



Innovative Approaches to Seaweed Farming: The Case of Tesabela Village, West Kupang, East Nusa Tenggara, Indonesia

**Rifqah Pratiwi^{1*}, Pieter Amalo², Ni Putu Dian Kusuma³, Lukas G.G.
Serihollo⁴**

Study Program of Aquaculture Engineering, Polytechnic of Marine and Fisheries Kupang,
Kampung Baru Pelabuhan Ferry Street, Bolok, West Kupang, East Nusa Tenggara, 85351,
Indonesia

Article Info

Article history:

Received: Jan 9, 2025

Revised: Jan 20, 2025

Accepted: Feb 05, 2025

Keywords:

*seaweed farming
community empowerment
sustainable aquaculture
East Nusa Tenggara*



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ABSTRACT

The coastal community of Tesabela Village, West Kupang, East Nusa Tenggara, predominantly practices traditional seaweed farming methods, such as longline and off-bottom techniques, which limit production efficiency due to environmental challenges and lack of advanced technological knowledge. This study evaluates and disseminates innovative solutions, including Kajarula Technology, Biorula Biofertilizer, Rula Basket, and Selvarula (Selection of Seaweed Varieties). These innovations address critical issues such as sedimentation, pest disruptions, and suboptimal seaweed growth caused by inadequate farming methods and environmental conditions. Community engagement activities from July to October 2023 involved participatory training sessions, production assistance, and the distribution of farming inputs, benefiting 50 participants, including farmers, academics, and local leaders. The implementation of Selvarula was particularly suited for the local shallow water environment, offering a sustainable, cost-effective approach to improve productivity and seed quality. Results highlight the potential of integrating these technologies to empower the community through knowledge transfer, improved production methods, and economic resilience. This initiative underscores the importance of collaborative efforts between academia and local communities in fostering sustainable development in coastal areas.

Corresponding Author:

Rifqah Pratiwi

*e-mail: r.pratiwi.kkp@gmail.com



INTRODUCTION

Seaweed farming is a vital activity contributing to the livelihood of coastal communities, particularly in regions with high potential for marine aquaculture, such as Tesabela Village in West Kupang, East Nusa Tenggara. Located approximately 12 km from Kupang City and bordered by the Timor Sea, Tesabela Village is characterized by its rich marine resources and a community primarily engaged in seaweed farming and fishing. However, despite the abundant natural resources, seaweed production in Tesabela remains suboptimal due to the use of traditional farming methods, such as longline and off-bottom techniques, and the limited adoption of modern technology.

Several challenges hinder the productivity of seaweed farming in this region. Environmental factors, such as sediment accumulation during low currents, damage to thallus due to strong waves, and predation by fish and turtles, often lead to reduced yield and compromised quality. Furthermore, limited knowledge, and skills in pre-production, production, and post-harvest handling exacerbates these issues, making it difficult for farmers to achieve sustainable and efficient production practices (Pratiwi, 2024; Pratiwi, 2020a; Pratiwi 2020b).

We have introduced several innovations based on previous research to address these challenges. These innovations include Kajarula technology, a modified longline system utilizing net bags on water columns; Biorula biofertilizer to accelerate growth; Rula Basket, a plastic recycling solution for harvest logistics; and Selvarula, a method for selective breeding of superior seaweed varieties (Kusuma *et al.*, 2021; Amalo *et al.*, 2022a; Pratiwi *et al.*, 2023b; Amalo *et al.*, 2022b). These innovations have been successfully applied in Tablolong Village, the team's first partner village, and are now being disseminated to Tesabela Village to improve the community's productivity and well-being.

This study aims to evaluate the implementation of these technologies in Tesabela Village and their effectiveness in overcoming the limitations of traditional seaweed farming methods. By integrating community participation, capacity building, and innovative tools, this initiative seeks to empower local farmers and enhance the sustainability of seaweed farming in the region. The results of this study enrich the expanding body of knowledge on sustainable aquaculture practices and highlight the critical role of collaborative initiatives in improving the socioeconomic well-being of coastal communities. The primary objectives of this study are to Educate seaweed farmers in Tesabela Village on innovative cultivation techniques; Implement and evaluate technologies to enhance productivity and sustainability; Empower the local community to adopt these methods for economic growth.

METHODS

The program was conducted in Tesabela Village, located approximately 12 km from Kupang City, from July to October 2023. The village features extensive coastal areas suitable for seaweed farming, though current practices are largely traditional.

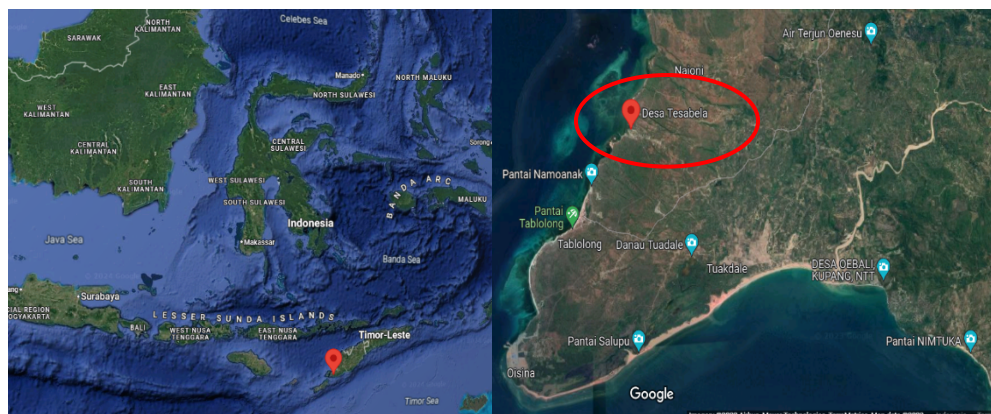


Figure 1. Tesabela Village, West Kupang, East Nusa Tenggara, Indonesia

The program engaged 50 participants, including researcher members from the Polytechnic of Marine and Fisheries Kupang, students from the Study Program of Aquaculture Engineering, local leaders, village officials, and seaweed farmers.

Key activities included:

1. Problem Identification : Discussions with local farmers to assess challenges and opportunities;
2. Training and Education : Workshops on innovative farming methods;
3. Technology Implementation : Demonstrating Kajarula, Biorula, Rula Basket, and Selvarula techniques;
4. Monitoring and Evaluation : Regular follow-ups to assess adoption and effectiveness.

Data were collected through observations, interviews, and surveys during the program. Production yields, community feedback, and adoption rates were analyzed to evaluate the impact.

RESULTS AND DISCUSSION

Innovations Introduced

Kajarula Technology

This method involves the use of seaweed net bags to protect crops from environmental stress and predation. While effective in deeper waters, its application in Tesabela was limited due to the shallow, muddy coastline. However, farmers acknowledged its potential in other areas with more favorable conditions, as it demonstrated the ability to reduce crop loss and enhance productivity by 200% in trials conducted in Tablolong Village (Pratiwi, 2024; Pratiwi *et al.*, 2023c; Serihollo *et al.*, 2021; Kusuma *et al.*, 2021).

Biorula Biofertilizer

Soaking seaweed seedlings in bionic fertilizer significantly improved growth rates and carrageenan quality. Laboratory tests indicated an increase in biomass production by 30% compared to traditional methods (Pratiwi, 2024; Kusuma *et al.*, 2022; Amalo *et al.*, 2022a). Furthermore, farmers in Tesabela began experimenting with creating their

organic fertilizers, inspired by the success of Biorula, which aligns with prior findings in Tablolong Village on the effectiveness of biofertilizers.

Rula Basket

Recycled plastic baskets were introduced as eco-friendly alternatives to traditional tools. This initiative supported environmental conservation and empowered local women to produce and sell these baskets (Pratiwi *et al.*, 2023a; Pratiwi *et al.*, 2023b). In Tesabela, women's groups reported earning supplementary income from selling Rula Baskets, which were also cost-effective substitutes for conventional harvesting tools. Previous studies have shown that integrating women into aquaculture activities significantly enhances household incomes and community resilience.

Selvarula (Selection of Seaweed Varieties)

This method focused on selecting high-quality seedlings through successive generations. It proved practical and cost-effective for local farmers, offering improved yields with minimal investment. Initial trials demonstrated a 25% increase in seaweed growth rates compared to non-selective breeding practices (Amalo *et al.*, 2022b).



Figure 2. Workshop on Innovative Approaches to Seaweed Farming in Tesabela Village

Community Impact

The program fostered greater awareness of sustainable practices and technological innovations. Farmers reported increased productivity and expressed enthusiasm for adopting these methods. Additionally, women's involvement in producing Rula Baskets highlighted the socioeconomic benefits of integrating aquaculture with community empowerment.

Introducing these innovations has shown that strategic education and resource support can drive the adoption of sustainable aquaculture practices. Farmers were particularly receptive to the Selvarula method due to its simplicity and low cost, which made it highly adaptable to local

conditions. Meanwhile, community discussions emphasized the need for consistent follow-ups and support to ensure sustained use of these technologies.

Challenges and Limitations

The shallow, sediment-rich waters of Tesabela Village limited the effectiveness of Kajarula technology. This aligns with observations from other regions where similar conditions reduce the utility of floating net systems.



Figure 3. Providing seaweed seeds and ropes with seaweed farmers in Tesabela village

Consistent engagement and follow-up are required to ensure the long-term adoption of these methods. Market access to new products, such as Rula Baskets, must be expanded. Collaborative efforts with local stakeholders and government agencies could address this limitation and enhance community income.

CONCLUSION

The introduction of innovative seaweed farming methods in Tesabela Village demonstrated significant potential for enhancing productivity and sustainability. While challenges remain, the positive reception by the community underscores the importance of continued support and capacity-building. Future programs should focus on refining these technologies and strengthening market linkages to maximize socioeconomic benefits.

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