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Utilization of Rice Straw for The Production of Bokashi Fertilizer in Nagari Koto Hilalang

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Abstract: This activity was carried out as part of the Community Empowerment Field Study Program (KKN-PPM). The purpose of this activity was to optimize the use of rice straw by processing it into bokashi fertilizer. This community service activity was carried out in Nagari Koto Hilalang, Kubung District, Solok Regency. The implementation method included the preparation stage (local materials: rice straw, manure, bran, rice husks, charcoal husks, sugar, and EM4; equipment: hoes, measuring cups, thermometers, and buckets), the fermentation implementation stage (training, monitoring fermentation), practical demonstrations, group discussions, the field application stage (the bokashi produced was applied to farmers' fields to test its effectiveness in improving soil fertility, and evaluation of harvest results). The result of this activity is bokashi fertilizer made from a mixture of straw, husks, bran, manure, sugar, and EM4. With this training, rice straw can be utilized optimally and sustainably. Bokashi fertilizer not only provides economic added value for farmers and local businesses, but also serves as an effective solution for maintaining soil fertility and reducing the environmental impact of straw burning. The production of bokashi fertilizer also encourages the development of micro and creative businesses, thereby improving community welfare and reducing dependence on chemical fertilizers.

Keywords: Bokashi Fertilizer, Community Service Learning (KKN-PPM), Rice Straw.

Introduction

Technological developments in the agricultural sector are crucial because they are an element of the revolution in the field of agriculture. The implementation of technology in the world of agriculture aims to increase food yields by shifting from conventional farming methods to a more modern agricultural system by utilizing more advanced technology. This contributes to the use of synthetic fertilizers and pesticides, which have the potential to damage the environment and ultimately can reduce productivity in agriculture (Mukhlis, et al., 2024).

Sustainable farming sytems were agricultural practices that do not harm, create a balance, and work in harmony with nature, which can be realized through four different systems (Salikin, 2011; Rasyid et al., 2024; Sirajuddin et al., 2025). One of the models that can be used in the implementation of sustainable agriculture is the integrated farming system (Mukhlis et al., 2023).

The integrated farming system, or IFS, is an agricultural approach that merges two or more sectors of agriculture (Channabasavanna et al., 2009; Ugwumba et al., 2010; Jaishankar et al., 2014). This system facilitates connections between different products, promoting a cycle of biological recycling (Prajitno, 2009; Changkid,

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2013; Thorat et al., 2015). It relies on minimal external inputs (Devendra, 2011; Nurcholis & Supangkat, 2011; Hilimire, 2011) and maximizes resource efficiency (Bosede, 2010; Balemi, 2012; Soputan, 2012). Various methods are implemented to enhance agricultural output, boost productivity, increase farmers' earnings, and promote sustainability (Gupta et al., 2012; Manjunatha et al., 2014; Thorat et al., 2015; Mukhlis et al., 2024). Integrated farming system of rice and cattle with utilization of cattle waste and rice crops is more feasible than monoculture farming system (Mukhlis et al., 2019; Nurhapsa et al., 2024).

In agrarian countries such as Indonesia, which is one of the world's largest rice producers, rice straw left over from the harvest becomes abundant agricultural waste that is often underutilized. Every year, millions of tons of straw are dumped into rivers, burned in fields, or left to rot naturally, which not only causes air pollution from carbon dioxide and fine particle emissions but also results in the loss of valuable organic resources that could enhance soil fertility. This problem is becoming increasingly urgent amid the challenges of climate change and declining soil quality due to excessive use of chemical fertilizers, which is prompting farmers to seek environmentally friendly and sustainable organic fertilizer alternatives. This is where the concept of rice straw bokashi production emerges as an innovative solution, transforming agricultural waste into high-quality fermented fertilizer with the help of microorganism technology such as Effective Microorganism (EM4) (Higa & Parr, 1997).

Bokashi is the result of fermenting organic materials such as husks, sawdust, straw, animal manure, and others. These materials are fermented with the help of activator microorganisms that accelerate the fermentation process. Among these materials, straw plays a crucial role as an abundant source of carbon, originating from rice stalks after the harvest season, which are usually discarded in the fields (Nugroho & Hartono, 2019). This straw is rich in cellulose and hemicellulose fibers, which not only provide essential nutrients for the growth of microbial colonies such as lactic acid bacteria and yeast, but also help maintain the structure of the fermentation mixture so that it remains aerated and does not become too wet during the process (Purwanto & Sudarsono, 2021).

This fermentation process is made even more effective thanks to the use of a special mixture of microorganisms known as Effective Microorganisms (EM4), a liquid-based activator product containing a combination of photosynthetic bacteria, lactic acid bacteria, yeast, and actinomycetes that work synergistically. This product, which is usually in the form of a liquid concentrate, contains a mixture of bacteria, yeast, and fungi that work synergistically to break down organic matter more efficiently (Susilowati & Purnomo, 2019). The use of EM4 not only accelerates the fermentation stage so that the process is completed in a shorter time, generally 7-14 days, but also effectively suppresses or reduces unpleasant odors that often arise due to the anaerobic decomposition of organic materials such as straw or animal manure, resulting in fertilizer that is more comfortable to process and environmentally friendly (Indrawati & Suryanto, 2018).

In the process of making rice straw bokashi using EM4, straw as the primary carbon source does not stand alone but is combined with various other complementary organic materials to create a balanced fermentation mixture with complete nutrients. These supporting materials not only enrich the nitrogen, phosphorus, potassium, and other microelements content, but also ensure that the fermentation process runs optimally, producing fertilizer that is rich in humus and beneficial microbes (Santoso & Widodo, 2017). What makes this method even more attractive is the abundant availability of these materials in agricultural areas such as Indonesia, where farmers can easily obtain them from livestock waste, rice milling, or household waste, and their very affordable prices, often free or requiring only minimal transportation costs, making them suitable for small or home-based farmers who want to switch to organic farming without a heavy financial burden.

Furthermore, the application of bokashi on a household or community scale not only minimizes financial burdens but also provides long-term benefits for the environment and agricultural productivity (Rahayu & Wulandari, 2022). This method helps reduce organic waste, which is often a source of pollution, thereby supporting environmentally friendly sustainable agricultural practices. Thus, small farmers can improve soil fertility naturally, produce healthier and higher-quality crops, and open up opportunities for collaboration with government programs or initiatives such as KKN to spread this knowledge more widely.

Ultimately, through the adoption of bokashi, rural communities can achieve better food security while contributing to the green economy at the local level. Moreover, bokashi also promotes public health by producing pesticide-free organic food, which can reduce the risk of environment-related diseases and improve overall quality of life. Additionally, this innovation can be integrated with digital technology, such as harvest tracking applications or online education platforms, to make it easier for farmers to monitor the process and share experiences, thereby accelerating the adoption of sustainable methods in various regions (Setiawan & Lestari, 2020). Thus, bokashi is not only a local solution, but also part of a global movement towards sustainable agriculture, where cooperation between the government, academics, and the private sector can strengthen implementation through supportive policies, such as subsidies for green technology or national training programs.

This will ultimately create a long-term impact, where future generations can enjoy a healthier environment and a more resilient economy, while inspiring similar innovations in other agricultural sectors. Therefore, it is essential for all of us, including students, farmers, and stakeholders, to actively support and implement initiatives such as bokashi through programs like KKN, so that we can accelerate the transition to a more inclusive and environmentally friendly agricultural system. With these concrete steps, Indonesia can not only achieve its sustainable development goals but also become a role model for other developing countries in utilizing local resources for mutual prosperity.

KKN students from the Agrotechnology Study Program believe that the bokashi production program is in line with the objectives of KKN, namely empowering rural communities through the utilization of straw waste. With this training, the community is expected to acquire new skills that have economic value. Additionally, this activity also serves as a means to raise community awareness of the importance of innovation in processing agricultural products. Thus, the production of bokashi from rice straw waste in Nagari Koto Hilalang not only utilizes existing waste but also saves costs on fertilizer purchases.

Method

This community service activity was carried out in Nagari Koto Hilalang, Kubung District, Solok Regency, which is a rural area with abundant natural resources, especially rice straw waste. The community service involved ing the community in making bokashi from rice straw waste based on the principles of KKN.

The implementation method included a preparation stage (identifying community needs and collecting local materials such as rice straw, manure, bran, burnt husks, coarse husks, sugar, and EM4). In addition, the equipment used, such as hoes, measuring cups, thermometers, and buckets, was also prepared. The next stage was fermentation, where the KKN team facilitated direct training for the village community on mixing dry materials with manure and EM4, which were placed at the bottom and covered with plastic sheeting to prevent air from entering, then monitoring the fermentation for 25 days. This stage included practical demonstrations, group discussions to share knowledge, and monitoring conditions such as humidity and temperature to ensure optimal fermentation. Next, the field application stage, where the produced bokashi is applied to the village's agricultural land to test its effectiveness in improving soil fertility, followed by an evaluation of the harvest results.

Result and Discussion

The results obtained from this KKN program show that the method of making bokashi from local materials is not only feasible but also effective in the context of agrarian villages in Indonesia. The high level of community participation indicates that the direct training approach (as described in the methods section) was successful in building new skills, in line with the KKN's goal of empowering communities through agricultural innovation. This is consistent with previous research findings that emphasize the importance of education in adopting environmentally friendly technologies.

The increase in soil fertility and crop yields after the application of bokashi confirms the long-term benefits of organic waste fermentation. Materials such as rice straw and manure serve as natural sources of nutrients, which help reduce dependence on synthetic chemical fertilizers, thereby supporting sustainable agricultural practices. However, these results need to be compared with external factors, such as weather conditions during the experiment, which may have affected the effectiveness of fermentation.

From a socio-economic perspective, waste reduction and potential additional income demonstrate the program's contribution to the green economy, as discussed earlier. Nevertheless, challenges such as the consistent availability of EM4 need to be addressed through collaboration with local governments in order to scale up the program.

Overall, these results prove that the KKN program has succeeded in achieving its goal of utilizing local potential for agricultural innovation. However, for optimization, further evaluation of factors such as the adaptation of digital technology in process monitoring is needed. This program not only utilizes agricultural waste such as rice straw, bran, burnt husks, coarse husks, manure, and EM4 to produce organic fertilizer, but also increases community participation, soil fertility, and local economic potential. Overall, the results show significant improvements in social, environmental, and financial aspects, where farmer groups are able to adopt simple technologies to achieve food security and reduce waste. This is in line with the objectives of the Agrotechnology Study Program's KKN, which is to utilize potential to create sustainable added value.

Procedure for Making Rice Straw Bokashi

The method for making bokashi from rice straw waste is as follows:

1. Prepare **tools** (hoe, machete, bucket, thermometer, spoon, measuring cup, block, and knife) and materials (straw, coarse husks, burnt husks, bran, cow manure, chicken manure, EM4, sugar, water, and plastic sheeting).
2. Cut the rice straw into small pieces (2-3 cm) so that it is easy to mix and ferment evenly. Make sure all ingredients are dry and clean. If the cow and chicken manure is still wet, dry it first in the sun.

3. Mix the rice straw, coarse husks, burnt husks, bran, cow manure, and chicken manure. Stir well using a hoe until homogeneous.

4. In a container, make a solution of 250 ml of EM4, ¼ kg of granulated sugar, and 5 liters of water. Stir until the sugar is completely dissolved. This solution serves as an inoculum of microorganisms that will accelerate anaerobic fermentation (without oxygen).
5. Pour the EM4 solution evenly over the dry ingredient mixture. Stir vigorously for 10-15 minutes until all ingredients are wet and thoroughly mixed. Ensure the moisture content is like soft dough but not watery (around 40-50% moisture). If it is too dry, add a little water; if it is too wet, add dry ingredients.

6. Cover the mixture with a plastic tarp to prevent air from entering. Store in a shaded place at a temperature of 25-35° C for 14-45 days. Stir the mixture every 2-3 days to ensure even fermentation and prevent foul odors.

7. After 14-45 days, the bokashi is ready if it smells sour like pickles (not rotten), is dark brown in color, and has no worms or mold. If it is not yet ripe, continue fermentation. Ripe bokashi can be used immediately as fertilizer or stored in sacks.

Challenges

In implementing the bokashi fertilizer production program, several challenges are encountered in the field, including:

1. Farmer habits
   Most farmers are accustomed to using chemical fertilizers because they are considered faster and more practical, so they are less convinced of the effectiveness of bokashi fertilizer.
2. Limited production facilities
   - Rice straw is still chopped manually, requiring extra labor.
   - There are not enough straw choppers available in farmer groups.
3. Weather conditions
   - Heavy rain or high humidity often disrupts the fermentation process.
   - Bokashi piles are difficult to dry evenly, causing unpleasant odors.
4. Farmers' time constraints
   Farmers are busy with their daily routines in the fields, making it difficult to turn the bokashi piles regularly.
5. Lack of knowledge and technical skills
   Not all farmers understand the fermentation process correctly, resulting in some failing to produce bokashi.

Social breakdown

1. Continuous education and assistance
   - Conducting regular socialization and retraining.
   - Providing real-life examples by comparing agricultural yields using bokashi fertilizer and chemical fertilizer.
2. Provision of supporting facilities
   - Encouraging village governments, farmer groups, or cooperation with relevant agencies to provide straw choppers for greater efficiency.
   - Utilizing simple equipment (machetes, grass cutters).
3. Adjusting to weather conditions
   - The fermentation process is carried out by covering the pile tightly with a tarp or storing it in a warehouse to avoid direct rain.
   - If the moisture content is too high, add husks or bran to dry it out.
4. Group work system
   Divide farmers into small groups so that the process of turning the bokashi pile can be done in turns, so that it does not burden one person alone.
5. Increasing farmer capacity
   - Provide leaflets or written guides on how to make bokashi.
   - Encourage young farmers and youth in the village to participate, ensuring knowledge regeneration.
6. Economic motivation
   - Demonstrate the potential of bokashi as an additional business opportunity if produced in large quantities and sold overseas.
   - Calculating together the cost efficiency of chemical fertilizers that can be replaced by bokashi.

Conclusion

The Community Service Program (KKN) in Nagari Koto Hilalang, Solok Regency, which focuses on making bokashi from rice straw waste using Effective Microorganisms (EM4), has successfully demonstrated the potential for sustainable agricultural innovation in Indonesia's agrarian areas. By utilizing local materials such as straw, husks, bran, manure, sugar, and EM4 through direct training, this program addresses agricultural waste, raises public awareness, and provides economic and environmental added value. High community participation in applying new skills, while bokashi reduces air pollution, improves soil fertility, and supports organic farming. Challenges such as EM4 availability and weather conditions need to be addressed through government collaboration and digital technology. Overall, this program supports food security, green economy, and sustainable development, with the potential to serve as a model for developing countries.

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