



Implementing the Blue Economy for a Sustainable Seaweed Business in Rote Ndao, Indonesia: An Institutional and Supply Chain Analysis

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ABSTRACT

Rote Ndao Regency, a major seaweed production center in Indonesia, possesses significant potential yet faces complex sustainability challenges. This research analyzes the implementation of the Blue Economy concept in achieving a sustainable seaweed business in this critical region. The study employs a mixed-methods approach with an explanatory sequential design, integrating quantitative data from surveys on costs, production, and income with qualitative data from in-depth interviews, observation, and document analysis. The analysis focuses on three main aspects: (1) the gap between government policy and on-the-ground implementation, (2) the structure and efficiency of the supply chain, and (3) an evaluation of business sustainability using the Triple Bottom Line (TBL) framework, covering economic, social, and environmental dimensions. The findings reveal a significant chasm between the Blue Economy policies outlined in planning documents and the operational reality, a gap caused by profound institutional capacity weaknesses. The supply chain structure is proven to be inefficient and inequitable, characterized by the dominance of middlemen (*tengkulak*) who control prices and information, thereby suppressing farmer profitability. The TBL analysis concludes that the sustainability of the seaweed business remains fragile: economically vulnerable to price volatility and a lack of downstream processing, socially overshadowed by unresolved conflicts, and environmentally at risk of damaging coastal ecosystems. This study recommends strategic interventions focused on strengthening farmer institutions through professionally managed cooperatives, promoting local downstream industries to capture value-add, enforcing marine spatial planning regulations to mitigate conflict, and providing incentives for environmentally friendly cultivation practices.

INTRODUCTION

The Blue Economy, a global paradigm that balances marine economic utilization with environmental and social imperatives (LAB45, 2023; Khoiriyah, 2024 Firdaus & Reswari, 2014), represents a strategic urgency for Indonesia. This commitment is embedded in national policy, such as the 2020-2024 National Medium-Term Development Plan (LAB45, 2023). However, translating this vision into local outcomes reveals a paradox between policy and practice, a challenge vividly illustrated by the seaweed industry in Rote Ndao Regency, East Nusa Tenggara. Rote Ndao is a nationally and globally significant producer of high-quality *Eucaema cottonii* seaweed, which forms the economic backbone for thousands of coastal families (Agromilenial, n.d.). Despite vast potential – with less than 10% of suitable area currently cultivated (Indonesia Climate Change Trust Fund, 2024b) – the sector is plagued by chronic problems. Farmers face extreme price volatility, an inequitable supply chain dominated by middlemen (*tengkulak*), and an industry reliant on exporting raw materials, with 93% of seaweed



leaving Indonesia unprocessed. These issues are compounded by environmental pressures from cultivation practices and external shocks like the 2009 Montara oil spill (Sari et al., 2024, Yayasan Konservasi Alam Nusantara, 2024).

This research, therefore, aims to: (1) analyze the gap between Blue Economy policies and their implementation in Rote Ndao; (2) map the seaweed supply chain to identify inefficiencies; (3) evaluate the sector's sustainability using the Triple Bottom Line (TBL) framework; and (4) formulate strategic policy recommendations. The study's novelty lies in its use of an Institutional Economics framework to diagnose these challenges not as simple state failures, but as a competition between weak formal government institutions and the dominant, deeply entrenched informal institutions of the traditional supply chain.

This study is guided by three integrated frameworks. First, the Blue Economy provides the normative policy goal, emphasizing principles like social inclusion, waste minimization, innovation, and creating economic multipliers through local value-addition (Firdaus & Reswari, 2014; Hasibuan et al., 2024). Second, the Triple Bottom Line (TBL) framework is used to holistically evaluate sustainability across its economic (Profit), social (People), and environmental (Planet) dimensions (Elkington, 1998; Goel, 2010). Third, Supply Chain Management provides the tools to dissect the operational flows of product, finance, and information to identify inefficiencies and power imbalances (Syarif, 2020, Zuriat, 2022). Finally, an Institutional Economics lens is applied to explain systemic failures. This approach focuses on the role of institutions – formal rules like laws and informal constraints like social norms – in shaping economic behavior. It helps explain the persistence of the current system as a story of institutional competition, where the weak, under-resourced formal institutions of the state are unable to compete with the highly functional, albeit extractive, informal institutions of the tengkulak-governed supply chain (Zuriat, 2022).

RESEARCH METHOD

This study employed an explanatory sequential mixed-methods design (Creswell & Creswell, 2023). The initial quantitative phase involved surveys with seaweed farmers and collectors in key cultivation villages across Rote Ndao to gather data on production costs, revenue, and marketing margins. The subsequent qualitative phase used the quantitative findings to guide in-depth interviews with government officials, community leaders, and supply chain actors, as well as participant observation and Focus Group Discussions (FGDs). This phase aimed to explain the "why" behind the quantitative trends. Data analysis involved descriptive statistics and farm enterprise analysis (R/C ratio) for quantitative data, and thematic content analysis for qualitative data (Samsu, 2021). Secondary data from government planning documents, statistical reports, and academic literature were used for triangulation and to provide context. The integration of these methods produced a comprehensive and validated understanding of the research problem.

RESULTS AND DISCUSSION



4.1 The Chasm Between Policy and Reality

A significant chasm exists between the government's formal Blue Economy policies and their implementation. While planning documents like the Strategic Plan by the Maritime Affairs and Fisheries Service show clear commitments and quantitative targets for developing the seaweed sector, these are undermined by severe institutional weaknesses. Field interviews confirmed that a lack of qualified human resources, inadequate funding for ambitious programs, and poor inter-sectoral coordination render the state apparatus incapable of translating its well-articulated vision into effective action on the ground (Anam, 2024; BRIN, 2024). This implementation failure creates an institutional vacuum, which is actively filled by the informal systems that govern the supply chain in practice.

4.2 Anatomy of an Inequitable Supply Chain

The Rote Ndao seaweed supply chain is a multi-layered system that is structurally inefficient and inequitable. The key actors and their roles are summarized below.

Table 4.1: Actors, Roles, and Challenges in the Rote Ndao Seaweed Supply Chain

Actor	Main Role	Key Process	Main Challenges / Obstacles
Cultivators (Farmers)	Upstream producers	Seed preparation, planting, maintenance, harvesting, drying	Dependence on seeds, pest/disease attacks (ice-ice), impact of climate change, price volatility, low bargaining position, limited access to capital
Field Collector	First buyer, village level aggregator	Direct purchase from farmers, initial sorting, transportation from cultivation location, temporary storage	Dependence on wholesalers for selling price determination, risk of price fluctuations, high logistics costs.
Large Scale Collector Traders	District level aggregator, investor	Large volume purchases from middlemen, further sorting, storage in large warehouses, packaging, inter-island transportation	Requires large working capital, complex logistics management, global market risks, ensuring consistent supply.
Processing Industry / Exporter	Downstream actors, creators of added value	Processing into semi-finished products (Alkali Treated Cottonii / ATC) or finished products (carrageenan), or directly exporting dry raw materials	Dependence on export markets (especially China), strict international quality standards, sustainability issues in the supply chain.

Source: Research Data, processed, 2025

The product flows from farmers to village collectors, then to larger traders, and finally to exporters, with quality control remaining subjective and controlled by buyers (Puspita, 2021). The financial flow is the most critical issue. While farm-level analysis shows the business is technically profitable (R/C Ratio > 1), this viability is fragile and dependent on prices set by intermediaries (Jayanti et al, 2020).



4.3 The 2023 Price Crisis: A Case Study in Policy Failure

The system's fragility was exposed during the 2023 price crisis, when prices crashed from ~IDR 40,000/kg to ~IDR 15,000/kg. This was exacerbated by a disastrous local policy, Governor's Regulation No. 39 of 2022, which banned the export of raw seaweed from NTT to force local industrialization. The policy backfired, severing established supply chains to major buyers in other provinces. This created a market glut, causing prices to collapse and inflicting severe economic damage before the regulation was eventually revoked. The event highlights the danger of top-down policies that ignore existing market structures and path dependencies (Heu et al, 2023)

4.4 Triple Bottom Line (TBL) Sustainability Scorecard

A holistic TBL evaluation reveals a system with interconnected vulnerabilities.

Table 4.3: TBL Sustainability Scorecard for Rote Ndao's Seaweed Sector

Dimension	Positive Findings	Negative Findings / Challenges	Sustainability Score
Profit	Economic backbone for thousands of families.	Extreme price volatility, inequitable profit distribution, dependence on raw material exports.	Sufficient, but Vulnerable
People	Improves welfare, empowers women.	Unresolved social conflicts (Montara spill), potential for new resource use conflicts, weak farmer institutions.	Enough
Planet	Grassroots initiatives for sustainable practices.	Damage to seagrass/coral reefs, plastic pollution, high vulnerability to external shocks (oil spills).	Low to Fair

This analysis reveals a vicious cycle: economic fragility (Profit) forces farmers into dependent relationships, perpetuating social inequity (People), which in turn disincentivizes investment in environmentally sound practices (Planet). Breaking this cycle requires a holistic intervention addressing all three dimensions simultaneously.

CONCLUSION

Conclusion

1. The Implementation of the Blue Economy is Largely Symbolic: A significant gap exists between policy documents and on-the-ground reality, caused by the government's weak institutional capacity for implementation.
2. The Supply Chain is Inefficient and Unjust: The seaweed supply chain is controlled by intermediaries, leading to an inequitable distribution of profits and leaving farmers as powerless price-takers.
3. Sustainability is Fragile and Multidimensional: The seaweed business is economically vulnerable, socially strained by conflict, and environmentally at risk, with these weaknesses reinforcing one another.



Recommendations

1. Strengthen Farmer Institutions: Proactively fund and provide long-term managerial mentorship for farmer-owned cooperatives to create a viable, inclusive institutional competitor to the tengkulak system.
2. Incentivize Local Industrialization: Create a conducive investment climate with fiscal and non-fiscal incentives for establishing local seaweed processing facilities to capture value-added.
3. Enforce Marine Spatial Planning: Finalize and enforce zoning regulations (RZWP3K) to mitigate conflict between aquaculture, tourism, and conservation, providing legal certainty for all stakeholders.
4. Promote Green Practices: Develop incentive programs (e.g., for using biodegradable materials, eco-certification) to encourage the adoption of environmentally friendly cultivation methods.

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