



APPLICATION OF REJECTED WAX APPLE FRUIT AS A BIO-CATALYTIC PHYTOACTIVATION (BCP) AGENT IN THE CULTIVATION OF *MIMUSOPS ELENGI*

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ABSTRACT

*In the conservation area, the growth of tanjung trees (*Mimusops elengi*) was found to be suboptimal due to low soil nutrient availability, limited microbial activity, and compact soil structure with poor porosity. In addition, there was an environmental issue related to the underutilization of rejected or rotten wax apple fruits (*jambu air afkir*), which have the potential to generate unpleasant odors and greenhouse gas emissions through open decomposition. To address these challenges, an innovation was introduced by converting rejected wax apple waste into liquid organic fertilizer (LOF) and compost, which function as biocatalysts to improve soil fertility and support the growth of tanjung trees. The study employed a before-and-after experimental approach (pre-test and post-test). The results showed that the company successfully planted 100 tanjung seedlings and processed approximately 80–120 kg of rejected wax apple waste per month into organic fertilizer products. Meanwhile, community members actively participated in collecting and sorting approximately 50–80 kg of rejected wax apple waste per month, enhanced their skills in organic fertilizer production, and gained the potential to reduce fertilizer expenses by approximately 20–30% for household gardens and small-scale farming activities. This finding indicates that rejected wax apple fruit waste can be utilized as liquid organic fertilizer and compost. This application can help promote vegetative growth in plants, resulting in growth of approximately 4 cm/month. Furthermore, it provides environmental, economic, and social benefits to the surrounding community. This effort represents an integrated solution to address two challenges simultaneously: organic waste management and suboptimal plant growth.*

Keywords: *Bio-Catalytic Phytoactivation; Mimusops elengi; Rejected Wax Apple Fruit*

1. INTRODUCTION

In conservation areas, the maintenance of tanjung trees (*Mimusops elengi*) has shown suboptimal vegetative growth due to low soil nutrient availability, limited microbial activity, and compact soil structure with poor porosity. Previous fertilization practices relied mainly on NPK fertilizers and generic compost with slow mineralization rates, resulting in nutrient availability that was not always synchronized with the critical growth stages of the plants [3]. An inactive rhizosphere environment, characterized by low microbial biofilm formation, reduces the efficiency of nitrogen (N), phosphorus (P), and potassium (K) uptake, while soil organic carbon content and the C/N ratio remain insufficient to support stable aggregate formation. Soil aggregate formation is strongly influenced by biological activity, climate, and parent materials that determine soil texture and aggregate characteristics [4]. The growth rate of the tanjung tree (*Mimusops elengi*) is only about less than 2–3 cm/month. At the same time, there is a potential accumulation of rejected or rejected wax apple fruit (*jambu air afkir*) waste that remains underutilized, contributing to organic waste loads and potentially generating unpleasant odors and greenhouse gas emissions through open decomposition. These combined factors lead to slow growth rates, low canopy density, fluctuating planting success rates, and inefficient maintenance costs.

This program was developed to support revegetation efforts and biodiversity conservation within the conservation area. The approach utilizes fermented wax apple products rich in simple sugars, organic acids, enzymes, phytohormones (auxins and cytokinins), and decomposer microbial consortia to activate biological processes in the root zone through a mechanism known as phytoactivation. Utilizing 80–120 kg of discarded wax apple waste per month can reduce the accumulation of organic waste, which naturally takes about 2–8 weeks to decompose. These compounds accelerate the decomposition of organic matter, enhance nitrogen and phosphorus mineralization, and increase the availability of nutrients in forms that are more readily absorbed by plants. The resulting products, consisting of LOF and solid organic fertilizer, are used to improve soil structure, stimulate rhizosphere microbial activity, and accelerate the juvenile growth phase of *Mimusops elengi* [2].

The challenges associated with current cultivation practices have encouraged the implementation of an innovative planting improvement method aimed at enhancing the productivity of tanjung trees in conservation areas. This innovation involves converting rejected wax apple fruit into liquid organic fertilizer and compost, which function as biocatalysts to improve soil quality and promote the growth of *Mimusops elengi* plants. The use of rejected wax apple waste was selected due to the potential accumulation of waste around the company that has not yet been optimally utilized. This condition increases the organic waste burden and may lead to unpleasant odors as well as greenhouse gas emissions resulting from open decomposition processes.

This research aims to convert rejected wax apple waste into LOF and compost that function as biocatalysts to enhance the growth of tanjung trees (*Mimusops elengi*) while supporting the reduction of organic waste in conservation areas.

2. RESEARCH METHOD

This study employed a field experimental method using a before-after comparison approach. According to Fraenkel, Wallen, and Hyun, as cited in [1], experimental research is a type of study that involves the deliberate application of a treatment to an experimental group and comparing the outcomes with a control group that does not receive the treatment in order to identify differences in results. In this study, the method was used to compare the condition of plants and planting media before and after the implementation of BCP derived from rejected wax apple fruit.

This study was conducted in a conservation area managed by the South Sumatra Provincial Forestry Service, utilizing rejected wax apples as the primary raw material for organic fertilizer production. The materials used included rejected wax apples, dried plant residues, EM4, sugar, and water. The study was carried out over a period of three months to compare the growth of tanjung trees (*Mimusops elengi*) treated with organic fertilizer derived from rejected wax apples and those treated with NPK fertilizer.

The compost was produced by mixing 5 kg of chopped rejected wax apples, 2.5 kg of plant residues, 50 mL of EM4, 50 g of sugar, and 1 liter of water. All materials were thoroughly mixed and fermented for 30–45 days until mature compost was obtained. Meanwhile, the LOF was ready for use after 14 days of fermentation. The effectiveness of the treatment was evaluated by comparing the increase in the height of tanjung trees before and after fertilizer application throughout the observation period.

3. RESULTS AND DISCUSSION

3.1. Required Changes

In the conservation area, the growth of tanjung trees (*Mimusops elengi*) was previously slow due to nutrient-deficient soil and limited microbial activity. At the same time, rejected wax apple fruit was discarded and contributed to organic waste accumulation. This innovation addressed these challenges by fermenting rejected wax apple fruit into liquid and solid organic fertilizers rich in bioactive compounds and decomposer microorganisms. These products activate rhizosphere processes and accelerate nutrient availability. As a result, soil fertility improved, plant growth and survival rates increased significantly, and organic waste generation was reduced.

3.1.1. Conditions Before Program Implementation

Prior to the implementation of the BCP-based cultivation system, *Mimusops elengi* growth relied primarily on conventional fertilization practices using NPK and standard compost. Soil organic matter content and

microbial activity were relatively low, resulting in limited nutrient availability and less favorable soil conditions for root development. Consequently, plant growth was relatively slow, with an average height increment of less than 2–3 cm per month, while root development remained shallow at less than 15–20 cm. The limited root system reduced the plant's ability to absorb water and nutrients efficiently, leading to lower growth performance, higher irrigation requirements, and less dense canopy development. These conditions indicated that the planting media had not yet reached its optimum capacity to support vigorous vegetative growth. costs.

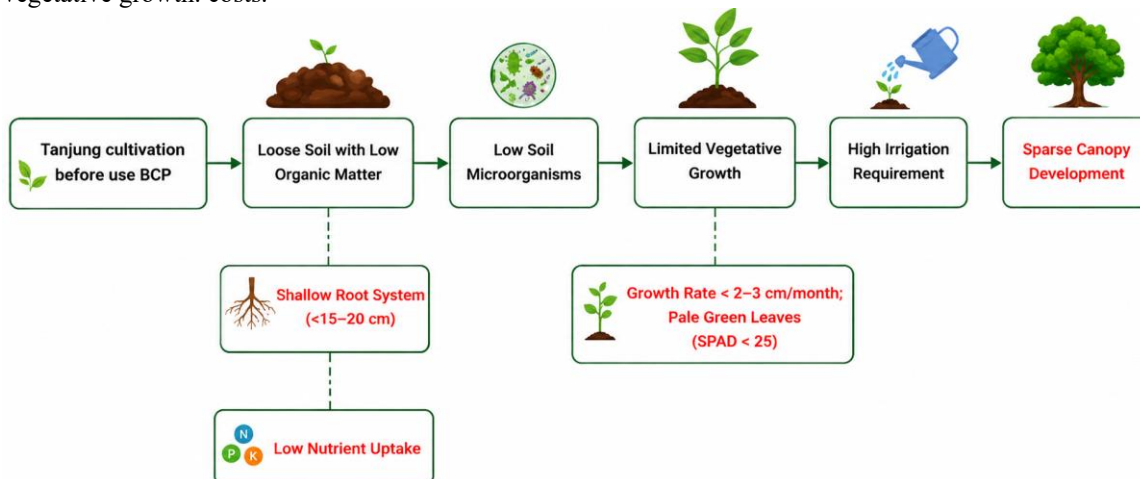


Figure 1. Program Flow Scheme Before BCP Implementation
Resource: Biodiversity Innovation Program Documentation, 2025

3.1.2. Conditions After Program Implementation

Following the program implementation, rejected wax apple fruit waste was utilized as a BCP agent through a controlled fermentation process to produce both LOF and solid organic fertilizer, aimed at enhancing the phytoactivation of *Mimusops elengi*. The fertilizer production process involved material collection, sorting, chopping, fermentation, maturation, and separation of liquid and solid fractions. Subsequently, the liquid fertilizer was applied through regular low-dose watering or foliar spraying, while the solid fertilizer was incorporated around the root zone as a soil conditioner. Monitoring activities were conducted to evaluate soil and plant indicators, including organic carbon content, C/N ratio, soil porosity, plant height, leaf number, and survival rate.

The addition of wax apple-based BCP had a simultaneous positive effect on both the planting media characteristics and the physiological growth of *Mimusops elengi*. The fermented wax apple waste contains organic compounds such as humic acids, amino acids, reducing sugars, and beneficial fermentative microorganisms, particularly *Lactobacillus* sp. and *Bacillus* sp., which function as natural biostimulants and soil conditioners.

Lactobacillus sp. plays an important role in producing organic acids, especially lactic acid, which accelerates the decomposition of organic matter, suppresses pathogenic microorganisms, and increases nutrient solubility in the soil. This process enhances nutrient availability and promotes a healthier rhizosphere environment. Meanwhile, *Bacillus* sp. contributes to nutrient cycling through the mineralization of organic matter, phosphate solubilization, and the production of plant growth-promoting substances such as indole-3-acetic acid (IAA). Several *Bacillus* species also produce enzymes that improve soil fertility and stimulate root development, thereby increasing nutrient uptake efficiency.

The synergistic activity of these microorganisms improves soil microbial activity, accelerates organic matter decomposition, and promotes the formation of more stable soil aggregates. As a result, the planting medium becomes looser and more porous, with improved aeration and drainage, allowing roots to grow more freely and deeply. Furthermore, improvements in the C/N ratio and the availability of base cations (Ca^{2+} , Mg^{2+} , and K^{+}) enhance the soil's cation exchange capacity (CEC) and water retention ability, creating a more stable moisture condition without causing waterlogging.

The resulting benefits include increased nutrient availability and uptake efficiency, enhanced rhizosphere microbial activity, improved soil structure and porosity, better vegetative growth and seedling survival rates, significant reduction of organic waste generation in support of a circular economy approach, and more cost-efficient maintenance practices within the conservation.

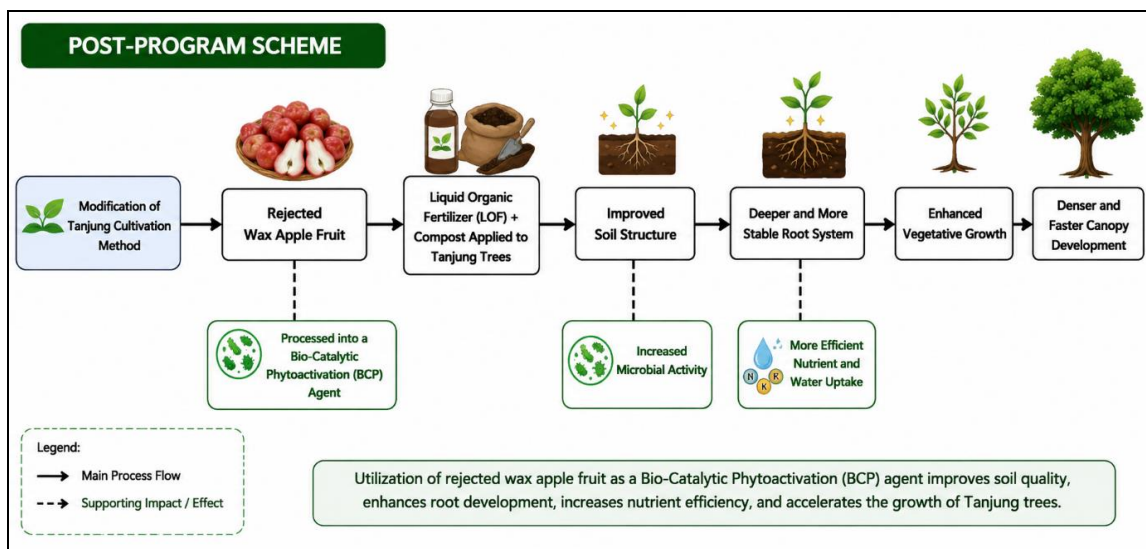


Figure 2. Program Flow Scheme After BCP Implementation
 Resource: Biodiversity Innovation Program Documentation, 2025

Following the application of the BCP approach using rejected wax apple fruit, the growth performance of *Mimusops elengi* improved significantly. The fermentation-derived LOF and compost enhanced soil fertility, increased microbial activity, and improved nutrient availability in the root zone. These improvements promoted deeper and more stable root development, enabling plants to absorb water and nutrients more efficiently. As a result, the average plant height increment increased from approximately 2 – 3 cm per month before treatment to up to 4 cm per month after BCP application. This accelerated growth was accompanied by healthier green leaves, stronger root systems, and denser canopy formation, indicating improved plant vigor and overall adaptation within the conservation area.

The increase in plant height resulting from the application of liquid organic fertilizer was also confirmed by a study conducted by Wahyudi et al. (2020). The study reported that the application of liquid organic fertilizer increased plant height by up to 8 cm 10 weeks after transplanting [5]. These results are supported by previous studies which reported that the increase in the height of *Mimusops elengi* seedlings differed among treatments. Treatment P3 (1,000 g of chicken manure) resulted in a height increment of 7.91 cm, while treatment P4 (1,250 g of chicken manure) produced an increment of 7.65 cm, compared to the control treatment P0 (0 g), which recorded an increment of 5.61 cm [2].

3.2. Environmental Criteria and Impacts Generated

The innovation program entitled “Application of Rejected Wax Apple Fruit as a BCP Agent in the Cultivation of *Mimusops elengi*” represents a sub-system transformation within the sustainable agriculture category. The program was implemented in collaboration with the South Sumatra Provincial Forestry Agency and Kemudi NGO, creating additional value throughout the conservation value chain. With an investment of IDR 30,000,000 in 2025, the program successfully generated value creation through the cultivation of 100 *Mimusops elengi* trees using an improved planting method designed to enhance plant growth performance. Beyond improving revegetation success, the innovation contributes to biodiversity conservation, organic waste reduction, soil quality enhancement, and the promotion of circular economy principles within conservation management practices.

In addition, the program improved cost efficiency by reducing dependence on chemical fertilizers. Prior to implementation, plant maintenance relied mainly on NPK fertilizer, which required regular procurement and contributed to higher operational costs. By converting 80–120 kg of rejected wax apple waste per month into LOF and compost, a portion of fertilizer demand could be supplied from locally available waste materials. The production process utilized low-cost inputs such as EM4, sugar, water, and plant residues, making it significantly more economical than continuous purchases of chemical fertilizers. This approach

not only reduced fertilization expenses but also transformed organic waste into a value-added product, creating both environmental and economic benefits. As a result, the program demonstrated that waste-based organic fertilizers can serve as a cost-effective alternative to conventional fertilizers while supporting long-term conservation and sustainability objectives.

3.3. Stakeholder Collaboration and Added Value

The cultivation of *Mimusops elengi* (Tanjung tree) was carried out through collaboration with key stakeholders, including the South Sumatra Provincial Forestry Agency and the Kemudi Community Organization. This multi-stakeholder partnership generated environmental, social, and economic benefits for all parties involved. For the company, the program enabled the planting of 100 *Mimusops elengi* seedlings while processing approximately 80–120 kg of rejected wax apple waste per month into liquid organic fertilizer (LOF) and compost, contributing to conservation efforts and organic waste reduction. The South Sumatra Provincial Forestry Agency provided technical guidance, monitoring, and program verification, while also benefiting from the enrichment of regional biodiversity data through the addition of *Mimusops elengi* to local vegetation records. Meanwhile, the Kemudi Community Organization played a central role in coordinating the collection of rejected wax apple fruits, managing composting and fermentation activities, facilitating community training programs, and supporting field monitoring and documentation. Community members also actively participated in collecting and sorting approximately 50–80 kg of rejected wax apple waste each month, improving their knowledge and skills in organic fertilizer production. In addition, the use of waste-based organic fertilizers created opportunities to reduce fertilizer expenditures by an approximately 20–30% or an estimated cost saving of approximately IDR 2,500,000–7,500,000 annually for household gardening and small-scale agricultural activities, thereby providing direct economic benefits to local communities.

Through this collaborative approach, the program not only supports the conservation and growth of *Mimusops elengi* but also promotes circular economy practices by converting organic waste into valuable agricultural inputs while strengthening community capacity and stakeholder engagement.

4. CONCLUSION

The program utilizing rejected wax apple fruit as a BCP agent in the cultivation of *Mimusops elengi* within the conservation area successfully improved planting media quality and plant growth through the conversion of organic waste into liquid and solid organic fertilizers, it even increases plant height by an approximately 4 cm per month. With the successful cultivation of 100 tanjung trees in 2025, the program demonstrates that the utilization of locally available organic waste can generate sustainable environmental, social, and economic benefits. The model has strong potential for replication in other conservation areas and can be adapted to different types of organic waste, thereby expanding the impact and contribution of the research. However, the study has several limitations, including a relatively short observation period and a limited number of plant samples, which prevent a comprehensive evaluation of the long-term effects of the treatment.

Recommendations

Based on the findings, conservation area managers are encouraged to adopt and implement this method on a sustainable basis to support organic waste management and improve revegetation success. Future researchers are recommended to evaluate the effectiveness of this approach on other plant species and under different fertilizer dosages and concentrations to obtain more comprehensive results. In addition, local governments are encouraged to support similar initiatives through policies and programs that promote the utilization of organic waste into value-added products while advancing the implementation of circular economy principles at the community level.

Reflection

The sustainability of the program is supported by several factors. First, the continuous availability of rejected wax apple fruit provides a reliable source of raw materials for producing organic fertilizers. Second, community participation in waste collection, fertilizer production, and plant maintenance helps ensure that the activities can continue over time. Third, support from local government and other stakeholders strengthens program implementation through policy support and technical assistance. In addition, the program offers environmental and economic benefits, such as reducing organic waste,

improving plant growth, and lowering maintenance costs. These factors indicate that the program has strong potential to continue and generate long-term benefits.

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