



Enhancing Economic Sustainability of Farmer through Resource Allocation Modeling in Rembang, Indonesia

ABS-066

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“Resilient Agribusiness for Global Food Security: Transformative Pathways to Sustainability”



Introduction



- Farmers are adopting polyculture (combining salt with shrimp and milkfish) to diversify income and use resources efficiently.
- Polyculture is an aquaculture method that combines multiple commodities in a single area to improve efficiency and increase income.
- However, current practices remain suboptimal due to the lack of structured and data-based management.
- This study aims to identify the most profitable combination of commodities and resource allocation using a linear programming approach.



Milkfish

Integrating milkfish cultivation into salt ponds.



Vannamei Shrimp

Adding high-value shrimp to the farming system.



Salt Production

Maintaining salt as a primary commodity.

Literature Review



1. Polyculture Potential

Polyculture—integrating commodities such as shrimp, milkfish, and seaweed—has been demonstrated to enhance pond productivity and support income diversification for aquaculture farmers (Widowati et al., 2024; Tahe, 2020). In Kaliori, however, the adoption of polyculture practices remains limited and lacks structured management.

2. Optimization Approach

Linear programming (LP) is applied to identify the most efficient combination of commodities and resource allocation within polyculture systems. This analytical method supports profit maximization by accounting for constraints in land, costs, and labor (Maulida & Munir, 2022; Pusvita et al., 2024; Alotaibi & Nadeem, 2021).

Methods

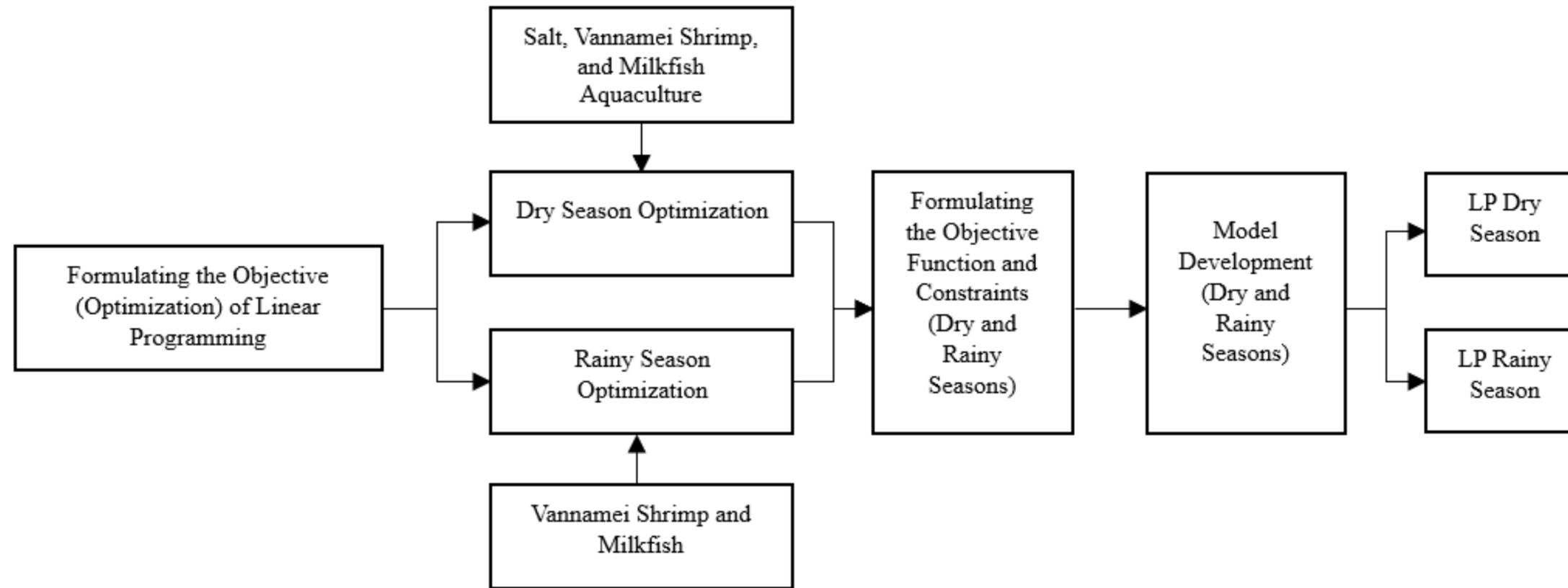


Figure. Flowchart of linear programming optimization analysis for pond utilization in Kaliori, Rembang.

Studi Area

Quantitative study conducted in Kaliori, Rembang, with 20 polyculture farmers from Sari Makmur Cooperative. Data collected via surveys, observations, and interviews.

Analytical Methods

Linear programming used to maximize profit under resource constraints (land, labor, capital) for salt, shrimp, and milkfish, considering dry and rainy seasons. (Figure 1)

Result and Discussion



Table 1. Results of Linear Programming Optimization During the Dry Season

Commodity	Land Allocation Decision (m ²)	Total Profit (IDR)
Salt (x1)	14,860	47,864,060
Milkfish (x2)	0	0
Shrimp (x3)	0	0

Dry Season Optimization

- During the dry season, optimal resource allocation is entirely devoted to salt production, yielding a profit of IDR 47,864,060. Labor is the most critical factor, with a shadow price of IDR 64,420 per additional unit.

Table 2. Results of Linear Programming Optimization During the Rainy Season

Commodity	Value	Total Profit (IDR)
Milkfish	12,795.45	4,707,023
Shrimp	2,204.55	Included in total

Rainy Season Optimization

- During the rainy season, salt production is not feasible. The optimal strategy is polyculture of milkfish and vannamei shrimp, yielding a profit of IDR 4,707,023.
- Labor is the main limiting factor (shadow price: IDR 1,886.364) due to its role in feeding, water monitoring, and pond maintenance. Efficient labor use—especially for regular feeding—can significantly increase the profitability of the polyculture system during this period.

Conclusion



- The results of the linear programming analysis show that seasonal land allocation is the most efficient strategy under limited resources such as capital, labor (HKO), and land area.
- During the dry season, salt farming offers the highest profit per square meter and labor efficiency, making it the optimal single-commodity choice. In contrast, during the rainy season—when salt production is not viable—the optimal solution is a polyculture of milkfish and vannamei shrimp.
- Sensitivity analysis confirms that these results remain stable despite changes in profit margins, while also identifying labor as the key limiting factor.

- Therefore, it is recommended that farmers implement seasonal commodity rotation: focusing on salt in the dry season and shrimp–milkfish polyculture in the rainy season. Improving labor efficiency through technology or training is essential for increasing profitability under these seasonal conditions.

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