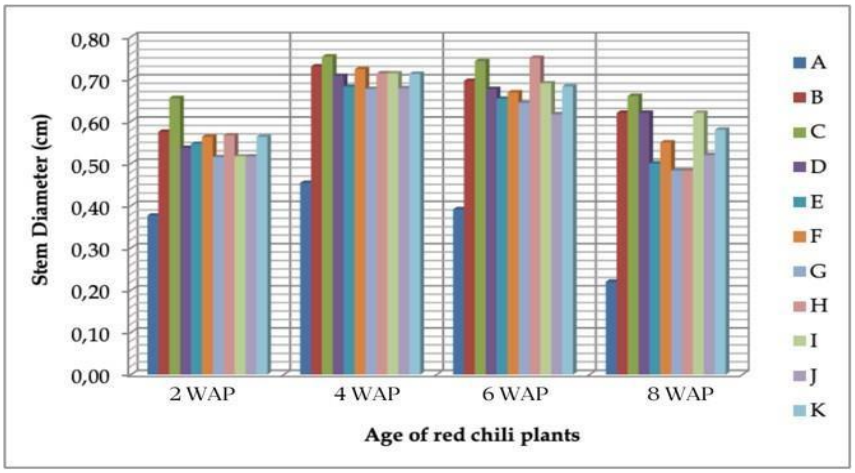


Figure 2. Stem diameter of red chili plats in various treatments.

Based on the research by Jayapala *et al*. (2019), the addition of phosphorus (P) can affect the stem diameter of chili plants by increasing cell wall thickness and tissue quality. Furthermore, as indicated by Omotade (2019), cell wall enlargement is also influenced by boron uptake, where the proper addition of boron can help ensure optimal cell wall formation, facilitating the development of stem diameter.

Phosphorus and Boron Uptake

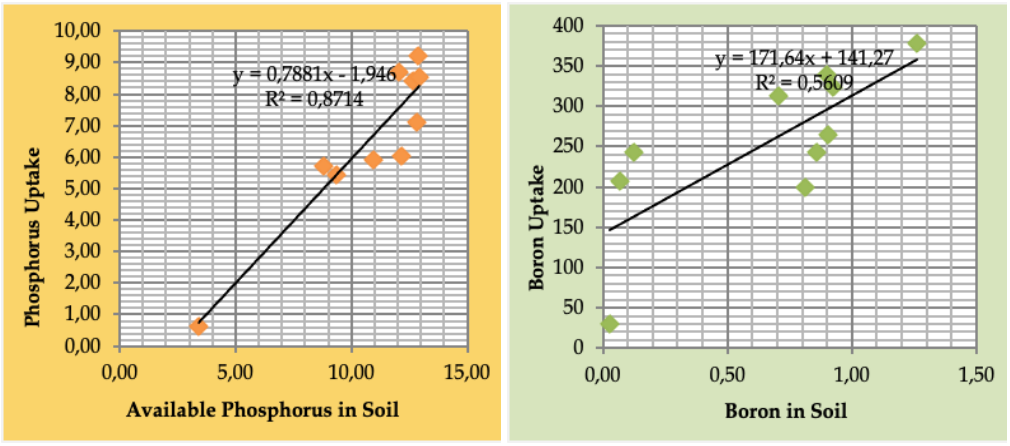
The application of Mixed Liquid Fertilizer (MLF) with NPK in red chili plants optimizes the uptake of phosphorus and boron. Table 9 below presents the results of phosphorus and boron tissue uptake analysis in chili plants. Treatments with 0.50%, 0.75%, and 1.00% MLF with a single NPK dosage exhibited the highest phosphorus and boron uptake. In contrast, chili plants grown in the control treatment in subsoil without fertilizer showed significantly lower uptake. According to Mitran *et al*. (2019), phosphorus from fertilizers aids in the formation and growth of strong roots, enhancing the plant's ability to absorb available phosphorus.

Table 1. Phosphorus (P) and Boron (B) Uptake by Chili Plants at 6 Weeks After Transplanting (WAT)

Treatments		Phosphor Uptake%)		Boron Uptake (ppm)	
A	Control	0.64	*a*	80.28	*a*
B	0 % MLF +1 NPK	1.42	*bc*	96.48	*ab*
C	0.25 % MLF + 1 NPK	1.90	*bc*	203.45	*bc*
D	0.50 % MLF + 1 NPK	2.49	*c*	312.59	*c*
E	0.75 % MLF + 1 NPK	2.51	*cd*	324.06	*cd*
F	1.00 % MLF + 1 NPK	2.62	*c*	378.51	*d*
G	0.50 % MLF + 3/4 NPK	2.54	*cd*	239.26	*bc*
H	0.5% MLF + 1/2 NPK	1.12	*b*	234.55	*bc*
I	0.50 MLF + 1/4 NPK	1,08	*b*	226.24	*bc*
J	0.50 MLF + 0 NPK	0,81	*ab*	221.12	*bc*
K	1 NPK Normal Soil	2.65	*d*	382.94	f

Description: P-uptake and B-Uptake presented per dry weight of red pepper plant. The mean value of the treatment in the same column followed by the same letter was not different based on Duncan test at the 5% significance level

Boron in the applied MLF serves as an easily absorbable source of boron for the plants, facilitating the transport of boron from the roots to the upper parts of the plant. This observation is also supported by Sopha and Murtiningsih (2020), who stated that the utilization of boron in the form of liquid fertilizer has a significant impact on the more efficient use of boron by plants for the formation of high-quality chili flowers and fruits.



(a)

(b)

Figure 3. (a) Correlation between available phosphorus in soil with phosphorus uptake (b) Correlation between available boron in soil with boron uptake

The availability of phosphorus (P) in the soil has a positive correlation with P uptake by chili plants, as demonstrated by Pereira *et al*. (2020). This correlation exists because P is an essential nutrient that supports various aspects of plant growth and development, as highlighted by Dasilva *et al*. (2021). Phosphorus is required for the formation of ATP molecules, which carry energy within plant cells, activate key enzymes for metabolism, facilitate the growth of strong roots for nutrient and water absorption, and play a crucial role in fruit and seed development. With adequate P availability in the soil, chili plants can optimize their growth (Putra *et al*., 2020), produce high-quality fruits (Islam *et al*., 2018), and achieve better harvest yields (Elhaissoufi *et al*., 2019).

Figure 3(a) illustrates an R-squared value of 0.87, indicating that approximately 87% of the variation in P uptake by chili plants can be explained by the variation in soil P availability within the regression model. This suggests a strong relationship between these two variables in the linear regression model, with most of the variance in P uptake by chili plants being attributed to variations in soil P availability used in the analysis. The availability of boron in the soil has an approximately 56% impact (R-squared value of 0.56) on the amount of boron absorbed by chili plants (Figure 3(b)). This implies that not all of the variation can be explained solely by soil boron availability, with approximately 44% being influenced by other factors affecting boron uptake by chili plants.

Table 2. Red chili yield components in various treatments

Treatment	fruit weight (g)	fruit length (cm)	Fruit Diameter (cm)	Fruit weight /Plant (g)
A = Kontrol	5,00 *a*	9,50 *a*	0.87 *a*	559 *a*
B = 0 % Mix Liquid Fertilizer + 1 NPK	6,87 *b*	12,18 *bc*	1.06 *bc*	1040 *c*
C = 0.25 % Mix Liquid Fertilizer + 1 NPK	7,05 *bc*	13,15 *bc*	1.18 *c*	1231 *d*
D = 0.50 % Mix Liquid Fertilizer + 1 NPK	6,98 *b*	13,45 *c*	1.19 *c*	1263 *de*
E = 0.75 % Mix Liquid Fertilizer + 1 NPK	**7,03 *bc***	**13,43 *c***	**1.20 *cd***	**1285 *e***
F = 1.00 % Mix Liquid Fertilizer + 1 NPK	**7,11 *b***	**13,25 *bc***	**1.21 *cd***	**1283 *e***
G = 0.5 % Mix Liquid Fertilizer + 3/4 NPK	7,07 *bc*	12,55 *b*	1.19 *c*	1173 *cd*
H = 0.5% Mix Liquid Fertilizer + 1/2 NPK	6,55 *ab*	10,56 *ab*	1.07 *bc*	1006 *bc*
I = 0.5 Mix Liquid Fertilizer + 1/4 NPK	6,48 *ab*	10,23 *ab*	1.01 *b*	994 *bc*
J = 0.5 Mix Liquid Fertilizer + 0 NPK	5,13 *a*	9,61 *a*	0.95 *ab*	898 *b*
K = 1 NPK Normal Soil	**7,24 *c***	**13,47 *c***	**1.28 *d***	**1301 *e***

Description: The mean value of the treatment in the same column followed by the same letter was not different based on Duncan test at the 5% significance levelYield

fruit weight (unit)

Several essential variables for assessing the impact of fertilizer application on red chili commodities include fruit weight, fruit diameter, fruit length, and the total number of fruits per plant (Kusumiyati *et al*., 2022). The data presented in Table 2 indicate that the application of MLF containing phosphorus and boron, along with NPK, significantly affects the quality and quantity of red chili fruits. Fruit weight, which did not differ significantly from the K treatment (normal soil), was observed in treatments C, E, and G.

Additionally, for the fruit length parameter, treatments D and E exhibited the best results and did not differ from the normal soil treatment. Furthermore, treatments E and F showed fruit diameter sizes equivalent to those in normal soil treatment. These findings suggest that the application of MLF alongside NPK fertilizer significantly influences the quality of red chili fruits, as evidenced by increased fruit weight, length, and fruit diameter compared to the control and standard fertilizer treatments. The uptake of nutrients N, P, and K by plants is influenced by their nutrient availability. Nutrient uptake by chili plants continues as long as the plant requires these nutrients for growth and development (Dubey *et al*., 2016).

Based on the findings of Sudasinghe *et al*. (2022), phosphate fertilization has a significant impact on increasing yield components, such as the size, length, and weight of chili fruits. Furthermore, the results of Malik *et al*.'s research (2020) revealed that the availability of boron can enhance the weight and thickness of chili fruits (Kamalakannan *et al*., 2020).

CONCLUSION

This research has revealed that the application of MLF containing Phosphorus and Boron significantly influences growth parameters, such as plant height and stem diameter. The availability of boron and phosphorus in the soil is positively correlated with their uptake by plants, though a significant portion of boron is absorbed through the leaves due to insufficient boron availability in the subsoil medium. Meanwhile, the correlation for phosphorus remains high, attributed to the supplementation of NPK fertilizer in the medium.

Furthermore, several yield components, including fruit weight, fruit length, and fruit diameter of red chili grown in the subsoil layer, also exhibited improvements compared to the control and basic fertilizer application.

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CONTRIBUTION OF PLANT BIOTECHNOLOGY IN SUPPORTING SUSTAINABLE AGRICULTURE AND AGRIBUSINESS DEVELOPMENT

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Abstract: Agricultural and Agribusiness Development in this article highlights the plant biotechnology technology contribution. Therefore, active collaboration among government, industry and research institutions is needed to ensure the widespread contribution of this technology that supports food security and strengthens sustainable economic development at local and international levels. The purpose of this article was to investigate the plant biotechnology contribution in supporting sustainable agricultural and agribusiness development. The main problem of this article was how does the enhancement of food security and productivity and adapt to climate change in the agricultural sector. The method applied involved literature analysis, case studies, and plant biotechnology technologies evaluation that have been applied in various countries or regions. The results showed that the plant biotechnology contribution was effective in increasing productivity, reducing dependence on pesticides, and strengthening plant resistance to various diseases. Apart from agronomic benefits, this technology also has positive economic impact by supporting product diversification, for example the enhancement of secondary metabolites production, value in other agro- industrial activities and agricultural sector. In conclusion, these biotechnology crops have an important role in achieving sustainable agricultural and agribusiness development goals that support food security and strengthen sustainable economic development.

Keywords: Agricultural; plant biotechnology; secondary metabolites.

INTRODUCTION

Agricultural and Agribusiness development is an important sector to support the economy of a nation and state. In the last few decades, plant biotechnology has provided innovations that have contributed to the agricultural sector. The focus of this article is to increase food security and strengthen sustainable economic development at local and international levels. Plant biotechnology has contributed a lot to the agricultural sector, but there are still challenges and problems that need to be resolved. The main problem of this article is how to increase food security, increase productivity, and adapt to climate change in the agricultural sector. To overcome challenges in this sector, collaboration among government, industry and research institutions is needed in determining the contribution of plant biotechnology that is relevant to Marc's opinion (2020). Active collaboration among government, industry and research institutions to ensure that this technology can have a broad positive impact on local and international levels. This article has several objectives, such as: (1) exploring the contribution of plant biotechnology. (2) analyzing the contribution to food security, secondary metabolite production, diversification of agricultural products and adaptation to climate change. (3) the importance of active collaboration among government, industry and research institutions in ensuring the effectiveness and sustainability of the application of plant biotechnology technology. (4) reduce dependence on pesticides and strengthen plant resistance to disease.

RESEARCH METHODS

This article was written using a literature analysis approach, case studies, and evaluation of plant biotechnology technology that has been implemented in various countries or regions. This approach helps in understanding various aspects of plant biotechnology's contribution to sustainable development of agriculture and agribusiness. It is hoped that the literature analysis method can accommodate the aims of writing the article as stated in the introduction.

RESULTS AND DISCUSSION

From the results and discussion obtained, it is clear that plant biotechnology is effective in increasing: (1 plant biotechnology contribution. (2) food security contribution, secondary metabolites production, agricultural products diversification and adaptation to climate change. (3) the importance of active collaboration among government, industry and research institutions in ensuring the effectiveness and sustainability of plant biotechnology technology application (4) reducing dependence on pesticides and strengthening plant resistance to disease can be explained below.

1. *The contribution of plant biotechnology*

The contribution of plant biotechnology has a significant positive impact on the agricultural and agribusiness sectors, including: (a) increasing productivity, (b) reducing dependence on pesticides, (c) increasing crop yield stability and food security, for example genetically modified corn has better performance. compared to the original isogenic line (Pellegrino et. all, 2018), (d) agricultural products diversification, (e) contributing to sustainable economic development.

2. *Contribution to food security, production of secondary metabolites*

The contribution of plant biotechnology has positive implications for food security and can produce secondary metabolites. Implications for food security include increasing crop yields which reduces the risk of food shortages. Furthermore, it contributes to plant varieties that are resistant to extreme environmental conditions which will increase food production stability. Plant biotechnology has the potential to increase the secondary metabolites production, which is used in various industries such as the pharmaceutical, cosmetic and food industries (Table 1) which opens up new opportunities for product diversification and economic strengthening.

Table 1. Plant Biotechnology Potential through in vitro culture for Secondary Metabolites production & used for Industry

in vitro culture-plant	Secondary Metabolite Products	intended for Industry	Reference
Suspension of Camellia sinensis	catechin	allelochemis	Sutini et. al. (2020)
Crocus Callus	catalase	conservation	Freytag et al. (2017)
Jatropha curcas suspension	Lectin, saponin	biodiesel	Kumar et. al. (2011)
Camellia sinensis callus	epicatechin	herbicide	Maria John et al. (2009)
Callus Pimpinella anisum L.	anisi	antioxidant	Lamara et. al. (2023)
Vicia villosa Roth	canavanine	alelochemis	Sasamoto et al. (2019)
Cell Suspension of Azadirachta indica A.Juss	Azadirahtin	Biopesticides	Zakiah et al. (2013)
root culture of Hyoscyamus reticulatus L	Tropanealkaloids	medicine	Moharrami et al. (2017)

3. *Diversification of agricultural products and adaptive to climate change*

Diversification of agricultural products through plant biotechnology application can have a positive impact on the agricultural sector and help to adapt to climate change. Climate changes such as extreme temperature changes, unseasonal rainfall and prolonged drought that is very damaging to plants can be overcome with plants biotechnology technology. Some ways in which the mixed system can adapt to future climate change, including through increasing supporting production efficiency, technical environment, infrastructure, information, and agricultural development challenges. (Philip and Herrero, 2014). Climate change will also increase pest resistance that can be overcome by plant biotechnology techniques. Through agricultural products diversification, the risk of production failure can be reduced. Plants that are resistant to extreme environmental conditions can provide more stable

harvests.

4. *The Importance of Government, Industry and Research Institutions Collaboration*

Active collaboration among the government, industry, and research institutions in the context of plant biotechnology implementation to support sustainable agricultural and agribusiness development. The government has a role in creating regulations related to security, sustainability, and technology access distribution. The government needs to cooperate with the industry and research institutions in developing policies that support research and plant biotechnology development, including progressive and innovative regulations. Collaboration with industry can accelerate the spread of plant biotechnology technology. Collaboration with research institutions allows the latest knowledge transfer from the academic world to industry and government. Collaboration of the partnership model can include the provision of funds, exchange of knowledge, and technology transfer facilitation.

5. *Reduction of dependence on pesticides, and eradicate disease pests*

Plant biotechnology can develop varieties of soybean AT1R1 (Tidar) plant the transformation result through agrobacterial tumefaciens which are more resistant to pod borer pests so can reduce the use of chemical pesticides (Tando and Muh, 2019). Plant biotechnology that reduces dependence on pesticides can help maintain balance between agricultural ecosystems. The transgenic insect resistant technology application and herbicide tolerance has reduced the spraying of pesticides by 8.3% (Brookes G and Barfoot P., 2020). Dependence on pesticides can be suppressed by implementing the use of biopesticides containing microorganisms as active ingredients and the control targets as stated in Table 2.

Table 2. Examples of biopesticide microorganisms and their control targets (Malik M.M. 2020)

No.	Organism	Target	Example
1	Bacteria	Insects	*Bacillus thuringiensis*
			Bacillus sphaericus
			Serratia entomophila
			Paenibacillus popilliae
2	Fungi	Insects	*Beauveria* spp.
			Metarhizium
			Lecanicillium lecanii
			Nomuraea
			Paecilomyces fumosoroseus
			Zoophthora
			Entomophaga
3	Protozoa	Insects	*Nosema*
			Vairimorpha
			Thelohania
4	Fungi	Weed control	*Colletotrichum gloeosporioides*
			Chondrostereum purpureum
			Cylindrobasidium leave

continued

			Xanthomonas campestris
5	Fungi	Plant disease control	*Ampelomyces quisqualis*
			Candida spp.
			Clonostachys rosea
6	Competitive inoculants	Plant disease control	*Coniothyrium minitans*
			Pseudozyma flocculosa
			Trichoderma spp.
			Bacillus pumilus
7	Composts, soil inoculants	Plant disease control	*Bacillus subtilis*

CONCLUSION

In conclusion, this article highlights the crucial role of plant biotechnology in the development of agriculture and agribusiness, especially in supporting food security and sustainable economic growth. With active cooperation among the government, industry, and research institutions, this technology can broadly contribute to productivity, reduce the use of pesticides, and increase plant resilience to disease. In addition to the benefits of agronomy, plant biotechnology also has a positive economic impact by supporting product diversification and added value in the agro-industrial sector.

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THE INFLUENCE OF AZOLLA DOSAGE ON THE GROWTH AND YIELD OF GREEN SPINACH PLANTS

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Abstract: Spinach (Amaranthus spp.) is a commonly cultivated plant for its leafy greens, popular in markets and favored for its high nutritional content. The use of organic fertilizers, such as Azolla, can significantly enhance soil quality by improving its physical, chemical, and biological properties. This study employed the Completely Randomized Design (CRD) experimental method with a single factor, namely various doses of Azolla compost. Treatments included no Azolla compost (control), 40 grams of Azolla compost, 80 grams of Azolla compost, and 120 grams of Azolla compost. Each treatment was replicated three times, resulting in a total of 12 experimental units, with each unit consisting of one sample and one reserve plant. The application of 40 grams of Azolla compost treatment B showed the highest values in all parameters of plant height and leaf count, although not significantly different from the control parameter.

Keyword: Spinach, Azolla pinnata, Growth

INTRODUCTION

Spinach (Amaranthus spp.), commonly grown as a leafy green vegetable, has a relatively higher iron content compared to other leafy vegetables, around 3.9 mg per serving. According to nutritional information from Deby, every 100 grams of spinach contains approximately 0.8 grams of fiber, 6090 IU of vitamin A, and 80 mg of vitamin C. The combination of vitamin A and C in spinach gives it good antioxidant properties. Green spinach is highly popular in society due to its high prospects, potential, and nutritional value. According to Haryanto et al. (2007), the potential yield of green spinach can reach 20-30 tons per hectare, while the average yield of green mustard in Indonesia is only around 11.43-12.04 tons per hectare (BPS, 2001). Therefore, measures are needed to increase and maintain the stability of green spinach production by applying effective and efficient production techniques. One effort that can be made is to improve fertilization efficiency. This efficiency can be achieved by considering the principles of appropriate fertilizer use, including the type, dosage, method, and timing of application suitable for the plant's needs (Syafruddin et al., 2009). According to Gunawan (2013), mistakes in fertilizer use can increase production costs without optimal results. Therefore, one solution that can be applied is the use of organic fertilization.

The use of organic fertilizers can provide significant benefits to soil quality, including improving the physical, chemical, and biological properties of the soil (Sutanto, 2002). One alternative to provide nitrogen-rich organic fertilizer is Azolla pinnata sp. This plant is a type of fern commonly found in aquatic environments, often considered as water weeds. Nevertheless, Azolla has a wide distribution, is easy to cultivate, and has rapid growth (Akhda, 2009). Azolla has a high nitrogen content due to its symbiosis with Anabaena, which aids in nitrogen fixation from the air. Like leguminous plants, Azolla also obtains nitrogen through association with cyanobacteria, such as Anabaena azollae, which live inside its leaf cavities (Sutanto, 2002). Therefore, the nitrogen content of Azolla can serve as a substitute for nitrogen usually provided through inorganic fertilizers. According to Syafi"ah (2014), the application of Azolla pinnata compost can improve various growth parameters of meat mustard plants, such as plant height, leaf count, total weight, and nitrogen content, with the best dosage being around 70 grams per plant. Research conducted by Pasaribu (2009) also indicates that the application of various doses of Azolla sp. compost can increase plant wet weight.

RESEARCH METHODS

Research Location

The research was conducted at Muria Kudus University from January to March 2023 in the agronomy laboratory, experimental field, and soil science laboratory.

Materials and Equipment

In this research, the necessary equipment includes polybags, sacks, buckets, analytical scales, rulers, and writing utensils. The required materials are spinach seeds, *Azolla pinnata*, and Alfisol soil.

Research Methods

The method used in this research is an experimental method. The experiment was arranged in Completely Randomized Design (CRD), using a singlefactor experimental design, namely the Azolla compost application consisting of 4 treatments: No Azolla compost (control), 40 grams of Azolla compost, 80 grams of Azolla compost, and 120 grams of Azolla compost. Each treatment was replicated 3 times, resulting in 12 experimental units, with each unit consisting of 1 sample and 1 reserve plant.

Research Procedures

a. Azolla Composting

Stack Azolla into sacks. Tie the sack containing the compost and let it sit for 5-7 days, then air the compost until dry, and it can be mixed into the planting media.

b. Fertilization

In all treatments, basal fertilization was carried out using SP36 fertilizer at a rate of 0.185 grams per polybag and KCl at a rate of 0.122 grams per polybag. The control treatment (P1) did not involve Azolla compost fertilizer and only received basal fertilizer. In treatment P2, 40 grams of Azolla compost fertilizer was used along with basal fertilizer, with 20 grams applied before planting (after the planting media was prepared in polybags) and another 20 grams applied after 7 days of planting. Treatment P3 used 80 grams of Azolla compost fertilizer, with 40 grams applied before planting and another 40 grams applied after 7 days of planting. Meanwhile, in treatment P4, 120 grams of Azolla compost fertilizer was used, with 60 grams applied before planting and another 60 grams applied after 7 days of planting (Luthfi, 2013).

Observed Parameters

1. Plant Height

Plant height was measured using a ruler (meter stick) in centimeters, measured from the base of the stem to the tip of the highest leaf. Plant height was measured every 3 days using a ruler after spinach seed planting.

2. Leaf Count

Leaf count was determined by counting the total number of leaves, expressed in leaf units. Observations were conducted every 3 days.

3. Leaf Area

Leaf area calculation was done by measuring using gravimetric method, by directly tracing the leaf onto a piece of paper that will be measured for its area. Leaf area was calculated based on the ratio of leaf replica weight to total paper weight, using the formula written by Sitompul and Guritno (1995) as follows: LD = Wr/WT x (LK).

4. Fresh and Dry Plant Weight

Fresh weight was determined by pulling up the plant and weighing all parts (roots, stems, and leaves). Subsequently, all plant parts were dried for 24 hours under sunlight and oven-dried at 60°C for several hours until the plant dry weight stabilized. Calculation of fresh weight and dry weight of plants was done on the last day of observation.

5. Fresh and Dry Canopy Weight

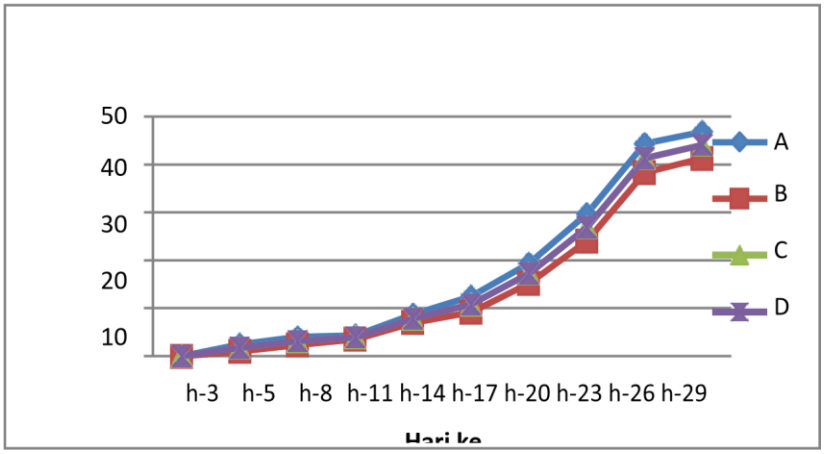
Canopy fresh weight was obtained by weighing the fresh stems and leaves of the plant. Then, the fresh stems and leaves were dried for 24 hours under sunlight and oven-dried at 60°C for several hours until the dry weight stabilized. Calculation of fresh weight and dry weight of canopy was done on the last day of observation.

DATA ANALYSIS

The research data were analyzed using Analysis of Variance (ANOVA), and if there were significant treatment effects, it was followed by Honestly Significant Difference (HSD) test α 0.05%.

RESULT AND DISCUSSION Plant Height (cm)

Plant height was the focus of this study because vegetative plant growth, such as plant height, is significantly influenced by nutrient content. According to Setyamidjaja (1986), nitrogen plays a crucial role in stimulating vegetative plant growth, including increasing plant height and branching stimulation.



Picture 1. Plant Height (cm)

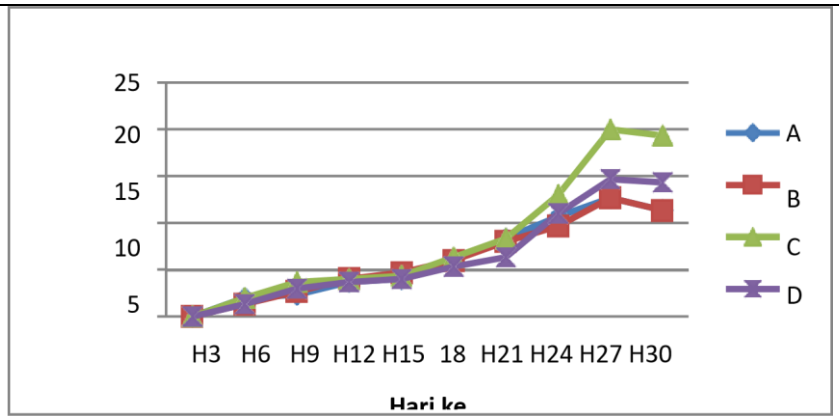
Table 1. Plant Height (cm)

Treatment	Average/ grams
A (Without Azolla Compost)	1,55a
B (Azolla compost 40 grams per polybag + SP36 fertilizer 0.185 grams + KCL 0.122 grams)	1,66a
C (Azolla compost 80 grams per polybag + SP36 fertilizer 0.185 grams + KCL 0.122 grams)	1,60a
D (Azolla compost 120 grams per polybag + SP36 fertilizer 0.185 grams + KCL 0.122 grams)	1,57a

The results show no significant difference between treatments in terms of plant height, as recorded in Table 1. Treatment B (Azolla compost 40 grams per polybag + SP36 fertilizer 0.185 grams + KCL fertilizer 0.122 grams) showed the highest plant height at 1.66 cm, while the control treatment had the lowest plant height at 1.55 cm. This may be due to the availability of nutrients, especially nitrogen, provided by Azolla in the early stages of plant vegetative growth. This allows the plant to optimize the absorption of these nutrients, thus responding quickly to its vegetative growth. According to Dhiya et al. (2015), Azolla has often been used as organic fertilizer because it contains a high level of nitrogen. Organic fertilizers from A. pinnata have abundant nitrogen content, so the higher the dose of nitrogen fertilizer given, the higher the plant growth (Akhda, 2007, and Gunawan & Kartina, 2012). The presence of more organic matter in the soil also contributes to increased nutrient availability in the soil, especially nitrogen, which is crucial for plant vegetative growth (Pasaribu, 2009). According to Lakitan (2007), plant growth is focused on meristematic tissue, which consists of new cells produced through cell division. Plant size enlargement occurs through these cell divisions, with meristematic tissue found at the root tips, stems, as well as at the base of stems and leaves. Plant growth is triggered by cell division and cell elongation processes, which require large amounts of carbohydrates (Kastono, 2005).

Leaf Count

Leaves are considered the main organ in the photosynthesis process. Therefore, observation of leaves is crucial, not only as a growth indicator but also as additional data to explain the growth process. According to Harin et al. (2014) research, nitrogen supply will cause plant parts to become greener due to the presence of chlorophyll, which plays a crucial role in photosynthesis.



Picture 2. Leaf Count

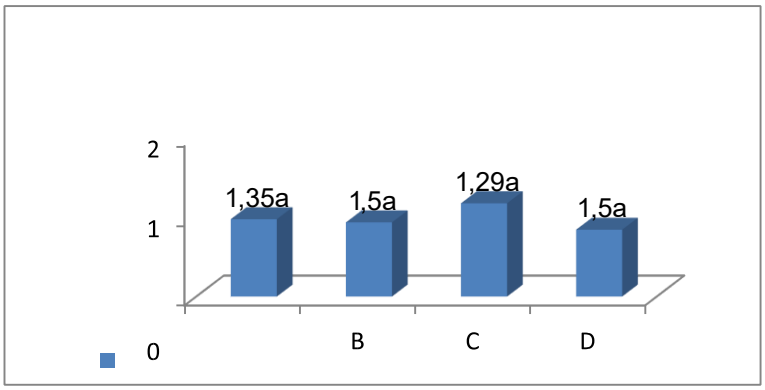
Table 2. Leaf Count

Treatment	Average/ grams
A (Without Azolla Compost)	1,10a
B (Azolla compost 40 grams per polybag + SP36 fertilizer 0.185 grams + KCL 0.122 grams)	1,10a
C (Azolla compost 80 grams per polybag + SP36 fertilizer 0.185 grams + KCL 0.122 grams)	1,24a
D (Azolla compost 120 grams per polybag + SP36 fertilizer 0.185 1,13a grams + KCL 0.122 grams)	1,13a

The recorded results in Table 2 show no significant difference between various treatments in terms of leaf count, with treatment C (Azolla compost 80 grams per polybag + SP36 fertilizer 0.185 grams + KCL fertilizer 0.122 grams) having a leaf count of 1.66, while the control treatment had the lowest leaf count at 1.1. According to Herlina (2014), the leaf formation process is highly dependent on the availability of nutrients such as nitrogen (N) and phosphorus (P) for plants. Based on CPS (2014) analysis, Azolla fertilizer contains total nitrogen content of 1.645%, total phosphorus 0.071%, total potassium 2.366%, and magnesium 0.089%. The availability of nitrogen (N) and phosphorus (P) nutrients will affect leaf characteristics and quantity, where the leaf count is influenced by plant height growth. According to Lingga (2007), leaf formation is closely related to plant height, which is itself influenced by stem growth. According to Sutanto (2002), Azolla decomposition results in rapid nitrogen (N) release, contributing to increased leaf count. Since nitrogen is an essential nutrient for plant vegetative growth, needed for chlorophyll protein formation used in the photosynthesis process. As plants enter the generative phase, they require higher mineral absorption, especially nitrogen, for tissue development. Wibowo (2010) stated that the higher the Azolla compost dose given, the higher the yield obtained, with most of the assimilates used by generative organs.

Leaf Area

Leaf area is closely related to the rate of photosynthesis performed by plants. The larger the leaf area, the more active the plant is in photosynthesis, which in turn can increase plant production.



Picture 3. Leaf Area

Table 3. Leaf Area

Treatment	Average/ grams
A (Without Azolla Compost)	1,35a
B (Azolla compost 40 grams per polybag + SP36 fertilizer 0.185 grams + KCL 0.122 grams)	1,50a
C (Azolla compost 80 grams per polybag + SP36 fertilizer 0.185 grams + KCL 0.122 grams)	1,29a
D (Azolla compost 120 grams per polybag + SP36 fertilizer 0.185 grams + KCL 0.122 grams)	1,50a

The research results show no significant difference between various treatments in terms of leaf area, as recorded in Table 3. The highest treatment, C (Azolla compost 80 grams per polybag + SP36 fertilizer 0.185 grams + KCL fertilizer 0.122 grams), had a leaf area of 1.66, while the control treatment had the lowest leaf area at 1.1. Hasibuan (2006) explained that nitrogen is required in large quantities at each stage of plant growth, especially in shoot formation or stem and leaf development. As is known, nitrogen plays a role in increasing leaf growth, thus increasing the number and size of leaves, and providing a more intense green color contributing to increased protein levels in plants. However, it should be noted that leaf area reduction can be caused by leaf thickening, which often occurs due to an increase in the number of mesophyll leaf cells (Pujisiswanto, 2008).

Table 4. Root length, fresh root weight, dry root weight, fresh canopy weight, and dry canopy weight

Treatment	Root Length	Fresh Root Weight	Dry Root Weight	Fresh Canopy Weight	Dry Canopy Weight
A	3.9 a	1.8 a	0,9 a	1.3 a	1,8 a
B	4,1 a	1.5 a	0,9 a	1.2 a	1,5 a
C	4.1 a	2.2 a	1.1 a	1.0 a	1,4 a
D	3.9 a	1,67 a	0.8 a	1.0 a	1,4 a

The results in Table 4 show that there is no significant difference between treatments in terms of root length, fresh root weight, dry root weight, fresh canopy weight, and dry canopy weight. Root length has an important impact on nutrient solution and water absorption by plants from the soil. Thus, the more and longer the plant roots, the larger the root absorption area to absorb water and nutrients from the planting media, thus ensuring the nutrient needs for plant growth and production (Lakitan, 2007). Root length is closely related to the plant's ability to absorb nutrients, where increased root length indicates better absorption ability, reflected in the growth of vegetative parts such as roots, stems, and leaves.

Fertilization with Azolla compost increases soil aeration, making the soil looser, facilitating the growth of long roots and nutrient absorption. This is caused by soil proliferation and interception (Aksan et al., 2014). Plant roots absorb nutrients from colloids formed during the composting process because the compost is retained in the soil and not carried away by water (Ajie, 2011). Canopy fresh weight is the weight of live plants, including leaf and stem parts, which is directly weighed at harvest before wilting due to water loss (Lakitan, 1996). Azolla pinnata sp has the ability to bind nitrogen from the air through symbiosis with cyanobacteria (Anabaena azollae) living in its leaf cavities. Good nitrogen nutrient quality in Azolla pinnata sp is important for chlorophyll, protoplasm, protein, and nucleic acids formation. These elements play a vital role in the growth and development of all living tissues (Brady and Weil, 2002). Plant canopy is the product of nutrient accumulation and plant photosynthesis. According to Havlin et al. (2005), nitrogen is absorbed by plants through water. Therefore, canopy fresh weight becomes an important indicator for evaluating nitrogen availability in the soil for plants, because nitrogen absorbed by plants through water only comes from forms that can be absorbed by plants, such as NO3- and NH4+.

CONCLUSION

The application of Azolla compost treatment B at 40 grams showed the highest in all parameters of plant height and leaf count, although not significantly different from the control parameter.

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FACTORS INFLUENCING FARMER EMPOWERMENT INTEGRATION OF COFFEE AND GOATS AT STARBUCK'S FOSTERED IN RONGGURNIHUTA DISTRICT, SAMOSIR REGENCY

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Abstract: This study aims to assess the empowerment level of integrated farmers using empowerment indicators and to investigate the impact of farmers' interest, participation in groups, and the involvement of extension agents on the empowerment of integrated farmers in the Ronggurnihuta District, Samosir Regency. The data analysis method used to assess farmers' empowerment is descriptive analysis using Likert scale measurement tools. To explore the impact of farmers' interest, participation, and the involvement of extension agents on the empowerment of integrated farmers, the study utilizes multiple linear regression analysis. According to the research findings, the empowerment level of integrated farmers, as assessed by empowerment indicators, varies between 74% and 87%, categorized as proficient and highly proficient. This suggests that the empowerment activities carried out by Starbucks can enhance farmers' ability to access markets and information, increase income/savings, and improve networking skills. The factors of interest, participation, and the involvement of extension agents exhibit positive regression coefficients with a significance level of < 0.05, suggesting that interest, participation, and the role of extension agents positively and significantly impact the empowerment of integrated coffee and goat farmers in the Ronggurnihuta District, Samosir Regency.

Keywords: Empowerment, Coffee, Goats, Integration

INTRODUCTION

Coffee is a crucial commodity within the plantation sector, holding significant sway in the national economy, particularly as a contributor to foreign exchange earnings. It offers avenues for employment and serves as a source of income for farmers and various economic stakeholders engaged in the cultivation, processing, and commercialization of coffee products. Samosir Regency is one of the coffee producing areas in North Sumatra, one of which is Ronggur Nihuta District, Samosir Regency. Most or almost 90% of the main income of the people in this sub-district is from coffee farming (Gultom & Hendarto, 2014).

Based on data from BPS Samosir Regency in 2019, it is known that Samosir Regency consists of 9 sub-districts with the highest area of coffee plantations, the highest being Ronggurnihuta Sub-district, namely 1,457.21 Ha. These data show that Ronggurnihuta District has quite good potential and prospects as a producer of coffee production which is It is quite promising if the farming community is fully aware and willing to develop it.

The large and potential coffee land area in this area can also be utilized to develop it into an integration-based farming business. This type of diversification business is seen as very supportive of increasing farmers' income and welfare in a sustainable manner. Thetype of livestock that can be integrated with coffee plants is goats. The potential for livestock development in Samosir Regency can be seen from the presence of a population of 1,034 goats in Ronggur Nihuta District. This shows that there is potential that can be developed to support the integration of coffee plants with goat farming, where coffee farming combined with goat raising will create a mutually beneficial relationship, namely, goats will get food from the grass available in coffee plantations and orchards. coffee will get fertilizer from goat dung which fertilizes the soil so that it can increase coffee production. Apart from that, farmers will be able to increase their income from selling goats.

Hence, it is imperative to empower farmers to enhance their developmental potential, particularly in addressing challenges such as weak bargaining power, limited access to capital, and low levels of education among farmers. By implementing comprehensive empowerment initiatives within farming communities, they can elevate the status and success of coffee farming businesses within the secommunities.

Coffee farmers in Ronggurnihuta District are Arabica coffee farmers who are coached by Starbucks by creating and implementing an empowerment program for Arabica coffee farmers with a system of integrating Arabica coffee with goat farming. Empowerment is considered important in improving the standard of living, level of welfare, economic development of society, in addition to increasing awareness, knowledge, experience and self-concept of society.

The integration of goat livestock and coffee plants is a sustainable plantation system. This integrated agricultural business system is implemented to support the economy of small farmers in rural areas (Prasmatiwi et al, 2017). An integrated

agricultural system involving both crops and livestock entails a close interconnection between these components within farming operations or a specific area. By combining goat farming with coffee plantations, farmers can diminish their reliance on synthetic chemical fertilizers, thus adopting a semi-organic approach to coffee cultivation. The interconnection of various components of the integration system is a triggering factor in encouraging the growth of farming community income and sustainable regional economic growth (Dananjaya, 2020).

The effectiveness of community empowerment initiatives is not solely contingent upon the organization facilitating the empowerment, but also on the engagement and proactive involvement of the empowered individuals in improving their circumstances (Maryani & Nainggolan, 2019).

Signs of farmer empowerment are the extent to which information can be accessed, the extent to which agricultural system technology that integrates coffee and goats can be used, the level of decision-making capacity, the capacity to overcome obstacles and problems, the capacity to collaborate and expand networks, and the capacity to meet family needs and ensure savings.

Farmer interest is one of the factors that originates from within the farmer which influences farmers to be empowered (Anggelia et al. 2020). Another factor that influences farmers to be empowered is the level of participation of the farmers themselves. Histiraludin in Putri (2021) states that participation is active public involvement in various programs, as a means of fostering a sense of community ownership and responsibility for each program. Participatory entails active community involvement in all stages of activities, including planning, implementation, monitoring, maintenance, and utilization (Suri, 2017). Agricultural extension serves as a catalyst for change, directly engaging with farmers.

Its primary objective is to modify farmer behavior through informal education, aiming to enhance their livelihoods sustainably. Extension agents play various roles, including motivators, educators, facilitators, organizers, communicators, and advisors to farmers (Jarmie in Sundari et all, 2015).

Therefore, the objective of this study is to assess the empowerment level of integrated farmers and to investigate the impact of farmers' interest, participation, and the role of extension agents on the empowerment of integrated farmers in Ronggurnihuta District, Samosir Regency.

MATERIALS AND METHODS

This research was conducted in Ronggurnihuta District, namely Ronggurnihuta Village & Paraduan Village, Samosir Regency. The selection of the research area was conducted purposefully due to the presence of coffee farmers receiving assistance from Starbucks. The population in this research is coffee farmers belonging to the coffee and goat integration farmer group assisted by Starbuck in Ronggur Nihuta Village, namely 18 families and Paraduan Village, 12 families. In this study, a sample size of 30 participants was utilized, employing the saturated sample method, which entails using the entire population as the sample.

To assess the empowerment level of integrated farmers, it's possible to utilize empowerment indicators via descriptive analysis, specifically by elucidating the empowerment status of integrated coffee and goat farmers. The measuring tool used to determine the level of farmer empowerment is the Likert scale. The Likert scale, frequently employed in questionnaires, is a psychometric scale commonly utilized in research surveys. It typically comprises four or more questions grouped together to generate a numerical score, reflecting individual characteristics (Maryuliana et al. 2016)

To analyze the influence of farmers' interest, participation and the role of extension workers on farmer empowerment, integration was analyzed using multiple linear regression with an equation model:

$$Y = a + b1\ X1 + b2\ X2 + ... + bn\ Xn$$

Information:
Y = Empowerment
a = Constant (Y value when X = 0)
b = Regression coefficient (value of increase or decrease)
X1 = Interest,
X2 = Participation,
X3 = Role of Extension Officer

RESULTS AND DISCUSSION

Empowerment of Integrated Farmers

There are three empowerment indicators used in this research to measure farmer empowerment, namely the farmer's ability to access markets and information, the farmer's ability to meet family needs and guarantee savings, and the farmer's ability to partner and improve networks. The findings of the study regarding the empowerment of integrated farmers, as observed through empowerment indicators, are presented in Table 1.

Table 1. Results of Research on Empowerment of Integrated Farmers Viewed from Empowerment Indicators

No	Indicators	%	Criteria
1	the farmer's ability to access markets and information	83	very empowered
2	the farmer's ability to meet family needs and guarantee savings	80,33	empowered 2
3	and the farmer's ability to partner and improve networks	84,67	very empowered

Source: Primary data processed

According to the data in Table 1, it is indicated that farmers' capacity to access markets and information stands at 83%, signifying a high level of empowerment. Similarly, their

ability to fulfill family needs and ensure savings, at 80.33%, is categorized as empowered. Furthermore, their capability to engage in partnerships and enhance networks, recorded at 84.67%, is deemed highly empowered.

The Influence of Farmers' Interest, Participation and the Role of Extension Workers on the Empowerment of Integrated Farmers

The interest aspect is evident when farmers demonstrate confidence and dedication in cultivating farming practices within an integrated agricultural system, when they display assurance in collaborating within farmer groups to advance farming based on such a system, and when they recognize integrated farming as a means to boost coffee farmers' income. Additionally, farmers' ability to perceive integration-based farming as a component of sustainable agriculture, their willingness to experiment with new approaches in coffee farming development, and their capacity to independently drive and advance farming within an integrated agricultural framework are indicative of their interest.

Participation can be seen from the statement that farmers participate in preparing and implementing each work program and design in implementing coffee farming with an integrated system, farmers participate in determining the amount of input used, the source and amount of costs required, and the time and location of joint activities, farmers participate in providing donations in the form of thoughts, expertise and skills regarding integrated farming, farmers contribute in the form of money, materials and materials for integrated farming, farmers participate in supervising the implementation of the integrated farming program, and farmers are active in providing criticism and suggestions in the implementation of the farming program integration.

The role of the extension worker is evident through various actions, such as assisting farmer group members in preparing administrative tools, facilitating access to information from diverse sources, providing guidance and suggestions for managing and developing farming businesses, offering solutions to farming challenges, organizing and coordinating tasks among group members, conducting regular member meetings, and motivating farmers to actively engage in farmer groups and advance agribusiness through integrated farming practices. Extension workers also encourage farmers to participate in training sessions on integrated agriculture to enhance their skills in processing agricultural and livestock waste. The empowerment levels of farmers in terms of their interest, participation, and the role of extension workers are depicted in Figure 1.

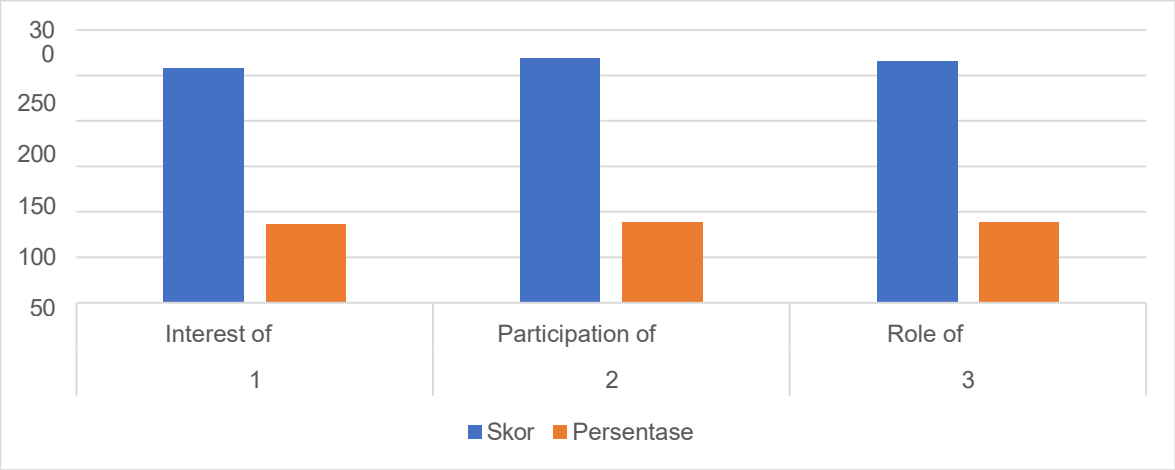

Figure 1. Level of Farmer Interest, Farmer Participation and the Role of Instructor Empowerment

Figure 1 indicates that farmers exhibit a very strong level of interest in integration- based farming, while their participation in groups and the role of extension workers is also classified as very strong. From this data, it can be seen the influence of the three variables of interest, participation and the role of instructors on the level of farmer empowerment. The research findings regarding the influence of these factors are presented in Table 2.

Tabel 2. The Influence of Interest, Participation and the Role of Instructors

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	4.388	2.406		1.824	.080
	Interest	.185	.064	.371	2.909	.007
	Partisipation	.374	.118	.403	3.164	.004
	Role Instructor	.208	.042	.431	4.955	.000

Source: processed data using SPSS

Based on table 2, the multiple linear regression model equation is obtained as follows: Y = 4.388 + 0.185 X1 - 0.374 X2 + 0.208 X3

The analysis results indicate that the interest variable (X1) has a positive and statistically significant partial effect on the empowerment of farmers engaged in integrating Arabica coffee and goat farming. Specifically, the regression coefficient for the Interest variable (X1) is positively valued at 0.185.

The participation variable (X2) has a positive and statistically significant partial impact on the empowerment of farmers involved in integrating Arabica coffee and goat farming. Specifically, the regression coefficient for the Participation variable (X2) is positively valued at 0.374.

The instructor's role variable (X3) has a positive and statistically significant partial impact on the empowerment of farmers engaged in integrating Arabica coffee

and goat farming. Specifically, the regression coefficient for the instructor's role variable (X3) is positively valued at 0.280. The positive sign indicates a unidirectional influence between the independent variable and the dependent variable. Additionally, the data processing results demonstrate a significant and positive simultaneous influence of variables X1, X2, and X3 on Y.

Coefficient of Determination (R^2)

The coefficient of determination, known as R-squared, indicates the extent to which the model can account for the variability in the dependent variable. In the data processing results, it is determined that the R-squared value is 0.809. This signifies that the independent variables of interest, participation, and the role of instructors can collectively explain approximately 80.9% of the variance in the dependent variable. The remaining 19.1% of the variance is attributable to factors outside the research model.

CONCLUSIONS

1. Coffee and goat farming integration farmers in Ronggurnihuta District, Samosir Regency are classified as capable or can be empowered in terms of accessing markets and information, increasing income/savings, and improving networks.

2. The levels of interest, participation, and the involvement of extension workers positively and significantly contribute to the empowerment of integrated coffee and goat farmers in the Ronggurnihuta District.

RECOMMENDATIONS

The Ronggurnihuta District Government needs to support an integrated system- based coffee farmer empowerment program so that the farmer empowerment program can be implemented in a sustainable manner to improve farmer welfare.

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THE INFLUENCE OF THE ROLE OF AGRICULTURAL EXTENSION AGENTS IN RICE FARMING ACTIVITIES ON SUBOPTIMAL LAND IN PANGANDARAN DISTRICT

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Abstract: Padaherang Subdistrict, which frequently experiences flooding during the rainy season or the discharge of Citanduy water sources, is one of the less desirable lands in the Pangandaran area. However, during the dry season, the land experiences drought due to being rainfed and being far from water sources. Farmers in the area carry out rice farming on about 112 ha of land. Farmers continue to engage in rice farming in order to meet household needs. This is done because the land is farmers' only income source. So, extension workers' role is highly prioritised in farming activities on suboptimal land. The objectives of this study were to: a. identify the intensity of utilisation of flood and drought-prone paddy fields in the study location; b. describe the actual role of extension agents as motivators, innovators, facilitators and dynamists in an effort to increase the capacity to optimise the use of paddy fields in the study location and c. make recommendations for strategies to increase

farmers' understanding capacity in optimising the use of floodprone paddy fields in the study location. The results showed that farmers still carried out the utilization of flood-prone paddy fields by planting a maximum of twice a year. Planting activities on suboptimal land are farming with floating rice field techniques and conventional rice fields. The role of extension workers in increasing the capacity of influential farmers is that of innovators, facilitators, and dynamists, while motivators have no effect. This is because extension activities in motivating farmers are only about 30 percent of those who still use rice fields during floods. So, the strategy that must be taken is to improve facilities and infrastructure in the application of rice farming and increase motivation to increase farming during floods.

Keywords: role of extension workers, suboptimal, farming

INTRODUCTION

Agricultural activities in various regions have been carried out through training and guidance through agricultural extension activities. Agricultural extension is a non-formal education activity aimed at changing farmers' behavior patterns and decision-making in dealing with their farming problems. Extension activities need to be carried out with participatory nuance so that there is equality, transparency, responsibility, accountability, and cooperation, a new change in empowering farmers (Anwarudin et al., 2020). Cooperation between extension workers and farmers is needed for good and quality farming activities. So, extension agents are needed to be motivators, communicators, facilitators, and innovators to improve the quality and sustainability of farmer farming.

The process of agricultural extension Agricultural extension activities is technically and managerially carried out by extension workers, who have the function of providing educational services and information needed by farmers. The role of agricultural extension workers is indispensable in guiding farmers and improving farmers' skills and knowledge. It also facilitates farmers in adopting new technologies (Marbun et al., 2019). One of them is the extension activities carried out in Padaherang District, Tasikmalaya Regency, which cultivate rice farming on suboptimal land. Agricultural extension activities are seen not only in technicalities in the field but also in the emotional strength of the community (Latif et al., 2022). Extension workers carry out this emotional strength to strengthen the relationship between farmers and farming activities and improve the farmer's economy. The activities carried out by PPL must act as a teacher, analyst, consultant, and organiser. One of them is the role of PPL for farmers who live in suboptimal areas that are prone to natural disasters. An area prone to natural disasters is Padaherang District in Pangandaran Regency.

Padaherang Subdistrict is an area in Pangandaran Regency with a sloping topography in the downstream Citanduy River basin. This results in the Padaherang Subdistrict being one of the areas prone to flooding from the Citanduy River. Rice fields and agricultural land in general, especially in Ciganjeng and Sukanagara Villages, are

the areas most affected by flooding. The area of land affected by flooding or suboptimal land is around 112 hectares. Agricultural land and rice fields are periodically inundated by Citanduy floods every year. This condition does not interrupt the rice farming activities carried out by farmers. In one planting season, farmers plant up to three times. This is done to fulfil the need for food and life derived from rice. Farmers do not shift to utilising land with more optimal commodities for the prevailing ecosystem conditions. Farmers in Padaherang are very adaptive to flood conditions that occur cyclically every year. Repeated experiences shape the attitudes and behaviours of farmers toward mitigating disaster situations. Rice farming activities are also supported by the role of agricultural extension workers carried out by PPL (Field Agricultural Extension Workers) from the local office and PPS (Independent Agricultural Extension Workers) from farmer groups. The number of PPLs in the sub-district is five people spread across various villages, while the number of PPS is 14 people under farmer groups' auspices.

The amount of rice production in Pangandaran Regency continues to experience a significant decline from 2019 to 2021 by 10.5% (BPS, 2023). The decline is due to the fact that some of Pangandaran's land is suboptimal. In addition, climate change affects farmers' rice farming activities. Therefore, activities are needed to increase the role of extension workers in rice farming activities. According to Sundari et al. (2015), the presence of agricultural extension workers contributes to the increase in farmer production. Even the results of research (Sundari et al., 2015) show that agricultural extension workers significantly influence increasing agricultural production. In addition, the results of research from various researchers (Fawaz et al., 2021; Latif et al., 2022; Faqih, 2014; Tanjung et al., 2020) explained that there were differences in income between farmers who received counselling and did not receive counselling. This study aimed to analyse the effect of agricultural extension on farming activities on suboptimal land, especially on land utilisation activities when flooded.

RESEARCH METHODS

Research activities were carried out in Padaherang District, Pangandaran Regency. The method of taking the research site was carried out by purposive sampling with the consideration that the area is the largest area, including suboptimal land in Pangandaran Regency. In addition, the area is filled with farmers who are actively engaged in rice farming activities. The research design used was a quantitative approach with a survey method. The population in this study were rice farmers in Padaherang District, Tasikmalaya Regency, with a total of 558 farmers. The non-probability sampling technique does sample determination. The number of sampling units or respondents for each village is proportional to the village population. The sample size refers to the Slovin formula (1960), which has a significance level, so 30 rice farmers respondents were obtained. The results of the study were tested for validity and reliability using the SPSS Version 18 application. The validity test criteria are said to be valid if the value of r count > r table. The reliability test in the study used the Cronbach Alpha test. Indicators are said to be reliable if the value > 0.6. The variables used to identify the role of agricultural extension workers are limited to the role of extension workers as motivators, innovators, facilitators, and dynamizers (Ariana et al., 2021).

Table 1. Role and Variables Indicator for Agricultural Extension

No.	Role of Extension Officer	Indicator	Ordinal Score
1	As a Motivator	Encourage farmers to become members and remain members of farmer groups	1-5
		Encourage the enthusiasm of farmers to take part in various extension/training activities	1-5
		Encourage farmers to apply rice farming technology	1-5
		Encourage farmers to become skilled at entrepreneurship	1-5
		Support government policies related to rice commodities	1-5
		Increasing farmers' knowledge of new ideas in rice farming	1-5
		Developing the enthusiasm of farmers in managing their farming business	1-5
2	As an Innovator	Extension workers provide training or ways to use new technology	1-5
		Extension workers provide support and encouragement to the group in improving the farmer group's business	1-5
		Extension workers provide support and encouragement to the group in improving the farmer group's business	1-5
		Delivering policies and regulations in the agricultural sector	1-5
		Bringing innovations that can advance farming	1-5
3	As a facilitator	Conveying agricultural aspirations	1-5
		Help accelerate the flow of information to farmers	1-5
		Helping farmers communicate in groups	1-5
		Developing farming groups so they can function as teaching and learning classes	1-5
4	As a dynamist	Encourage planned and structured efforts	1-5
		Assist farmers in the decision-making process	1-5

The largest possible score with 30 sampling units is 2700 and the smallest is 540. The difference between the largest and smallest scores is 2160, divided into five classes, so the interval score between classes is 432. Conclusion criteria to express the actual level/achievement of the role of agricultural extension workers using Table 2.

Table 2. Achievement of instructor's role score

Indicator Score Achievement	Criteria for Achievement of the Role of Extension Officers
540 < score ≤ 972	Very small
972 < score ≤ 1404	Small

1404 < score ≤ 1836	Enough
1836 < score ≤ 2268	Big
2268 < score ≤ 2700	Very large

RESULTS AND DISCUSSION

Agricultural activities in Ciganjeng and Sukanagara Villages, Padaherang Subdistrict, Pangandaran Regency are rice farming. The land area owned is around 520 hectares and affected by Citanduy floods around 225 hectares or 50% of the land area. Based on the survey results, several characteristics of the respondents are listed in Table 3.

Table 3. Characteristics of Respondents

No	Description	Average	Unit
1	Age	50.31	Year
2	Years of Education	7-8	Year
3	Farming experience	11	Year
4	The number of dependents	3	Person
5	Land area	0.50	Ha

Sources: processed primary data (2023)

Farmers have an average age of 50 years and above. This is not a productive age and is an advanced age. In fact, there are no farmers whose age is below 30 years. This indicates that farming actors in Ciganjeng and Sukanagara villages have no regeneration. In fact, the oldest age is 67 years old. Although classified as an unproductive age, farmers there are still actively conducting rice farming activities. Based on the length of formal education taken by farmers, the average elementary school graduate (SD) is only about 15%, or one respondent who has taken undergraduate education. This is due to inadequate economic problems, so many people in Ciganjeng and Sukanagara Villages cannot continue their education at the college level and prefer to work as farmers, labourers, or outside the area.

The experience of rice farming in Ciganjeng and Sukanagara villages is, on average, over 10 years, namely 11 years, and they have joined the Mekar Jaya farmer group. This shows that the longer farmers join the farmer group, the more the attitude or level of adoption of information or technology provided by the agricultural extension. Respondents' land area averaged 0.5 ha; the most extensive land is 1.12 ha, and the smallest is 0.14 ha. On average, the land managed by group members is their own. They never sell their land to outsiders to maintain the resilience of the area. In fact, land is one of the inheritances that should not be sold to their children and grandchildren. Rice farming activities in Ciganjeng and Sukanagara villages are strongly influenced by climate conditions, considering that the area is the borderland of the Citanduy water source. During the rainy season, agricultural land will be flooded for more than 3–5 months. So rice farming activities in the area use floating rice planting media by planting above flood water However, this is less effective because the time of flooding cannot be predicted, so it recedes easily. In addition, the constraints of planting media are easily damaged, and pest attacks occur when using floating media. Rice productivity in the area has an average of 2.2 tons/ha in one harvest. Planting activities are only carried out twice a year.

Rice farming activities in the two villages are supervised by 4 PPLs (Field Agricultural Extension Workers) and 11 PPSs (Independent Agricultural Extension Workers). The PPLs come from the agriculture office while the PPSs are volunteers from farmer groups that have been mentored by the PPLs. Routine counseling and coaching activities are carried out once every 2 weeks with both PPL and PPS. Training is even conducted on vine cultivation when suboptimal land cannot be used. This is also done to increase farmers' income.

Agricultural extension officers are government institutions that help the community change the behaviour of farmers and their families so that they know and can solve problems in farming activities. The role of agricultural extension consists of motivators, facilitators, communicators, and innovators. Based on the results of research on the role of agricultural extension to the capacity of farmers in rice farming is in a very high category with a total score of 2399. This can be seen in Table 4.

Table 4. Achievement of the instructor's role score

Indicator Score Achievement	**Criteria for Achievement of the Role of Extension Officers**
540 < score ≤ 972	Very small
972 < score ≤ 1404	Small
1404 < score ≤ 1836	Enough
1836 < score ≤ 2268	Big
2268 < score ≤ 2700	Very large

Source: processed primary data (2023)

Motivators that extension workers have done for farmers are in the medium category with a score of 529. This is because the programs carried out by PPL and PPS (Independent Agricultural Extension Workers) are by the wishes of farmers, especially motivation for applying technological innovations to rice farming. Extension agents act as motivators in the high category because extension activities provide motivation for good farming methods and provide examples so that farmers apply these methods. This is in line with research by Marbun et al. (2019) and Halimah and Subari (2020) that the role of extension as a motivator is in the high category of 67.2% because, according to farmers, extension workers have motivated farmers in developing their farms and farmer groups. The role of extension as a motivator helps farmers get information about how to process their products, providing direction on how to cultivate good land, how to use technology, and how to increase the added value of production, as well as providing examples and motivating farmers about how to farm well (Setia Umbara et al., 2019).

Based on the research results, the role of extension workers as innovators is in a very high category, with a score of 657. This is because there are routine activities carried out by PPL and PPS for farmer groups in various ways to utilise the latest innovations. Based on the majority of respondents categorized as high, this has a good impact on the development of farmer groups and their businesses because extension

workers help farmers in the introduction of new technology (pest control), assist farmers in technology adoption, provide innovations in farming, introduce farmers to superior or latest seeds, teach farmers how to farm environmentally friendly, use organic fertilizers, and assist farmers in implementing changes in how to cultivate rice plants, which include seeding, seedling, tissue culture, plant production, pests and diseases, harvesting processes, packaging, and distribution. Based on the results of the observations that have been made, it can be said that the role of extension workers as innovators has an effect on farmers. This can be seen from the willingness of farmers to change their mindset as well as new changes in how to cultivate land using modern agricultural tools. While the role of extension workers as facilitators has a high category with a score of 577. Based on observations in the area, extension workers are facilitators who assist farmers in the provision of production facilities and agricultural equipment. In addition, providing examples to farmers in using agricultural production facilities and even facilitating farmers in accessing information from the government about new policies and market prices and providing facilities for advancing farmers' businesses. Farmers have no place to sell their crops when they need funds for their lives. The role of extension officers as facilitators is influential in the development of farmer groups where farmers and farm women are given information in increasing agricultural production to increase their income. One of them is breaking into MSMEs by processing crops. This is in line with research (Anwarudin et al., 2018; Fawaz et al., 2021) which states that the function of extension workers as facilitators is extension workers who can facilitate in terms of business partnerships, access to markets, capital, and so on.

The role of agricultural extension workers as dynamicators or communicators is said to be very high, with a score of 636. This is because the extension workers in the area come from their respective regions. The closeness of language and kinship makes it easier for extension workers to provide counseling or coaching. This is also by the opinion of farmers, who stated that agricultural extension workers as communicators help farmers in decision-making, learn how to solve problems being faced by farmers, accelerate the flow of information, improve farming skills, and are easy to find when farmers experience difficulties.

Meanwhile, measure the capacity of farmers to deal with disaster mitigation, is seen from various indicators, including rendang and activities, gadu and activities and utilization of rice fields when flooded. Based on the results of the score of farmers' capacity on suboptimal land is at an average score of 4.3, meaning High. Scores on the capacity of farmers, among others, can be seen in Table 5.

Table 5. Extension Role Score

No.	The role of the instructor	Total score1	Category
1	Motivator	529	Tall
2	Innovator	657	Very high
3	Facilitator	577	Tall
4	Dynamist	636	Tall
Total score		2399	Very high

Source: processed primary data (2023)

The provisions for determining farmers' capacity level are seen in how often farmers implement farming activities. One is categorized as low, two is sufficient, three is moderate, 4 is frequent, and five is very frequent. *rendeng tandur* activities carried out by farmers are carried out more than five times a year. As for *rendeng tandur* activities carried out by farmers three times a year, when utilizing rice fields during floods, horticultural crops and even fish livestock and rice planting is carried out even though it is not optimal. Based on the results of the study, the role of agricultural extension agents is said to affect the capacity of farmers to implement rice farming. However, the effect is not significant on the role of the motivator. This can be seen in Table 6.

Table 6. Results of multiple regression analysis

No	Coefficients	Unstandardized Coefficients		Standardized Coefficients			R-Square	Adjusted R-Square
	Model	B	Std. Error	Beta	T	Sig.		
1	(Constant)	4.727	3.745		1.262	.219	0.718	0,673
	Motivator	.100	.118	.094	.852	.402		
	Inovator	.273	.117	.432	2.331	.028		
	Fasilitator	-.458	.198	-.388	-2.315	.029		
	Dinamisator	.426	.134	.723	3.170	.004		
a. Dependent Variable: Kapasitas								

continued

Source: processed primary data (2023)

Based on the results of multiple regression analysis, the following equation is shown:

$$Y = 4{,}72 + 0{,}1\ X_1 + 0{,}27\ X_2 - 0{,}45 X_3 + 0{,}42\ X_4$$

Of the four variables of the role of extension workers, three are significant, while one is not. The coefficient of determination (R^2) is 0.673. This value indicates that the role of agricultural extension workers (motivators, communicators, facilitators, and innovators) affects the capacity of farmer groups in rice farming by 67.3%, while other factors influence the remaining 33.6%. The positive coefficient value (motivator, innovator, and dynamizer) indicates that the role of extension workers has increased and that there is an increase in the capacity of farmers. This shows that in Ciganjeng and Sukanagara villages, the role of extension workers helps farmers in the development of their farmer groups, such as in getting information about how to manage land, add value from production, increase production and production facilities, increase income, market access, and technology adoption. In addition, there is guidance for each farmer group on how to increase business effectiveness. Farmer groups are able to grow and develop progressively, improving the welfare of each member of the group.

Based on the results of the t-test analysis for the role of extension workers as motivators, a sig. value of 0.402 > 0.05 was obtained, which indicates that Ho is

accepted and Ha is rejected, which means that the role of extension workers as motivators partially does not affect farmers' capacity in suboptimal land utilisation. This is because farmers' motivation is still not stable considering that when the land is flooded, they tend to switch to other professions to support their needs. There are also some farmers who rarely come to training and counseling activities organized by PPL and PPS. Based on the results of the t-test analysis for the role of extension workers as innovators, the sig. value is 0.028.

Based on the t test analysis results for the role of extension agents as facilitators, a sig. value of 0.029 <0.05 indicates that Ho is rejected and Ha is accepted, which means that the role of extension agents as facilitators partially affects the capacity of farmers. This is because agricultural extension workers help farmers advance their businesses, where extension workers provide facilities in terms of partnerships, market access, capital, agricultural tools, fertilizers, and so on. In addition, the results of the t-test analysis for the role of extension as a dynamic obtained a sig. value of 0.04 > 0.05, which indicates that Ho is rejected and Ha is accepted, which means that the role of extension as a dynamic partially affects the capacity of farmers. This is due to farmers' land use changes, then making environmentally friendly organic fertilizers, easier cultivation techniques, and pest control. In addition, the ease with which farmers meet and understand the training conducted by extension workers is also important.

CONCLUSION

Based on the results of this study show that farming activities carried out by farmers in Ciganjeng and Sukanagara Villages on suboptimal land are still planting with a planting frequency not as high as on optimal land. This is due to flooding from Citanduy, so it will take a long time to start planting. Then, the role of extension workers in the area often involves training, so the role of extension workers in increasing the capacity of farmers is in the high category. This is due to the efforts of PPL and PPS in empowering land and infrastructure facilities with innovative and creative training and guidance. However, the role of extension workers in terms of motivating is not significant because the motivation of farmers has not fully utilized suboptimal land. So, the suggestion from this research is that farmers need to coordinate the new technology produced and increase efforts to utilize suboptimal land for crops other than food.

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ANALYSIS OF THE DIFFERENCES IN GOVERNANCE OF TOURISM AND AGRICULTURE VILLAGE OWNED ENTERPRISES (BUMDES)

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Abstract: The research purpose was determined the differences in governance of tourism and agricultural sectors village owened enterprises. The research method applied analytical descriptive research using primary data collected by interviews, field observations and secondary data from BUMDes operating in the tourism and agricultural sectors in several areas in Karo Regency, North Sumatra Province. Sampling determination used “purposively” or deliberately with certain considerations. The research sample was 50 people, namely 1 person managing an Agricultural BUMDes

(Sempa Arih Village) and 1 person from a Tourism BUMDes (Raya Villafe) in Karo Regency, 11 local people, 11 tourists and 2 Village/Regency government people in each BUMDes. The research results shown that BUMDes governance in the tourism sector has a stronger focus on tourism destination development, promotion, and supporting infrastructure such as accommodation and tourist facilities. On the other hand, BUMDes in the agricultural sector places greater emphasis on land management, agricultural production and marketing of local products. Differences in resources, risks and partnership networks were also identified between the two sectors. Tourism BUMDes tend to have risks that are more related to external factors such as holiday seasons and fluctuations in tourism trends, while agricultural BUMDes are more vulnerable to internal factors such as weather conditions and production risks. This research provides an in-depth understanding of the essential differences in BUMDes governance between the tourism and agricultural sectors, providing a basis for developing more focused and sustainable policies and management strategies for BUMDes in these two sectors.

Keywords: BUMDes Tourism, Agriculture, Governance.

INTRODUCTION

The tourism and agricultural sectors have a large contribution to national GDP. The tourism and agricultural sectors, through the involvement of various elements of society and related parties, can be an alternative solution to problems related to unemployment and poverty. Law No. 6 of 2004 concerning Villages, states that in order to grow rural economic activities, Village Economic Institutions were created in the form of VillageOwned Enterprises, which are legal entities aimed at channeling the desires of village residents to take part in managing the resources available in the village. The existence of BUMDes is ultimately an institution that is a source of income to strengthen the village treasury. BUMDes activities need to be optimized by opening up business opportunities in productive fields, including in the agricultural and tourism sectors. Village areas have advantages in the fields of tourism and agriculture if they are managed well so that they can strengthen the economic strength of village communities (Hidayat, 2023).

There are several roles of BUMDes, including empowering the local economy, encouraging financial inclusion, managing local resources, driving village tourism, encouraging village independence, developing infrastructure and services, developing innovation and creativity. Village tourism and village agriculture activities based on BUMDes have the opportunity to be improved, because their existence has a good legal basis, so it is hoped that BUMDes will be able to improve the welfare of the community, along with the presence of entrepreneurs in the village through the development of the tourism sector managed by the village community (Fitrian et al., 2023).

Karo Regency is a district that has advantages in the fields of agriculture and tourism. Sempayaja Village (Peceren) is a village on the edge of Berastagi City, ± 2km from Berastagi City. This village has BUMDes Sempa Arih which is one of the villages in Karo Regency that has BUMDes activities in the agricultural sector. The agricultural sector is developing very rapidly in Sempajaya village, therefore BUMDes Sempa Arih set up a fertilizer shop with the hope that village residents can easily access fertilizer purchases without having to waste time.

BUMDes Arih Ersada in Raya Village is one of the BUMDes that manages the tourism sector. Raya Village is at the height of the mountains, so it has cool air. Fertile land conditions are also a mainstay for Desa Raya to develop the agricultural sector as the main source of the economy, through the development of a flower garden tourist area in Desa Raya. This flower garden tourism has become a tourist destination that attracts the attention of local residents to visit. This condition causes Raya village to become increasingly famous, and tourist visits also increase. Facilities built to complement this flower tourist park include a cafe, souvenir shop and selfie spot. BUMBDes Arih Ersada manages 4.5 hectares of land. Raya Village residents are willing to provide their land to be managed by BUMDes Arih Ersada.

According to (Rahmat, 2020), the application of BUMDes governance principles includes prioritizing an attitude of professionalism, responsibility, transparency, emphasizing community participation, prioritizing the use of local resources, and sustainability. Professionalism is a way of organizing that is carried out in accordance with established regulations and implemented by personnel who have sufficient competence and skills. Transparent means that the management of BUMDes must be open so that the community can monitor it, besides that BUMDes information and data can be accessed at any time by the community. Responsibility means that BUMDes in its management must be accountable to the village community. Participation meaning that opens up opportunities for all village residents to play an active role in managing BUMDes by contributing ideas, energy, time, skills and finances so that all village residents can use and utilize BUMDES results. BUMDes management prioritizes using the natural resources and human resources available in the village. Sustainable means that BUMBDes must be able to meet the current needs of village communities without reducing the ability of future generations to fulfill their desires (Gorda et al., 2023).

The concept of governance, according to (Revida et al., 2022), is a decision-making process in an institution that is related to the process of achieving the institution's goals.

Governance can also be interpreted as: (1) government, (2) managing, (3) administering government, (4) administering the state, and (5) state administration. Correct governance can be achieved if there are two elements that support each other, namely (1) village residents play an active role, have awareness and responsibility, together with the government in a transparent, responsive manner, and have a willingness to listen and involve community (inclusive); (2) governance is understood as a process, not just about organizations or institutions. The processes that grow in the governance of an institution involve all groups that have an interest in the institution. Governance as a system for controlling the internal conditions of an institution aims to:

1. Planning is a planned process for determining short-, medium- and long-term goals and the processes that must be followed to achieve the institution's goals. Planning activities are carried out to determine the types of activities that will be held in the future.

2. Organizing is a process for determining the type of work that will be carried out and completed by members of the institution. Apart from that, work relationships between members of the institution are also determined, and the creation of an adequate environment and facilities to support this work.

3. Directing is a series of jobs to provide direction and orders to subordinates or other people in the institution so that the achievement of organizational goals can run optimally.

4. Motivating is an activity carried out by the leadership which is intended to provide enthusiasm, inspiration and work ethic to subordinates so that the activities of the institution can run as they should.

5. Controlling is a process to ensure that an activity can be carried out according to what has been planned and determined and goes through the appropriate stages.

RESEARCH METHODS

The sample determination used a "purposive" or deliberate method with certain considerations. The sample consisted of 50 people, including 1 person managing an Agricultural BUMDes (Sempa Arih Village) and 1 person from a Tourism BUMDes (Raya Village) in Karo Regency, 11 local people, 11 tourists and 2 Village/Regency government people in each BUMDes. Research data consists of primary and secondary data. Primary data was obtained from direct informants used in-depth interview techniques, while secondary data was obtained using literature study techniques regarding the governance of tourism and agricultural BUMDes.

RESULTS AND DISCUSSION

The earliest activity carried out was conducting observations at the two BUMDes, namely the Tourism BUMDes and the Agricultural BUMDes. The results of observations at the tourist BUMDes in Arih Ersada shown that BUMDes governance is quite good, it already has a good organizational structure so that BUMDes Arih Ersada is able to develop until now. Tourist visits to BUMDes Arih Ersada continue to increase, this is also supported by the natural potential of Raya village which is able to increase the income of the local community. The existence of flower tourism managed by BUMDes Arih Ersada and the development of new tourist destinations have made Raya village even more famous and able to attract local tourists and a few

foreign tourists. Another development carried out by the flower tourism park is equipped with cafe facilities, souvenir shops and interesting photo spots. Residents and manager of BUMDes Arih Ersada are improving the 4.5 Ha area, and residents are also lending their land so that it can be managed well by BUMDes. The Arih Ersada tourist BUMDes also tend to have risks that are more related to external factors such as the holiday season and fluctuations in tourism trends, so that this BUMDes must continue to develop its activities in order to be able to attract tourists to visit the area.

The results of observations at BUMDes Agriculture Sempa Jaya show that the governance of BUMDes Sempa Jaya is still poor, ambiguous and even though it already has an organizational structure, it cannot run well. BUMDes Sempa Jaya has a Fertilizer Shop that sells fertilizer at competitive prices to make it easier for farmers to meet the fertilizer needs of their crops. However, the fertilizer shop operated by BUMdes cannot run well because people in the area still often buy fertilizer but do not pay immediately. This is due to a lack of firmness from the BUMdes management.

BUMDes Sempa Jaya operates with a system that is still dominated by family relationships, making it difficult to develop BUMDes activities in Sempa Jaya to progress in terms of increasing the development of agricultural BUMDes. Another factor that makes Sempa Jaya agricultural BUMDes governance experience problems that agricultural BUMDes are more vulnerable to internal factors such as weather conditions that can damage agricultural products and production risks.

CONCLUSION

Based on the description above, it can be concluded that the comparison of the governance between the Tourism BUMdes in Arih Ersada and the Sempa Jaya Agricultural BUMdes is very inversely proportional. The governance of tourism BUMdes is better than agricultural BUMdes. This is due to the high level of public interest in the natural tourism offered by BUMdes tourism and also the administrators who have innovation in developing this tourism with the aim that visitors will not get bored of visiting this tourist attraction again. Meanwhile, agriculture BUMdes is still an ambiguous word due to the lack of interaction between BUMdes Agriculture administrators and the local community. So, the business built by the Agricultural BUMdes cannot develop.

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PLANNING OF SALARAN GARDEN TOURIST EDUCATIONAL WITH THE BUSINESS MODEL CANVAS APPROACH

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Abstract: Edu-tourism is part of a branch of the tourism sector that combines recreation and learning. The Faculty of Agriculture and Business SCWU has great potential to utilize the facilities and

infrastructure owned in supporting the edu-tourism program at Salaran garden. The edu-tourism design is a means of learning and business activities that are managed jointly. Based on these reasons, it is necessary to create a business model about the edu-tourism program that will be run sustainably. This research aims to 1) Knowing consumer needs for edu-tourism at Salaran garden. 2) Creating an edu-tourism design design with a Business Model Canvas (BMC) approach. The technique of taking respondents used in this study was quota sampling and purposive sampling. The results of the study revealed 1) The components prioritized by the public for planning Edu-tourism of Salaran Garden include: Attractions of harvest & post-harvest vegetable crops (lettuce), medicinal plants (ginger), ornamental plants (orchids), fruit plants (grapes); Amenity needs the main toilet facilities; The main accessibility is on road access that is easy for vehicles to pass. 2) Components of 9 BMC blocks that exist in this model, 5 components including Customer Segment, Value Proposition, Channel, Customer Relationship, Key Resources have existed but have not been carried out optimally. While the other 4 components such as Revenue Streams, Key Activities, Key Partnerships, Cost Structure are still in the planning stage.

Keywords: Edu-tourism, Business Model Canvas, and Salaran Garden

INTRODUCTION

Edu-tourism is one branch of the tourism sector that combines recreation and learning. According to Ratih, et al (2013) environmental edu-tourism is a tourism program that invites visitors to visit a tourist location with the aim of gaining experience from a direct learning in the tourist attraction. The utilization of edu-tourism activities has been carried out on various campuses in the world and nationally in campus areas and public places that can be a source of income and as a place for edu-tourism as well as recreation. The trend of agricultural edu-tourism needs offers a variety of tourism options such as learning crop cultivation, harvesting crops, processing products, and providing outbound activities (A.J. Muljadi, 2012). Edu-tourism becomes a traveling and learning activity for tourists at a tourist attraction. This activity makes an edu-tourism has an attraction for local and outside communities. The attraction component in the tourism industry is very important. The attraction of an edu-tourism needs to have a variety of attractions to be enjoyed by tourists in order to attract tourists to visit.

Changes in tourism trends have occurred in tourist behavior, one of which is Polycentric Lifestyle (Kemenparekraf / Baparekraf RI, 2023). This trend is based on the desire of tourists to find uniqueness in the attractiveness of the area to be visited. The challenges of shifting tourist behavior need to be aligned with the design of a

sustainable tour. Educational attractions need to be presented to provide satisfaction to tourists. The attraction of a tourist attraction consists of attractions, amenity, and accessibility (Hasdian & Setyorini, 2016). The uniqueness of the attraction of edutourism is needed to be a novelty from other edu-tourism. Cultivation attractions and harvest, post-harvest attractions will always exist in edu-tourism with an agricultural theme. The concept of edu-tourism needs to be designed by combining aspects of recreation harmonized with education, starting from land preparation, seedling, harvesting care, sorting, to processing that is packaged in an attractive and sustainable manner (Pradiana, et all, 2021).

Salaran garden is a research garden laboratory owned by the Faculty of Agriculture and Business of SCWU located in Wates Village, Getasan District, Semarang Regency with an area of 2.8 ha. The activities of Salaran garden are used as a means of off-field learning such as practicum and research. The implementation of research activities and experiments that have been carried out by FPB has stopped since the Covid-19 pandemic took place. In addition, institutionally it has not been well coordinated, so it has not been optimal. The potential for educational tourism can be developed by FPB as a tourist attraction, but further commitment is needed so that this educational tourism program can be sustainable and successful in the future. The sustainability aspect can be implemented without changing the existing resources (Goodfrey et all, 2000). Although Salaran garden has the potential to become an edutourism destination, it still requires a measurable and clear business model. This is in accordance with the expression of Muthuraman et all (2019) that a tourism plan without a business model will be difficult to run. According to Bibin et all (2018), key elements that affect tourism activities need to be considered first before going further in designing a tourism program. The formation of a business framework is necessary to find out the parties that influence the running of the edu-tourism program at Salaran Garden using the business model canvas. The purpose of this research is to find out the needs of the public for edu-tourism and make edu-tourism design with a business model canvas approach.

RESEARCH METHODS

This research was conducted at Salaran Garden, Wates Village, Getasan District, Semarang Regency. The research was carried out for 3 months, namely July - October 2023. The type of research approach carried out was descriptive qualitative. According to Sugiyono (2020), the descriptive approach is carried out to determine one variable or more than one variable without making comparison variables to look for other variable relationships. This type of descriptive research seeks to describe a social phenomenon in the conditions of a group of people, research objects, current conditions, and current events. The research method used uses qualitative research.

Determination of respondents in the study using double sampling, namely qouta sampling and purposive sampling. Determination of the number of respondents is proportional, so that it approaches the number of members in the population (Kasiram, 2010). The number of respondents obtained amounted to 51 people, obtained through a google form survey. The determination of key informants and informants in this study amounted to 3 people, namely the Dean of FPB SCWU, Head of the FPB SCWU Laboratorium, and the Tourism Bureau.

The data analysis technique in this study went through 3 stages, namely data reduction, data presentation, and conclusion drawing. According to Sugiyono (2020), qualitative data analysis is carried out interactively and continues continuously until the data obtained is saturated. Searching for information needs to be done continuously until what is obtained is really deeper and to the deepest point of the desired information.

RESULTS AND DISCUSSION

Public demand for Edu-tourism

A. ATTRACTIONS

1. Desired Attractions

Table 1. Attractions that respondents want at the Salaran Garden Educational Center

Desired attractions	Total	%
Cultivation attractions	25	49%
Harvest & post-harvest attractions	26	51%

Source: Primary Data, 2023

Cultivation attractions obtained 49% who chose, harvest & post-harvest attractions obtained 51% who chose, and. From these results, respondents prefer both harvest & post-harvest attractions to exist in Edu-tourism at Salaran garden.

a. Desired crop commodities

Table 2. Commodities that respondents want program in the edu-tourism Salaran garden

Commodities	Ranking
Vegetable crops	1
Fruit crops	2
Medicinal plants	3
Ornamental plants	4

Source: Primary Data, 2023

Respondents tend to want vegetable crops because vegetable crops are easier to cultivate and the planting period tends to be faster. Especially if using modern technology with planting such as the use of hydroponics, it tends to be more environmentally friendly and does not need to require a large area of land for planting. This will certainly be able to be easily done by the public when later visiting in addition to gaining knowledge and experience from Edu-tourism Salaran garden, can also apply the methods that have been taught and can bring the results already practiced there.

b. Desired vegetable crops

The types of vegetable plants desired in the Salaran garden eco-tourism by respondents are:

Table 3. Desired types of vegetable plants in the Edu-tourism Salaran garden

Tanaman Sayur	Total	%
Spinach	2	4%
Mustard Greens	3	6%
Kale	1	2%
Pak choy	14	27%
Lettuce	17	33%
Tomato	13	25%
Kangkung	1	2%

Source: Primary Data, 2023

Based on table 3. obtained the type of vegetable crop lettuce 33% choose. This is because the lettuce plant has a fast-planting period. Within 15-30 days the lettuce plant is harvested, so many respondents choose lettuce for cultivation. Lettuce plants are easy to care for when cultivated and minimal maintenance.

c. Desired fruit crop

Table 1. Types of fruit plants that respondents want in Edu-tourism Salaran garden

Fruit	Total	%
Grapes	19	37%
Dragon Fruit	1	2%
Oranges	10	20%
Melon	6	12%
Strawberry	15	29%

Source: Primary Data, 2023

Based on table 5. obtained the type of medicinal plants desired in Edu-tourism Salaran garden ginger plants 55%. This is because ginger plants are better known in medicinal plants. Because respondents chose ginger plants, besides that ginger plants have many benefits. Ginger plants can be created in various types of products to be presented at Salaran garden.

d. Desired type of medicinal plant

Table 2. Types of medicinal plants that respondents want in Edu-tourism Salaran garden

Medicinal Plants	Total	%

Ginger	28	55%
Kaempferia galanga	2	4%
Turmeric	6	12%
Rosemary	1	2%
Lemongrass	10	20%
Curcuma zanthorrhiza	4	8%

Source: Primary Data, 2023

Based on table 5. obtained the type of medicinal plants desired in Edu-tourism Salarangarden ginger plants 55%. This is because ginger plants are better known in medicinal plants. Because respondents chose ginger plants, besides that ginger plants have many benefits. Ginger plants can be created in various types of products to be presented at Salaran garden.

e. Desired ornamental plants

Table 3. Types of ornamental plants that respondents want in Edu-tourism Salaran garden

Ornamental Plants	Total	%
Orchid	16	31%
Begonia	4	8%
Krisan Chrysanthemum	15	29%
Marry Gold	1	2%
Rose	15	29%

Source: Primary Data, 2023

B. AMENITIES

Table 4. Amenity (Facility) required by respondents based on ranking

Fasilitas	Ranking
Toilet	1
Garbage can	2
Food court area	3
Large parking area	4
Meeting room	5
Mosque	6
Clean water, rest area, entrance ticket, and parking.	7

Source: Primary Data, 2023

Based on table 7. facilities needed in Edu-tourism Salaran garden, toilets are in the first place in the ranking order obtained from respondents. The need for toilet facilities in a tourist spot is needed to support visitors to the Edu-tourism Salaran garden. The total availability of toilets is also considered to avoid the accumulation of queues due to the limited total toilets available, therefore it needs to be anticipated by determining the total number of toilets when it will be designed later.

C. ACCESSIBILITY

Table 5. Accessibility required by respondents based on ranking

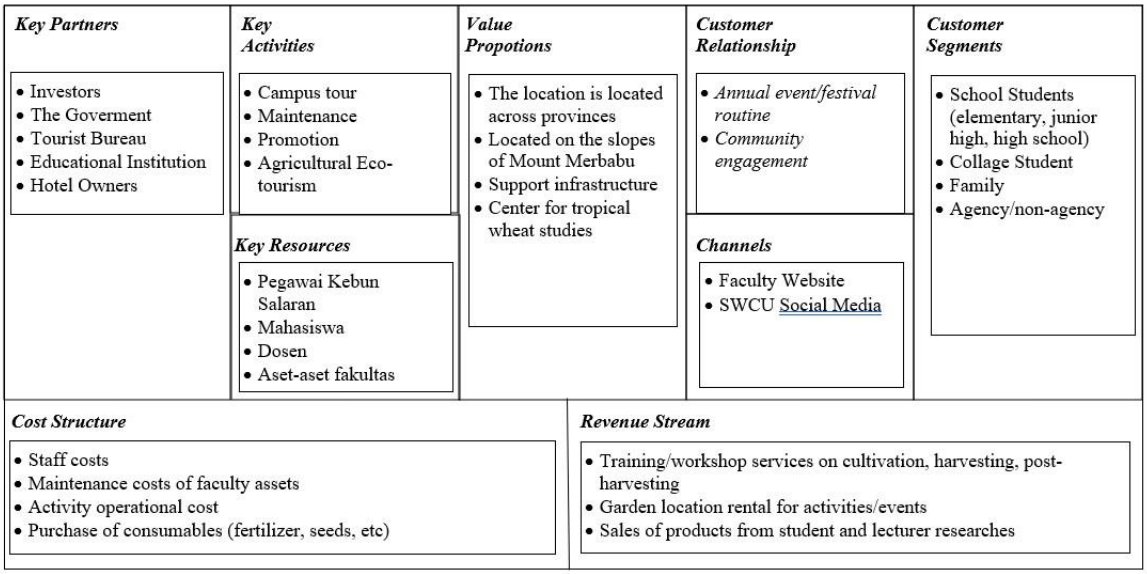
Accessibility	Ranking

Road access that is easily traveled by vehicles	1
Edu-tourism locations can be found on the online map (*Google Maps*)	2
Convenient location with highway access	3
Adequate public transportation	4

Source: Primary Data, 2023

Based on table 8. obtained Accessibility (affordability) needed in Edu-tourism Salaran garden, road access is in the first rank order because the terrain of a location to Salaran garden determines the consideration of the public when going to visit Edutourism Salaran garden.

Business Model Canvas Planning



Picture 1. Business Model Canvas Framework for Edu-tourism Salaran garden
Source: Primary Data, 2023

A. Customer Segment

Consumer segmentation is needed before designing a business concept that will be run. The target consumers to be targeted need to be determined in order to

know the right steps to take next. Consumer segmentation in Edu-tourism Salaran garden will facilitate the treatment given to visitors later. According to (Setyorini et all, 2017) Customer segment determines who is the target customer. The potential target market target consumers or tourists of Edu-tourism Salaran garden in all ages, the category of tourist segments in families, students and students, agencies and non-agencies. Edutourism Salaran garden can be aimed at all ages because the tour packages that will be offered such as cultivation attractions and harvest and post-harvest attractions can be enjoyed by all ages.

B. Value Proposition

The added value or Value Proposition of an Edu-tourism is very important to know what selling points it has to provide to consumers. Value Proposition must really ensure that a business becomes a solution to what is being needed by the target Customer Segment. This will certainly be a solution to the problems of target consumers. According to Osterwalder et all (2012) Value proposition is one of the reasons for visitors to switch from one tourist spot to another. Added value (value proposition) is needed in a product or service to Edu-tourism visitors. The added value of the Salaran garden is that the location is located on the Central Java-Yogyakarta cross provincial road, geographically located under the slopes of Mount Merbabu, and the center of tropical wheat studies.

C. Channels

Channels are elements that contribute to the formation of value propositions to customers, increase awareness of the products sold, allow customers to buy more specific products and/or services. The role of channels is useful for the means by which a company can communicate and reach out to its customers. The channels needed by Edu-tourism Salaran garden are as follows:

1. FPB SCWU Website
2. FPB Social Media

Utilization of publications through digital platforms needs to be intensified to reach customers widely. Promotion through social media and websites can be done more quickly spread as the times develop. In the current digital era in the field of technology, the role of social media as a source of information to reach the public easily cannot be separated.

D. Customer Relationship

Establishing relationships with consumers is an effort to maintain consumer loyalty on an ongoing basis. This is said to be relationship marketing (Dharmmesta, 1997). Activities that need to be carried out at SAlaran Garden are holding regular events (wheat harvest festival). By holding regular events at Edu-tourism Salaran garden routinely becomes a featured icon that is highlighted. Opportunities to maintain and improve relationships with visitors are carried out to maintain good relationships to remain loyal, thus creating customer retention goals (Setyorini et all, 2017).

E. Revenue Stream

Revenue Stream is the source of income of a company from the Value Proposition offered to its Customer Segment. Sources of income from Edu-tourism Salaran garden can be through:

1. Training/Workshop services on cultivation, harvesting, post-harvesting.
2. Rental of garden location for activities/events
3. Sales of products from student and lecturer research.

F. Key Resources

The Key Resources section of the business model canvas contains the key resource components for the business model to function. The resources in question are components that operate as expected. The resources owned by FPB over Salaran garden include:

A. Salaran Experimental Garden Laboratory which consists of the Salaran garden land, greenhouses, employee mess, and assets and buildings located in the Salaran garden.
B. Access to the location in the Kopeng tourist area, an alternative road between Central Java and Yogyakarta, and adequate road access.
C. There is a hotel area around Kopeng and Salatiga which is not far from the location of Salaran garden.

G. Key Activities

The Key Activities section of the business model canvas contains the key resource components for the business model to function. The resources in question are components that operate as expected. The resources owned by FPB over Salaran garden include:

1. Salaran garden tour, to invite visitors and prospective students to tour the land owned by the Faculty of Agriculture and Business of SWCU.
2. Agricultural Edu-tourism, teaching and introducing visitors to education wrapped in tourism around agriculture.

H. Key Partnership

Partners an important role in a business that will be run (Prihanto, et all. 2018). There needs to be various parties to launch the business activities carried out. To develop FPB SCWU Edu-tourism Salaran garden, institutions and organizations separate from the SCWU academic public are needed. Parties that can be invited to collaborate include:

1. Investor
2. Government
3. Tourist Bureau
4. Education Institution
5. Hotel Owners.

I. Cost Structure

Cost Structure is a component of the costs that a business needs to incur to run a business model. Costs used to create a product & service, provide added value to products & services, maintain relationships with consumers, and operational needs. The costs incurred to support the activities in the Edu-tourism Salaran garden are employee costs, maintenance costs of faculty assets, operational costs of activities, purchase of consumables (fertilizers, seeds, etc.).

CONCLUSION

Based on the results of the research, the needs of the public for Edu-tourism Salaran garden are harvest & post-harvest attractions including cultivation of vegetable plants such as lettuce, medicinal plants such as ginger, ornamental plants such as orchids, fruit plants such as grapes; The need for toilet facilities is the most desirable; Access to transportation that is easily passed by motorized vehicles. Of the 9 components of the Business Model Canvas designed, 5 blocks already exist but have not been optimized, while the other 4 components are still in the planning stage.

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THE STRATEGIC ROLE OF FARMERS' WIVES IN ENHANCING THE WELFARE OF PINEAPPLE FARMING FAMILIES IN EAST KOTAWARINGIN REGENCY

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Abstract: East Kotawaringin Regency in Central Kalimantan is a major pineapple producer with high potential in pineapple farming. Pineapple farmers in this area often face challenges in achieving sufficient income due to high production costs. The main objective of this research is to analyze the relationship between the involvement of farmers' wives in agricultural activities with the welfare of farming families and to investigate the determining factors of farmers' wives' involvement that affect the household welfare, especially pineapple farmers. The study was conducted in the Baamang Subdistrict, namely Baamang Hulu Village, Tanah Mas Village, and Tinduk Village, with 200 respondents determined through accidental sampling methods. The household welfare level was analyzed using descriptive analysis, where per capita consumption expenditure was used as a proxy for household welfare. To examine the relationship between variables influencing the involvement of farmers' wives in pineapple farming activities and further analyze its relationship with the welfare level of pineapple farming families, Partial Least Square-Structural Equation Modelling (PLS-SEM) was used, operated using SmartPLS software. The results indicate that the involvement of farmers' wives has a significant relationship with the welfare of farming families. Experience and participation in associations have a positive effect on the involvement of farmers' wives, while education has a negative impact on the involvement of farmers' wives in pineapple farming.

Keywords: Farmer wives, Welfare, Pineapple, PLS-SEM

INTRODUCTION

East Kotawaringin Regency is one of the five main regencies in Central Kalimantan known for its significant potential as a pineapple producer, with pineapple production reaching 336.4 tons (Badan Pusat Statistik Kabupaten Kotawaringin Timur, 2023). Unfortunately, pineapple farming in East Kotawaringin is predominantly carried out by small-scale farmers who are vulnerable to fluctuations in agricultural product prices. Farmers often face challenges in achieving adequate income, primarily due to high production costs, especially in acquiring quality pineapple seeds, using fertilizers, pesticides, and paying labor wages (Ceballos, Kannan, & Kramer, 2021). These difficulties are exacerbated by the fact that high production costs can exceed the income from pineapple sales.

Therefore, the participation of farmers' wives in agricultural activities is crucial, as, in addition to providing additional labor, they can also make a significant contribution to various aspects of efficient farm management (Mulyana, Fitri, Zahri, & Damayanthy, 2021).

The importance of women's participation in development is not only seen as a demand for equal rights but also as an integral element. As women, farmers' wives play a significant role in various aspects of agricultural activities, including decision-

making and task implementation in the field (Kismini, 2018) ;(Jaim & Hossain, 2011); (Rahman, Salauddin Palash, Jahan, Jalilov, & Mainuddin, 2020). Some research results indicate that about half of the women in African and Asian countries are involved in agricultural activities (Rahman et al., 2020). According to the FAO, women can contribute around 60%-80% to food supplies and help improve the food security of farming households (FAO, 2011); (Asadullah & Kambhampati, 2021); (Ishaq & Memon, 2016). The involvement of farmers' wives in agricultural activities also has a positive impact on increasing family income and promoting inclusivity in the development process (Rahmaniah, Darma, Nasaruddin, & Arsyad, 2022).

Gender challenges and disparities in resource utilization remain prominent issues in various countries, despite extensive research on the role of women in the agricultural sector (Bryan & Garner, 2022) ;(Ali, Bowen, Deininger, & Duponchel, 2016). In Indonesia, women still face male domination in terms of access and control over agricultural resources (Puspitawati, Faulkner, Sarma, & Herawati, 2019). Moreover, women often do not receive balanced benefits compared to men, especially in terms of workload, working hours, wages, technology utilization, decision-making, and crucial property and land ownership rights (Pattnaik & Lahiri-Dutt, 2020).

This research aims to analyze the relationship between the involvement of farmers' wives in agricultural activities and the welfare of farming families. The study contributes to the literature on the opportunities for the involvement of farmers' wives in agricultural activities and investigates the determining factors of farmers' wives' involvement that affect the welfare of farming households, especially pineapple farmers in the research location.

RESEARCH METHODS

This research has been conducted in the Baamang Subdistrict, which is the largest pineapple production center in East Kotawaringin Regency (Badan Pusat Statistik Kabupaten Kotawaringin Timur, 2023). The population in this study comprises all small-scale farmers whose income relies on pineapple cultivation in the East Kotawaringin Regency, Central Kalimantan, Indonesia. The purposive sampling method was used to select three villages, namely Baamang Hulu Village, Tanah Mas Village, and Tinduk Village (Figure 1). A total of 200 wives of pineapple farmers have become respondents using the accidental sampling technique.

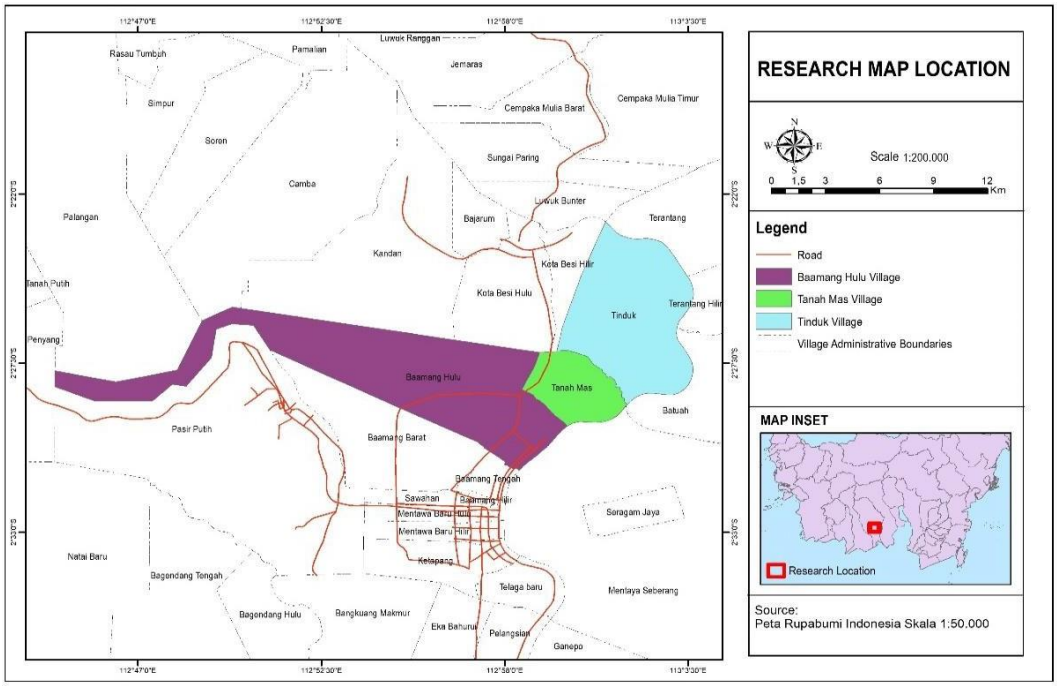

Figure 1. Research Location

The welfare level of farming households was analyzed using descriptive analysis, where per capita consumption expenditure was used as a proxy for household welfare (Mmbando, Wale, & Baiyegunhi, 2017). Per capita household consumption was based on both food (self-production, purchases, assistance, or gifts) and non-food expenditures adjusted for adults. Welfare criteria were divided into three categories: High Welfare (> IDR 5,000,000), assigned a value of 3; Moderate Welfare (IDR 1,000,000 – IDR 5,000,000), assigned a value of 2; and Low Welfare (< IDR 1,000,000), assigned a value of 1 (Badan Pusat Statistik, 2020).

Partial Least Squares-Structural Equation Modeling (PLS-SEM) operated using SmartPLS software, is an econometric approach that has been utilized as an analytical tool to examine the relationships among variables influencing the involvement of farmers' wives in pineapple farming activities. This analytical tool has also been used to further analyze its relationship with the welfare level of pineapple farming families in the research location. The variables used to determine the factors influencing the involvement of farmers' wives in agricultural activities include age, education, experience, number of dependents, land ownership status, land area, agricultural income, participation in farmer groups, and participation in agricultural associations. This research provides an overview of the relationship between the involvement of farmers' wives in pineapple farming activities and the welfare of farming households (Figure 2). This relationship will also be assessed through indicators such as the coefficient of determination, path coefficients, and the t-test value.

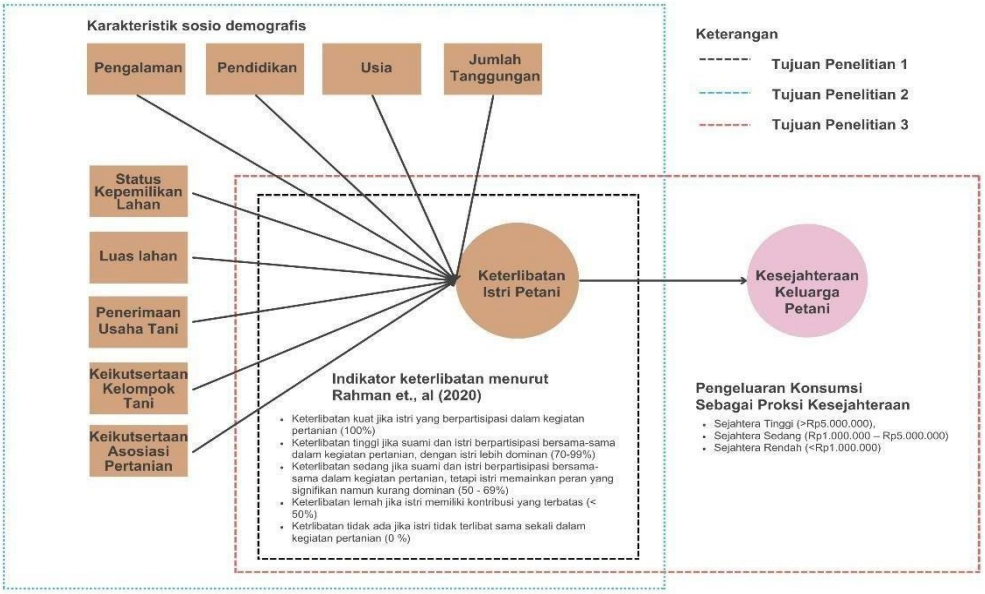

Figure 2. Research Framework

RESULTS AND DISCUSSION

Demographic and Socio-Economic Characteristics of Pineapple Farmers' Wives

Based on the findings presented in Table 1, there are 4 farmers' wives who are not involved in pineapple farming activities. Furthermore, there are 34 individuals with low involvement, 29 with moderate involvement, 101 with high involvement, and 32 with strong involvement. The characteristics of respondents based on the level of involvement have also been presented in Table 1, revealing interesting patterns in the relationship between the level of involvement of farmers' wives in pineapple farming and various observed variables. It can be observed that the average experience of respondents' wives tends to increase with the level of involvement. Additionally, the highest level of education is generally held by respondents with moderate involvement, while those not involved have a lower average education. On the other hand, although the highest average age is found in the high involvement category, age variation is low for all categories.

Tabel 1. Distribution of Characteristics of Pineapple Farmers' Wives

Variable	Involvement Of Farmer's Wife				
	Not involved n= 4 mean (st. dev)	Weak n=34 mean (st. dev)	Medium n=29 mean (st. dev)	High n=101 mean (st. dev)	Strong n=32 mean (st. dev)
Experience (Year)	6.5 (3.87)	7.65 (3.78)	9.55 (5.13)	9.07 (4.69)	11.31 (4.41)
Education (Year)	9.25 (3.77)	7.97 (2.88)	8.59 (2.23)	6.74 (2.04)	7.07 (2.32)
Age (Year)	45.5 (17.16)	43.59 (9.18)	40.21(6.19)	43.25 (7.40)	47.59 (8.19)

continued

Number of dependents (people)	2.5 (1.29)	2.35(1.25)	2.14 (1.22)	2.72 (1.28)	2.59 (1.07)
Land size (m^2)	8231.25 (9.547)	10215.44(8.468)	15975.86 (10.182)	15267.33 (6209)	17379.31 (6467)
Farming Revenue (IDR .000,-)	3.565 (4.146)	3.849 (3.112)	6.066 (3.960)	5.253 (1.831)	6.232 (2.317)
	f (%)	f (%)	f (%)	f (%)	f (%)
			Land Ownership Status		
Own land	75.00	67.65	65.52	62.38	53.13
Rent	25.00	68.75	34.48	37.62	46.88
			Participation in Farmer Groups		
Participate	50.00	47.06	34.48	36.63	43.75
Not participate	50.00	52.94	65.52	63.37	56.25
			Agricultural Association participation		
Participate	0.00	20.59	31.03	41.58	21.88
Not participate	100.00	79.41	68.97	58.42	78.13

Source: Primary Data Processing, 2023

The relationship between the involvement of farmers' wives in pineapple farming activities and the welfare of pineapple farming families.

Determination Coefficient (R2)

The coefficient of determination (R2) is a measure of the extent to which the variance in the dependent variable can be explained by the influencing variables. In other words, R2 depicts how much variance in the data can be explained, and a high value indicates the model's ability to explain the variance in the dependent variable well. The research results presented in Table 2 indicate that the involvement of pineapple farmers' wives can be explained by its constituent variables to the extent of 23.60%, while the welfare of farmers can be explained by the involvement of farmers' wives in pineapple farming activities to the extent of 12.9%.

Table 2. Results of R-Square Analysis (R2)

Variable	R^2
Involvement of Farmers' Wives	0.236
Welfare of Farmers	0.129

Source: Primary Data Processing, 2023

Path Coeficient

Table 3. Hypothesis Test Results

Hypothesis	Coef. Path	T-Stat.	P-Value	Description
Participation in Farmer Groups -> involvement of farmer's wife	-0.262	1.723	0.085	not accepted
Agricultural Association participation -> involvement of farmer's wife	**0.704**	**5.821**	**0.000**	**Accepted**
Land Size -> involvement of farmer's wife	0.125	1.185	0.236	not accepted
Education -> involvement of farmer's wife	**-0.215**	**3.144**	**0.002**	**Accepted**
Farming Revenue -> involvement of farmer's wife	0.120	1.061	0.289	not accepted
Experience -> involvement of farmer's wife	**0.184**	**2.940**	**0.003**	**Accepted**
Land Status -> involvement of farmer's wife	-0.045	0.281	0.779	not accepted
Number of dependents -> involvement of farmer's wife	-0.023	0.367	0.713	not accepted
Age -> involvement of farmer's wife	-0.095	1.248	0.212	not accepted
involvement of farmer's wife -> farmer's welfare	**0.365**	**5.771**	**0.000**	**Accepted**

Source: Primary Data Processing, 2023

Participation in Agricultural Association

Based on the research findings presented in Table 3, it is evident that there is a significant relationship between participation in the Agricultural Association and the involvement of farmers' wives ($P < 0.01$). The path coefficient of 0.704 indicates that when farmers' wives participate in Agricultural Association, there is an opportunity to engage in pineapple farming activities by 0.704 units. Through participation in agricultural associations, farmers' wives can access knowledge, information, and resources related to agriculture (Setiawati, Wijaya, & Setyowati, 2021). Agricultural associations can provide opportunities to share knowledge, exchange experiences, and receive support from the farming community. These associations often play a role in facilitating farmers' access to markets, business partnerships, and marketing opportunities (Sitoe & Sitole, 2019). Through participation in associations, farmers' wives can expand market reach, increase sales, and develop their farming enterprises. This can provide greater motivation for farmers' wives to actively engage in farming activities. Furthermore, participation in agricultural associations can provide a space for farmers' wives to have a more visible and recognized role in farming activities. This can boost their confidence and motivation to actively participate in decision-making, planning, and implementing farming tasks.

Education

There is a significant relationship between the level of education and the involvement of farmers' wives. The path coefficient of -0.215 indicates that each one-unit increase in the level of education is followed by a decrease of 0.215 units in the involvement of farmers' wives. Based on field observation data, it is observed that the higher the level of education of pineapple farmers' wives, the lower their involvement in pineapple farming activities. This is attributed to the fact that higher education levels among pineapple farmers' wives can create job opportunities outside the agricultural sector. This is in line with the findings of Study (Osanya, Adam, Otieno, Nyikal, & Jaleta, 2020) and (Sahidu, Made, & Riniwati, 2021) When women receive education, they have more opportunities for employment and entrepreneurship. With higher education, pineapple farmers' wives can possess relevant skills sought in other sectors such as services, trade, or industry. This implies that they have flexibility and options to seek employment outside agriculture, which, in turn, can influence their involvement in farming activities. The involvement of pineapple farmers' wives in non-agricultural jobs can impact their participation in farming. They may have limited time and energy to actively engage in farming activities, especially if jobs in other sectors require greater time commitment.

Experience in pineapple farming

There is a significant relationship between experience and the involvement of farmers' wives. The path coefficient for the experience variable (0.184) indicates that each one-unit increase in experience contributes to an increase of 0.184 units in the involvement of farmers' wives. Experience can provide farmers' wives with the knowledge, skills, and confidence needed to actively engage in farming activities. Through experience, farmers' wives can learn how to manage crops, use farming tools, overcome potential challenges, and optimize agricultural yields (Ainembabazi & Mugisha, 2014). With better experience, farmers' wives can play a more active role in agricultural decision-making, share knowledge with their husbands and other family members and contribute to the planning and implementation of farming activities (Rayasawath, 2018). Experience can also boost the confidence of farmers' wives in interacting with external parties, such as extension officers, business partners, or farming groups, thereby expanding social networks and collaboration opportunities.

Involvement of Farmers' Wives in Family Welfare

There is a significant relationship between the involvement of farmers' wives and the welfare of farmers. The path coefficient for the involvement of farmers' wives (0.365) indicates that each one-unit increase in the involvement of farmers' wives contributes to an increase of 0.365 units in the welfare of farmers. From the research results, it is found that the participation of farmers' wives in farming activities often provides additional labor. In the conducted study, it was discovered that participation in agricultural associations, experience, and education of farmers' wives collectively have a significant impact on their involvement in pineapple farming. Participation in agricultural associations provides access to information, training, and social networks that strengthen the involvement of farmers' wives. Previous experience in farming imparts the knowledge and skills needed, while higher education enhances understanding and skills in various aspects of agriculture. The involvement of farmers'

wives in pineapple farming positively impacts the welfare of farmers through increased productivity (Rahmaniah et al., 2022), better decision-making (Gebre, Isoda, Rahut, Amekawa, & Nomura, 2021), and enhanced income (Jaim & Hossain, 2011).

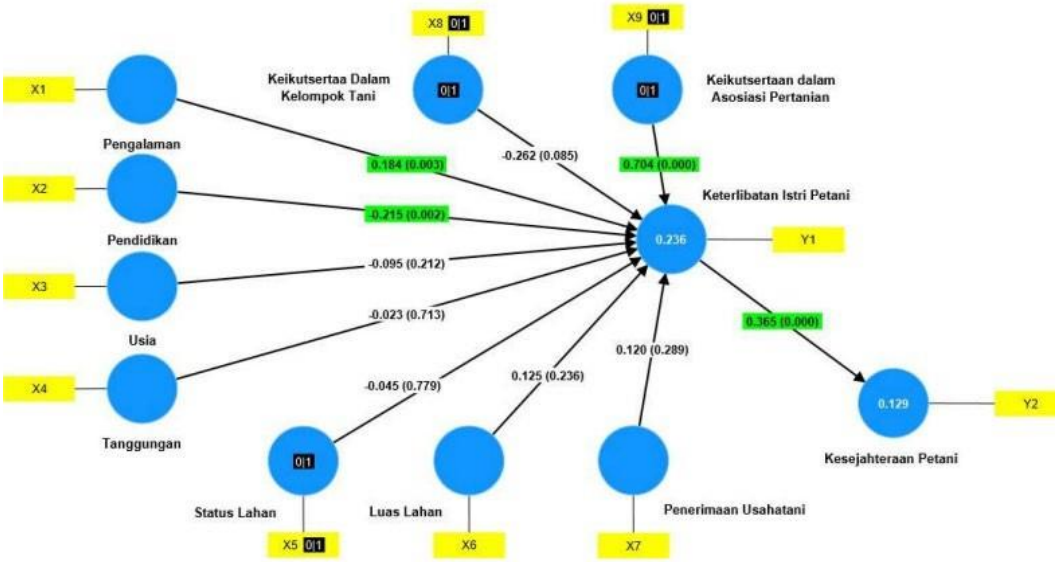

Figure 3. Structural model testing by PLS

CONCLUSION

The main focus of this research is to analyze the relationship between the involvement of farmers' wives in agricultural activities and its impact on the welfare of farming families. Based on the research results, it indicates that the involvement of farmers' wives has a significant relationship with the welfare of farming families, where the involvement of farmers' wives in pineapple farming in the research location is considered high. Experience and participation in associations positively influence the involvement of farmers' wives, while education has a negative effect on the involvement of farmers' wives in pineapple farming.

These findings have important implications in the context of sustainable agricultural development. Participation in agricultural associations and experience prove to be crucial factors in enhancing the involvement of farmers' wives. Therefore, there is a need for more intensive education and training programs to enhance the understanding and involvement of farmers' wives. Meanwhile, efforts to improve the education level of farmers' wives should also be considered. In the policy context, it is recommended that the government and agricultural organizations develop strategies that support the participation of farmers' wives in agricultural associations and provide further support to aspects that strengthen their involvement in pineapple farming.

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EXPLORING FARMERS' AND FARM WORKERS' PERSPECTIVES ON MECHANIZATION AND ITS IMPACT ON THE EDUCATION OF THEIR CHILDREN: A FOUNDATION FOR ENHANCING INCOME OPPORTUNITIES

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Abstracts: The study investigates the pivotal role of farmers' and farm workers' perceptions of mechanization in shaping educational opportunities for their children and influencing income augmentation strategies. Employing a quantitative-descriptive research design, 40 respondents in Nueva Ecija were purposively sampled, and structured questionnaires were administered. Farmers and farm workers overwhelmingly view mechanization as a significant economic asset, streamlining tasks and enhancing profitability. While farmers believe mechanization positively contributes to meeting their children's educational needs, covering miscellaneous fees, extracurricular activities, events, and educational tours, farm workers express skepticism about its efficacy in facilitating tertiary education access for their children. The research recommends seminars to empower both groups, create job opportunities, and diversify income sources. It also suggests financial support from local lending institutions and government recognition of landless farm workers through subsidies and welfare programs. This study provides a foundation for developing strategies that align mechanization, education, and income augmentation to foster sustainable rural development.

Keywords: Mechanization perception, agricultural practices enhancement, perspective of farmers, farm workers, income strategies.

INTRODUCTION

Agriculture in the Philippines stands as a vital economic pillar, encompassing four distinct sub-sectors: fisheries, forestry, livestock, and farming. In 2021, this sector played a significant role in the country's economic landscape, contributing a gross value added (GVA) of 1.76 trillion pesos, equivalent to 9.6 percent of the Gross Domestic Product (GDP). This underscores the crucial role of the agricultural sector in supporting rural communities and providing livelihoods for families engaged in agricultural activities. However, despite its importance, a notable gap exists in the literature, particularly in understanding the impact of agricultural mechanization on social and economic aspects, such as child labor and education.

The integration of technology into agricultural practices has given rise to agricultural mechanization, a term encompassing the production, distribution, and utilization of tools, implements, and machines to enhance farmland development, agricultural output, and post-production procedures. This process leverages various sources of power, including human, animal mechanical, natural, and non-conventional sources of energy. Widely acknowledged for optimizing farm operations, reducing production costs, and minimizing post-harvest losses, agricultural mechanization is crucial for increasing farmers' income. Historical evidence reveals its role in Western industrialization, a trend that many Asian countries, including the Philippines, have embraced in the 21st century through the development of tailored laws and infrastructure.

Despite the potential benefits, Filipino farmers are faced with challenges in adopting agricultural mechanization. Government policies and the country's low mechanization level, as identified by Suministrado (2009), pose significant barriers. Factors such as abundant rural labor, high machine costs, small landholdings per farmer, and unfavorable government policies contribute to this low level. This gap in understanding the impediments to mechanization in the Philippines is essential for developing effective strategies to promote its adoption and enhance the agricultural sector's productivity.

Furthermore, research by Rob VOs and H. Takeshima (2021) underscores the social implications of agricultural mechanization, particularly in relation to child labor and education. The study indicates that the use of machinery, such as tractors, considerably decreases the likelihood of child labor and improves children's attendance in school. However, the scale of these effects is moderate and dependent on factors such as household income, rural infrastructure quality, and education accessibility. This highlights the need for a more nuanced understanding of the socio-economic impact of mechanization in the Filipino context.

The concern of child labor in agriculture extends beyond the Philippines, with recent FAO_IFPRI research indicating varying prevalence rates across Asian and African nations. This study aligns Sustainable Development Goal 2 (SDG 2) for "zero hunger" and SDG 4, focusing on inclusive and equitable quality education for all. The existing gap in literature regarding the specific socio-economic implications of agricultural mechanization on child labor and education emphasizes the importance

of this research in contributing to the broader understanding of sustainable agricultural development.

In conclusion, this introduction identifies the significance of the agricultural sector in the Philippines, introduces the concept of agricultural mechanization, and highlights a critical gap in the literature concerning its impact on social and economic aspects, particularly child labor and education. The subsequent sections of this paper aim to address and contribute to filling this gap, providing valuable insights for policymakers, researchers, and stakeholders in the agricultural sector.

RESEARCH METHODS

Research Design

This study adopts a quantitative research design, specifically utilizing the survey method to explore the perceptions of farmers and farm workers in Nueva Ecija regarding agricultural mechanization and its implications for their children's education. Quantitative research involves systematically collecting quantifiable data and employing statistical, mathematical, or computational techniques to analyze phenomena, situations, or populations. The survey method, one of the main types of quantitative research, involves the use of survey questionnaires to gather information.

Sampling Design

Purposive sampling was employed in this study, where participants were deliberately chosen to align with the study's objectives. According to Jim Frost (2007) and Robinson (2007), purposive sampling involves selecting participants based on their ability to explain a specific theme, concept, or phenomenon. The researchers intentionally selected 20 farmers and 20 farm workers, totaling 40 respondents from Nueva Ecija, to ensure a targeted and purposeful sample.

Research Instrument: A set of closed-ended questions, constructed by the researchers, was used in the form of a survey questionnaire to collect data. The questionnaire consists of four main parts, covering the demographic profile of farmers and farm workers, perceptions of mechanization in terms of economy, income, and labor, and implications of mechanization on the education of farm workers' children. A Likert scale was employed to assess the suitability of each indicator, with weighted points assigned to different ranges to gauge the respondents' agreement or disagreement.

Procedure of the Study

The researchers employed a purposive sampling technique, as described by Neetij R. (2004), to select participants based on the characteristics of the population and the study's objectives. Survey questionnaires were distributed to the children of farmers and farm workers in Nueva Ecija University of Science and Technology.

Target Participants: The primary focus of this study is on farmers in Nueva Ecija, but the survey questionnaires were distributed to the children of both farmers and farm

workers who are 1st to 4th-year students under the BSIE and BTLED programs.

Statistical Treatment

After collecting completed questionnaires, data were collated and analyzed using frequency and percentage tables and weighted mean. Frequency distribution was utilized to present demographic profile data, while percentages were computed to analyze data on various profiles. Weighted frequency, indicating the estimated count in the population with the combination of values, was applied.

Data Gathering

The data gathering process involved several steps such as approval, permission, identification, actual survey, presentation, tabulation, and analysis of data.

RESULTS AND DISCUSSION

This includes the presentation, analysis and interpretation of the gathered data on the profile of the respondents in terms of sex and age.The data collected from the questionnaires were presented through frequency and percentage distribution.
This section describes the respondents in terms of sex and age.

Table 2 a. Respondents in terms of sex and age

Sex	Frequency	Percentage (%)
Male	16	80%
Female	4	20%
Total	20	100%

The majority of the respondents, constituting 16 individuals or 80% of the total sample, identified as male while the remaining portion of the respondents, comprising 4 individuals or 20% of the total sample, identified as female. The table includes a total of 20 respondents, representing the entirety of the population surveyed.

Table 2 b. Respondents according to sex of farm workers

Sex	Frequency	Percentage (%)
Male	16	80%
Female	4	20%
Total	20	100%

Among the respondents, 16 individuals identified as male, constituting 80% of the total sample. There were 4 female respondents, representing 20% of the total sample.The table includes a total of 20 respondents, encompassing both male and female participants. The percentages reflect the proportion of each gender category concerning the total number of respondents.

Table 2 c. Frequency and percentage Distribution of the

Respondents according to age of farmers

Age	Frequency	Percentage
25-30	0	0%
31-35	0	0%
36-40	1	5%
41-45	5	25%
46-50	4	20%
51-55	7	35%
56-60	3	15%
Total	20	100%

The table includes a total of 20 respondents, covering different age groups. The distribution suggests a skewed representation toward older age groups, with the majority of farmers being between 41 and 55 years old. Consideration of age is crucial when interpreting findings, as different age groups may have distinct perspectives on agricultural mechanization. Researchers are cautious about generalizing findings to younger farmers, given the lack of representation in the 25-35 age range.

Table 2.c Frequency and percentage distribution of the respondents according to age of farm workers

Age	**Frequency**	**Percentage**
25 - 30	2	10%
31 - 35	1	5%
36 - 40	6	30%
41 - 45	3	15%
46 - 50	3	15%
51 - 55	3	15%
56 - 60	1	5%
61 - 65	1	5%
Total	**20**	**100%**

The table presents a varied distribution of farm worker respondents across different age groups. The largest representation is observed in the 36 - 40 age range, comprising 30% of the total sample. This breakdown provides valuable insights into the age composition of farm workers participating in the study. Researchers should consider these variations in age when interpreting the collected data, recognizing potential differences in perspective and experiences related to agricultural mechanization among different age groups.

1. How do farmers and farm workers perceive farm mechanization in terms of:

Table 3.1a Economy (Farmers)

No	Economy	Mean	Verbal Interpretation
1	Farm mechanization helps accomplish cultural practices like harvesting	3.75	Strongly Agree
2	Farm mechanization helps the national economy	3.55	Strongly Agree
3	Farm mechanization may help reduce farm losses due to typhoon and flooding	3.55	Strongly Agree
4	Farm mechanization may help increase productivity and crop yields	3.55	Strongly Agree
5	Farm mechanization will help nation building	3.55	Strongly Agree
6	Farm mechanization may help poverty alleviation for farmers and farm workers	3.45	Strongly Agree
7	Farm mechanization plays an important role not just in rural development but in economic as well	3.40	Strongly Agree
8	Farm mechanization helps improve the farmers' and farm workers' economic condition.	3.30	Strongly Agree
9	Farm mechanization reduces poverty and achieves food security while improving people's livelihood.	3.15	Agree
10	Farm mechanization creates employment and is useful for urbanization	3.15	Agree
11	Farm mechanization increases industrial production	3.15	Agree
	Pooled Mean	3.42	Strongly Agree

Legends: *1.00 - 1.75 Strongly disagree (1); 1.76 - 2.50 Disagree (2); 2.51 -3.25 Agree; (3), 3.26 - 4.00 Strongly Agree (4)*

The table depicts farmers' perceptions of farm mechanization's role in the economy, presenting a pooled mean of 3.42 and an overall verbal interpretation of "strongly agree." Noteworthy strong agreements include the belief that farm mechanization aids in accomplishing cultural practices, contributes to the national economy, and may reduce farm losses due to natural disasters. Farmers strongly agree that mechanization is pivotal for rural and economic development, indicating a positive outlook on its multifaceted benefits. Additionally, the study aligns with findings from "The Impact of Agricultural Mechanization on Agricultural Production, Income, and Mechanism; Evidence from Hubei Province, China," supporting the notion that increased mechanization positively influences crop yields, agricultural production, and income. This suggests farmers view mechanization as a significant factor in enhancing agricultural profitability, labor efficiency, and overall livelihoods, underscoring its potential for sustainable development and poverty reduction.

Table 3.1b Economy (Farm Workers)

No	Economy	Mean	Verbal Interpretation
1	Farm mechanization plays an important role not just in rural development but in the economy as well	3.80	Strongly Agree
2	Farm mechanization helps accomplish cultural practices like harvesting	3.70	Strongly Agree
3	Farm mechanization reduces poverty and achieves food security while improving people's livelihood.	3.60	Strongly Agree
4	Farm mechanization helps in the agricultural development of the country.	3.60	Strongly Agree
5	Farm mechanization may help poverty alleviation for farmers and farm workers.	3.55	Strongly Agree
6	Farm mechanization may help reduce farm losses due to typhoon and flooding	3.30	Strongly Agree
7	Farm mechanization helps improve the farmers and farm workers' economic status.	3.50	Agree
8	Farm mechanization increases industrial production	3.20	Agree
9	Farm mechanization helps the national economy	3.15	Agree
10	Farm mechanization helps increase productivity and crop yields.	3.30	Agree
11	Farm mechanization helps in creating/providing opportunities that are useful for urbanization.	3.00	Agree
13	Pooled Mean	3.43	Strongly Agree

Legends: *1.00 - 1.75 Strongly disagree (1); 1.76 - 2.50 Disagree (2); 2.51 -3.25 Agree; (3), 3.26 - 4.00*
Strongly Agree (4)

The table outlines farm workers' perceptions of farm mechanization's impact on the economy, presenting a pooled mean of 3.43 and an overall verbal interpretation of "strongly agree." Notable strong agreements include the belief that mechanization plays a crucial role in rural and economic development, achieves cultural practices, reduces poverty, enhances food security, and improves overall livelihoods. Additionally, farm workers agree that mechanization contributes to agricultural development, aids in poverty alleviation, reduces farm losses due to natural disasters, and has positive implications for economic status and industrial production. The findings affirm a positive outlook among farm workers regarding the multifaceted benefits of farm mechanization. This aligns with existing literature, such as studies on the socioeconomic impact of mechanization in agriculture (e.g., cite references), providing further support for the positive perceptions held by farm workers regarding the broader economic contributions of mechanization. The strong agreement on these aspects indicates a consensus among farm workers on the pivotal role of mechanization in shaping economic outcomes in agriculture.

Table 3.1c Labor (Farmers)

No	Labor	Mean	Verbal Interpretation
1	Farm mechanization resolves labor shortages	3.60	Strongly Agree
2	Farm mechanization helps farmers and farm workers perform their job easily	3.55	Strongly Agree
3	Farm mechanization helps in easily accomplishing agricultural activities like harvesting	3.40	Strongly Agree
4	Farm mechanization helps in decreasing the demand for manual labor	3.05	Agree
5	Farm mechanization helps in easily accomplishing agricultural activities like harvesting	3.25	Agree
6	Farm mechanization helps farmers and farm workers to expand their farming activities.	3.25	Agree
7	Farm mechanization reduces labor expenses	3.05	Agree
8	Farm mechanization increases labor efficiency and productivity	3.10	Agree
9	Farm mechanization helps the national economy	3.01	Agree
	Pooled Mean	3.30	Strongly Agree

Legends: *1.00 - 1.75 Strongly disagree (1); 1.76 - 2.50 Disagree (2); 2.51 -3.25 Agree; (3), 3.26 - 4.00 Strongly Agree (4)*

The table presents farmers' perceptions of farm mechanization's impact on labor, with a pooled mean of 3.30 and an overall verbal interpretation of "strongly agree." Noteworthy strong agreements include the belief that mechanization resolves labor shortages (Mean: 3.60), helps farmers and farm workers perform their jobs easily (Mean: 3.55), and facilitates the easy accomplishment of agricultural activities like harvesting (Mean: 3.40). The highest result, "Farm mechanization resolves labor shortages," underscores the importance of mechanization in addressing labor challenges, potentially indicating farmers' recognition of its efficiency in mitigating workforce gaps. On the other hand, the lowest result, "Farm mechanization helps the national economy" (Mean: 3.01), while still falling within the "agree" range, is relatively lower compared to other statements. This may suggest that farmers, while generally positive about the economic impact of mechanization, may not perceive it as strongly linked to national economic growth compared to other aspects (Taonga, 2002).

According to Sidhoum,A. A. (2001), agricultural mechanization has become more prevalent in the twentieth century as a means of accelerating production.To highlight the positive effects of mechanization on labor efficiency and productivity, aligning with the farmers' perceptions in this table. The acknowledgment of mechanization in resolving labor shortages aligns with existing literature on the

transformative impact of technology in addressing agricultural labor challenges. The overall agreement on these statements reflects farmers' positive attitudes toward the labor-related benefits of farm mechanization, contributing to increased efficiency and productivity in agricultural practices.

Table 3.1d (Labor Workers)

No	Labor	Mean	Verbal Interpretation
1	Farm mechanization helps in decreasing the demand for manual labor.	3.65	Strongly Agree
2	Farm mechanization helps farmers and farm workers perform their job easily.	3.65	Strongly Agree
3	Farm mechanization helps in easily accomplishing agricultural activities like harvesting.	3.60	Strongly Agree
4	Farm mechanization reduces labor expenses.	3.50	Strongly Agree
5	Farm mechanization increases labor efficiency and productivity	3.30	Strongly Agree
6	Farm mechanization resolves labor shortages.	3.25	Agree
7	Farm mechanization helps farmers and farm workers to expand their farming activities	3.20	Agree
8	Farm mechanization increases the demand for hired labor	3.05	Agree
9	Farm mechanization may provide livelihood for farmers and farm workers.	3.05	Agree
	Pooled Mean	3.33	Strongly Agree

Legends: *1.00 - 1.75 Strongly disagree (1); 1.76 - 2.50 Disagree (2); 2.51 -3.25 Agree; (3), 3.26 - 4.00 Strongly Agree (4)*

The table reveals labor workers' perceptions of farm mechanization's impact on labor-related aspects, yielding a pooled mean of 3.33 and an overall verbal interpretation of "strongly agree." Noteworthy strong agreements include the belief that mechanization helps decrease the demand for manual labor (Mean: 3.65) and assists farmers and farm workers in performing their jobs easily (Mean: 3.65). These results highlight the efficiency and ease that labor workers associate with the adoption of mechanized practices, underscoring the positive impact on manual labor requirements and job performance. The highest result, "Farm mechanization helps in decreasing the demand for manual labor," emphasizes the significant role of mechanization in reducing reliance on manual labor, potentially leading to increased efficiency and cost-effectiveness in agricultural activities.The lowest results, "Farm mechanization increases the demand for hired labor" and "Farm mechanization may provide livelihood for farmers and farm workers" (both with a mean of 3.05), still fall within the "agree" range but are relatively lower compared to other statements. This suggests that labor workers may not perceive mechanization as strongly linked to increased demand for hired labor or as a direct source of livelihood compared to other aspects, Raman, M. (2018).

To support these findings, studies such as the study of Sidhoum,A.A. (2001),

agricultural mechanization has become more prevalent in the twentieth century as a means of accelerating production, emphasizes the positive effects of mechanization in reducing manual labor demand and enhancing overall efficiency in agricultural activities. The high agreement on these statements aligns with existing literature on the transformative impact of technology in optimizing labor utilization and contributing to sustainable livelihoods in agriculture.

Table 3.1e Income (Farmers)

No	Income	Mean	Verbal Interpretation
1	Farm mechanization helps farmers and farm workers to produce more products leading to high profits.	3.45	Strongly Agree
2	Farm mechanization helps increase farmers' and farm workers' profit.	3.40	Strongly Agree
3	Farm mechanization helps increase farmers and farm workers' profit.	3.40	Strongly Agree
4	Farm mechanization helps farmers and farm workers to save money by using farm machinery.	3.35	Strongly Agree
5	Farm mechanization improves the ability of farmers and farm workers in using agricultural machinery and equipment to increase operating profits.	3.35	Strongly Agree
6	Farm mechanization helps reduce farm operation cost.	3.30	Agree
7	Farm mechanization helps enhances market access by allowing farmers and farm workers to sell more than just the raw products.	3.30	Agree
	Pooled Mean	3.36	Strongly Agree

Legends: *1.00 - 1.75 Strongly disagree (1); 1.76 - 2.50 Disagree (2); 2.51 -3.25 Agree; (3), 3.26 - 4.00*
Strongly Agree (4)

The table outlines farmers' perceptions of farm mechanization's impact on income-related aspects, yielding a pooled mean of 3.36 and an overall verbal interpretation of "strongly agree." Notable strong agreements include the belief that mechanization helps farmers and farm workers produce more products leading to high profits (Mean: 3.45) and increases their overall profit (Mean: 3.40). These results underscore the positive association between farm mechanization and enhanced income generation, highlighting the potential for increased productivity and profitability. The highest result, "Farm mechanization helps farmers and farm workers to produce more products leading to high profits," indicates the perceived ability of mechanization to boost production output, contributing to higher profits. This aligns with existing literature, such as studies on the economic impact of mechanization in agriculture (cite references), which supports the idea that mechanization can lead to increased yields and, consequently, higher profits. The lowest results, "Farm mechanization helps

reduce farm operation cost" and "Farm mechanization helps enhance market access by allowing farmers and farm workers to sell more than just the raw products" (both with a mean of 3.30), while still within the "agree" range, are relatively lower compared to other statements. This suggests that farmers may not perceive the impact of mechanization on cost reduction and market access as strongly as other income-related aspects.

In summary, the strong agreement on statements related to increased production and profits indicates farmers' positive attitudes toward the income generating potential of farm mechanization. These perceptions align with the broader understanding that mechanization contributes to economic benefits for farmers and farm workers.

Table 3.1f Income (Farm Workers)

No	Income	Mean	Verbal Interpretation
1	Farm mechanization helps farmers and farm workers to produce more products leading to high profits.	3.35	Agree
2	Farm mechanization helps increase agricultural productivity.	3.25	Agree
3	Farm mechanization enhances market access by allowing farmers and farm workers to sell more than just the raw products.	3.15	Agree
4	Farm mechanization helps increase farmers' and farm worker's profit.	3.01	Agree
5	Farm mechanization improves the ability of farmers and farm workers in using agricultural machinery and equipment to increase operating profits.	3.01	Agree
6	Farm mechanization helps farmers and farm workers to save money by using farm machinery.	2.95	Agree
7	Farm mechanization helps reduce farm operational cost.	2.09	Agree
	Pooled Mean	3.11	Agree

Legends: 1.00 - 1.75 Strongly disagree (1); 1.76 - 2.50 Disagree (2); 2.51 -3.25 Agree; (3), 3.26 - 4.00 Strongly Agree (4)

The table outlines farm workers' perceptions of farm mechanization's impact on income-related aspects, yielding a pooled mean of 3.11 and an overall verbal interpretation of "agree." Notable agreements include the belief that mechanization helps farmers and farm workers produce more products leading to high profits (Mean: 3.35) and increases agricultural productivity (Mean: 3.25). These results suggest that farm workers acknowledge the positive association between farm mechanization and improved income generation, emphasizing enhanced productivity and profitability. The highest result, "Farm mechanization helps farmers and farm workers to produce more products leading to high profits," signifies the perceived ability of mechanization to contribute to increased production output, translating into higher profits. This aligns with existing literature on the positive economic impact of mechanization in agriculture,

supporting the notion that mechanization can lead to higher yields and, consequently, improved profits. The lowest result, "Farm mechanization helps reduce farm operational cost" (Mean: 2.09), while still within the "agree" range, is relatively lower compared to other statements. This suggests that farm workers may not perceive the impact of mechanization on operational cost reduction as strongly as other income-related aspects.

According to prairieland partners (2021), farm mechanization helps both small and large farms earn more money and reduces the labor that needs to be paid while the overall agreement on statements related to increased production and profits indicates farm workers' positive attitudes toward the income-generating potential of farm mechanization. These perceptions align with the broader understanding that mechanization contributes to economic benefits for farmers and farm workers.

Table 4.1a Education Farmers' Children

No	Economy	Mean	Verbal Interpretation
1	Farm mechanization eases worry of providing proper education to children.	3.60	Strongly Agree
2	Farm mechanization profit helps in providing the children 's uniforms and school supplies.	3.60	Strongly Agree
3	Farm mechanization helps provide for children's needs.	3.55	Strongly Agree
4	With the help of farm mechanization, it is easier to send children up to tertiary school.	3.50	Strongly Agree
5	With the help of farm mechanization, school contribution can be paid.	3.35	Strongly Agree
6	With the help of farm mechanization fees for extracurricular activities, events, and educational tours for children are provided.	3.35	Strongly Agree
7	With the help of farm mechanization, there is enough time to attend school activities of children.	3.30	Strongly Agree
8	Farm mechanization helps improve household income and local conditions such as quality of rural infrastructure, accessibility of education and other social services.	3.35	Strongly Agree
9	With the help of farm mechanization, children's school expenses such as miscellaneous fees can be provided.	3.25	Agree
10	With the help of farm mechanization, it is easier to provide the needs and wants of the children.	3.30	Agree
	Pooled Mean	3.41	Strongly Agree

Legends: *1.00 - 1.75 Strongly disagree (1); 1.76 - 2.50 Disagree (2); 2.51 -3.25 Agree; (3), 3.26 - 4.00 Strongly Agree (4)*

The table elucidates farmers' perceptions regarding the impact of farm mechanization on the education of their children, yielding a pooled mean of 3.41 and an overall verbal interpretation of "strongly agree." The results reveal that farmers

strongly agree with statements emphasizing the positive influence of farm mechanization on the educational aspects of their children. The highest result, shared by statements 1 and 2 with a mean of 3.60, suggests that farmers strongly believe that farm mechanization eases worry about providing proper education to their children and contributes to providing uniforms and school supplies. These outcomes highlight the farmers' conviction in the educational benefits brought about by farm mechanization, aligning with the idea that increased income and improved living conditions positively impact children's education. The lowest result, statement 9 with a mean of 3.25, although still within the "agree" range, is relatively lower compared to other statements. This suggests that farmers may perceive providing miscellaneous school fees as less impacted by farm mechanization compared to other aspects of education.

In summary, the strong agreement on statements related to easing worries, providing resources, and supporting various aspects of children's education indicates farmers' positive attitudes toward the educational benefits of farm mechanization. These perceptions align with the broader understanding that increased income and improved living conditions can contribute to better educational opportunities for children.

CONCLUSION

The findings of this study affirm the significant contribution of farm mechanization to the country's economy. The positive impact of farm mechanization is evident in its ability to alleviate the labor burden on both farmers and farm workers, leading to heightened efficiency in agricultural activities. This effectiveness extends to the economic realm, with farm mechanization not only bolstering income but also reducing overall farming costs while enhancing agricultural productivity. However, the study sheds light on specific limitations, particularly in terms of facilitating tertiary education for the children of farmers and farm workers. Despite aiding in meeting basic financial needs for education, such as uniforms and school supplies, the study emphasizes the existing challenges in supporting higher education expenses.

While farm mechanization undeniably brings about notable economic advantages, this study underscores the necessity for targeted interventions or support mechanisms to address the unique challenges associated with higher education costs. Policymakers and stakeholders in agricultural development should consider these nuanced findings when formulating strategies to optimize the benefits of farm mechanization. This approach is crucial for fostering sustainable and inclusive agricultural growth that comprehensively addresses the needs and aspirations of individuals engaged in farming activities.

RECOMMENDATION

Based on the findings of the study, several recommendations can be put forth to enhance the impact of farm mechanization on the livelihoods of farmers and farm workers. Firstly, there is a need for targeted interventions or support programs to address the specific challenges related to higher education expenses for the children of farmers. As the study revealed, while farm mechanization contributes significantly to income and reduces certain education-related costs, it may not be sufficient to

support tertiary education needs. Policymakers and relevant stakeholders should explore possibilities for educational assistance programs or scholarships to ensure access to higher education for the next generation of farming communities. Additionally, efforts should be directed towards continuous technological advancements and training programs to maximize the benefits of farm mechanization, ultimately improving labor efficiency and increasing overall productivity. Moreover, financial literacy programs tailored for farmers and farm workers could empower them to manage their increased income effectively and allocate resources strategically. These recommendations aim to build upon the positive aspects identified in the study and address the existing limitations, fostering sustainable development in agricultural communities.

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ANALYSIS OF TOBACCO FARMING INCOME, BUKIT BARISAN DISTRICT, LIMAPULUH KOTA REGENCY, WEST SUMATRA PROVINCE

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Abstract: The purpose of this research to find the average income of tobacco farmers.The data collected in this research is primary data and secondary data.The analysis used to determine the average income of tobacco farmers is seen from the subtraction between total farming revenues and total costs.From the results of this research, it was found that the average income of tobacco farmers in Bukik Barisan District per crop season (6 months) was IDR. 7,465,760.09 with an average production of 95.73 Kg. Then the average monthly income is Rp. 1,244,293.

Keywords: Income, cost, revenue, tobacco

INTRODUCTION

Tobacco is one of Indonesia's most important commercial products. The most important commercial tobacco products are tobacco leaves and cigarettes. Tobacco and cigarettes are valuable products, and several countries, such as Indonesia, play a role in the national economy as one source of tobacco. currency, government income sources and taxes, farmer income sources and community employment (agriculture and cigarette processing) (Kustiawati Ningsih, 2017).

Research on tobacco farming analysis is important to do because farming analysis can illustrate whether farming is profitable or not,by comparing costs and revenues in a production process.In addition, the purpose of this farm analysis is to maximize profits or minimize costs and find information about the diversity of a farm from various aspects.The study of these various aspects is very important because each type of farming at each type of business scale and specific location is different from one another,because there are differences in the characteristics of the farms in question (Soekartawi, 1995:1).

Based on the description above, the author wants to know how much the average income of tobacco farmers in Bukik Barisan District, Lima Puluh Kota Regency, West Sumatra Province.

RESEARCH METHODS

The study was conducted in Bukit Barisan subdivision, Puluh Kota district of Lima.The research site was purposefully selected based on the fact that the Bukit Barisan area is the center of tobacco production in the Puluh Kota area of Lima and has low tobacco productivity. The data collected in this study is primary and secondary data. Basic information was obtained from the results of interviews and direct data collection for each tobacco farmer, extension workers and related persons using questionnaires. Secondary data is additional data obtained from Plantation Office, BPS and results of literature surveys.

The study involved tobacco farmers in the Bukit Barisan district of Lima Puluh Kota kingdom. A total of 30 people were tested. Sampling was done with purposive sampling, so in this study, the selection of the sample is based on farmers who were engaged in tobacco cultivation during the study.

Analysis of Farm Net Income

To determine net income, the following formula is used:

$$P = TR - TC$$

Description:

P : Net farm income
TR : Total farming revenue
TC : Total cost

To calculate Revenue can be calculated using the following formula:

$$TR = P \; x \; Q$$

Description:

TR : Total Revenue
Q : Quantity
P : Price

RESULTS AND DISCUSSION

Agricultural income is the total income from the results of agricultural activities and the deduction of all the total costs of the production process. The total income of the farm is a multiplier of the production and sale price of agricultural products, while the total expenses are all expenses incurred on the farm. The average price received by tobacco farmers in the Bukit Barisan subdistrict is Rp. With 112,633 tobacco farms with an average production of 95.73 kg, the income from tobacco cultivation in Bukit Barisan subdistrict is Rp. 10,782,357.1. The average income of tobacco farmers in Bukik Barisan district per harvest season (6 months) is Rp. 7,465,760.09 with an average production of 95.73 kg and an average cost of Rp. 3,316,597. Then the average monthly income is Rp. 1,244,293. Compared to the West Sumatra Provincial Minimum Wage (UMP) in 2023 of Rp. 2,742,476 euros per month, income from tobacco cultivation in Bukik Barisan District,Limapuluh Kota Region, West Sumatra Province is classified as low as it continues to be under the UMP.

CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that the average income of tobacco farmers in Bukik Barisan district per crop season (6 months) is Rp. 7,465,760.09 and an average production of 95.73 kg. Then the average monthly income is Rp. 1,244,293. Compared to the West Sumatra Provincial Minimum Wage (UMP) in 2023 of Rp. 2,742,476 euros per month, income from tobacco cultivation in Bukik Barisan District, Lima Puluh Kota Region, West Sumatra Province is classified as low as it continues to be under the UMP.

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INFLUENCE OF PRODUCT QUALITY CONSUMER SATISFACTION ON SEBLAK IN CIREBON, WEST JAVA PROVINCE

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Abstract: Seblak is a traditional food originating from the city of Bandung, West Java Province, which is famous for its fragrant aroma, savory and spicy taste, making it very popular among teenagers, especially students. Seblak is served to consumers in a variety of practical containers, but the taste is guaranteed so that consumer satisfaction can still be maintained. This study aims to analyze the effect of containers on seblak consumer satisfaction in Cirebon City along with the indicators that best explain the conditions of these two variables. The research was conducted in April-May 2023 using a quantitative research design and survey method. The research population is seblak consumers in Cirebon City whose number is unknown, so the sample size is determined based on the Lemeshow formula, namely 100 respondents. Data analysis using the Structural Equation Model instrument. The results of the study concluded that the container has a positive effect on seblak consumer satisfaction (0.81) and the indicator that can best explain the condition of the product variable is "receptacle" while the consumer satisfaction variable is "feels happy". Thus, it is suggested to seblak business actors to always maintain the existing seblak containers or packages and to other researchers to research seblak consumer preferences so that consumers can find out the attributes that consumers like.

Keywords: Cirebon, Lemeshow, Receptacle, Seblak, Traditional food

INTRODUCTION

In recent times, spicy culinary delights have become increasingly popular among Indonesian people. The tempting spicy sensation attracts people to challenge themselves to try the various levels of spiciness on offer. One of the popular spicy culinary delights is seblak. This food, which is known to originate from West Java, is made from a mixture of cikur (kencur) spices and various toppings such as chewy yellow crackers, noodles, macaroni, meatballs, aci and chili.

When buying food or drink, it certainly cannot be separated from the container or place. Disposable food containers commonly used by traders in Indonesia are generally made from various materials, including leaves, paper, plastic and styrofoam. Nowadays, the use or utilization of disposable containers in food packaging is increasingly using Styrofoam and plastic packaging, this is due to their resistance to wet food and easy carrying anywhere as well as their practical value. The type of Styrofoam packaging that is often used is actually called polystyrene foam or polystyrene foam, which is one of the container options that is often used to wrap and place food, which is practical and easy because it can be carried anywhere. Examples of using Styrofoam include delivery food, snacks, or takeout food (food brought home)

at a restaurant.

Seblak itself is one of the contemporary foods that is popular with culinary lovers, especially young people. Seblak itself sells seblak which emphasizes its taste, especially spicy taste. There are so many seblak culinary delights, especially in the city of Cirebon, that you have to rack your brain to create a variant of the seblak menu that is popular with the public. Seblak in Cirebon City must be able to set affordable prices and must continue to improve the quality of its products, especially in terms of taste, so that it can continue to compete with the same culinary businesspeople. (Rahmawati. & Sigit Prihanto Utomo., 2022).

Product quality is the ability of the product to satisfy consumer needs or wants. Quality can be achieved when a company can provide products that meet and even exceed customer expectations. Companies that offer quality create good customer relationships. Good relationships created in the long term make the company understand the expected needs of the customer. Such things bring positive benefits to the company (Karjuni and Susliawati, 2021). Kotler (2000) states that consumer satisfaction is the level of a person's feelings after his known performance or results have been compared with his expectations. the performance also does not meet the expectations, the customer feels dissatisfied, and if the performance meets the expectations of the consumer, the customer is satisfied. This means that consumers form a more favorable perception of a product or service that has been positively evaluated by consumers. Satisfaction can be interpreted as an effort to achieve something or to do something sufficient. (Nasution, 2017).

The difference between this research and previous research is that this research examines the variables that influence consumer satisfaction using the Structural Equation Model (SEM) data analysis method, so that it can see the loading factor (weight) of each indicator on the variable, whereas in previous research it only discussed The relationship or influence of price variables on consumer satisfaction is linear so that you cannot see the loading factors (weights) of the indicators on the variables because they use the multiple linear regression data analysis method.

In previous research, there was no research that discussed the factors that influence seblak consumer satisfaction, whereas in this research we will discuss the variables that influence seblak consumer satisfaction. Therefore, this research includes development research from previous research. Development research is a research method used to produce certain products (new products) and test the effectiveness of these products (Maydiantoro, 2019).

RESEARCH METHODS

The research was carried out at Kedai Seblak in the city of Cirebon from April to May 2023. This research was prepared using quantitative methods, with the variables used in this research being Product and Consumer Satisfaction. The research objects are consumer satisfaction variables seblak (Y) and product (X). For an explanation of the variables and indicators, see table 1.

Table 1. Quantitative methods of this research

Variable	Indicator	Measurement

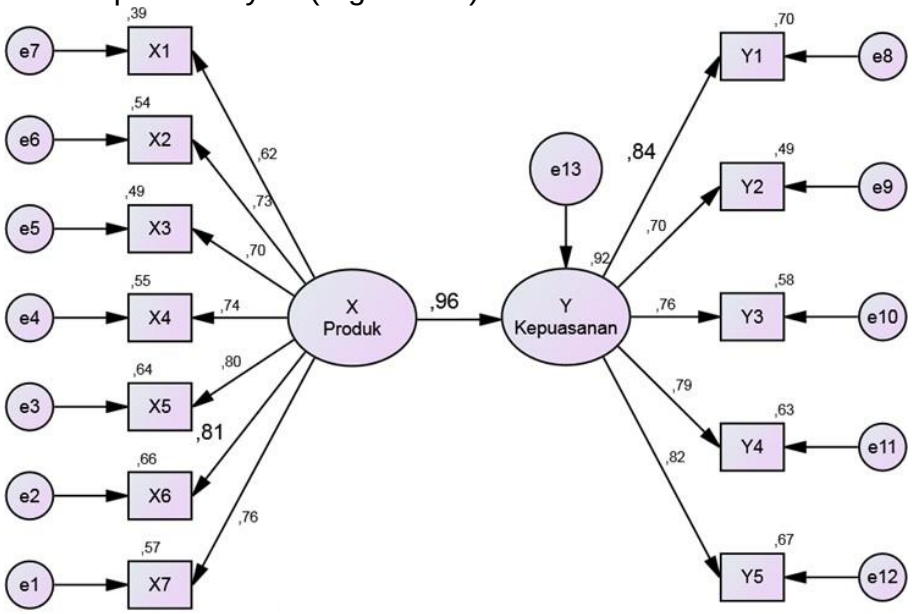
		scale
Consult Satisfaction (Y)	1. Feeling of satisfaction after consuming	Likert
	2. Repurchase	Likert
	3. Fulfilled expectations	Likert
	4. Give positive comments	Likert
	5. Paying less attention to other restaurants	Likert
Product (X)	1. Taste image and opinion of seblak products	Likert
	2. The smell of seblak food	Likert
	3. The stock is not available	Likert
	4. Has a varied menu	Likert
	5. Orders meet expectations	Likert
	6. Quality containers or packaging	Likert
	7. The seblak shop is well known to the public	Likert

Source: Data processed (2023)

The research population is seblak consumers in Cirbeon City, whose number is unknown. Therefore, the determination of the sample size was based on the loading factor of 0.81, so the number of respondents was 100. The sampling technique is random sampling (random). The data analysis technique uses Structural Equation Modeling (SEM) using AMOS application calculations (Analytical Moment of Structural) (Febriyanti et al., 2022).

RESULTS AND DISCUSSION

Based on the results of the analysis using SEM-AMOS, results were obtained in the form of factor and path analysis (regression) as can be seen in Picture 1.



Picture 1. Results Of Factor and Path Analysis
Souce: Data processed (2023)

Picture 1 shows that the variable X that significantly influences Y is X6 (Container recommendation). The significant information (sig) of the influence of X6 on Y is clarified by the printout results of the SEM-AMOS analysis which can be seen in table 2.

Table 2. Description of the significance of X6 to Y. Regression Weights: (Group number 1 - Default model)

Indicator	**Measurement scale**
Y_Satisfaction <--- X_Product	1,085 ,130 8,351 *** par_11
X7 <--- X_Product	1,000
X6 <--- X_Product	1,077 ,128 8,415 *** par_1
X5 <--- X_Product	1,029 ,124 8,329 *** par_2
X4 <--- X_Product	.968 .127 7.602 *** par_3
X3 <--- X_Product	.939 .132 7.103 *** par_4
X2 <--- X_Product	,900 ,120 7,530 ***par_5
X1 <--- X_Product	.855 .136 6.272 *** par_6
Y1 <--- Y_Satisfaction	1,000
Y2 <--- Y_Satisfaction	,884 ,113 7,837 ***par_7
Y3 <--- Y_Satisfaction	,884 ,100 8,820 *** par_8
Y4 <--- Y_Satisfaction	.964 .103 9.358 *** par_9
Y5 <--- Y_Satisfaction	,891 ,090 9,852 *** par_10

Source: Data processed (2023)

Table 3. Standardized Regression Weights: (Group number 1 - Default model)

	Estimate
Y_Satisfaction <--- X_Product	,959
X7 <--- X_Product	,756
X6 <--- X_Product	,810
X5 <--- X_Product	,803
X4 <--- X_Product	,741
X3 <--- X_Product	,698
X2 <--- X_Product	,735
X1 <--- X_Product	,624
Y1 <--- Y_Satisfaction	,838
Y2 <--- Y_Satisfaction	,699
Y3 <--- Y_Satisfaction	,761
Y4 <--- Y_Satisfaction	,792
Y5 <--- Y_Satisfaction	,819

Source: Data processed (2023)

Table 2 shows that the influence of X6 on Y is marked with 3 stars (***) in column P (Probability) or in the estimate column the number 0.810 is written, which means the influence of Product quality is the overall combination of product characteristics from marketing, manufacturing engineering and maintenance that make the product used meet customer expectations. (Karjuni & Susliawati, 2021). This has the implication that containers or packaging have a big influence on a business, including in the culinary sector. Therefore, the product becomes a very important variable (influences) on consumer satisfaction. Containers play an important role in the marketing mix, because the choice of container or packaging is directly related to the income received by the seblak shop.

The role of packaging in products is 1) As a container that allows a product or item to be transported from one place to another or from producer to consumer. 2) Protect the packaged product from the effects of weather, impacts, piles and so on. 3) Providing information, brand image and as promotional media with the consideration that it is easy to see, understand and remember. So, the need for packaging to provide information is the most important part. Labeling and branding food and other products is very important as a differentiator from competitors. In order for the packaging design to appear attractive, you can consult a packaging designer. (Widiati, 2020).

According to Kottler and Armstrong (2012) (Nf Mufreni, 2016), “packaging includes the design and manufacture of the container or envelope of the product”, which means that packaging includes the design and manufacture of the product to protect it. You can find the weight or loading factor of each indicator with the output variables in Table 4.

Table 4. Indicator weights with product variables (X6)

X7 <--- X_ Product	756
X6 <--- X_ Product	,810
X5 <--- X_ Product	,803
X4 <--- X_ Product	,741
X3 <--- X_ Product	,698
X2 <--- X_ Product	,735
X1 <--- X_ Product	,624

Source: Data processed (2023)

Table 4 shows that in the measurement model (indicator measurement model with This is consumer satisfaction in the influence of product recommendations for containers or packaging from seblak customers in Cirebon City which can attract buying interest and will result in repurchases or repurchases of seblak products which can increase product quality.

The influence of products is very important, especially in the increasingly

competitive business environment in the culinary sector. The role of products, especially in packaging or containers in Seblak shops in Cirebon City, is very important to maintain product quality for Seblak consumer satisfaction.

According to Kotler and Keller (2008:30) Mukrimaa et al., 2016) "Packaging is all the activities during which product storage containers are designed and manufactured".A product is a combination of content and packaging. Many say that packaging is just wasteful and increases the cost of sales. However, this is not the case, instead, standard packaging can improve the image of the product, bring added value to the sale and protect the product well. The package must meet the expectations of the consumer. The packaging can provide good protection to the product against weather, light/rays, temperature changes, drops, piles, dirt, insects, bacteria etc. The packaging structure is easy to open, easy to close and easy to transport (ergonomics). (Widiati, 2020).

CONCLUSION

Based on the results of the research and discussion above, a conclusion can be drawn that the product variable (packaging or container) has an indirect influence on the consumer satisfaction variable seblak in Cirebon City. So, it is recommended that seblak business actors if they want to increase satisfaction, pay attention to the satisfaction of the packaging or container.

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MALE AND FEMALE LABOR INTENSITY OF POTATO FARMING IN KARANGREJA SUB-DISTRICT, PURBALINGGA DISTRICT

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Abstract: Karangreja sub-district is a potato-producing area. Potato production in the sub-district fluctuates due to labor factors that experience gender inequality. Female labor has minimal access to agricultural resources. The labor comes from family farming households. The purpose of this study is to examine 1) Male and female labor in potato farming in Karangreja Sub-district, Purbalingga Regency, 2) compare the differences between male and female labor in potato farming in Karangreja Sub-district, Purbalingga Regency. The research method was conducted descriptively. The sampling technique used purposive sampling. The sample size was 70 potato farmers in Karangreja Sub-district. Data collection techniques were questionnaire, observation, and document study. Data analysis used work effort analysis. The results showed that 1) The total work effort of men in potato farming is 2,225.93 HKSP (men's equivalent working days) per 20.92 Ha of land while the total work effort of women is 997.07 HKSP (men's equivalent working days) per 20.92 Ha of land 2) There is a difference between male and female work effort in potato farming in Karangreja District, Purbalingga Regency.

Keywords: Labor, male labor, female labor, potato farming

INTRODUCTION

Agricultural commodities in Indonesia are very diverse, ranging from horticulture, food crops, plantations, and fisheries to livestock. The commodity with the highest production in Indonesia is horticulture. The horticultural production index in 2019 amounted to 112.43 points, in 2020 amounted to 119.26 points and in 2021 amounted to 121.39 points (BPS, 2022).

One type of horticultural product is vegetables. Vegetables with the highest production in Indonesia in 2022 are shallots at 1,982,360.2 tons, cayenne pepper at 1,544,440.9 tons, potatoes at 1,503,998.3 tons, cabbage at 1,503,797.6 tons, and tomato at 1.168.743,7 tons (BPS, 2023). Potatoes are the only vegetable with the fifth highest production in Indonesia that can be used as a substitute for staple foods. Potatoes are a carbohydrate tuber substitute for rice in Indonesia (Kusumaningtyas 2021).

Potatoes contain minerals, fiber, vitamins, and phytochemicals that can fulfill people's nutritional needs (Sari 2021). It is unsurprising that Indonesia's potato production is increasing every year because it has a lot of nutritional content. Indonesia’s potato production has increase yearly with 1,503,998 tons produced in 2022 (BPS, 2023) compared to 1,361,064 tons in 2021 (BPS, 2022). Potatoes grow well in highland areas with an altitude of more than 1000 meters above sea level and a low air temperature of 170C - 200 C (Djuariah, Handayani, and Sofiari 2017). One of the highland areas that produce potatoes is in Central Java, namely Purbalingga Regency, precisely in Karangreja District. The area of potato land in Karangreja in 2021 was 308 ha (BPS, 2022). There are only two villages in Karangreja District that are planted with potatoes, namely Kutabawa and Serang villages. The amount of potato production in Karangreja Sub-district is as follows:

Table 1. Potato Production in Karangreja Sub-district

Year	Production (Kw)
2018	33.517,75
2019	17.220,00
2020	73.630,00
2021	61.550,00

Source: BPS (2022)

Potato production in 2018 amounted to 33,517.75 kw, decreased by 48.62 percent to 17,220.00 kw in 2019. Then, there was an increase of 427.58 percent to 73,630.00 kw in 2020 and fell back by 16.41 percent to 61,550.00 kw. Several factors influence potato production in Karangreja to fluctuate, namely fertilizer, pesticides, land area, and labor time (Rulianto Fajar, Utami Dyah Panuntun, and Hasanah Uswatun 2019). Preliminary research conducted by the author identified that fertilizers, pesticides and land area do not affect potato production in Karangreja District, Purbalingga Regency, because potato farmers have partnered with PT Indofood company, which has Standard Operating Procedures (SOP). The amount of fertilizers and pesticides used is the same every year according to the standards of the partner company. Farmers' land area is also the same size every year because the land is hereditary. Therefore, labor time is a factor that needs to be investigated to determine the causes of fluctuations in potato production in Karangreja District, Purbalingga Regency. This is in accordance with Asdar's statement (2022), which states that optimal labor increases potato production.

Labor in potato farming is taken from the farmer's household, namely male farmers (husband) and female farmers (wife). However, male farmers have more access to resources such as assets, inputs, agricultural services, and employment opportunities in potato farming and making more decisions than female farmers, resulting in gender inequality. FAO (2011) mentions that agriculture has poor performance in many developing countries, including Indonesia, which makes women have less access to agricultural resources than men.

The gender inequality of farmers is not only in potato farming, but there is gender inequality in farmers' households, especially in household domestic activities. Male farmers do less domestic work than women. Research by Novita et al (2022) in coastal families of Puger Kulon Village, Jember Regency, men have the task of earning

a living only while women have a double role (double burden), namely earning a living and having domestic responsibilities. Research by Kamilna et al (2022) on families in Cut Reubee Delima Village, Pidie Regency, women have a double burden as housewives, farming to meet family needs and their social role as community members.

Gender equality in potato farming households can be defined as giving male and female farmers equal rights to participate in farming and domestic activities. Gender equality can be determined by identifying the gender allocation of labor in potato farming households and the time potato farming households devote to farming, domestic and social activities.

Based on the background description, it is necessary to research the male and female labor intensity of potato farming in Karangreja Sub-district, purbalingga.

RESEARCH METHODS

The research method uses a descriptive method with a quantitative approach. Quantitative descriptive explains the social situation by describing the variables related to the research (Mulyadi 2011). This research was conducted in Kutabawa Village and Serang Village in Karangreja Sub-district. The selection of the research site was based on purposive sampling, considering that both villages are potato-producing villages in Karangreja Sub-district, Purbalingga Regency. The target of the research was potato farming households in Kutabawa and Serang villages in Karangreja sub-district, Purbalingga district.

The sampling technique used is a nonprobability sampling of purposive sampling type. Purposive sampling is the determination of samples with various researcher considerations (Sugiyono 2016). The number of samples taken is based on the formula proposed by Isaac and Michael (Stephen Isaac 1981).

The following is the research sample formula:

$$s = \frac{\lambda^2 . N . P . Q}{d^2 \ (N - 1) + \lambda^2 . P . Q}$$

Where:
s = number of samples
λ2 = Chi quadrad whose price depends on degrees of freedom and error rate
N = total population
P = Chance of being correct (0.5)
Q = Chance of being wrong (0.5)
d = Difference between sample mean and population mean

The population of potato farmers in Karangeja is 500 people, so the number of samples taken is 67.8 and rounded to 70, consisting of 35 households of potato

farmers in Serang Village and 35 households of potato farmers in Kutabawa Village, represented by the head of the family.

Data collection techniques used interviews, questionnaires, document studies, and observation. The data analysis technique used Mosher's analysis for work allocation and work devotion analysis to determine work devotion. Mosher's analysis maps the time of men and women based on gender in the family into three types of activities, namely productive (work), reproductive (household), and social activities (Sitanggang 2020).

RESULTS AND DISCUSSION

Overview of the Research Location

The research was conducted in Kutabawa Village and Serang Village in Karangreja Sub-district, Purbalingga Regency. Both villages are potato-producing villages in the Karangreja Sub-district. Serang Village is located at an altitude of 650 - 1650 m above sea level. The village has an air temperature of 160 C - 280 C. Generally, the air temperature in the village is 160 C. The condition of the area is mostly sloping, as much as 45% of the area, hilly, as much as 25%, and flat, as much as 30% of the area. Serang Village has five hamlets consisting of 8 neighborhood associations (RW) and 48 neighborhood associations (RT). The village area is ± 2,878.390 ha. The village has a total population of 8,523, consisting of 4,380 men and 4,143 women (Serang 2022).

The following research location is in Kutabawa Village. This village is located at an altitude of 650 - 1650 m DPL. The village has an air temperature of 160 C - 280 C. Generally, the air temperature in this village is 160 C. The condition of the area is primarily flat, as much as 60% of the area, (Serang 2022) hilly, as much as 15% of the area and sloping as much as 25% of the area. The village has five hamlets consisting of 5 neighborhood associations (RW) and 19 neighborhood associations (RT). The total area of the village is ± 427.40 ha. Kutabawa Village has a total population of 6,832, consisting of 3,467 men and 3,365 women (Kutabawa 2022).

General Description of Farming

Potato farming in Serang Village and Kutabawa Village is in partnership with PT Indofood Sukses Makmur Tbk. The flow of partnership with PT Indofood is registration, provision of facilities and contracts, control, and harvesting. First of all, farmers who want to partner with PT Indofood register with the field coordinator of each village. Then, the field coordinator provides Standard Operating Procedures (SOP) and contracts that contain provisions for farming. Farmers enter into a contract by selling all farm products to the company according to the price at the beginning of the contract. After agreeing to the in a contract, farmers are given facilities such as seeds, pesticides and fertilizers. The field coordinator and his staff then control the crops so that their growth is well maintained. Harvesting is done 90 days after planting. Staff from the partner company send labor for harvesting and then transport to the company.

The average harvest price is IDR 8,000/kg. Farmers get harvest money after all the harvesting and transportation processes are completed. Farmers get harvest money by multiplying the number of harvest times the selling price, which has been reduced by facility costs such as seeds, fertilizers and pesticides.

Respondent Identity

The respondents selected in this study were in accordance with the calculation of the sample size, namely 70 farmer households represented by the head of the family. A total of 35 heads of farmer households in Serang Village and 35 heads of farmer households in Kutabawa Village.

Table 2. Farmers' land area

Land area (Ha)	Number of farmers (people)	Percentage (%)
0,05 - 0,29	40	57,14
0,30 - 0,53	27	38,57
0,54 - 0,76	0	0,00
0,77 - 1,00	3	4,29
Total	**70**	**100,00**

Source: Data processed (2023)

The land area of potato farmers in Karangreja District is between 0.05 Ha and 1.00 Ha, with a total land area of 20.92 Ha. This is similar to the research of Sinaga et al (2021), which states that the potato land area in Berastagi District, Tanah Karo Regency, is between 0.20 Ha and 1.00 Ha.

Table 3. Farmer farming experience

Farming experience (years)	Number of farmers (people)	Percentage (%)
1-13	38	54,29
14 -26	20	28,57
27-38	9	12,86
39-50	3	4,29
Total	**70**	**100,00**

Source: Data processed (2023)

Most potato farmers in Karangreja Subdistrict have between 1 and 13 years of farming experience, at 54.29%. This is different from the research of Prabowo et al (2022) which states that the majority of potato farmers' farming experience in Tranggulasi, Batur Village, Getasan District, Semarang Regency is 21 to 30 years, meaning that the farming experience of potato farmers in Karangreja District is less than the farming experience in Getasan District.

Table 4. Age of farmers

Age (th)	Number of farmers (people)	Percentage (%)
21 - 35	28	40,00

36 - 49	32	45,71
50 - 63	8	11,43
64 -77	2	2,86
Total	**70**	**100,00**

Source: Data processed (2023)

The majority of the number of family dependents of potato farmers in Karangreja District is 4 to 6 people, as much as 61.43 percent, with an average number of family dependents of 4 people. This is in accordance with the research of Sulu et al (2022) in Passi Timur District of Bolaang Mongondow, which states that the majority of potato farmers' family dependents are between 3 to 4 people, as much as 52 percent.

Work Hours

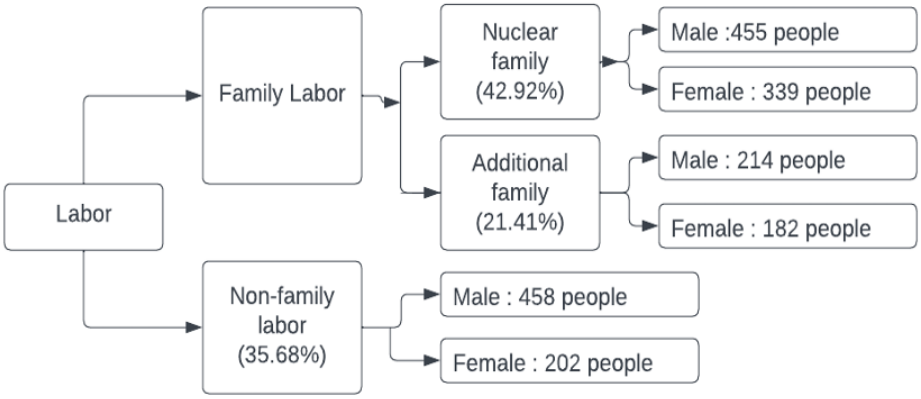
Potato farming in Karangreja Subdistrict, Purbalingga Regency, is carried out by men and women together. Male labor is needed more than female labor. Labor is 64.32%, while family labor is 35.68%. The detailed labor of potato farming in Karangreja Subdistrict:

Table 6. Labor force of potato farms in Karangreja Subdistrict

Type of Work	Labor (people)						Percentage of labor (%)	
	Nuclear Family		Additional Family		Non-Family			
	Male	Female	Male	Female	Male	Female	Male	Female
Land processing	70	51	28	11	64	7	69,26	30,74
Planting	70	64	59	67	62	30	73,86	26,14
Weeding	70	52	7	6	10	3	91,22	8,78
Stake installation	70	45	15	6	23	5	82,93	17,07
Spraying	70	31	16	0	13	0	90,00	10,00
Harvest	70	66	86	92	219	134	47,08	52,92
Post-harvest	35	30	3	0	67	23	43,04	56,96
Total	**455**	**339**	**214**	**182**	**458**	**202**	**64,32**	**35,68**

Source: Data processed (2023)

Labor is divided into three, namely nuclear family, additional family and non-family. The nuclear family consists of a father and mother, while children who are still students do not do farm work. Additional families are families outside the core, such as brothers or sisters of farmers, nephews and so on. Labor outside the family is taken from the surrounding community, who work as farm laborers. There are more men than women in the labor force. The labor chart is as follows:



Picture 1. Labor of Potato Farmers in Karangreja Subdistrict

The workforce consists of the nuclear family, as many as 455 men and 339 women, with a total percentage of 43% of the total workforce. Additional family workers are 214 men and 182 women, with a total percentage of 21% of the total workforce. Nonadditional family workers are 458 men and 202 women, with a total percentage of 36% of the total workforce. The labor analyzed in this study is the labor that comes from the farmer's household, namely husband and wife. Husbands and wives work together in potato farming operations. This labor requires an outpouring of work to work on potato farming. Labor is the time or number of working hours used to carry out farming activities. This labor output uses the unit of HOK (person days worked), which is calculated based on working hours during one potato planting period. In addition to HOK (person-days), labor can also use the HKPS (male equivalent working days) standard. According to Karmini (2018), HOK and HKSP have the same standardization, so either or both can be used. One male HOK is equal to one HKSP, while one female HOK is equivalent to 0.8 KHSP. The formula for HKSP work expenditure according to Soekartawi (2006) in Pilomonu et al (2020) as follows:

$$1\ \text{HKSP} = \frac{x}{y}\ x\ z$$

Where:
x = wage of the labor concerned;
y = male labor wage;
z = one HKSP

The calculation of labor expenditure with male farmers' wages is IDR 67,928.57 per day, while female wages are IDR 56,428.57 per day. The HKSP obtained is one female HKSP equal to 0.83 male HKSP. The work effort using HKPS of potato farmers in Karangreja Sub district is as follows:

Table 7. Household labor hours of potato farmers (HKSP)

Type of Work	Total male labor	Total female labor	Total male labor	Total female labor	Total work effort of men and

	expenditure (HOK)	expenditure (HOK)	supply (HKSP)	supply (HKSP)	women (HKSP)
Land processing	610,50	390,79	610,50	324,35	934,85
Planting	147,50	152,64	147,50	126,69	274,19
Weeding	161,14	101,93	161,14	84,60	245,74
Stake installation	205,43	99,71	205,43	82,76	288,19
Spraying	854,57	230,00	854,57	190,90	1.045,47
Harvest	211,57	201,86	211,57	167,54	379,11
Post-harvest	35,21	24,36	35,21	20,22	55,43
Total	**2.225,93**	**1.201,29**	**2.225,93**	**997,07**	**3.223,00**

Source: Data processed (2023).

Total male labor expenditure amounted to 2,225.93 HOK, equivalent to 2,225.93 HKSP. The total labor of women amounted to 1,201.29 HOK, which is equivalent to 997.07 HKSP. One HKSP of female farmers is equivalent to 0.83 HKSP of male farmers. This is similar to the research of Maulana et at (2019) on tobacco farming women in Temanggung Regency, which states that one woman's labor expenditure in HKSP is equal to 0.8 HKSP of men.

The results showed that the most significant total labor expenditure on spraying was 1,045.47 HKSP because potato plants require intensive maintenance, including spraying. This is in accordance with the statement of Salim et al (2019) that the highest labor expenditure in farming is spraying activities because it is done repeatedly. The minor work expenditure is post-harvest activities, with a total work expenditure of 55.43 HKSP because post-harvest is taken over by the partner company so that farmers do not devote too much energy to post-harvest activities. This is in accordance with the statement of Kautsar et al (2018) that the smallest amount of labor is post-harvest because there is no post-harvest activity. Farmers sell their crops wet so that intermediaries or partner companies will carry out post-harvest activities.

Differences between Male and Female Work Hours

A t-test does a calculation of the difference between male and female work expenditures with the condition of fulfilling the homogeneity test. The homogeneity test is carried out in order to find out whether some variances are similar or not as a condition for analyzing the t-test (Usmadi 2020).

The homogeneity test hypothesis in this study is as follows:

H0: The work effort of men and women have the same variance at the 5% significance level.

H1: The work effort of men and women has unequal variance at the 5% significance level.

Table 8. Homogeneity test results

Levene Statistic	df1	df2	Sig.
0,062	1	138	0,804

Source: Data processed (2023)

The homogeneity test results yielded a significant value of 0.804. This value is more than 0.05, so it is homogeneous, meaning that there is a similarity between the work effort of men and the work effort of wives, so H0 is accepted, and H1 is rejected. Male and female work hours have the same variance at the 5% significance level.

Difference Test

The t-test was conducted to determine whether there is male labor and female labor. The results of the t-test are as follows:

Table 9: T-test results

t test for Equality of Means		Description
Equal variances assumed	0,000	Significant

Source: Data processed (2023)

The results of the difference test analysis show that Equal variances assumed Sig. (2 tailed) 0.000. This value is less than 0.005, which means that there is a significant difference between the work effort of men and the work effort of women. Men have more labor than women because several jobs are done mainly by men. Potato farming land processing in Karangreja Subdistrict requires 64% male labor, planting 58.01%, weeding 61.26%, installing stakes 67.04%, spraying 68.59%, harvesting 57.12% and post-harvesting 56.94%. The majority of farming activities require men to labor because men are more potent than women. This is similar to research conducted by Prawirasari et al (2022) on coffee farming families in Sukorejo Village, Sumber Wringin Subdistrict, Bondowoso Regency) which states that men's labor is more significant than women's because there are several types of money-farming activities carried out by men but not by women. The activity that requires less work from women is spraying. Spraying is done by male farmers using a hand sprayer with a capacity of 14 liters. Women are not strong enough to carry a 14-liter sprayer, so many women do not participate in spraying activities. This is in accordance with the research of Unu et al (2018) on rice farmers in Rasi Satu Village, Ratahan District, Tenggar Minahasa Regency. Women do not play a role in providing labor in pest control in the form of spraying. Spraying activities are only carried out by men.

CONCLUSION

Based on the description in the discussion, the conclusions obtained are 1) The total work effort of men in potato farming is 2,225.93 HKSP per 20.92 Ha of land while the total work effort of women is 997.07 HKSP per 20.92 Ha of land, 2) There is a difference between male and female work effort in potato farming in Karangreja District, Purbalingga Regency.

Suggestions for researchers who will examine the topic of work allocation of potato farmers should provide more specific questions, such as adding the role of education, training and access to resources for farmers in order to achieve optimal research results.

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ANALYSIS OF MARKETING EFFICIENCY OF TEMPEH PRODUCTS AT UD. NEW SOYA GROUP IN BIREM BAYEUN DISTRICT, EAST ACEH REGENCY

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Abstract: This research was conducted in Alue Drien Village, Birem Bayeun District, East Aceh Regency with the research title "Marketing Efficiency Analysis of Tempeh Products at UD. New Soya Group in Birem Bayeun District, East Aceh Regency" in August 2022. The purpose of this study was to determine the marketing channel pattern of tempeh products at UD. New Soya Group in Birem Bayeun District in Alue Drien Village, Birem Bayeun District, East Aceh Regency, the amount of margin, farmer's share and marketing efficiency of each marketing channel. The results of this study indicate that the marketing channel pattern of tempeh products at UD. New Soya Group in Birem Bayeun District, East Aceh Regency consists of three patterns, namely from producers-retail traders-consumers, producers-retail traders-consumers, producers roving traders-consumers. Determination of respondents is done by means of intentional (purposive), namely 1 leader with the consideration that the respondent knows everything that relates to tempeh products at UD. New Soya Group in Birem Bayeun District, East Aceh Regency. Determination of trader respondents used snowball sampling method or respondents found when researchers were in the field. The results showed that there were 3 forms of tempeh marketing channels for tempeh products at UD. New Soya Group in Birem Bayeun Subdistrict, namely: a) producers - retail traders - itinerant traders - consumers, b) producers-retail traders - consumers c) producers - retailers - consumers.

Keywords: Margin, Farmer's Share, Marketing Channel

INTRODUCTION

Indonesia is a country that has abundant natural resources, one of which is in the field of agro-industry, because agro-industry as an effort to create added value for agricultural commodities, among others, through processed products in the form of semi-finished or finished goods whose raw materials come from agricultural products. Agricultural businesses that lead to agro-industrial activities are processing agricultural products into food ingredients, one of the agricultural products that can be processed is soybeans (Ashari & Syamsir, 2021).

Aceh is one of the areas with high soybean production, namely in 2017 amounted to 6,932 tons and in 2018 experienced an increase of 15,835 tons. tons. It can be seen that with the increase in soybean production in Aceh, it will have an impact on the soybean-to-tempe industry in the Aceh region. will have an impact on the soybean-to tempe industry in the Aceh region (Ministry of Agriculture of the Republic of Indonesia).

Soybeans are a strategic commodity in the food security system because many people consume soybeans in processed form and it is believed that soybeans are a food commodity that has high nutritional value. Soybeans act as a source of vegetable protein which is very important in the context of improving community nutrition, because in addition to being safe for health it is also relatively cheap compared to animal protein sources (Sudaryanto, 2016).

Tempeh is a processed soybean food that is widely consumed by the people of Aceh. The nutritional content contained in tempeh makes its own appeal and in terms of price in the market, processed soybeans are very cheap. That is the reason why Acehnese people in general consume a lot of processed soybeans in the form of tempeh. UD. New Soya Group is a business engaged in tempeh processing with sales targets in the Latos market in Langsa City. UD. New Soya Group is located in Alue Drien Village, Birem Bayeun District, East Aceh Regency, Alue Drien Village, Samarinda Hamlet. This business has been running for 10 years and obtained a Health Office permit in 2015. UD. New Soya Group is a business container that is run with the aim of increasing household income in Alue Drien Village, Samarinda Hamlet.

The pre-survey in the field, what this research wants to get is the extent to which UD. is the extent to which UD. New Soya Group conducts soybean tempeh marketing channels and whether UD. and whether UD soy tempeh. New Soya Group has been said to be efficient or not. The importance of marketing in a business is one of the most important indicators. very important. Marketing is a process that involves various marketing to channel products from producers to end consumers. Channel marketing channel is the desired goal in a trading chain where the distribution of goods from producers to final consumers can be carried out to improve the quality of products. distribution of goods from producers to end consumers can be carried out to fulfill marketing goals that can be seen from two sides, namely marketing goals. fulfill marketing goals that can be seen from two sides, namely market goals and development goals (Yanis et al., 2014). market and development goals (Yanis et al., 2018).

The length of the marketing channel results in higher costs being incurred, as well as some of the costs being passed on as profit to the trader. This tends to reduce the proportion received by producers and increase the costs paid by consumers. In addition, long marketing channels are also thought to cause inefficient marketing and affect profits. (Linda et al., 2019).
Clear marketing channels will have an impact on the marketing efficiency of UD. New Soya Group so that the business can be said to be efficient or not. The marketing channel process and marketing efficiency are the benchmarks of a successful business at UD. New Soya Group because its role is very important and dynamic. So it is necessary to conduct research on "Marketing Efficiency of Tempeh Products at UD. New Soya Group in Birem Bayeun District, East Aceh Regency".

RESEARCH METHODS

Description of the Study Area

This research was conducted in August 2022. The research area chosen was in Alue Drien Village, Birem Bayeun District, East Aceh Regency.

Site and Farmers Selection

Determination of respondents was carried out purposively, in this case 1 leader with the consideration that the respondent knew everything related to the company, especially marketing. Determination of respondents of marketing institutions was carried out using the Snowball Sampling method, meaning that respondents were taken from intermediary traders to consumers so that a marketing chain could be formed.

Data collection methods

The data used in this study are primary and secondary data. Primary data was obtained from the survey method; this research instrument was used using questionnaires and interviews. Secondary data is obtained from books, articles, journals, literature and readings related to related agencies such as the Central Statistics Agency (BPS) of East Aceh Regency as well as from other supporting sources that have a relevant relationship with the issues discussed in this study.

Data analysis methods

Based on the objectives to be achieved in this study, to determine or calculate the amount of marketing margin, the Yohanes formula can be used, (Timisela & Luhukay, 2019).

$$M = Hp - Hb$$

Description:
M = Marketing Margin
Hp = Sales Price (IDR/Pack)
Hb = Purchase Price (IDR/Pack)

Meanwhile, the total marketing margin can be calculated using the formula (Rini Mastuti et al, 2021):

$$Mt = M1 + M2 + Mn$$

Description:
MT = Total Marketing Margin
M1 = 1st Marketing Margin
M2 = 2nd Marketing Margin
Mn = Mn Marketing Margin

To calculate part of the price received by producers, the following formula is used:

$$Sf = \frac{Pf}{Pr} \times 100\%$$

Description:
Sf = Price Received by Producer
Pf = Producer Selling Price (IDR/Package)
Pr = Consumer Purchase Price (IDR/Package)

To calculate farmer's share, the following formula is used:

$$Fs = \frac{Pf}{Pr} \times 100\%$$

Description:
Fs = Percentage of Price received by producers
Pf = Producer Selling Price (IDR/Package)
Pr = Consumer Purchase Price (IDR/ Package)

To calculate the marketing efficiency of tempeh UD. New Soya Group in Birem Bayeun District, East Aceh Regency used the following formula:

$$Eps = \frac{TB}{TNP} \times 100\%$$

Description:
Eps = Marketing Efficiency
TB = Total Marketing Cost
TNP = Total Value of Products marketed

RESULT AND DISCUSSION

Marketing Channels and Institutions

Four marketing institutions involved in tempeh marketing channel activities at UD. New Soya Group in Birem Bayeun District, East Aceh Regency, namely producers, retail

traders, itinerant traders and consumers. While the tempeh marketing channel at UD. New Soya Group in Birem Bayeun District, East Aceh Regency, there are 3 marketing channels, namely the first channel consisting of producers, retail traders, itinerant traders and consumers, the second channel consists of producers, retail traders and consumers and the third channel consists of producers, itinerant traders and consumers.

Marketing Analysis of Tempeh Products at UD. New Soya Group

Marketing channels are a series of processes that distribute goods involving marketing institutions from producers to consumers with the aim of creating good channels. Marketing channels can increase the efficiency of sales of tempeh products at UD. New Soya Group in Birem Bayeun District, East Aceh Regency because it involves marketing institutions consisting of First Channel: Producer-Retailer-Mobile Consumer, Second Channel: Manufacturer- P.Retail-Consumer, Third Channel: Producer -Grocery Consumer.

Based on the picture above, it can be seen that there are four marketing institutions involved in tempeh marketing channel activities at UD. New Soya Group in Birem Bayeun District, East Aceh Regency, namely producers, retail traders and itinerant traders. While the tempeh marketing channel at UD. New Soya Group in Birem Bayeun District, East Aceh Regency, there are 3 marketing channels, namely the first channel consisting of producers, retail traders and itinerant traders, the second channel consists of producers, retail traders and consumers and the third channel consists of producers, traders and consumers.

Marketing Function in Marketing Efficiency Analysis

No	Marketing Function	Producer	Retail Traders	Itinerant Traders
1	Purchase	-	√	√
2	Sales	√	√	√
3	Storage	√	√	√
4	Transportation	√	-	√
5	Sorting	√	-	-
6	Risk Taking	√	-	√

Description: (-) not done, (√) done

Marketing Margin

The marketing margin of tempeh products at UD. New Soya Group in Birem Bayuen District, East Aceh Regency is divided into three, namely the first channel marketing margin, the second channel marketing margin and the third channel marketing.

First Channel Margin

Table 4. Price, Margin and Price Share Received by Tempeh Producers at "UD. New Soya Group in Birem Bayeun District, East Aceh District" through the First Channel, 2023.

No	Marketing Organization	Purchase Price (IDR/Pack)	Price (IDR/ pack)	Selling Price (IDR/Pack)	Mar gin Total (IDR)	Producer's Share of Price Received (%)
1	Producer	-	1.500.-	-		
2	Retail Traders	1.500.-	1.800.-	300.-		
3	Itinerant Traders	1.800.-	2.000.-	200.-	500.-	75
4	Consumers	2.000.-	-	-		

Source: Primary Data After Processing, 2023

Based on Table 4 above, it can be explained that producers sell tempeh at UD. New Soya Group to retail traders for IDR. 1,500. - / pack. Furthermore, retail traders sell tempeh products at UD. New Soya Group to New Soya Group to itinerant traders for IDR. 1,800. - / pack and then itinerant traders sell tempeh soya Ud. New Soya Group to consumers for IDR. 2,000. - / pack. Thus, the marketing margin of tempeh products UD. New Soya Group in Birem Bayeun District, East Aceh Regency is IDR. 500.- and the share of the price received by the producer is 75%.

Second Channel Margin

Table 5. Price, Margin and Price Share Received by Tempeh Producers at "UD. New Soya Group in Birem Bayeun District, East Aceh District" through the Second Channel, 2023

No	Marketing Organization	Purchase Price (IDR/Pack)	Harga Jual (IDR/ Bungkus)	Selling Price (IDR/Pack)	Margin Total (IDR)	Producer's Share of Price Received (%)
1	Producer	-	1.500.-	-		
2	Retail Traders	1.500.-	2.000.-	500.-	500.-	75
3	Consumen	2.000.-	-	-		

Source: Primary Data After Processing, 2023

Based on Table 5 above, it can be explained that producers sell tempeh at UD. New Soya Group to retail traders for IDR. 1,500. -/package. Furthermore, retail traders sell tempeh products at UD. New Soya Group directly to consumers for IDR. 2,000. - / pack. Thus, the marketing margin of tempeh products at UD. New Soya Group in Birem Bayeun District, East Aceh Regency is IDR. 500.- and the share of the price received by the producer is 75%.

Third Channel Margin

Table 6. Price, Margin and Share of Price Received by Tempeh Producer at "UD. New Soya Group in Birem Bayeun District, East Aceh District" through the Third Channel, 2023

No	Marketing Organization	Purchase Price (IDR/Pack)	Harga Jual (IDR/ Bungkus)	Selling Price (IDR/Pack)	Margin Total (IDR)	Producer's Share of Price Received (%)
1	Producer	-	1.600.-	-		
2	Itinerant Traders	1.600.-	2.000.-	400.-	400.-	80
3	Consumen	2.000.-	-	-		

Source: Primary Data After Processing, 2023

Based on Table 6 above, it can be explained that producers sell tempeh at UD. New Soya Group to itinerant traders for IDR. 1,600. -/package. Furthermore, itinerant traders sell tempeh products to UD. New Soya Group directly to consumers for IDR. 2,000. - / pack. Thus, the marketing margin of tempeh products at UD. New Soya Group in Birem Bayeun District, East Aceh Regency is IDR. 400, - and the share of the price received by the producer is 80%.

Farmer's Share

Farmer's share product tempeh products at UD. New Soya Group in Birem Bayuen District, East Aceh Regency divided into three, namely Farmer'share first channel and Farmer'share second channel and Farmer'share third channel.

First Channel Farmer's Share

Table 7. Farmer’s Share of "UD. New Soya Group in Birem Bayeun District, East Aceh District" through the First Channel, 2023

Purchase Price (IDR/Pack)	Selling Price (IDR/Pack)	Farmer’s Share (%)
1.500.-	2.000.-	75

Source: Appendix 13

Based on table 7 above, it can be explained that the farmer's share through the first channel was amounting to 75% of the sum of the selling price from the producer of IDR. 1,500. - / pack and the selling price in the hands of consumers of IDR.2,000. - / pack and multiplied by 100%. and multiplied by 100%. This means that the value of farmer's share value of the first channel> 50% and has been said to be efficient (Nuriati, 2019).

Farmer's Second Channel Share

Table 8. Farmer's Share at "UD. New Soya Group in Birem Bayeun East Aceh District" through the Second Channel, 2023

Purchase Price (IDR/Pack)	Selling Price (IDR/Pack)	Farmer's Share (%)
1.500.-	2.000.-	75

Source: Appendix 14

Based on table 8 above, it can be It can be explained that the farmer's share through the second channel is 75% of the sum of the selling price from the producer of IDR. 1,500. - / pack and the selling price in the hands of consumers of IDR. 2,000. - / pack and multiplied by 100%. This means that the farmer's share value of the second channel is > 50% and has been said to be efficient (Nuriati, 2019).

Third Channel Farmer's Share

Table 9. Farmer's Share of "UD. New Soya Group in Birem Bayeun District, East Aceh District" through the Third Channel, 2023

Purchase Price (IDR/Pack)	Selling Price (IDR/Pack)	Farmer's Share (%)
1.600.-	2.000.-	80

Source: Appendix 15

Based on Table 9 above, it can be explained that the farmer's share through the first channel is 80% of the sum of the selling price from the producer of IDR. 1,600. - and the selling price in the hands of consumers of IDR.2,000. - and multiplied by 100%. This means that the farmer's share value of the first channel is> 50% and has been said to be efficient (Rahayu., et al 2020).

Marketing Efficiency

In calculating marketing efficiency in the tempeh business at UD. New Soya Group in Birem Bayeun District must be considered the total sales value of each marketing channel. There are three marketing channels marketing channels that exist in the tempeh business UD. New Soya Group in Birem Bayeun District and the total sales value of the largest marketing channel is in the first channel which is IDR. 32,400,000. - while the highest total marketing channel costs are in the first channel as well. This is because the first marketing channel is longer than other marketing channels. For more details, it can be seen in Table 10.

Table 10. Total Cost and Sales Value of Each Marketing Channel, 2023

No	Channel Marketing	Sales Volume (Packs)	Selling Price (IDR/Pack)	Total Sales Value (IDR)	Total Cost (IDR)
1	First Channel	16.200	2.000.-	32.400.000.-	10.510.000.-
2	Second Channel	8.100	2.000.-	16.200.00.-	3.910.000.-
3	Third Channel	4.050	2.000.-	8.100.000.-	2.925.000.-

Source: Primary Data After Processing, 2023.

Appendix 16

In table 10 the highest total cost is in the first marketing channel of IDR. 10,510,000. - and the largest total sales value is in the first channel also amounting to IDR. 32,400,000. - and the smallest total cost is in the third marketing channel of IDR. 2,925,000. - the smallest total sales value is also in the third channel of IDR. 8,100,000.-. After knowing the total cost and sales value of each marketing channel, then look for the marketing efficiency of each marketing channel. Marketing Efficiency of tempeh products at UD. New Soya Group in Birem Bayeun District, East Aceh Regency is divided into three channels. East Aceh Regency is divided into three channels, namely the first channel, the second channel and the third channel.

First Channel Marketing Efficiency

Table 11. Marketing Efficiency at "UD. New Soya Group in Birem Bayeun District, East Aceh Regency through the First Channel, 2023

Channel Marketing	Total Cost (IDR)	Total Sales Value (IDR)	Efficiency (%)
Produsen – Pedagang Eceran – Pedagang Keliling – Konsumen	10.510.000.-	32.400.000.	32

Source: Primary Data After Processing, 2023

Appendix 17

Based on table 11 above, it can be explained that the total cost through the first channel is IDR. 10,510,000. - and the total sales value in the first channel is IDR. 32,400,000. - with an efficiency of 32%. This means that the marketing efficiency of the first channel is <50% and it can be said that the first channel is efficient (Wulandary., et al 2018).

Second Channel Marketing Efficiency

Table 12. Marketing Efficiency at "UD. New Soya Group in Birem Bayeun District, East Aceh Regency through the Second Channel, 2023

Channel Marketing	Total Cost (IDR)	Total Sales Value (IDR)	Efficiency (%)
Producer - Retailer - Consumer	3.910.000.-	16.200.000.-	24

Source: Primary Data After Processing, 2023

Appendix 18

Based on Table 12 above, it can be explained that the total cost through the second channel is IDR. 3,910,000. - and the total sales value in the first channel is IDR.16,200,000. - with an efficiency of 24% This means that the marketing efficiency in the first channel is <50% and it is said that the second marketing channel is efficient (Yohanes., et al 2019).

Third Channel Marketing Efficiency

Table 13. Marketing Efficiency at "UD. New Soya Group in Birem Bayeun District, East Aceh Regency through the Third Channel, 2023.

Channel Marketing	Total Cost (IDR)	Total Sales Value (IDR)	Efficiency (%)
Producer - Retailer - Consumer	2.925.000.-	8.100.000.-	36

Source: Primary Data After Processing, 2023
Appendix 19

Based on Table 12 above, it can be explained that the total cost through the third channel is IDR. 2,925,000. - and the total sales value in the first channel is IDR. 8,100,000. - with an efficiency of 36% This means that the marketing efficiency in the third channel is <50% and it can be said that the third channel is efficient (Anwarudin, et al 2020).

CONCLUSION AND SUGGESTION

Conclusion

Based on the results of data analysis and discussion of tempeh marketing at UD. New Soya Group in Birem Bayeun District, East Aceh Regency, the most effective marketing channel is the second marketing channel with a farmer's share value of 75% and already above> 50%, a marketing efficiency value of 24% and already below < 50% of the criteria for farmer's share value and marketing efficiency.

Suggestion

To market tempeh products at UD. New Soya Group in Birem Bayeun District, East Aceh Regency, business owners should use the second channel where the price received by producers is greater and the costs incurred are relatively small and the need for government attention to improve the welfare of tempeh business actors in East Aceh in increasing tempeh production.

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DEVELOPMENT STRATEGY OF PROCESSED CASSAVA AGROINDUSTRY

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Abstract: The processed cassava agroindustry in Mukiran Village, Kaliwungu District, Semarang Regency has existed since 2003. The level of sales in this business cannot be ascertained because it only relies on collectors. Implementing the right strategy in the development process will greatly influence business performance. This research aims to determine 1) the condition of the cassava processed agroindustry in Mukiran Village, 2) internal factors and external factors in the cassava processed agroindustry in Mukiran Village. and 3) development strategy for the processed cassava agroindustry in Mukiran Village. This research was conducted from 1 August to 30 September 2023. This research used a qualitative approach. The results of the research reveal 1) the condition of the cassava processing agro-industry in Mukiran village has not experienced much development. This is because the processing is still traditional and does not use social media in product promotion. 2) internal factors that are strengths are product quality and flavor variants, while weaknesses are the lack of use of social media; The external factor that becomes an opportunity is that the price of competitors' products is higher, while the threat faced is that business competitors are more active in carrying out promotions. 3) The development strategy that can be implemented is a progressive strategy by increasing strength through exploiting opportunities (SO). The strategy is to improve the quality and taste variants of the product while still applying a selling price that is lower than competitors' prices.

Keywords: agro-industry, cassava chips, Mukiran Village

INTRODUCTION

Cassava is an agricultural commodity that is very suitable to be used as a business unit because it has various useful benefits and has a promising market share as a raw material. Cassava chips, for example, are in great demand by various groups of people, both children and adults, and from various social backgrounds. Given that cassava is an upstream commodity, the cassava chip industry can be considered a downstream industry. Internal factors refer to factors that affect the development of the company and come from within the company itself, namely strengths and weaknesses (Amaliya, 2023). The company's strengths can be identified by looking at whether the company has quality products, prices that are affordable to consumers, and an efficient company structure. On the other hand, to identify the company's weaknesses, it is necessary to see whether the company has low-quality products, prices that are too high to be affordable by consumers, and an unclear organizational structure (Luntungan & Tawas, 2019). The internal environment that will be examined in this study is production, product quality, production prices, human resources, use of marketing and promotion processing technology.

External factors refer to factors that can affect the continuity of the company from outside the company itself, namely opportunities and threats (Amaliya, 2023). The external environment that will be examined in this study is the price of raw materials, processed cassava competitors, the price of complementary components, market opportunities, market demand, weather. According to Jauch and Glueck (1988 in Syah, 2009) strategy involves achieving corporate excellence and overcoming environmental challenges, with the aim of ensuring the achievement of the company's main objectives through proper implementation. The unifying character implies that the strategy serves as a tool that captivates the entire agro-industry into an integrated whole. The broad characteristic covers all aspects that are important in the agro-industry. The integrated characteristic indicates that strategies are plans that are interrelated with one another.

RESEARCH METHODS

a. Location and Time of Research

This research was conducted at a cassava processed agro-industry in Mukiran Village, Kaliwungu District, Semarang Regency. The reason for choosing this agro-industry is because it has not maximized production and obtained optimal profits even though it has been established for more than 20 years. In addition, the level of cassava production in Semarang Regency, especially Kaliwungu District, which is quite high,

shows that there are opportunities for the development of processed cassava agro-industry. This research was conducted from August 1 to September 20, 2023.

b. Data Collection Technique

The data collected is primary data. primary data data is data obtained directly by data collectors. In this study, the data was obtained directly by means of observations and interviews with owners and consumers of processed cassava agro-industry (Sugiyono, 2017). Meanwhile, secondary data is data obtained not directly by data collectors, but through related documents. In this study, the data were obtained from literature studies in books, the internet, journals, theses, and BPS (kaliwungu) (Sugiyono, 2017).

c. Samplle Collection Technique

According to Sugiyono (2017) The technique of determining informants using purposive sampling method is a sampling method with predetermined criteria so that it can provide correct and precise information. There are two sources in this study, namely:

1. Key informant (Key informant) is someone who has the main information and understands it so that he can share the information needed in the research.

2. An informant is someone who is directly involved in activities related to the research topic. The key informants selected in this study were 2 people and the informants used in this study were 2 people.

d. Data Analysis Technique

SWOT is one of the instruments used to determine the optimal strategy that can be applied by a business. According to Susanthi (2017), SWOT analysis is an analytical tool that is considered effective for knowing problems in the business environment. The analytical tool can analyze and classify both internal and external business environments in a structured manner. Recognizing the business environment is the right effort to find out the optimal strategy in utilizing strengths and opportunities and minimizing the weaknesses and threats it faces. The most important stage in the SWOT analysis process is to analyze and understand all business information as well as the issues and problems that occur, so as to get the optimal solution to overcome existing problems (Rusdiansyah, 2016).

1. IFAS (Internal Factor Analysis summary) Internal analysis is carried out to determine the strength factors and weakness factors owned by the agroindustry. Strength factors will be used optimally, while weakness factors will be minimized or anticipated. The IFAS matrix is used to categorize existing internal factors. The steps for determining the weight, rating, and making the matrix are:

    a. Determine the Strengths and Weakness factors.

b. Give weight to each factor using pairwise comparisons with a total weight equal to one. The weighting value consists of 1 (very unimportant), 2 (not important), 3 (quite important), 4 (important), and (very important).
c. Rating each factor according to agro-industry conditions. The rating value consists of 1 (very small positive influence), 2 (small positive influence), 3 (neutral), 4 (large positive influence), and 5 (very large positive influence).
d. Calculate the score of each factor by multiplying the weight and rating. After that, add up each score.

2. EFAS (External Factor Analysis summary)
External analysis is carried out to determine the opportunity factors and threat factors that the agro-industry has. Opportunity factors will be utilized for agro-industry development, while threat factors will be anticipated. The EFAS matrix is used to categorize existing external factors. The steps for determining the weight, rating, and making the matrix, namely:

a. Determine the opportunity factors (Opportunity) and threats (Threat)
b. Give weight to each factor using pairwise comparisons with a total weight equal to one. The weighting value consists of 1 (very unimportant), 2 (not important), 3 (quite important), 4 (important), and 5 (very important).
c. Rating each factor according to agro-industry conditions. The rating value consists of 1 (very small positive influence), 2 (small positive influence), 3 (neutral), 4 (large positive influence), and 5 (very large positive influence).
d. Calculate the score of each factor by multiplying the weight and rating. After that, add up each score.

3. SWOT Matrix Analysis
This research uses SWOT analysis techniques, with methods to identify internal and external factors to formulate the necessary strategies. The data used in SWOT analysis are strengths and weaknesses (internal) opportunities and threats (external).

The SWOT matrix can illustrate how opportunities and threats from the company's external environment are anticipated with the strengths and weaknesses of the cassava processed agro-industry in Mukiran Village. The SWOT matrix will make it easier to formulate various strategies. So that the SWOT matrix will obtain four groups of alternative strategies called SO strategies, ST strategies, WO strategies, and WT strategies.

Table 1. Matrix SWOT

Internal / External	**Strengths (S)** Determine 5-10 company strengths factors	**Weakness (W)** Determine 5-10 company weakness factors
Opportunities (O) Determine 5-10 company opportunity factors	**Strategy S-O Capitalize** Determine 5-10 company weakness factors Strategy W-O on agro- industry	**Strategy W-O** Minimize the company's weakness by taking

	strengths and opportunities to attract profits	advantage of existing agroindustry opportunities
Threats (T) Determine 5-10 company threat factors	**Strategy S-T** Utilize the strengths of the agro industry to overcome the impact of the threats facing the agro-industry	**Strategy W-T** Minimize weakness and overcome threats with the right strategy

RESULTS AND DISCUSSION

A. History of Cassava Processed AgroIndustry

Cassava processed agro-industry in Mukiran village was started by Mrs. Sulami about 20 years ago. She did her business with the help of her family. The products made are ceriping, gadungan, and godril. Then followed by other residents, namely Mrs. Jiah. But in fact, until now there has been no significant development of the processed cassava Agroindustry. The lack of use of modern processing technology and the utilization of social media is one of the factors inhibiting the development of the agro-industry. This agro industry carries out the production process every day, but when the rainy season comes, production will be reduced due to the low main raw materials owned. Overcoming this, the two-cassava processed agro-industries in Mukiran Village will carry out a large production process during the summer even though there are no orders, so that when the rainy season comes, they still have a supply of products to sell.

B. IFAS Matrix Analysis

Table 2. Weighting of IFAS

Strengths	**Weight**	**Rating**	**Total Score**
Cassava is easy to obtain	0.12	4	0.48
Cassava quality is good	0.12	4	0.48
The quality of the products produced is good	0.14	4	0.56
Production has been done optimally	0.14	4	0.56
Product flavors are diverse and interesting	0.14	4	0.56
			2.64
Weakness			
Lack of employee	0.06	2	0.12
Processing techniques are not modern	0.08	2	0.16
Product marketing is not yet optimal	0.06	2	0.12
Attractive packaging	0.06	2	0.12
Social media utilization is not maximized	0.08	2	0.16
			0.68
Total	**1.00**		**1.96**

Based on Table 2. obtained the highest score in the strength variable is good product quality, optimal production, and has a variety of flavors, with a score of 0,56. This indicates that these three indicators are factors that support the business and must be maintained and improved. In the weakness variable, the highest score is in the indicator of modern processing techniques and less than optimal utilization of social capital, with a score of 0,16. This indicates that the two indicators are weak factors for Cassava Processed Agrotourism, so they need to be considered and improved.

C. EFAS Matrix Analysis

Table 3. Weighting of EFAS

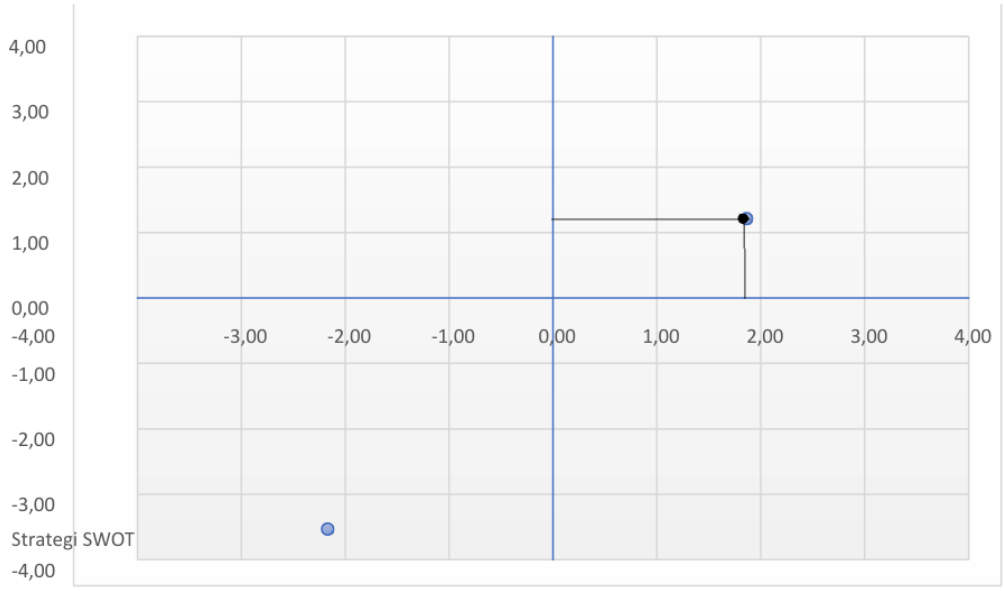
Opportunity	Weight	Rating	Total Score
Cheap cassava price	0.11	4	0.44
Products according to consumer tastes	0.14	5	0.77
High demand on holiday	0.10	3	0.30
Competitor's product price is higher	0.14	5	0.70
Competitor products have no flavor variants	0.11	4	0.44
			2.58
Threat			
Long harvest period hampers production	0.06	2	0.12
Weather hampers production	0.07	2	0.14
Having processed cassava competitors	0.11	4	0.44
Business competitors are more active in promotion	0.11	4	0.44
Increase in material prices affects the product	0.05	2	0.10
			1.24
Total	**1.00**		**1.34**

continued

Based on Table 3. obtained the highest score in the opportunity variable is the product according to consumer tastes and higher competitor prices, with a score of 0,70. This indicates that these two indicators are factors that can support business continuity, so they need to be considered utilized. In the threat variable, the highest score is in the existing and more active competitors' indicator, with a score of 0,44. This indicates that the two indicators are factors that must be considered and overcome.

D. SWOT Quadran Analysis

Based on the results of the IFAS and EFAS matrix analysis that has been carried out, the IFAS weighting value is 1,96 and EFAS is 1,34. Furthermore, the SWOT quadrant determination is carried out using the IFAS and EFAS weight values.



Picture 1. SWOT Quadran

E. SWOT Matrix Analysis

Table 4. Matrix S-O

Internal / External	**Strengths (S)** Cassava is easily available Cassava quality is good The quality of the products produced is good Production has been done optimally Product flavors are diverse and interesting
Opportunities (O) Cassava price Product according to consumer taste High demand on holidays Competitor's product price is higher Competitor products have no flavor variants	Has good product quality with relatively cheap price and a variety of flavors that can meet consumer tastes. (S3, S5, O2, O4)

SO (Strength-Opportunities) has good product quality with relatively cheap prices and a variety of flavors that can meet consumer tastes. The quality of processed cassava products is influenced by good raw materials and has a variety of flavors at a low price which can provide benefits for the business. Based on this, agro-industry must pay attention in terms of product quality, price and flavor variants, or with a quadrant one (progressive) strategy.

Table 5. Matrix W-O

Internal / External	**Weakness (W)** Lack of employees Modern processing techniques Product marketing is not yet optimal Attractive packaging Social media utilization is not optimal
Opportunities (O) Cassava price Product according to consumer taste High demand on holidays Competitor's product price is higher Competitor products have no flavor variants	Improve processing technology and promotion through social media by providing lower price than competitors. (W2, W5, O2, O4)

WO (Weakness - Opportunity) improves processing technology and promotion through social media by providing lower prices than competitors. Based on quadrant three strategy, namely changing strategies, Cassava Processed Agroindustry needs to start developing in terms of utilizing processing technology and learning social media technology so that production can increase and be more efficient, as well as increasing the level of sales and marketing of products, by taking advantage of opportunities for prices that are lower than competitors and diverse flavors that competitors do not have.

Table 6. Matrix S-T

Internal / External	**Strengths (S)** Cassava is easily available Cassava quality is good The quality of the products produced is good Production has been done optimally Product flavors are diverse and interesting
Threats (T) Long harvest period hampers production Weather hampers production Has cassava processed competitors Business competitors are more active in promotion Increase in the price of ingredients affect the product	Increase online promotion by introducing diverse product variants in order to be able to compete with other enterpreneurs. (S3, S4, S5, T3, T4)

ST (Strenghts-Threats) increases online promotion by introducing diverse product variants in order to compete with other entrepreneurs. Based on quadrant two or diversification strategy, Cassava Processed Agroindustry needs to utilize optimal production, diversity of product variants and good product quality by conducting more active promotions such as online. This can make the products owned by Cassava Processed Agroindustry better known and more competitive with other cassava processed competitors.

Table 7. Matrix W-T

Internal / External	**Weakness (W)** Lack of employees Modern processing techniques Product marketing is not yet optimal Attractive packaging Social media utilization is not optimal
Threats (T) Long harvest period hampers production Weather hampers production Has cassava processed competitors Business competitors are more active in promotion Increase in the price of ingredients affect the product	Improve processing technology and promotion on social media so as not to lose to other enterpreneurs. (W2, W5, T3, T4)

WT (Weakness - Threats) improves processing technology and promotion on social media so as not to lose to other entrepreneurs. Based on the quadrant four strategy, namely the survival strategy, Cassava Processed Agroindustry needs to increase the use of technology in the processing process and promotion on social media in order to carry out production more efficiently and introduce products actively so that it can maintain business and compete with other cassava processed competitors.

CONCLUSION

Cassava processing agro-industry in Mukiran Village has been carried out since 20 years ago but has not experienced development or stagnation. The products made by the Agroindustry are ceriping, gadungan, and godril. The processing techniques used are still traditional. Marketing using social media is not done optimally, only by word of mouth without utilizing social media. The production process will be carried out in large quantities during the summer, because the main raw material, namely cassava, will be easier to obtain.

Internal factors in Mukiran Village's processed cassava Agroindustry are cassava with good quality is easy to obtain, the quality of the products produced is good and has a variety of interesting variants, production is optimal but has not been carried out in a modern way and still lacks employees, the packaging used is less attractive, namely only clear plastic without product identity for ready-to-eat cassava and sacks for raw cassava, the utilization of social media is not optimal so that product marketing is not optimal. External factors are the low price of cassava but when the rainy season arrives and it is not harvest season, cassava is difficult to obtain and then hampers production, has processed cassava competitors but the product price is cheaper than competitors and has various flavors, products made according to consumer tastes but the increase in material prices affects the product, product demand will be high on holidays, and competitors are more active in conducting promotions.

The development strategy that can be carried out is a progressive strategy, namely increasing strength by utilizing opportunities (SO). The strategy is to improve product quality and product flavor variants while still applying a low selling price or lower than competitors' selling prices.

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IMPROVING PRODUCTS TO BUILD CONSUMER SATISFACTION FOR JAMBLANG RICE

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Abstract: When the consumer states his satisfaction, consumption of product or service will Keep going continuously so that business practitioners can Keep going to obtain profit as well as business continuity. study This aims to know the influence of product variables on satisfaction of Jamblang rice consumers in Cirebon City. This study was carried out from November to December 2023. Design used in study This is quantitative descriptive use method survey, with the

sample size was 100 respondents Jamblang rice customers in the city of Cirebon. Data analysis using Structural Equation Model instrument. Research results conclude that variable product itself has a real influence on customer satisfaction by 81% with the most contributing indicator in variable price is "product stock availability" while on consumer satisfaction is "fulfilled hope".

Keywords: Cirebon, Jamblang rice, product availability, sem , variable product

INTRODUCTION

Business culinary is one of the efforts in build village agriculture to get it increase economy the village, activities business in field culinary covers utilization results agriculture for processed become ready food _ served to customers _ (Dewandini and Huda 2023). Tour culinary is one of the efforts in increasing excellence and power competitiveness from some areas (Ariani et al. 2022). impact from tour culinary This has been felt by the farmers and fishermen who experienced its enhancement Because become a supplier for MSMEs and restaurants (Rahayu, Diatmika, and Haryadi 2022).

In the tourist city of Cirebon culinary own roles that don't lose importance from tour others, there are culinary potential _ food typical Cirebon capable of interesting interest travelers (Basiran et al. 2023)).Jamblang rice is one of food typical from there are many cities in Cirebon interested with percentage of 35% among three others ie empal gentong 41%, 12% lengko rice , 12% lian etc (Setiawati and Suryono 2023) . Jamblang rice consists of various side dishes, the vegetables that come from agriculture, yield sea, and animal husbandry (Atjil 2022).

Even though it’s jamblang rice, empal gentong, lengko rice and other Cirebon specialty Still become favorite tourists, but Currently _ Lots there are culinary new ones emerging in the city of Cirebon (Mustafa and Khalim 2023). Lots of them popping up are culinary new so will tighten competition. Bisser culinary must endure in face of strict competition Because competition not only appears from within the area but also from outside areas (Maulida and Indah 2021). Therefore _ perpetrator business must know the condition of the economy at the moment, so that the perpetrator business can make suitable product _ interest consumers (Ramadhani, Sabila, and Wachdijono 2023).

As a matter of so, it studies variable products to satisfy consumers of jamblang rice, which aims to know how to influence variable products to satisfy Jamblang rice consumers in Cirebon City. Research conducted by Setiadi and Manafe (2021) states when consumers state his satisfaction so consumption to product or service will Keep going so that perpetrator business can Keep going obtain profit as well as continuity business. Ibrahim and Thawil (2019) Conclude there are significant relationship _ from quality product to satisfaction consumer. Azizah, Ammbiya, and Wachdijono (2023) conclude there is influence directly from quality products and prices to satisfy consumers on Chips Cassava Qtela.

RESEARCH METHODS

Location study determined in a way on purpose namely in Cirebon City, because Cirebon city is a city with various culture acculturation legacy era colonialism so that Lots visited by tourists Muslim (Kurniawan 2021). And the choice of jamlang rice as object study Because Jamblang rice is very popular and sought after by tourists. Study implemented in October -November 2023 and object his research in the form of product variables (X) and consumer satisfaction variables (Y). The definition of operational variable arranged aim makes it easier in measurement to the variables related (Ernanda and Sugiyono 2017). as following:

Table 1. Operationalization variables and indicators study in 2023

Variables	Indicators	Criteria	Measurement Scale	Unit measurement	No. question items
Satisfaction Consumer (Y)	Feeling of satisfaction (Y1)				1
	Repurchase (Y2)				2
	Fulfilled hope (Y3)				3
	Give comment positive (Y4)				4
	Less attention another restaurant (Y5)			5 = strongly agree	5
Product (X)	Product Scent (X1)	Good taste	Likert	4 = agree	1
	Product Taste (X2)	Fragrant aroma			2
	Availability Products (X3)	Always available		3 = sufficient agree	3
	Product Variants (X4)	Many variants the product			4
	Packaging Products (X5)	Packaging product hygienic and clean		2 = no agree	5
	Product Brand (X6)	Product brand Already famous		1 = absolutely no agree	6
	Uniqueness Products (X7)	There is product unique			7

Population study is the number of jamblang rice consumers in Cirebon City No known, Hair in Sobri et al. (2023) explain amount if indicator No is known so amount population taken _ product of _ numbers 5 - 10. Because characteristic scale unstable Likert, therefore _ taken is the highest i.e. number 10. then sample amounting to 100 respondents. sample taken in a way incidental with provision the same respondent calculated onetime thing This done for prevent happen calculation. design used _ in

study This is quantitative descriptive use method survey. Data analysis uses the Structural Equation Model (Yusfaningrum and Ghozali 2005). using SPSS and AMOS version 20 software.

RESULTS AND DISCUSSION

Obtained results analysis with tool help statistics in the form of SEM-AMOS with Factor analysis and regression are shown in Figure 1.

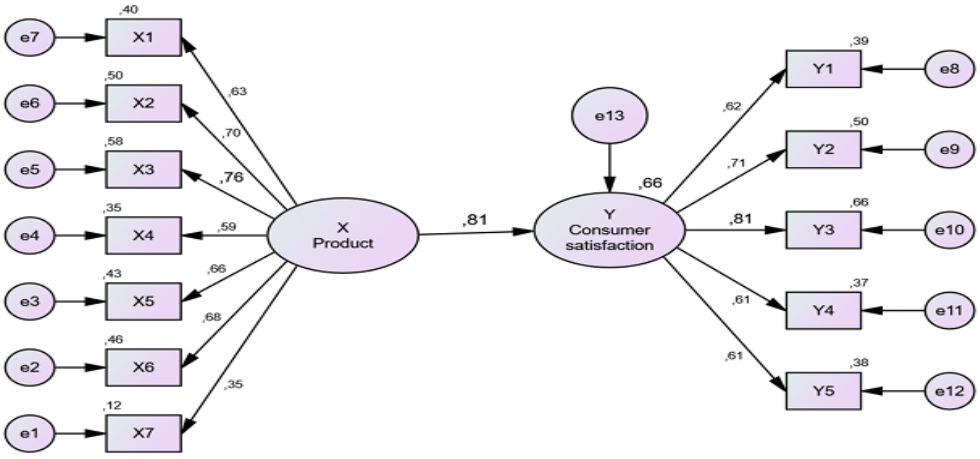

Figure 1. Influence of x on y along with loading factor value of every indicator

Contribution from an indicator be measured from the factor loading number, if factor loading value above 50% then indicator the stated Enough representative for can explain unobserved variables (Syahriyal 2018). In variable X the indicator has the highest loading factor value found in the X3 indicator is 76%, meaning variable X3 (Availability Product) provides contribution by 76% against variable product. Meaning the perpetrators Jamblang rice business in the city of Cirebon want to Keep going guard satisfaction consumers, then one of them with notice indicator “Availability Product”, therefore X3 of the sub variable product need get it priority main.

Table 2 Significance value (P) on the effect variable X to Y

			Estimate	S.E	CR	P	Label
Y_Consumer_satisfaction	<---	X_Product	1,439	,478	3,011	,003	par_11
X7	<---	X_Product	1,000				
X6	<---	X_Product	1,922	,600	3,202	,001	par_1
X5	<---	X_Product	1,820	,572	3,180	,001	par_2
X4	<---	X_Product	1,736	,563	3,084	,002	par_3
X3	<---	X_Product	2,196	,668	3,290	,001	par_4
X2	<---	X_Product	2,006	,620	3,234	,001	par_5
X1	<---	X_Product	1,764	,562	3,141	,002	par_6
Y1	<---	Y_Consumer_satisfaction	1,000				
Y2	<---	Y_Consumer_satisfaction	1,151	,204	5,630	***	par_7
Y3	<---	Y_Consumer_satisfaction	1,291	,210	6,135	***	par_8
Y4	<---	Y_Consumer_satisfaction	,981	,195	5,031	***	par_9
Y5	<---	Y_Consumer_satisfaction	1,006	,200	5,037	***	par_10

Conditions set _ in limitation statistics for p (probability) must below 5% and children arrow with One marking end _ influence direct. so seen from table 2 is available influence directly from variable product to satisfaction consumer. And value coefficient the regression in Figure 1 is 81% interpreted if variable X is increased by 100% of its value so mark variable y will also increase by 81%. From information on so recommended towards the decision makers concerned with development jamblang rice business in matter product always guard availability the product so that can Keep going increase satisfaction Jamblang rice consumers in the city of Cirebon.

CONCLUSION

Based on the results, the study concluded that there is a direct influence from the variable product to the satisfaction of consumers of jamblang rice in the city of Cirebon, with the most descriptive indicator influencing the variable product to the satisfaction of the consumer being the availability of the product.

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THE INFLUENCE OF AGE AND EDUCATION LEVEL ON THE USE OF DIGITAL MARKETING AMONG ORNAMENTAL PLANT ENTREPRENEURS IN BANYUMAS

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Abstract: An organization's ability to market effectively determines its success. A business's marketing technique must incorporate digital media to reach more customers. Businesses in the agriculture industry also need to use digital marketing strategies. Various internal and external factors might impact how agricultural businesses apply technology. Business actors are the source of internal factors, and external business actors are the source of external factors. Due to digital marketing, Banyumas-based entrepreneurs who sold ornamental plants made significant revenues throughout the pandemic. Nevertheless, some have not used digital marketing; thus, they cannot reach a wider audience of customers. This study aims to ascertain whether the age and education level of ornamental plant entrepreneurs in Banyumas influence their use of digital marketing. With 100 respondents, a poll conducted in March and April of 2022

yielded the primary data. Logit regression and analytical descriptive techniques are used in data analysis. Banyumas business owners who sell ornamental plants make use of digital marketing. The impact of age and education level is shown by the logit regression value of X2 24.649 > X2 table 5,991 (DF = 2). In the meantime, Banyumas decorative plant entrepreneurs' use of digital marketing is somewhat influenced by their age. Entrepreneurs in Banyumas who sell ornamental plants employ digital marketing to varying degrees, depending on their educational background. As a result, the government must consider and encourage the Banyumas decorative plant industry. Government assistance can take the kind of internet corners, landing sites, and training programs for digital marketers.

Keywords: ornamental plants, digital marketing, age, education level, and entrepreneurs

INTRODUCTION

Currently, business actors are concentrating on digital marketing to expand their market. Microbusiness players today confront several challenges, including the inability to compete in the sales process to a broader market, financial access, and the use of information technology that is not yet optimal, according to a study by the Asian Development Bank Institute (2016). Digital marketing applies to businesses in the agricultural sector as well. Ornamental plants are among the goods with potential for digital marketing. Plants with certain qualities of beauty and attractiveness are considered ornamental. Indent and outdoors, ornamental plants are economically valuable for aesthetic or decorative purposes. Ornamental plants have economic worth. Therefore, they can be grown for profit in the lucrative ornamental plant industry (Widyastuti, 2018).

The success of Banyumas' decorative plant enterprises is impacted by the usage of digital marketing (Fajri et al., 2023). Entrepreneurs who sell decorative plants have a lot of opportunities thanks to the usage of digital media. Therefore, they must be tech-savvy. Owners of businesses must also comprehend consumer demands. Conventional marketing methods are rendered ineffective due to the rapid pace of technological advancement and shifts in client preferences (Rebstein et al., 2009).

Increasing internet connectivity in Indonesia's distant regions contributes to the country's digitization process. In 2021, there were 202.6 million internet users in Indonesia, up 15.5% (or 27 million) from the year before. There are currently 274.9 million people living in Indonesia. This indicates that at the start of 2021, the percentage of Indonesians using the Internet was 73.7% (HootSuite, 2021). Digital marketing can occasionally be challenging due to various issues, particularly internal concerns affecting company actors. These internal characteristics may influence their understanding of digital marketing. This knowledge affects how digital marketing is

used in the operating company. From the standpoint of rural cooperatives, one of the difficulties in marketing agricultural products is that education makes the most significant difference (Arbabi et al., 2015). According to the Central Statistics Agency's 2023 Agricultural Census, 42.39 percent of farmers are between the ages of 43 and 58, while 25.61 percent are between the ages of 27 and 42.

The declining interest of young workers in the agricultural industry requires consideration of internal issues. The perception of the farm sector as less prestigious, high risk, and offering less assurance of level, stability, and continuity of income contributes to the younger generation's lack of interest in it. Other factors include the narrow average land tenure, the lack of development in non-agricultural businesses and the low level of farming management succession, the absence of specific incentive policies for young or beginning farmers and shifts in youth perspectives in the postmodern era.

It would be interesting to find out if age and education level impact the awareness of digital marketing amongst entrepreneurs selling ornamental plants in Banyumas, given the lack of enthusiasm shown by the younger, better-educated generation with expertise in digitalization.

RESEARCH METHODS

Sugiono (2009) defines the analytical descriptive method as one that describes or gives an overview of the research object by gathering data or samples to make conclusions and apply them to the general public. Descriptive analysis is the research method used in this study. This study was carried out at a deliberately chosen area in Banyumas, an ornamental plant business. The study was carried out in 2022 between March and April. Both primary and secondary data are used in this study. Primary data was collected using a questionnaire. The Banyumas Regency's ornamental plant entrepreneurs are the study's target population. Snowball sampling was utilized in this study's survey of entrepreneurs growing ornamental plants. A maximum of 100 responders served as the sample size quota. Primary data for this study was collected through questionnaire responses. The Banyumas Regency's Ornamental plant entrepreneurs are the study's target population. With the aid of software data processing from SPSS (Statistical Package for Social Science) version 25, the logistic regression analysis data analysis approach is employed.

Overall Model Fit

Overall model fit indicated every independent factor influences the dependent variable. The statistical framework relies on the likelihood function, which assesses how well the suggested model represents the input data, termed likelihood L (Ghozali, 2018). -2 log-likelihood was used to evaluate the alternative and null hypotheses. Comparing the initial -2LL value with the subsequent -2LL value completes the testing process. The regression model is superior if the value of -2LL block number = 0 is more significant than that of -2LL block number = 1, as indicated by the reduction (-2 logL) (Ghozali, 2018). The following is the hypothesis that was used to test the complete model:

H0: The data suits the proposed model.
H1: The data do not fit the proposed model.

Goodness of Fit Test

The feasibility test of the model was indicated by the chi-square value (X2). This model investigates the null hypothesis, according to which the model fits the empirical data if there is no difference between the two (i.e., the model can be considered to fit) (Ghozali, 2018).

Nagelkerke R Square

Because the Nagelkerke R square value can be read similarly to the R square value in multiple regression, the Nagelkerke R square in logistic regression shows the coefficient of determination. The Cox and Snell coefficient is modified by the Nagelkerke R Square to guarantee that the value will fluctuate between 0 (zero) and 1 (one). A Nagelkerke R square value near zero suggests that the variables have little power to explain the dependent variable. On the other hand, a Nagelkerke R square value near one indicates that the independent variable has all the information required to forecast the dependent variable's variability (Ghozali, 2018).

Hypothesis Test Model

Logistic regression analysis will be used to examine this study hypothesis. The research problem, which is the impact of two or more independent factors on the independent variable, is what it seeks to address. As a result, the following is the equation for logistic regression analysis:

Information:
Y: The Use of Digital Marketing
α: Constant
β1: Age Regression Coefficient
X1: Age
β2: Regression coefficient for education level
X2: Education level
ε: error

Wald Test (t Partial Test)

The Wald test reveals how much the independent variable partially influences the dependent variable (Ghozali, 2018). The Wald test (t-test) value is calculated with a significance threshold of 5%.

Omnibus Tests of Model Coefficients (Simultaneous F Test)

Simultaneous statistical tests, or f tests, are omnibus tests of model coefficients. This study aims to determine if the independent factors affect the dependent variable simultaneously (Ghozali, 2018:98).

RESULTS AND DISCUSSION

The characteristics of ornamental plant industry actors in Banyumas can be explained by age, education, and business location. Most Banyumas' ornamental plant business owners come from the Baturraden sub-district and have completed elementary school between the ages of 40 and 46.

Table 1. Characteristics of Ornamental Plant Agribusiness in Banyumas

No	Characteristic	Quantity (people)	Percent (%)
1	Education		
	Elementary School	37	37
	Junior High School	21	21
	Senior High School	33	33
	Undergraduate School	9	9
2	Location		
	Kedungbanteng	11	11
	Sumbang	13	13
	Karanglewas	1	1
	Baturraden	65	65
	Purwokerto Utara	3	3
	Sokaraja	7	7
3	Age		
	19-25	3	3
	26-32	11	11
	33-39	15	15
	40-46	32	32
	47-53	22	22
	54-60	13	13
	61-68	4	4

Source: primary data (2022)

Manyamsari & Mujiburrahmad (2014) state that because individuals in this age range are thought to be able to produce products and services, they are categorized as productive workers in the 15–64 age range. One of the keys to farming success is being of a productive age. Hasyim (2006) and Ryan et al. (2018) assert that farmers of productive age will perform more effectively and efficiently than those who do not. Older farmers, however, have a better understanding of the field conditions. It agrees with Novia's (2011) assertion that older farmers typically possess comparatively less knowledge but are better able to assess the state of their farmland.

The chi-square value of Hosmer and Lemeshow indicates the feasibility of the model. This model examines the null hypothesis, which states that if there is no difference between the model and the data, the model can be said to fit the empirical data. The Chi-Square (X2) value in the Hosmer and Lemeshow Test tables is displayed in Table 2.

Table 2. Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	8.010	8	.432

Source: SPSS, 2023

Based on the observed value, the Chi-square (X2) value is 8.010 with a significance value of 0.432, more significant than the model's p-value (0.05). Thus, the

observed value can be predicted by the goodness-of-fit test. Table 3 displays the overall model fit and coefficient determination.

Table 3. Overall Model Fit and Coefficient Determination

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	113.620[a]	.218	.292

Source: SPSS, 2023.

The total model fit is explained in Table 3. The independent variable from the model is fit, as indicated by the log-likelihood value (113.620) < 126.141 (DF = 97). 138,269 is the initial -2 log-likelihood. The simultaneous influence of dependent and independent factors is ascertained using maximum likelihood. The length of the education variable and age account for 29,2% of the Negelkerke R square value (0.292), whereas other variables not included in the model account for 70.8%.

The final and starting likelihood are subtracted to get the maximum likelihood. A maximum likelihood value of 24.649 > 5.991 (DF = 2) is obtained by taking the difference between the initial and final likelihood values, 138.269 and 113.620. It demonstrates the simultaneous impact of age and education level on using digital marketing by Banyumas based ornamental plant entrepreneurs. Variable addition may change the model.

Table 4. Wald Test (t Partial Test)

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Age	-.091	.030	9.335	1	.002	.913
	Education	.161	.077	4.385	1	.036	1.175
	Constant	2.638	1.666	2.507	1	.113	13.987

Source: SPSS, 2023.

The age variable partially influences the use of digital marketing by businesses growing ornamental plants in Banyumas (Sig 0.002 < α = 0.05). The usage of digital marketing by entrepreneurs selling ornamental plants in Banyumas is partially influenced by their varying educational backgrounds (Sig 0.036 < α = 0.05). According to Soekartawi (2006), farmers' attitudes toward embracing innovation and putting ideas into practice are typically influenced by their education. Accordingly, farmers with more education levels pick up new technology and apply it more quickly. As a result, farmers with higher education levels are more productive at work and make better decisions when it comes to farming operations. According to Novia (2011), farmers with a higher degree of formal education will have an easier time accepting the explanations offered. As a result, their understanding, emotions, and propensity to act will be better. Higher-educated farmers are typically more engaged in Facebook communities, actively seeking information on agriculture and posting questions and thoughts about it.

$$Y = 13.987 + 0.913X1 + 1.175X2 + e$$

Information:
Y: The Use of Digital Marketing
α: Constant
β1: Age Regression Coefficient
X1: Age
β2: Regression coefficient for education level
X2: Education level
ε: error

The growing use of digital marketing is influenced by age and education level. Nonetheless, raising the age range will result in a more significant comprehension of digital marketing; therefore, when the entrepreneurs of ornamental plants in Banyumas age, their comprehension will also grow in tandem with the advancement of society. In Banyumas, entrepreneurs of ornamental plants are often of a productive age. However, there hasn't been much focus on market channel selection for decorative plants in Banyumas. Growers were less price-sensitive because they preferred to sell to independent garden centers, whose competitive position was frequently based on quality and service (Hampton, 2001; Brand and Leonard, 2001). The ability of entrepreneurs who sell decorative plants to recognize market opportunities and identify which channels are most conducive to selling their products is reflected in the development of market channels.

CONCLUSION

The use of digital marketing is impacted concurrently by age and education level. Adopting new technology is more accessible for young businesses, particularly in digital marketing. More educated entrepreneurs are better able to accept and utilize digital marketing. The government must consider and encourage the rebirth of the Banyumas decorative plant industry. Government assistance can take the kind of internet corners, landing sites, and training programs for digital marketers.

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FORECASTING OF RICE PRODUCTION IN KUDUS REGENCY BY LEAST SQUARE METHOD

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Abstract: Rice plays a crucial role in Indonesia as a vital commodity, serving as a primary food source and a key income generator for millions of farmers. Securing access to inexpensive rice is crucial for national resilience, security, and the stability of the government. Acknowledged as a vital commodity, rice carries substantial social, political, and economic importance, emphasizing the imperative of boosting production to fulfill the dietary requirements of the majority of the Indonesian populace. This study, undertaken in Kudus Regency, Central Java, during the period of November to December 2023, employs the Least Squares technique to predict forthcoming rice production in the area. The aim is to contribute valuable insights that can inform government policies geared towards addressing food security concerns. The research utilizes secondary data obtained from the Central Bureau of Statistics (BPS) of Central Java and the Agriculture Service, with a particular emphasis on rice production in Kudus Regency from 2002 to 2022. Using meticulous simulations with the Least Squares model, the study forecasts a continual increase in rice production in Kudus Regency for the upcoming decade (2023-2032). The forecast indicates an average annual increase of 1.47% in rice production during this period. In gauging the precision of these forecasts, the study utilizes the Mean Absolute Percentage Error (MAPE), indicating a comparatively small error value of 1.58%. This underscores the reliability of the forecasting model and its potential utility in aiding policymakers in addressing the challenges associated with ensuring an adequate rice supply in Kudus Regency.

Keywords: forecasting; paddies; production

INTRODUCTION

The agricultural sector is crucial in shaping Indonesia's Gross Domestic Product (GDP) every year. This is due to Indonesia being an agrarian country, making the agricultural sector a government's primary focus. The agricultural sector's contribution is significant to the development of Indonesia's economy, as more than 50% of the national income comes from the agricultural sector (Ario, 2010). The agricultural sector has emerged as a dependable avenue for enhancing the welfare of the population due to the significant portion of Indonesians employed within this sector (Permata, 2016). This is further substantiated by data suggesting that approximately 65% of Indonesia's population resides in rural regions, with the remaining 35% dwelling in urban areas (Karmila, 2014). In her research, Karmila also mentioned that the majority of the rural communities work in the agricultural sector.

Rice, as a staple crop, holds immense importance in Indonesia's agricultural landscape. Beyond serving as a fundamental dietary staple, rice also serves as a principal source of livelihood for millions of farmers (I. I. Sari & Kurniawati, 2020). Furthermore, the availability of rice at affordable prices for the public is a crucial factor for national resilience, security, and governmental stability (Suwarno, 2010). Rice is a strategic commodity with social, political, and economic value, as it serves as the staple food for a majority of the Indonesian population. In addition to its role as a basic food item, the increased production of this food commodity receives high priority (Wahyuni, 2011; Yahumri et al., 2020).

Kudus Regency is one of the areas in Central Java that contributes significantly to food crops, especially rice, and the community's demand for rice is quite substantial (R. K. Sari, 2019). Kudus Regency is recognized as one of the rice-producing regions, benefiting from its agricultural land suitable for rice cultivation and the availability of farm resources conducive to the development of rice crops within the agricultural sector. This assertion is supported by data from the Central Bureau of Statistics in 2023 (Badan Pusat Statistik Jawa Tengah, 2023). The harvested land area in 2020 amounted to 31,698.29 hectares, which decreased to 30,112 hectares in 2021, before rising to 33,322 hectares in 2022. Concurrently, rice production in 2020 stood at 175,730.59 tons, declined to 171,357 tons in 2021, and then increased to 196,822 tons in 2022.

The discrepancy between land area and consistent rice yields necessitates investigations in Kudus Regency to assess whether forthcoming rice production will suffice to meet community consumption needs. Forecasting rice production can inform governmental policy formulation to tackle these challenges.

Forecasting is an art and science of predicting events that have not yet occurred, with the aim of estimating future occurrences by always relying on data from the past (Yuniastari & Wirawan, 2014). Another perspective on forecasting is that it serves as a tool or technique to predict or estimate a value in the future by considering relevant data or information, whether it be from the past or present. Forecasting is almost universally practiced by everyone, including governments, companies, and even the general public, dealing with various issues such as weather conditions,

inflation rates, political issues, and currency exchange rates of a country (Hutasuhut, Anggraeni, & Tyasnurita, 2014). The objective of this research is to predict rice production in Kudus Regency for the upcoming decade using the Least Square method and to evaluate the adequacy of rice consumption in the region.

RESEARCH METHODS

This study was conducted between November and December 2023 in Kudus Regency, Central Java. The selection of the research site was done meticulously, considering Kudus Regency's status as one of the key rice-producing areas in Central Java. The research employed quantitative data analysis methods. Secondary data from the Central Bureau of Statistics (BPS) and the Agriculture Service of Central Java were utilized as the primary data sources for this study. The required secondary data encompassed rice production statistics in the Kudus region from 2002 to 2022. The research methodology involved the application of the Least Square Method to forecast rice production.

The Least Squares Method is utilized to identify the linear correlation between two variables by establishing a trend line with the minimal sum of squares of disparities between the original dataset and the data points on the trend line. The outcome of this technique is an equation representing a line, with coefficients reflecting either a negative or positive trend. Consequently, utilizing this line equation enables the estimation of values for upcoming periods (Septiawan, Kridalukmana, & Windasari, 2016).

Generally, the linear equation of the Least Squares Method is as follows.

$$Y = a + bX \qquad (1)$$

Information:
Y: Calculated value in the predicted variable
a: Trend value in the base year
b: average trend value growth each year
X: year period

Following the analysis of forecasts, the accuracy and error rate of the forecasts are evaluated by comparing them with the actual values (Susilawati, Darmawan, Ardiansyah, & Adlimi, 2023). The subsequent equation can be employed to compute the forecast error value:

$$et = Xt - Ft \quad (2)$$

Information:
et = error in the t-period
Xt _= value of rice production in period t.
Ft = forecasted results for period t.

$$\text{MAPE} = \frac{\sum_{t=1}^{N} \frac{Xt-Ft}{Xt}}{N} x\ 100\% \quad (3)$$

Information:
X t = actual data in period t.
Ft _ = forecasted value in period t.
N = number of periods
e t = error in period t.

The MAPE calculation results are interpreted as follows: a model is considered to have outstanding performance if the MAPE value is less than 10%, while it demonstrates good performance if the MAPE value falls between 10% and 20% (Budiartha, Wiedyaningsih, Yuniarti, & Prithadewi, 2023).

RESULTS AND DISCUSSION

Results of the forecast for rice production The dataset utilized for analysis was collected by BPS Jawa Tengah and encompasses yearly data on rice production in Kudus Regency from 2002 to 2022. The findings of the least squares estimation are summarized as follows (Badan Pusat Statistik Jawa Tengah, 2023):

Table 1. Data regarding rice production in Kudus Regency from 2002 to 2022.

No	Year	Production (Y)	X	XY	X2
1	2002	121411,00	-10	-1214110,00	100
2	2003	141176,00	-9	-1270584,00	81
3	2004	136548,00	-8	-1092384,00	64
4	2005	138737,00	-7	-971159,00	49
5	2006	156276,00	-6	-937656,00	36
6	2007	126238,00	-5	-631190,00	25
7	2008	128550,00	-4	-514200,00	16
8	2009	161217,00	-3	-483651,00	9
9	2010	173666,00	-2	-347332,00	4
10	2011	124758,00	-1	-124758,00	1
11	2012	148054,00	0	0,00	0
12	2013	140201,00	1	140201,00	1
13	2014	127319,00	2	254638,00	4
14	2015	171278,00	3	513834,00	9
15	2016	171278,00	4	685112,00	16
16	2017	164164,00	5	820820,00	25
17	2018	159544,00	6	957264,00	36
18	2019	208566,20	7	1459963,40	49
19	2020	175730,59	8	1405844,72	64
20	2021	171357,00	9	1542213,00	81
21	2022	196822,00	10	1968220,00	100
Total		3242890,79		2161086,12	770
Value Coefficient	a)	1154423,37		(b) 2806,61	

Source: Badan Pusat Statistik Jawa Tengah, (2023)

In the presented table, Table 1, there is an overview of paddy production data covering the previous 21 years. This study utilizes the predictive variable, denoted as Y, to represent the quantity of rice production, while X corresponds to the year code. The least squares method is utilized, incorporating both odd and even references. The variable X in the table illustrates the weight assigned to each time period. Due to the unconventional characteristics of the data, the reported outcomes show a one-point discrepancy, with the average starting from zero. This follows the opinion (Kuncahyo, et al., 2013), which states that in determining the value of x, alternative techniques are often used by assigning scores or codes. In this instance, the data is segregated into two sets: even and odd data. Furthermore, each time frame is elaborated in the XY table, acquired through the computation by multiplying the actual production in each period by a predetermined factor. The X2 value provided in the table for each period is derived from calculating the squared weight value for that particular period. Utilizing Y, X, and XY, adjustments are made and a forecast model for rice production for the period from 2023 to 2032 is determined.

Table 2. Forecasting outcomes for the total rice production in Kudus Regency

No	Year	X	Forecasting (Tons)
1	2023	11	185296,03
2	2024	12	188102,64
3	2025	13	190909,24
4	2026	14	193715,85
5	2027	15	196522,45
6	2028	16	199329,06
7	2029	17	202135,66
8	2030	18	204942,27
9	2031	19	207748,87
10	2032	20	210555,48
MAPE			1.58%

A good forecasting method produces forecast results that are not significantly different from the actual occurrences (Wardah & Iskandar, 2017). The Forecasting Error Test involves the comparison of forecasted results with real data. According to (Monica & Setiawan, 2019), to determine which method is considered superior, an analysis of the forecast error values is conducted. The level of forecast error provides a measure of accuracy and a metric for comparing alternative methods that may be utilized. MAPE provides a benchmark for the magnitude of prediction errors compared to the actual values obtained from the calculations (Nabillah & Ranggadara, 2020). Mean Absolute Percentage Error (MAPE) is used when the size of the variable in the forecasting is a significant factor in evaluating the accuracy of the forecast. MAPE indicates the level of absolute error resulting from the forecast compared to the actual values obtained (Maricar, 2019). The computation of the forecasting error for rice production using MAPE (Mean Absolute Percentage Error) yields a slight error value of 1.58%. This suggests that the forecasting accuracy of the Ability model with the Least Square method is remarkably high in predicting the amount of rice production in Kudus Regency.

CONCLUSION

Projections suggest that rice production in Kudus Regency will see annual increases over the next decade. Based on research findings, it is crucial to provide recommendations to assist farmers in optimizing their land cultivation techniques, with the goal of improving productivity and boosting rice yields.

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