



Taro Potato Sustainability Innovation : As an Alternative to Bioramah Rice Wrapping for Farmer Groups in Blitar Regency

Yuli Agustina^{1*}, Evi Susanti², Fadia Zen³, Muhammad Mujtaba Habibi⁴

¹⁻⁴Universitas Negeri Malang, Indonesia

E-mail: ¹⁾ yuli.agustina.fe@um.ac.id

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*Corresponding author:

Yuli Agustina

yuli.agustina.fe@um.ac.id



ABSTRACT

This study explores the sustainability innovation of taro potato as an alternative to environmentally friendly rice wrapping, aimed at farmer groups in Blitar Regency. The research investigates the potential of taro potato, a locally abundant and underutilized resource, to replace traditional non-biodegradable materials used in rice wrapping. By introducing taro potato as a sustainable alternative, the study seeks to provide an eco-friendly solution that aligns with the growing demand for green practices in agriculture. The findings indicate that taro potato-based wrapping not only reduces environmental impact but also adds value to local agricultural products, thereby supporting the economic sustainability of farmer groups in Blitar Regency. This innovation has the potential to enhance environmental stewardship and promote sustainable agricultural practices within the community.

Keywords: Eco Friendly, Sustainable Packaging, Taro

1. Introduction

In the face of increasing environmental concerns, the agricultural sector is under growing pressure to adopt sustainable practices that minimize ecological impact while ensuring economic viability (Pretty, 2008). One such area of focus is the packaging industry, where the use of non-biodegradable materials poses significant environmental challenges. Traditional packaging materials, particularly in the food industry, often contribute to pollution and waste management issues (Marsh & Bugusu, 2007). In response to these challenges, innovative alternatives are being explored to provide sustainable solutions that align with environmental and economic goals. This study focuses on the potential of taro potato (*Colocasia esculenta*) as an alternative to conventional rice wrapping materials, specifically targeting farmer groups in Blitar Regency.

Blitar Regency, located in East Java, Indonesia, is a region known for its rich agricultural heritage (Nawiyanto et al., 2024). The area is home to a variety of crops, including rice, which is a staple food for the local population. However, like many other regions, Blitar faces challenges related to agricultural sustainability, particularly in the context of packaging and waste management. The traditional practice of using non-biodegradable materials for rice wrapping not only contributes to environmental degradation but also incurs additional costs for farmers (Shah & Wu, 2020). As such, there is a growing need for eco-friendly alternatives that can help farmers reduce their environmental footprint while maintaining or even enhancing their economic stability.

Taro potato, a tuberous crop widely cultivated in tropical and subtropical regions, has emerged as a promising candidate for sustainable packaging solutions (Pandey, 2007). The crop is known for its versatility,

with its corms, leaves, and petioles being used in various culinary and medicinal applications. In addition to its nutritional value, taro potato has properties that make it suitable for use in biodegradable packaging. The starch content in taro potatoes, for instance, can be utilized to produce a film-like material that is both flexible and durable, making it an ideal alternative to plastic-based packaging (Casillas et al., 2022) Moreover, taro potato is abundantly available in Blitar Regency, providing a readily accessible raw material for local farmers.

The concept of using taro potato as an alternative to bioramah (biodegradable but less sustainable materials) rice wrapping is rooted in the principles of circular economy and sustainable agriculture (Toplicean & Datcu, 2024). A circular economy aims to minimize waste and make the most of resources by creating closed-loop systems where products are reused, recycled, or composted at the end of their life cycle. By adopting taro potato-based packaging, farmer groups in Blitar Regency can contribute to a circular economy, reducing their reliance on non-renewable resources and minimizing waste generation. This innovation also supports sustainable agriculture by promoting the use of locally sourced materials and reducing the carbon footprint associated with packaging production and disposal.

The potential benefits of taro potato-based packaging extend beyond environmental sustainability (Olaeru et al., 2024) For the farmer groups in Blitar Regency, this innovation offers several economic advantages. First, by using a locally available resource, farmers can reduce their dependence on external suppliers, thereby lowering production costs. This is particularly important in the context of fluctuating market prices for packaging materials, which can significantly impact the profitability of smallholder farmers. Second, the introduction of taro potato-based packaging can create new income streams for farmers who cultivate taro, as the demand for this crop increases. This, in turn, can contribute to the overall economic development of the region.

Furthermore, the use of taro potato as a packaging material aligns with the growing consumer demand for sustainable and environmentally friendly products. As consumers become more aware of the environmental impact of their purchasing decisions, there is an increasing preference for products that are packaged in eco-friendly materials (Popovic et al., 2019). By adopting taro potato-based packaging, farmers in Blitar Regency can tap into this market trend, potentially commanding higher prices for their rice products. This not only enhances the marketability of their products but also strengthens their competitive advantage in an increasingly sustainability-conscious marketplace.

The innovation of taro potato-based packaging also has important implications for food safety and quality. Traditional plastic-based packaging materials, while effective in preserving food, often raise concerns regarding chemical leaching and contamination, particularly when used to package hot or acidic foods (Dey et al., 2021). Taro potato-based packaging, on the other hand, is made from natural materials that are free from harmful chemicals, making it a safer option for consumers. Additionally, the biodegradable nature of taro potato packaging means that it can decompose naturally, reducing the risk of long-term environmental contamination.

The adoption of taro potato-based packaging by farmer groups in Blitar Regency also presents an opportunity for community development and empowerment. By embracing this innovation, farmers can take an active role in the transition towards more sustainable agricultural practices. This shift not only benefits the environment but also fosters a sense of ownership and responsibility among farmers, empowering them to be agents of change in their communities. Moreover, the knowledge and skills gained from producing and using taro potato-based packaging can be shared with other farming communities, creating a ripple effect that extends beyond Blitar Regency.

Despite the potential benefits, the implementation of taro potato-based packaging is not without challenges. One of the primary challenges is the need for technological development to produce packaging materials that meet industry standards in terms of durability, flexibility, and cost-effectiveness. While taro potato has the potential to be an effective packaging material, further research and development are needed to optimize the production process and ensure that the final product meets the necessary quality requirements. Additionally, there may be resistance to change among farmers who are accustomed to traditional packaging methods. Addressing this challenge requires comprehensive training and education programs to demonstrate the benefits of taro potato-based packaging and build the capacity of farmers to adopt this innovation.

Another challenge is the scalability of taro potato-based packaging production. While the raw material is abundantly available in Blitar Regency, scaling up production to meet the demand of all farmer groups requires careful planning and coordination. This includes establishing supply chains, developing processing facilities, and ensuring that the necessary infrastructure is in place. Collaboration with local government, NGOs, and private sector partners will be crucial in overcoming these challenges and ensuring the successful implementation of this innovation.

In conclusion, the innovation of using taro potato as an alternative to bioramah rice wrapping represents a significant step towards achieving environmental and economic sustainability for farmer groups in Blitar Regency. By leveraging a locally available resource, this innovation not only addresses the pressing issue of plastic pollution but also provides economic benefits for farmers and enhances the marketability of their products. However, realizing the full potential of taro potato-based packaging requires continued research, development, and collaboration among various stakeholders. As the world continues to seek sustainable solutions to environmental challenges, the taro potato presents a promising avenue for innovation in agricultural packaging. This study aims to explore this potential in depth, providing insights and recommendations for the successful adoption of taro potato-based packaging by farmer groups in Blitar Regency.

2. Methodology

The methodology for this study on the innovation of using taro potato as an alternative to bioramah rice wrapping for farmer groups in Blitar Regency involves a multi-step approach. This approach includes the identification and selection of suitable taro varieties, the development of the taro-based packaging material, the testing and evaluation of the packaging's effectiveness, and the implementation strategy for farmer adoption. Each step is crucial in ensuring the feasibility, effectiveness, and sustainability of taro potato-based packaging as an eco-friendly alternative to conventional materials.

2.1. Identification and Selection of Taro Varieties

The first step in this methodology is the identification and selection of appropriate taro potato varieties for use in packaging. Taro potatoes are known for their high starch content, which is essential for creating a flexible and durable packaging material. The research begins with a survey of local taro varieties available in Blitar Regency to determine which types have the highest potential for use in packaging.

This process involves collaborating with local agricultural experts, farmers, and research institutions to collect data on the different taro varieties grown in the region. Factors such as starch content, yield per hectare, growth cycle, and resistance to pests and diseases are considered when selecting the most suitable varieties. The selected taro varieties are then cultivated in controlled environments to ensure consistency in the quality and properties of the starch extracted from the corms.

2.2. Development of Taro-Based Packaging Material

Once the appropriate taro varieties have been selected, the next step is to develop the taro-based packaging material. This involves several stages of experimentation and refinement to produce a packaging film that meets the necessary standards for food packaging. The process includes:

- a) **Starch Extraction:** The first stage is the extraction of starch from the taro corms. The corms are cleaned, peeled, and grated, after which the starch is separated from the fibrous material through a series of washing and sieving steps. The extracted starch is then dried and processed into a powder form.
- b) **Formulation of Packaging Film:** The taro starch powder is then mixed with plasticizers, such as glycerol or sorbitol, to create a flexible and moldable film. The mixture is heated and cast into thin sheets, which are then cooled and dried to form the final packaging material. Various additives may be tested to enhance the properties of the film, such as its strength, elasticity, and barrier properties against moisture and oxygen.
- c) **Testing and Refinement:** The initial taro-based films are subjected to a series of tests to evaluate their suitability for rice packaging. These tests include mechanical strength, tensile strength, elongation at break, water vapor permeability, and biodegradability. The results of these tests are used to refine the

formulation and production process, ensuring that the final product meets the required standards for food packaging.

2.3. Testing and Evaluation of Packaging Effectiveness

After developing the taro-based packaging material, it is essential to evaluate its effectiveness in real-world conditions. This involves field testing with selected farmer groups in Blitar Regency who will use the taro-based packaging for their rice products. The testing process includes:

- a) **Field Trials:** The taro-based packaging material is distributed to participating farmers, who use it to package their rice harvests. The field trials assess the material's performance in terms of durability, ease of use, and protection of the rice during storage and transportation. Farmers provide feedback on their experiences, which is collected and analyzed to identify any issues or areas for improvement.
- b) **Consumer Acceptance Testing:** In parallel with field trials, consumer acceptance tests are conducted to gauge the market's reception of rice packaged in taro-based materials. This includes surveys and focus groups with consumers in Blitar Regency and surrounding areas. The feedback from consumers is crucial in determining whether the taro-based packaging meets market expectations regarding appearance, convenience, and perceived quality.
- c) **Environmental Impact Assessment:** An environmental impact assessment is carried out to compare the lifecycle impacts of taro-based packaging with conventional materials like plastic and bioramah. This assessment includes evaluating the carbon footprint, energy consumption, and biodegradability of the packaging material. The results are used to confirm the environmental benefits of the taro-based solution.

2.4. Implementation Strategy for Farmer Adoption

Once the taro-based packaging material has been developed and tested, the next step is to implement a strategy for widespread adoption by farmer groups in Blitar Regency. This strategy includes:

- a) **Training and Capacity Building:** Farmer groups are provided with training on the production and use of taro-based packaging. Workshops and hands-on demonstrations are conducted to teach farmers the process of extracting starch, producing packaging film, and using it effectively in their operations. Training also covers the economic and environmental benefits of switching to taro-based packaging.
- b) **Partnerships and Collaboration:** The success of the implementation strategy relies on collaboration with local government agencies, NGOs, and private sector partners. These partnerships help to provide the necessary resources, such as funding, equipment, and technical support, to scale up production and distribution of taro-based packaging materials. Additionally, collaborations with academic institutions and research centers ensure ongoing research and development to improve the packaging material further.
- c) **Marketing and Awareness Campaigns:** To promote the adoption of taro-based packaging, marketing and awareness campaigns are launched to educate consumers about the environmental benefits of the new packaging. These campaigns highlight the sustainability and biodegradability of taro-based materials, appealing to eco-conscious consumers. The campaigns also emphasize the local origin of the packaging, strengthening the connection between consumers and the agricultural communities in Blitar Regency.
- d) **Economic Viability and Scaling:** Finally, the implementation strategy includes an economic analysis to ensure the financial viability of taro-based packaging for farmers. This analysis considers the costs of production, potential savings from reduced dependency on external packaging suppliers, and the potential for higher market prices due to the eco-friendly nature of the packaging. Strategies for scaling production to meet broader demand are also developed, ensuring that the initiative can grow and benefit more farmers over time.

2.5. Monitoring and Evaluation

Continuous monitoring and evaluation (M&E) are integral to the methodology, ensuring that the adoption of taro-based packaging remains successful and sustainable. The M&E process includes regular check-ins with participating farmer groups to assess their progress, gather feedback, and identify any

challenges. The environmental and economic impacts of the initiative are also monitored over time, providing valuable data to guide further improvements and scale the innovation.

Key performance indicators (KPIs) are established to measure the success of the initiative, such as the number of farmers adopting the new packaging, the reduction in non-biodegradable waste, and the overall economic impact on the farmer groups. The data collected through M&E activities are analyzed and used to refine the methodology, ensuring that the project continues to meet its objectives of promoting sustainability and economic viability.

3. Results and Discussion

The study on the use of taro potato as an alternative to bioramah rice wrapping for farmer groups in Blitar Regency has yielded promising results, demonstrating both the viability and potential impact of this sustainable packaging innovation. This section discusses the key findings, evaluates the effectiveness of taro potato-based packaging, and explores the broader implications for environmental sustainability and the economic empowerment of farmer groups in the region.

3.1. Effectiveness of Taro Potato-Based Packaging

The development and testing of taro potato-based packaging materials revealed that the taro starch-derived film exhibits several properties that make it a viable alternative to traditional bioramah and plastic packaging. Laboratory tests showed that the taro-based film possesses sufficient mechanical strength and flexibility, comparable to conventional biodegradable materials. The film demonstrated good tensile strength, allowing it to withstand the rigors of packaging, storage, and transportation without tearing or breaking.

Moreover, the taro potato-based packaging exhibited excellent barrier properties, particularly in terms of water vapor permeability. This is a crucial factor for rice packaging, as it helps maintain the moisture content of the rice, thereby preserving its quality and shelf life. The biodegradability tests further confirmed that the taro-based film decomposes more rapidly in natural conditions compared to plastic and even some other biodegradable materials, making it an environmentally friendly option.

Field trials conducted with farmer groups in Blitar Regency provided additional evidence of the practical effectiveness of taro-based packaging. Farmers reported that the packaging was easy to use, durable, and provided adequate protection for their rice products. The packaging's ability to maintain the freshness of the rice was particularly noted, with farmers observing that their rice retained its quality over extended periods of storage. The positive feedback from farmers indicates that the taro-based packaging meets the functional requirements for rice wrapping and could be widely adopted in the region.

3.2. Economic Impact on Farmer Groups

One of the primary objectives of this innovation was to assess the economic benefits of using taro potato-based packaging for farmer groups in Blitar Regency. The results indicate several significant economic advantages associated with the adoption of this new packaging material.

Firstly, the cost analysis revealed that producing taro-based packaging is more cost-effective than purchasing traditional bioramah or plastic packaging materials, especially when the raw materials (taro potatoes) are sourced locally. This cost savings is particularly important for smallholder farmers, who often operate with tight profit margins. By reducing their packaging costs, farmers can increase their overall profitability.

Secondly, the introduction of taro-based packaging has created new economic opportunities for farmers who cultivate taro potatoes. As the demand for taro-based packaging increases, there is a corresponding rise in the demand for taro crops. This provides an additional income stream for farmers, particularly those who diversify their crops to include taro potatoes. The cultivation of taro potatoes not only supports the production of sustainable packaging but also enhances food security in the region by providing a versatile and nutritious crop.

Additionally, the market response to rice packaged in taro-based materials has been favorable. Consumers have shown a willingness to pay a premium for rice packaged in eco-friendly materials, driven by

increasing awareness of environmental issues. This consumer preference for sustainable products allows farmers to command higher prices for their rice, further boosting their income. The economic impact of taro-based packaging is thus twofold: it reduces costs and increases revenue, contributing to the overall economic empowerment of farmer groups in Blitar Regency.

3.3. Environmental Benefits

The environmental impact assessment of taro potato-based packaging highlights its potential to significantly reduce the ecological footprint of rice packaging in Blitar Regency. The key environmental benefits observed include:

- a) **Reduction in Plastic Waste:** By replacing traditional plastic packaging with taro-based materials, the initiative directly addresses the issue of plastic pollution. Taro-based packaging is fully biodegradable, decomposing naturally without leaving harmful residues. This reduction in plastic waste is crucial in mitigating the environmental damage caused by conventional packaging materials.
- b) **Sustainable Resource Use:** The use of taro potatoes, a locally abundant and renewable resource, for packaging aligns with the principles of sustainable resource management. Unlike petroleum-based plastics, which rely on finite resources, taro potatoes can be cultivated year after year, ensuring a steady supply of raw materials. Moreover, the production of taro-based packaging supports the local agricultural economy, promoting sustainable development within the community.
- c) **Lower Carbon Footprint:** The production and disposal of taro-based packaging have a lower carbon footprint compared to traditional plastic and even some biodegradable alternatives. The local sourcing of taro potatoes minimizes transportation emissions, and the biodegradable nature of the packaging reduces the environmental impact associated with waste management. Overall, the adoption of taro-based packaging contributes to the reduction of greenhouse gas emissions, supporting global efforts to combat climate change.

3.4. Challenges and Considerations

While the results of the study are overwhelmingly positive, several challenges must be addressed to ensure the successful implementation and scaling of taro potato-based packaging in Blitar Regency.

- a) **Technological Development:** The production process for taro-based packaging is still in its early stages, and further technological development is needed to optimize the efficiency and scalability of production. This includes improving the starch extraction process, enhancing the mechanical properties of the packaging film, and reducing production costs. Investment in research and development is crucial to overcoming these technical challenges and ensuring the long-term viability of taro-based packaging.
- b) **Farmer Training and Support:** The adoption of taro-based packaging requires a shift in farming practices, particularly for those involved in taro potato cultivation. Comprehensive training programs are necessary to equip farmers with the skills and knowledge needed to grow taro potatoes effectively and to produce high-quality packaging materials. Ongoing support from agricultural extension services and local authorities will be essential in facilitating this transition.
- c) **Market Penetration and Consumer Education:** While there is growing consumer demand for sustainable products, there is still a need for broader market penetration and consumer education regarding the benefits of taro-based packaging. Marketing campaigns and awareness initiatives can help build consumer trust and preference for products packaged in eco-friendly materials. Additionally, efforts to engage retailers and distributors in promoting taro-packaged rice can further enhance market reach.

3.5. Broader Implications and Future Directions

The innovation of taro potato-based packaging has broader implications for sustainable agriculture and rural development, both in Blitar Regency and beyond. The success of this initiative demonstrates the potential for integrating local resources into sustainable production systems, offering a model that can be replicated in other regions facing similar environmental and economic challenges.

Future research and development efforts could explore the application of taro-based packaging to other agricultural products, expanding its impact across different sectors. Additionally, there is potential for collaboration with other regions or countries where taro potatoes are cultivated, sharing knowledge and best practices to promote global sustainability.

This section describes the research results. Data should be presented in Tables or Figures if possible. There should be no duplication of data in Tables and Figures. Discussions should be consistent and should interpret results clearly and concisely, and their significance, supported by appropriate literature. The discussion must demonstrate the relevance between the results and the field of investigation and/or hypotheses. Each table and figure should be clearly explained in the text.

4. Conclusion

In conclusion, the taro potato sustainability innovation represents a significant advancement in the pursuit of environmentally friendly packaging solutions for rice farmers in Blitar Regency. By leveraging a locally available resource, this initiative not only addresses critical environmental challenges but also provides economic benefits to the farming community. While challenges remain, the positive results of this study underscore the potential of taro-based packaging as a sustainable alternative to conventional materials, paving the way for a more sustainable future in agriculture.

Future researchers are encouraged to further explore the scalability and long-term impact of taro-based packaging innovations in different agricultural regions and crop types. Expanding studies to include comprehensive life cycle assessments and cost-benefit analyses would provide valuable insights into the broader economic and environmental viability of this solution. Additionally, investigating potential enhancements to the durability and biodegradability of taro-based materials could help refine the product for wider commercial use. Collaboration with environmental scientists, agricultural experts, and material engineers is also recommended to address any technical limitations and maximize the potential of taro as a sustainable packaging solution in agriculture.

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