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Study of Students' Knowledge about Bokashi Fertilizer, Its Benefits for Plants, and Science Education Students' Perspectives on Its Use in Society

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ABSTRACT
Understanding the environment and natural resource management is very important for science students because it can support the application of sustainability principles in everyday life. This study aims to describe the knowledge and understanding of science education students at Sultan Syarif Kasim State Islamic University, Riau, about the use of bokashi fertilizer in sustainable agriculture. The research design used is cross-sectional research, which is a type of descriptive research to describe the characteristics or phenomena that exist in the population. The sample in this study was selected randomly using a simple sampling technique, with the number of samples adjusted to the inclusion criteria. Data collection was carried out using a questionnaire consisting of closed and open questions designed to explore students' knowledge about bokashi fertilizer, its ecological benefits, and students' views on the application of this fertilizer in agricultural practices. The data obtained were then analyzed descriptively to describe the level of students' knowledge and attitudes towards bokashi fertilizer. Statistical analysis was carried out by calculating the frequency and percentage of each variable measured. The respondents in this study were students majoring in science education at Sultan Syarif Kasim State Islamic University, Riau. Based on the results of the recorded knowledge evaluation, a value of 69.1% was obtained with a category of strongly agreeing with the statement that the use of bokashi fertilizer can fertilize plants. Regarding the benefits of the activity, a value of 50.9% was obtained with the category of benefits of this program for sustainable agriculture. Based on the results of this study, it is recommended to increase socialization about the benefits of bokashi fertilizer to students and the community. In conclusion, Science students have a fairly good understanding of the benefits of bokashi fertilizer, especially in terms of increasing soil fertility and reducing the negative impacts of using chemical fertilizers.

Keywords: *environment, medicinal plants, bokashi*

INTRODUCTION

Fertilizer is Wrong One element important in agriculture that has vital role in increase fertility land And productivity plant (Alnaass et al., 2021) . In a number of decade Lastly , the use of fertilizer chemistry in a way intensive has cause various problem environment , such as decline quality land , water pollution , and the disappearance diversity life (Hossain et al., 2022). By Because that , the need will alternative more fertilizer friendly environment the more urgent . One of the

many solutions introduced is fertilizer organic, wrong the only one is fertilizer bokashi (Gashua et al., 2022).

Fertilizer bokashi is fertilizer organic made from ingredients fermented organic with use microorganisms certain. Fertilizer This own various benefit for land And plants, including is increase content element happiness in land, repair structure land, and increase activity microorganisms supportive land fertility land (Septiani et al., 2021) . In addition that, the use of fertilizer bokashi Also can reduce dependence to fertilizer chemicals that can damage ecosystem And reduce quality environment life (Umanailo & Lestari, 2022) .

Understanding about environment and natural resource management are very important for science students, especially in the context of waste management and sustainability (Yusuf dan Fajri, 2022). One concept that needs to be mastered is compost, which plays a vital role in the process of managing organic waste and improving soil quality. Compost is the result of the decomposition of organic waste, such as food waste, plant waste, and other organic materials. If managed properly, compost can reduce the amount of waste that goes to landfills and reduce dependence on chemical fertilizers that can damage the environment (Keramitsoglou & Tsagarakis, 2018). In addition, compost fertilizer has been shown to increase soil fertility, improve soil structure, and support the diversity of healthy soil microorganisms. .

One of the main factors contributing to the low utilization of bokashi fertilizer is the limited understanding among students, particularly in the field of science, regarding its production process and ecological benefits. In fact, students play a strategic role as agents of change in educating society about sustainable agricultural practices and more efficient waste management. The lack of integration of bokashi fertilizer concepts into formal education also poses a challenge in raising environmental awareness among students and the general public. Furthermore, awareness of the importance of organic waste management through fermentation technology such as bokashi remains limited. Many communities still rely on conventional waste disposal methods, which ultimately contribute to the increasing volume of waste in landfills and exacerbate environmental impacts. Therefore, further studies are needed to examine the level of understanding among science students regarding the concept of bokashi fertilizer and how their involvement can contribute to more sustainable organic waste management efforts.

The importance of fertilizer bokashi as an environmentally friendly alternative attracts the attention of many groups, including students in the field of science. As agents of change in society, they play an essential role in developing and disseminating knowledge about the benefits of bokashi fertilizer for the sustainability of agriculture and the environment (Sulistyo et al., 2024). For science students, understanding the process of making compost and its benefits is very important. This knowledge increases insight into the natural cycle and provides practical skills that can be applied in everyday life. By practicing composting, students can reduce the negative impacts of organic waste that often piles up and is not managed correctly (Mann, 2023). In addition, students can also play an active role in disseminating this knowledge to the community through various activities, such as volunteering in housing complexes to teach how to make compost (Christie & Waller, 2019). This activity can increase public awareness regarding waste management and the importance of a sustainable environment.

Although various studies have highlighted the benefits of bokashi fertilizer in improving soil fertility and reducing dependence on chemical fertilizers, esearch that examines science students' understanding of the application of bokashi fertilizer in waste management and environmental sustainability remains limited. Most studies focus more on the effectiveness of bokashi fertilizer in enhancing agricultural yields or its impact on soil ecosystems, while the educational aspect and the role of students as agents of change in disseminating the practice of using bokashi fertilizer have rarely been explored in depth. Furthermore, research on the integration of bokashi fertilizer management concepts into higher education curricula, particularly

for science students, has not yet developed optimally. In fact, students' understanding of organic waste management through bokashi fertilizer can be key to shaping environmental awareness and encouraging concrete actions in sustainability practices. Studies that link the mastery of bokashi fertilizer concepts with their application in daily life, as well as their impact on students' mindset and behavior in managing organic waste, are still highly needed.

Therefore, this study aims to fill this gap by analyzing the extent to which science students understand the concept of bokashi fertilizer and how this knowledge can be applied in sustainable environmental management. Thus, this research can contribute to the development of more effective and applicable environmental education strategies in both academic and broader societal contexts.

Students can contribute to creating a society that cares more about the environment through activity management compost. They can motivate others to reduce the use of plastic waste and switch to more environmentally friendly organic fertilizers. Therefore, understanding and implementing the concept of compost fertilizer can be an important step in realizing a society that is more aware of environmental sustainability and has a more environmentally friendly lifestyle. friendly environment (Goddard et al., 2023).

Study This aims to analyze knowledge and benefit of fertilizer bokashi for environment and society and view student Science about implementation of fertilizer This in a context-friendly farming environment. It is expected that the results of this study can give a new outlook on potential fertilizer bokashi as a solution to face global challenges related to climate changes and environmental damage (Ristiyana et al., 2023).

METHODOLOGY

This study aims to analyze students' level of understanding of the concept of bokashi fertilizer and its ecological benefits in sustainable agriculture. Additionally, this research explores students' attitudes toward using bokashi fertilizer as an environmentally friendly alternative and its potential application in organic waste management. By understanding the extent to which students are familiar with and apply this concept, the study's findings are expected to provide recommendations for enhancing environmental awareness through a more effective educational approach. More specifically, this study seeks to identify the level of knowledge among science education students regarding bokashi fertilizer, analyze their perceptions of its use, determine their role as agents of change in promoting the practice of bokashi fertilizer, and explore the factors that influence their awareness and acceptance of bokashi fertilizer in daily life.

This study used a cross-sectional study design, which is a type of descriptive research that aims to describe specific characteristics or phenomena in a population at one point in time (Pandis, 2014; Wang & Cheng, 2020). In this study, a cross-sectional study was used to analyze students' views on bokashi fertilizer and their understanding of its benefits and applications in environmentally friendly agriculture (Kinyili, 2024). This method was chosen because it can provide a clear and fast picture of students' knowledge of bokashi fertilizer at a certain time (Catillo, 2024).

The primary data in this study were obtained through questionnaires that measured students' knowledge of bokashi fertilizer, including its production process, ecological benefits, and applications in agriculture. Additionally, the questionnaire was used to evaluate students' attitudes toward using bokashi fertilizer as an alternative organic fertilizer and their perceptions of its environmental impact compared to chemical fertilizers. This primary data serves as the foundation for assessing students' understanding of bokashi fertilizer and their potential to implement and promote this technology. Furthermore, it helps identify gaps in environmental education that need to be addressed to enhance students' awareness and sustainable practices.

In addition to primary data, this study also collected supporting data, including respondents' demographic information such as age, semester, gender, and experience in environmental or agricultural fields. Other supporting data were obtained from previous research references on the use of bokashi fertilizer and its impact on soil and agricultural sustainability. Moreover, observations and open-ended interviews were conducted with selected respondents to understand the factors influencing their awareness and acceptance of bokashi fertilizer. This supporting data plays a crucial role in providing a broader perspective on respondents' backgrounds and external factors that may affect their attitudes and level of understanding regarding bokashi fertilizer.

With a well-structured research framework, this study is expected to contribute to the development of more practical and student-centered environmental education strategies. The findings of this research can also serve as a basis for educational institutions in designing curricula that emphasize sustainability and organic waste management, particularly through fermentation-based approaches like bokashi fertilizer. Furthermore, this study aims to encourage the implementation of more environmentally friendly agricultural practices and enhance student involvement in sustainable environmental management efforts..Following is a flowchart that describes the stages of sectional study about knowledge And benefits fertilizer bokashi for environment and society, with view student Science :

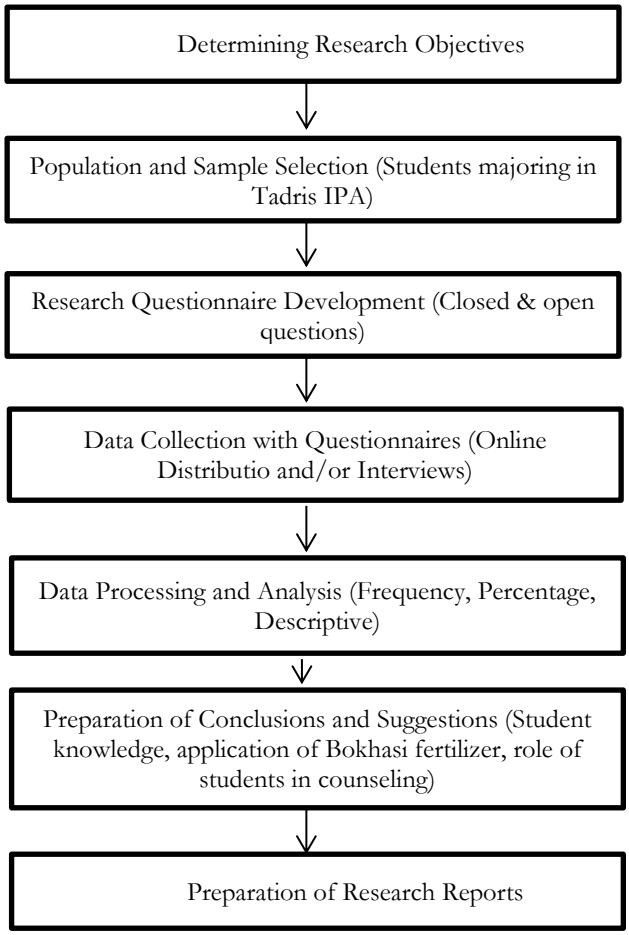

Figure 1. Flowchart of Bokashi Fertilizer Research

Explanation of Stages and Study Procedures is the first stage is the Determination of Study Objectives, which aims to identify the main objective of the study—analyzing students' knowledge and perspectives on bokashi fertilizer. The second stage is the Selection of Population and Sample, where students from Chemistry and Science majors were chosen as the population, and samples

were taken randomly to ensure good representation. The third stage is the Development of the Study Questionnaire, which was designed with questions covering aspects of students' knowledge about bokashi fertilizer, its environmental benefits, and their views on its implementation in agriculture. The fourth stage is Data Collection through Questionnaires, where data was gathered by distributing questionnaires online or conducting direct interviews with respondents to obtain the required information. The fifth stage is Data Processing and Analysis, where the collected data was analyzed descriptively by calculating frequencies and percentages of each studied variable (knowledge, views, and attitudes toward bokashi fertilizer). The sixth stage is Conclusion and Suggestions Compilation, which involves drawing conclusions based on the analysis results, including students' knowledge about bokashi fertilizer and suggestions for its implementation in the community. The final stage is the Study Report Compilation, where the research report is prepared to present the findings comprehensively, including data analysis and recommendations for the development of bokashi fertilizer in sustainable agriculture.

RESULT AND DISCUSSION

This study aims to analyze students' level of understanding of the concept of bokashi fertilizer and its ecological benefits in sustainable agriculture. Based on research conducted with cross sectional study method (Pandis, 2014; Wang & Cheng, 2020), as introduction students involved have biographical data participant like on table 1 below:

Tabel 1. Gender and Recidence of Participant

Statement		Score
Gender	Man	8
	Woman	48
Recidence	City	10
	Village	46

Based on table 1 above, 56 student respondents were obtained, namely 85.7% women and 14.3% men, then 82.1% of the respondents came from the village and 17.9% from the city. This data shows that the majority of respondents come from villages, which likely have a greater reliance on agriculture and sustainability-based agricultural practices, such as the use of bokashi fertilizer. In addition, most of the respondents were women, which can be an important indicator in seeing the role of gender in the application of agricultural technology in society (Azhar, 2023;Ernestivita, 2024). On the other hand, a smaller distribution of respondents from cities can provide insight into the adoption of agricultural technology in urban areas where space is limited.

Then , the results There is a number of findings main related knowledge And view student Science about fertilizer bokashi can seen from the following table:

Table 2. Evaluation of Knowledge of Bokashi Fertilizer Utilization

No	Statement	Score				
		Strongly Agree	Agree	Quite Agree	Disagree	Strongly Dissagree
1.	I know benefit fertilizer bokashi for plant	36.4%	63.6%	0%	0%	0%
2.	I know method making fertilizer bokashi	56.4%	41.8%	1.8%	0%	0%
3.	Use fertilizer bokashi can to fertilize plant	69.1%	29.1%	1.8%	0%	0%
4.	Fertilizer bokashi suitable applied For plant medicine in the yard narrow	34.5%	47.3%	8.2%	0%	0%

No	Statement	Score				
		Strongly Agree	**Agree**	**Quite Agree**	**Disagree**	**Strongly Dissagree**
5.	Utilization fertilizer bokashi can prevent pollution environment	47.3%	30.9%	12.7%	9.1%	0%

Based on table 2, the knowledge evaluation obtained a value of 69.1% in the category of strongly agreeing with the statement that the use of bokashi fertilizer can fertilize plants. This is also supported by research (Syahputra, 2024) that by using organic waste to make bokashi fertilizer, there is an opportunity to reduce the impact on environmental sustainability (Gashua, 2022). Another study also stated that bokashi fertilizer contributes to reducing environmental impacts, because it converts organic waste into useful materials, while minimizing greenhouse gas emissions from waste that is disposed of in landfills, the natural nutrient cycle is renewed, and waste that can cause pollution and environmental degradation is reduced. This improves environmental balance and cleanliness, supporting long-term ecosystem sustainability (Siregar, 2023). Routine use of bokashi helps improve soil structure by increasing water absorption capacity, thus supporting agriculture that is more resistant to drought (Mardhiah et al., 2023). The bokashi fertilizer utilization education program has successfully integrated household organic waste management, thus creating a sustainable solution to the waste problem while producing high-quality fertilizer (Nurlaelah et al., 2023) . Furthermore, the lowest value in the strongly agree category was 34.5% with the statement that bokashi fertilizer is suitable for application to medicinal plants in narrow yards, of course this is a concern for researchers so that they can follow up on the activities and results of future utilization programs.

Table 3. Benefits of the Program Bokhashi

No	Statement	Score				
		Strongly Agree	**Agree**	**Quite Agree**	**Disagree**	**Strongly Dissagree**
1.	Utilization program fertilizer bokashi create peace , comfort environment around	36.4%	56.4%	7.3%	0%	0%
2.	This program beneficial in agriculture sustainable	50.9%	47.3%	1.8%	0%	0%
3.	This program increase awareness And knowledge moms House ladder in process waste	45.5%	52.7%	1.8%	0%	0%
4.	This program effective in increase health land And support growth plant drugs	43.6%	49.1%	3.6%	0%	3.6%
5.	This program can carried out in the environment urban with room limited	43.6%	43.6%	12.7%	0%	0%

Based on table 3 regarding the benefits of activities, a value of 50.9% was obtained in the category of the benefits of this program in sustainable agriculture, in line with this in the study (Siregar, 2023). It is mentioned that farmers should be educated and trained on sustainable agricultural practices because it is very important to achieve food sustainability. Farmers need to get enough knowledge and training to adopt sustainable practices successfully (Lei dan Yang, 2024). In addition, the development of sustainable agricultural systems depends on collaboration and partnerships between governments, farmers, researchers, and the private sector. If people work well together, they can share knowledge, technology, and resources to achieve common goals.

These data indicate that although students have a high awareness of the benefits of bokashi fertilizer in large-scale agriculture, its use at the household level is still overlooked. These findings serve as a basis for formulating more effective educational strategies to enhance the adoption of this technology across different levels of application.

Most students are aware that bokashi fertilizer can increase soil fertility without damaging the environment. Bokhashi fertilizer is said to increase soil water retention capacity, improve loose soil structure, and increase the activity of microorganisms that are beneficial to the soil (Septiani et al., 2021) . In addition, the use of bokashi fertilizer can reduce dependence on chemical fertilizers that are harmful to the ecosystem. Students generally have a positive view of the application of bokashi fertilizer in agriculture, especially in the context of organic and sustainable agriculture. They realize that the use of bokashi fertilizer can reduce negative impacts on soil quality and improve agricultural sustainability (Ristiyana et al., 2023) . However, some students also noted that the main challenge in the application of bokashi fertilizer is the low level of adoption by small farmers who are still accustomed to chemical fertilizers (Castillo et al., 2024). Students in the Science field feel they have an important role in introducing bokashi fertilizer to the community, especially among farmers. They argue that through research, extension, and education programs, students can help improve farmers' understanding of the benefits of bokashi fertilizer and more efficient manufacturing techniques (De Souza dan Da Silva, 2025). Students also propose extension through social media and seminars to reach farmers in remote areas.

The development of sustainable agricultural systems must consider social and economic aspects (Çakmakçı, 2023). Several studies have also revealed the benefits of fertilizer utilization activities, namely by (Tjilen et al., 2024) explained that training-based programs on the use of organic fertilizers can increase public awareness of the importance of maintaining soil fertility without damaging the ecosystem. Then (Alkatiri et al., 2024) explained that programs on the use of organic fertilizers have been proven to help farmers increase their land productivity sustainably, while reducing dependence on chemical fertilizers (Abebe, 2022).

The main hypothesis of this study is that students' understanding of bokashi fertilizer is directly proportional to their awareness in implementing sustainable agricultural practices. The research findings support this hypothesis by demonstrating that the higher the level of students' knowledge, the more positive their attitude toward the use of bokashi fertilizer. This is evidenced by the high percentage in the "strongly agree" category regarding the ecological benefits of bokashi fertilizer. However, a gap in direct application remains, particularly in the context of urban agriculture and home gardening.

The results of this study align with the findings of Syahputra (2024), who stated that the utilization of bokashi fertilizer can reduce environmental impact and enrich soil nutrients. Similarly, a study by Siregar (2023) found that the use of bokashi can decrease dependence on chemical fertilizers and enhance soil water retention capacity, thereby supporting more sustainable agriculture. An international study by Christodoulou et al. (2022) revealed that fermentation technology in organic waste management has a significant impact on improving agricultural production efficiency and reducing greenhouse gas emissions. These findings reinforce the current study's conclusion that bokashi fertilizer contributes to ecosystem sustainability.

However, compared to other studies, this research indicates that the adoption rate of bokashi fertilizer in urban agriculture remains relatively low. A study by Zhang et al. (2023) emphasized that more intensive education and training are necessary to enhance the adoption of organic fertilizers in urban areas. Therefore, digital education strategies and direct extension programs could serve as effective solutions to expand the use of bokashi fertilizer across various sectors.

Based on the results of the questionnaire, participants admitted that they did not experience difficulties in implementing this activity due to cooperation among group members which made the work easier, then the use of bokashi fertilizer which can be implemented anywhere, and the

explanation from the resource person was quite helpful during the manufacturing process. Participants also commented that the activity of utilizing bokashi fertilizer was appropriate and met their expectations. With this activity, participants gained new knowledge and skills on how to plant plants using bokashi fertilizer to increase agricultural productivity in a sustainable and environmentally friendly manner. In addition to improving technical skills, this program also includes management and marketing elements to encourage MSME products.

This study introduces a novel perspective by analyzing the role of students as agents of change in promoting the use of bokashi fertilizer. Furthermore, it delves deeper into the social factors influencing the acceptance of this fermentation technology in organic waste management, particularly in the context of higher education. This study contributes to the advancement of knowledge by offering an environmental education-based approach that can be integrated into formal curricula to enhance understanding and sustainability practices in agriculture.

Despite providing valuable insights, this study has several limitations. First, it was conducted exclusively among science students at the State Islamic University of Sultan Syarif Kasim Riau, making its findings not necessarily generalizable to students at other universities or those outside the science education field. Second, the data collection method relied on surveys, which may not fully capture students' in-depth understanding. Future research could incorporate in-depth interviews to enrich the findings.

For future studies, it is recommended to expand the sample scope by including students from various disciplines, such as agriculture, environmental studies, and economics, to better understand interdisciplinary factors influencing the adoption of bokashi fertilizer. Additionally, field experiments could be conducted to test the effectiveness of bokashi fertilizer application in different agricultural scenarios, both in urban and rural areas. Further research may also explore technology-based educational strategies, such as interactive modules or social media campaigns, to enhance awareness and adoption of bokashi fertilizer among students and the wider community.

CONCLUSION

The results of this study indicate that the knowledge evaluation obtained a value of 69.1% in the category of strongly agreeing with the statement that the use of bokashi fertilizer can fertilize plants and a value of 50.9% in the category of program benefits so that bokashi fertilizer has great potential to support environmentally friendly and sustainable agriculture. Science students have a fairly good understanding of the benefits of bokashi fertilizer, especially in terms of increasing soil fertility and reducing the negative impacts of using chemical fertilizers. However, the main challenge faced is the low level of adoption among farmers, which needs to be supported by broader education and extension programs. It is important for students to continue to develop their knowledge and skills in applying more environmentally friendly agricultural technology, as well as playing an active role in promoting the use of bokashi fertilizer to the community. Through further research and collaboration with related parties, such as the government and non-governmental organizations, bokashi fertilizer can be applied more widely to create a more sustainable agricultural system.

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